Water, International Development and Collective Action: An impact assessment of an irrigation management project in Southern Kyrgyzstan.

by

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DEDICATION

This work is dedicated to the memory of my grandmother.

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I dedicate this work to the memory of my grandmother.

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Chapter 1

Introduction

Water scarcity is a severe and growing global challenge. Given the threats of large-scale conflict, increased poverty, and significant environmental degradation, the stakes are high for finding viable solutions to critical water shortages. Over the last 50 years, water withdrawals have tripled due to economic development and rapid population growth, placing serious pressure on the planet's water systems. By 2030 almost half of the world's population will be living in countries facing high water stress, and areas that face critical water scarcity are expected to witness the displacement of anywhere between 24 and 700 million people. By 2050, population growth is projected to reach nine billion, further exacerbating the threats posed by water scarcity (UNESCO 2009).

Agriculture remains the most significant consumer of water, accounting for approximately 75% of all global water use.[1] In the next three decades, the demand for irrigated water is expected to rise by approximately 14%, with a corresponding increase in competition for water between industrial, domestic and agricultural sectors. Millions of rural agriculture-dependent farmers in Africa, Asia and the Middle East already face devastating shortages of irrigation water, a situation that will have severe implications for food security and economic development across the globe. Efforts to improve irrigation are thus crucial, yet attempts to engineer large increases in supply are no longer feasible. Therefore, efficient irrigation water management will be critical to sustain and enhance water quality and meet the growing demand for water resources (Pomeranz 2009; UNESCO 2009).

The World Bank, United States Agency for International Development (USAID), and the Asian Development Bank have invested billions of dollars in irrigation

[1] Industrial and domestic water use accounts for approximately 20% and 5% of global water consumption, respectively (WWRD, 2009).

management across the developing world. Throughout the 1970s and 80s, irrigation schemes in many developing countries were centrally governed, and massive technical infrastructure projects were planned and pursued by the development community (Tang 1992). However, a lack of funds for operation and maintenance, as well as poor state-led outcomes such as continued water shortage concerns, irrigation deterioration and water-use conflicts, motivated the gradual shift to a community-driven development approach to irrigation management. In particular, many countries adopted the policy of Irrigation Management Transfer which delegated control of decisions, authority and responsibility for irrigation to local institutions of irrigators known as Water Users' Associations (Garces-Restrepo, Vermillion, and Munoz 2007).

The assumption guiding Irrigation Management Transfer (IMT) is that the establishment of Water Users' Associations (WUAs) and introduction of an irrigation service fee will motivate efficient and equitable irrigation management (Degnbol, Gislason, Hanna, Jentoft, Raakjaer, Sverdrup-Jensen, and Wilson 2006). The Water Users' Association (WUA) thus represents the necessary institutional structure and democratic foundation for water governance, while the irrigation service fee is a tool designed to incentivize efficient and equitable distribution of water, and to ensure the collection of adequate cost-recovery funds for operation and maintenance of the system. Since water users must pay the irrigation service fee for water delivery or risk losing their access to water, it is expected that they will efficiently manage water to avoid paying for supplemental water supplies.

Therefore, the predominant policy discourses on irrigation reform view WUAs as central to the growth and viability of the irrigated agricultural sector in developing countries. However, important theoretical and empirical challenges have been raised concerning community-driven development. Although natural resource and development scholars agree that local institutions work better than "top-down" rules not seen as credible by resource users (Acheson 2003), many have questioned both the benefits and success of community-driven development (Ensminger 1990; Mosse 2003; Platteau 2004; Ruddle and Hickey 2008). Scholars argue that this community-based approach has not had the intended effect on community involvement, and has actually promoted local elite capture of benefits. Moreover, the problems with community-driven development

have often been attributed to the "blue-print" approach, wherein donor-funded efforts turn control over to residents (Nagendra 2007; Ostrom 2007b). This blue-print approach generally engages a small group of leaders during the implementation of development projects and establishment of local associations, and fails to involve the broader community in the process. In addition, the quick set-up of local institutions usually precludes any substantive efforts at institutional development and capacity building (Platteau 2004).

Research has also shown mixed results for Irrigation Management Transfer (IMT). Many WUAs are failing to achieve their fundamental mandate to improve irrigation management outcomes (Garces-Restrepo, Vermillion, and Muñoz 2007; Meizen-Dick 2007). This dissertation focuses on WUA performance in Kyrgyzstan, where, despite the theoretical expectations that IMT will succeed, there is extreme variation in the effectiveness of WUAs. In many instances, they are failing to overcome the fundamental collective action dilemmas inherent in irrigation systems. In Kyrgyzstan, numerous water users are not paying irrigation service fees or contributing to critical maintenance and rehabilitation projects; violations of irrigation schedules are a frequent and expected occurrence; and damage to the already dilapidated infrastructure continues unabated in many areas. The inability to stop farmers' pursuit of "water-maximizing" behavior has had an especially deleterious effect on farmers at the end of the canal systems, and conflict over irrigation water during the water season has become the norm in many areas (Abdullaev, Jumaboe, Kazbekov, and Manthritilake 2008; Sehring 2007; Wegerich 2006; Zavgordnaya 2006).

This dissertation seeks to advance our applied knowledge of irrigation water management by answering a basic yet critical question regarding natural resource governance. Did a specific policy intervention help to support local institutions and ultimately encourage better irrigation outcomes in Kyrgyzstan? To achieve the research objectives, the study investigates the impact of community-driven development on irrigation outcomes. More specifically, the study undertakes a rigorous program evaluation of an international development project dedicated to improving the performance of Water Users' Associations (WUAs) in the small, poor, post-Soviet country of Kyrgyzstan. The program of interest represents a correction strategy to the

blue-print approach for establishing WUAs. Thus, the program is designed to foster the capacity of WUAs through institutional development, social mobilization and participatory rehabilitation efforts that are intended for all categories of water users.

Research Setting

Kyrgyzstan provides an excellent context to examine the impact of international development efforts on irrigation outcomes for two primary reasons. First, irrigation is crucial for the agricultural sector. Second, following the collapse of the Soviet Union, Kyrgyzstan has emerged as the poster child for Western development intervention in Central Asia. Demonstrating a high level of accommodation to reform pressures from international organizations, the country aggressively embarked on economic and political reforms in the early nineties. In contrast to its neighbors, Kyrgyzstan welcomed outside influence, including a large influx of United Nation's programs, private organizations, non-governmental organizations (NGOs), and other international organizations.

Similar to many developing countries, the livelihoods of millions of Kyrgyzstan's rural population are heavily dependent on irrigation, and the country faces increasingly severe challenges to the productivity, growth, and viability of its agricultural sector. Along with gold and rare earth minerals, such as mercury and uranium, in the country's vast mountain ranges, water serves as the country's most important natural and economic resource (CIA World Factbook). Two tributaries begin in Kyrgyzstan – the Naryn and Kara Darya – and flow into the Syr Darya, one of the two main water sources for Central Asia.[2] Among the countries in the Aral Sea Basin, Kyrgyzstan represents an upstream, water-rich state with a yearly average of 10,000 cubic meters of water per capita. In contrast, the downstream countries of Uzbekistan and Turkmenistan face extreme water shortage problems. With 700 and 200 cubic meters of water per capita respectively, these countries are well below the 1000 cubic meter baseline used to determine "water-short" countries (Envsec 2005).

With an average elevation of 2750 meters above sea level, only 6.55% of the land in Kyrgyzstan is suitable for agriculture. Nevertheless, agriculture represents a critical economic sector, accounting for 25% of gross domestic product (GDP) and employing

[2] The other is the Amu Darya which originates in Tajikistan.

48% of the country's workforce (CIA World Factbook).[3] Over two-thirds of the population live in rural areas and are dependent on agriculture. Due to the arid continental climate, it would be impossible to cultivate much of the country's agricultural land without irrigation. Thus, over 90% of the country's water use is dedicated to irrigated agriculture, and some of the largest irrigation systems in the world begin in Kyrgyzstan and extend into Kazakhstan and Uzbekistan (ADB 2004; Envsec 2005; Sehring 2007).

However, despite this abundance of water in Kyrgyzstan, many areas of the country face increasing problems concerning both the quantity and quality of irrigation water. While the arid climate is partially responsible, this water scarcity has been primarily driven by poor management, including the inefficient usage and distribution of available water resources and deteriorating infrastructure (Envsec 2005). Kyrgyzstan inherited many of these management and infrastructure problems from a Soviet period characterized by corruption and extremely inefficient water distribution, resulting in average water losses around 50% (Thurman 2000).

Following the collapse of the Soviet Union, Kyrgyzstan acquired this dilapidated irrigation system without the financial or human capital means to properly manage it and reverse the degradation. In many areas, canals and drainage systems have not been cleaned or repaired since the mid-1980s. Most canals have significant structural damage and missing or broken sluice gates, which makes water regulation highly difficult or virtually impossible in some locales. Thus, water supply has become increasingly erratic, especially for water users located at the end of canal systems; due to this situation, many communities have lost thousands of hectares of arable land (Envsec 2005; WB 2003; Sallaku, Kristo and Burton 2003). Under increasing economic strain, independent Kyrgyzstan adopted Irrigation Management Transfer (IMT) in 1999, and the international community began the task of implementing Water Users' Associations (WUAs) throughout the country to address these deficiencies.

A substantial amount of donor funding and development work has been devoted to irrigation management reform in the country since the collapse of the Soviet Union,

[3] The country's main agricultural products include cotton, tobacco, wool, and meat. Only cotton and tobacco are exported.

including projects to establish WUAs and foster their development. As the international community hoped to promote Kyrgyzstan as a model of economic and political reform, multilateral aid flowed into the country along with a host of Western NGOs, international organizations and scholars. My dissertation represents the most sophisticated attempt to determine if and how development intervention worked in the critical arena of irrigation water management.

Kyrgyzstan's receptivity to Western policies and the influx of Western actors and agencies have been driven by a critical need for financial assistance, along with insecurities associated with its geographic position between far more powerful countries such as Russia, China and Uzbekistan (Schoberlein 2000). The country is small, mountainous, very poor, and landlocked between China, Kazakhstan, Tajikistan and Uzbekistan. With an area of approximately 200,000 square km, Kyrgyzstan is slightly smaller than South Dakota, and besides Tajikistan, is the poorest country of the former Soviet Union. Forty percent of the population lives below the poverty line and the unemployment rate hovers around 18%; these economic indicators put Kyrgyzstan in an economic development category with countries like Ghana and Benin (CIA World Factbook).[4]

The significant donor support for Kyrgyzstan has been motivated by its symbolic and political significance for western countries. In the decade following independence from the Soviet Union, Kyrgyzstan was described as an "island of democracy" in Central Asia. Kyrgyzstan allowed political opposition, an independent media, the development of civil society, and followed Western prescriptions for deepening economic reform. These attempts stood in stark contrast to the records of its more authoritarian neighbors regarding human rights, free-market and democratic reforms (Schoberlein 2000).

While on the one hand, Kyrgyzstan has been perceived as a 'laboratory' demonstrating that democracy and international aid could work in Central Asia, geo-political concerns have also greatly informed Western policy towards the country. For the United States, the strategic importance of Kyrgyzstan is linked to the Manas air force

[4] In contrast to the CIA World Factbook and other sources, the US Department of State cites the unemployment rate at 11.1% as of 2008.

base in Bishkek Kyrgyzstan, which represents a critical supply line for U.S. and NATO missions in Afghanistan (VOA 2009).

However, despite two decades of Western attempts to transform Kyrgyzstan into the "Switzerland of Central Asia," Kyrgyzstan has experienced a large *increase* in poverty and social stratification. Similar to their counterparts in the region, extravagance, corruption, and nepotism characterize the country's leadership. In April 2010, against the backdrop of rising state repression, corruption and economic grievances, an increase in utility prices sparked a violent political rebellion that forced President Kurmanbek Bakiyev to flee the country (Reeves 2010). The uprising against the Bakiyev regime was closely followed by costly and destabilizing ethnic violence in Southern Kyrgyzstan between ethnic Uzbeks and ethnic Kyrgyz. Overall, 2010 observed a 3.5% contraction of the Kyrgyz GDP, along with an estimated 2.6 billion USD increase in the country's external debt (Khamidov 2011). The country's economic and democratic prospects are bleak, and the success of the Western model seems doubtful.

The results for Irrigation Management Transfer (IMT) are also mixed. The capacity of local, regional and national actors to continue the policy without further substantial support from the international aid community is highly questionable. At the local level, there is extreme variation in the effectiveness of Water Users' Associations (WUAs) across the country. In Kyrgyzstan, the inability of WUAs to collect irrigation service fees from water users and conduct the necessary operation and maintenance on their canal systems translates into an acute threat to the viability of the irrigation system. Additionally, because of the inter-related nature of the extensive Central Asian system, the continued deterioration of the infrastructure in Kyrgyzstan has important consequences not only for Kyrgyzstan but for Uzbekistan and Kazakhstan as well (see Chapters 2 and 3).

It seems unlikely that the international community will continue to provide Kyrgyzstan with levels of funding comparable to those received during the past two decades. The end of the U.S. mission in Afghanistan will have serious implications for Kyrgyzstan's strategic importance. Moreover, although international donors promised over one billion USD in aid and substantial loans following the events of 2010, there have been significant delays in the release of these funds due to the country's record of

corruption and historical misuse of aid. Consequently, it is becoming ever more important for development agencies to efficiently and effectively utilize a limited stream of funds for natural resource management.

Approach

This project seeks to provide a better understanding of the variation in performance outcomes for Water Users' Associations (WUAs), as well as explain the *processes* linking a development program to these outcomes. To achieve the research objectives, I conduct a program evaluation of an international development project committed to improving irrigation management in Southern Kyrgyzstan. My research focused on the Water Users' Association Support Program (WUASP), a project dedicated to building the capacity of WUAs. In many ways, the Water Users' Association Support Program (WUASP) fulfills the prescriptions for an intervention to improve irrigation management outcomes. The program methods of social mobilization, institutional development, and participatory rehabilitation are congruent with factors argued to promote desired behavioral changes among water users. By pursuing an impact assessment in a region defined by communities that exhibit significant variation in water scarcity, economic equality and historical experience with irrigation, I am able to explore whether the influence of the development program was mediated by these three factors.

WUASP is implemented by Winrock International and funded by the United States Agency for International Aid (USAID). Winrock International is an American NGO that specializes in development work related to irrigation and agriculture. In the language of program evaluation, WUASP represents the "treatment," and the WUAs – where WUASP implemented the program – represent the treatment groups. Correspondingly, WUAs where WUASP was not implemented serve as "control" sites or groups.[5]

Research on collective action in natural resource management has long posed significant methodological problems. The plethora of causal variables and complex linkages between these factors make it exceptionally difficult to develop a specific causal path linking a variable to a collective action outcome and to isolate the effect of that

[5] Both treatment and control sites also received basic World Bank institutional development and support.

variable (Agrawal 2008; Dolšak and Ostrom 2003; Ostrom 2009). Consequently, my use of rigorous quantitative research methods represents a significant methodological intervention in the field of collective action studies. Specifically, a panel data set of WUA performance indicators is analyzed with the use of regression techniques to test the effect of WUASP. Additionally, survey data from a large N probability survey is evaluated to explore the program's association with four individual behavioral mechanisms that link the program to better common property resource outcomes.

Furthermore, my quantitative methods are informed and complemented by qualitative methods. Agrawal (2001) has criticized research on common property resources for ignoring how power dynamics are played out in natural resource governance and devoting little attention to historical or macro-social processes. Thus, I seek to explore variation in WUA outcomes at the micro level through a dynamic approach that does not lose sight of the political, social and historical context. While econometrics enables me to measure whether and how much a variable mattered to an outcome, qualitative research allows me to explain *why* it mattered, by providing the context for the empirical analysis. The qualitative data includes focus group reports, interview data, and field notes gathered during nine months of field research in Kyrgyzstan. Hence, attention to sociological and historical processes plays an important role in this study and helps to generate a more precise understanding of the factors hindering irrigation system governance in Southern Kyrgyzstan.

I carried out the majority of this work as an academic researcher within the international aid community. At the beginning of my field work, my access to interviews in Bishkek, Kyrgyzstan was linked to my positions as a research fellow at the Social Research Center of the American University in Bishkek and as a part-time intern with the Foundation for Tolerance International. Moreover, my access to interviews and data in Southern Kyrgyzstan often depended upon my ties to Winrock International and the Water Users' Association Support Program (WUASP).

I observed the work of the Winrock International staff for twenty-eight weeks in the summer of 2008 and winters of 2009 and 2010. This involved visiting twenty WUAs and villages in the Jalalabad, Osh and Batken provinces of Kyrgyzstan, where the Winrock staff had implemented or was in the process of implementing WUASP. The

field visits included semi-structured interviews with the WUA Director and/or Council Chairman, in addition to informal conversations with farmers. In all but five cases, these interview sessions also involved other individuals who had affiliations with the WUA, such as the accountants and engineers.[6]

A significant portion of my field research took place as a volunteer "program evaluator" for Winrock International. This institutional affiliation helped me gain access to communities and data that would never have been possible as an independent researcher with a restricted budget. For example, I was able to acquire World Bank panel data and oblast level economic data because of the 'good reputation and work of the project.'[7] Winrock provided my transportation to and from many of the field sites and helped me secure a reliable research assistant and competent survey research team. Thus, I was heavily dependent on Winrock for many aspects of my research. Winrock provided information, logistics, contacts, and help with data collection—all critical requirements for my study.

Furthermore, I spent a tremendous amount of time with the Winrock staff in both professional and social settings. In particular, I had an office in the Winrock headquarters in Osh during the field study. During the three months of the official volunteer mission, I even shared an office with the country director. Not only did I work in the same building and accompany the staff on field visits, I also ate lunch with them, attended their weekly meetings, participated in their office parties, and lived with a staff member for almost three months during my second field visit to Southern Kyrgyzstan.

I am aware that this personal relationship with the staff both complements and biases my work. It allowed me to study the program implementation in a very personal manner; as such I gained privileged and private insights. However, due to my close relations and reliance on the staff for a large portion of the data collection, I am aware the objectivity of my work must remain a constant concern. I have done my best to present the work as a relatively objective observer, given my personal ties and dependence on WUASP for funding, logistics and data.

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[6] All discussions with farmers were conducted with the help of the Winrock staff. While I could sometimes ask questions in Russian, the farmers felt comfortable replying in Kyrgyz, Uzbek or a mix of Russian and the local language.

[7] This was a compliment I often heard on field visits and during interviews with NGOs and IOs about the Winrock project.

Furthermore, my association with the program clearly influenced the way I was perceived by the population and the conversations I had with community members. During my site visits I was seen as a Winrock staff member and as an American who could bring resources to the community. I believe that social desirability effects and fear of losing the Winrock project support affected many of the interview responses from WUASP-supported Water Users' Associations. I am sensitive to these contextual issues and aware of potential biases. Therefore, while my qualitative data provides important information, my claims are based heavily on the quantitative data analysis.

In addition, although the data from my informal conversations does not offer a full representation of the processes occurring at the village level, my participant observation of Winrock did enable me to acquire a first-hand account of implementation problems. I was in a privileged position to obtain a great deal of information about the day-to-day successes and failures of the project. Indeed, my focus on the WUAs often shifted to WUASP's office politics, staff problems, problems between the Osh staff and Winrock headquarters or USAID, as well as an attempt to understand whether and how the program had deviated from its program theory. This understanding of implementation problems facilitates a better analysis of the program outcomes.

I completed the data collection in February 2010. Since the WUASP project in Kyrgyzstan was set to close in the spring of 2010, my program evaluation was due to WUASP in April 2010 for use in their final project report for USAID. Given the very short time-span for the evaluation, I completed a relatively quick impact assessment of WUASP with the help of a PhD student in the Department of Economics at the University of Michigan. Since the submission of the "condensed" program evaluation to Winrock, there has been no ongoing interaction or influence from Winrock/USAID in the dissertation.

Findings

The program evaluation comparing WUASP-supported Water Users' Associations (WUAs) to control WUAs implemented by the blue-print approach strongly suggests that the project has, in fact, improved the performance of WUAs. There is evidence of positive results regarding institutional development, social mobilization, and

canal infrastructure, as well as some improvement in financial indicators. Nevertheless, the evaluation results do not meet certain expectations concerning the treatment's influence on several objectives. The quantitative results indicate that WUASP failed to improve communal relations over water, and did not have a consistently positive impact on women and water users located at the end of the canals. The qualitative findings further indicate that cooperative outcomes such as equitable water distribution and community involvement in the rehabilitation process were only evident in a sub-set of the treatment sites.

My research supports arguments concerning the critical role that social capital plays in collective action for natural resource governance. Despite WUASP's rhetoric and program theory, the program failed to develop this essential pre-requisite for cooperation in treatment sites. The program's 'social mobilization' did not build social capital assets and improve communal relations; in some instances, it likely worsened them. Thus, the success of WUASP in motivating broad-based collective action was contingent on program involvement in communities that already had a foundation of 'good' communal relations. I identified a pattern of this positive community dynamic in WUAs with a large Uzbek population, as well as areas where there was a relatively equal wealth or financial dynamic.

In order to describe *why* WUASP either failed to improve social capital or worsened it, I maintain that structural social and economic inequality motivates significant resentment over resource distribution in some communities. In addition, there were implementation problems with the program. WUASP social mobilization meant different things for different population groups: the "genuine" social mobilization focused on the leadership and active farmers, whereas attempts to "mobilize" the remaining water-users for rehabilitation projects functioned as a separate task. This form of mobilization included efforts to achieve a quorum of members to approve rehabilitation projects and to "mobilize" the community to contribute labor and funds for implementation. However, since this second approach did not effectively empower these

individuals, rehabilitation benefits may have provided even greater power and advantages for local elites and privileged groups.[8]

In particular, given the significant structural inequalities in some communities, the program did not possess the capacity to make a positive difference in such a short time period. Meaningful change was especially difficult due to historical processes that created large, unexpected challenges to the program theory and implementation. In particular, the borders and territory of a WUA generally coincide with those of the former state and collective farms. As a result, Sehring (2009) argues that WUAs are "replacement" institutions that reproduce the power structures of the Soviet organizations. In addition, the manner in which land reform was conducted in the early nineties means that inequality was not only reproduced but was reinforced and exacerbated. Uneven and inequitable land distribution created or increased the gap between wealthy farmers (or family farms) with large landholdings and water users with small tracts of land in many areas.

Hence, I conclude based on my research that, although there are circumstances under which community-driven development has a real and substantial positive impact, this approach still faces many of the same concerns and threats to success as the blue-print approach. In particular, there is a clear distinction between WUASP's effect on WUA performance outcomes and its impact on community-wide cooperation for irrigation resource management. I argue that positive performance outcomes for WUAs *do not* necessarily reflect improved collective action among a broad population of water users in a service area. For example, in the context of Kyrgyzstan, a small group of wealthy individuals or families can support and subsidize the work of a WUA, thereby producing positive outcomes for some aggregate indicators. Thus, the program may motivate better collective action among a subset of the community to the detriment of broader cooperation goals and long-term success of a WUA. WUASP's efficiency gains among select population groups, such as local elites, may have been at the expense of equity and efficiency gains for average water users. Overall, my project offers evidence to support both the positive effects of community-driven development as well as essential

[8] While I believe that the general population of water users might have received some residual form of genuine social mobilization prior to 2008, this was not the case for the cohort of treatment WUAs selected for WUASP in 2008.

criticisms that have been raised about equity versus efficiency concerns associated with this approach.

Road Map

Chapter 2 provides an historical overview of irrigation in Kyrgyzstan and summarizes the macro-social and political processes that affect how irrigation management unfolds at the local level. This overview examines the impact of Soviet policies on traditional irrigation practices and highlights important land reform processes that occurred in the early 1990s, following Kyrgyzstan's independence. In addition, the chapter presents important background information concerning irrigation reform – Irrigation Management Transfer (IMT) – which transferred the operation and management of Kyrgyzstan's irrigation system to hundreds of locally-based Water Users' Associations (WUAs).

Chapter 3 examines the primary constraints faced by WUAs in Kyrgyzstan at the local, regional and national level. It also provides detailed background information about the methods and theory underlying the Water Users' Association Support Program (WUASP).

Chapter 4 describes how WUASP affects the variables argued to promote collective action. I develop hypotheses about the program effect on four individual behavioral mechanisms, which function as precursors to improved collective action. Behavioral mechanisms represent micro or individual level processes linking the program to the performance outcomes of interest; these help to explain the presence or absence of variation in cooperative capacity and the performance of WUAs. The following mechanisms are explored in this study: (1) *knowledge* regarding the WUA and irrigation management, (2) *participation* in the WUA, (3) *attitudes* concerning WUA capacity and ownership roles, and (4) *social capital*.

Chapter 4 also discusses some of the important contextual factors that may mediate the program effect. These include a WUA's population and land size, social and economic heterogeneity, as well as ecological scarcity. Each of these variables represents important factors of interest and debate for natural resource scholars.

The majority of Chapter 5 is committed to a discussion of the panel data analysis used to examine WUASP's impact on WUA performance *outcomes*. I also describe my tests of the interaction effects between WUASP and ecological scarcity, social and economic heterogeneity, as well as population and land size.

Whereas Chapter 5 focuses on *outcomes*, Chapter 6 fulfills the dissertation's second major research objective by examining the *processes* linking the program to WUA performance outcomes. Survey data is used to test for an association between the program and four individual behavioral mechanisms developed in Chapter 4. Given the divergent historical experiences with irrigation and agriculture among ethnic Uzbeks and ethnic Kyrgyz, I also compare outcomes for the mechanisms among these two social groups. Finally, to provide a more comprehensive investigation of claims that development work often sacrifices equity for efficiency gains, I assess WUASP influence on individual behavioral mechanisms for disadvantaged groups, including women and water-users located at the end of the canal system (tail-enders).

Chapter 7 places my study and findings in relation to existing academic, policy and methodological discourses on international development policy and collective action research on natural resources management.

Chapter 2

Research Setting and Historical Overview of Irrigation Management

This dissertation is a contemporary study focused in the Southern Kyrgyzstan provinces of Batken, Jalalabad and Osh. Chapter 2 explores some of Kyrgyzstan's historical circumstances that influence contemporary policies, habits, expectations and beliefs concerning irrigation water management. The first half of the chapter situates the study in Southern Kyrgyzstan and provides an historical overview of irrigation management. The second half of the chapter focuses on irrigation reform in independent Kyrgyzstan and concludes with a discussion of Water Users' Associations (WUAs).

To avoid some of the anthropological complications, 'traditional' is defined here to denote practices that have some degree of historical continuity among a group of people.

The Research Setting: Southern Kyrgyzstan

Kyrgyzstan is a relatively new state that gained its independence from the Soviet Union in 1991. The country is characterized by a sharp division between the North and South. This split is reflected in the significant economic and cultural differences that define the two regions and is reinforced by the Tien Shan Mountains, which divide the country starkly and significantly hinder interactions between the regions.[9] The North is heavily influenced by its longer history of interaction and cooperation with the Russians;[10] it is economically and politically more powerful than the South. It consists of Chuy, Talas and Naryn oblasts and is home to the country's industrial base. The

[9] The physical geography makes travel by car between the two parts an arduous trip. Also, there is not a rail system linking the two regions, and the cost of a flight from Bishkek to Osh is prohibitively expensive for a majority of the population.

[10] Following the conquest of the North, resistance continued in the South.

population is Russified, educated and relatively modern/secular (Bond and Koch 2010; Megoran 2010).

On the other hand, Southern Kyrgyzstan is defined by a rural, agriculture dependent population that is less educated and more socially conservative than the North. Its cultural and economic makeup has been shaped by its location on the edges of the Ferghana Valley. The Ferghana Valley is one of the most fertile, culturally diverse and densely populated areas in Central Asia, surrounded by the Ala-Tau Mountain Range in the north, the Tien Shan Mountains in the east and the Alay Mountains in the south. While the majority of the central part of the Valley is in Uzbekistan (Andijan, Namangan and Ferghana provinces), parts of the northern and eastern sections of the Valley are in Kyrgyzstan (Batken, Jalalabad and Osh provinces) and a small portion of the west and southeast lies in the territory of Tajikistan (Sogd province) (Abdullaev et. al, 2008: 4).

Before Central Asia's conquest and incorporation into the Russian empire in the 19th and 20th centuries, the current geographic boundaries and modern state structures were not part of the population's daily life. It was not until 1936 that the Soviets finished carving out the present-day republics of Kyrgyzstan, Kazakhstan, Turkmenistan, Tajikistan and Uzbekistan, as part of the process of national delimitation. These republics supposedly reflect the "ethnic" composition of the region.

However, given the shifting, contradictory and complex manifestations of identity, scholars criticize both the official ethnic labels applied during the national delimitation process, as well as contemporary scholarship that assumes the accuracy and historical continuity of these identities.[11] Instead, the ethnic identity categories that define the population of Southern Kyrgyzstan – and Central Asia – are new and unequally laid over the groups. Central Asia is a culturally diverse region characterized by centuries of population movements and mixed marriages that have produced an area where languages and groups are completely intertwined. Thus, attempts to categorize the Central Asian population into discrete and enduring groups of 'Tajiks,' 'Kazakhs,' 'Turkmen,' 'Uzbeks' and 'Kyrgyz' are highly problematic (Schoberlein-Engel 1994).

[11] For example, during the imperial era, the group known today as Kazakhs were called Kirgiz or Kirgiz Kaisak. Following the Soviet's national delimitation project in 1924, the Kirgiz and Kirgiz Kaisak were renamed Kazak. Also, please refer to Schoberlein-Engel (1994) for a detailed study of the complexity of Central Asian identities.

Nevertheless, despite their modern creation, ethno-national sentiments have been made real and powerful by Soviet state policies that constructed and shaped these identities (Northrop, personal communication, 2011). In particular, through the twentieth century, the Soviets undertook extraordinary efforts to promote national identities through administrative, educational and cultural methods. For example, "passport nationality" required the declaration of national identity on passports and museums were established throughout Central Asia to show the historical development of the ethnic groups in the region. These efforts, in conjunction with an economic system which distributed resources on the basis of national identity, helped to make these identities real and meaningful for people (Hirsch 2005). Furthermore, these identity categories have been hardened by violence between ethnic Uzbeks and ethnic Kyrgyz in Southern Kyrgyzstan in the summer of 1990 and spring of 2010.

Therefore, despite the artificial nature of the boundaries, borders and identities, these features are essential for understanding contemporary Southern Kyrgyzstan. The two main social groups in Southern Kyrgyzstan are ethnic Kyrgyz and ethnic Uzbeks; these affiliations are crucial for individual identity and hold great significance in people's lives. The association of ethnic Kyrgyz and ethnic Uzbeks with very different traditional lifeways is important for my research because it implies a fundamental distinction in their experience and expertise with water management. Uzbeks are associated with a historically settled population of oasis dwellers; this includes agriculturalists that practiced irrigation and produced crops of grain, fruits and vegetables (Geiss 2003; Thurman 2000). In contrast, Kyrgyz are linked to a nomadic tradition. For millennia prior to the Russian conquest of Central Asia, nomadic groups lived on the edges of the oases and in the mountains. They produced meat, dairy products, skins and wool for subsistence (Campbell 2011; Michaels 1998).

The perception of a cultural difference between settled people and nomadic people is strong among Central Asians (Schoberlein-Engel 1994). Since I seek to explore whether and how varying levels of historical experience with irrigation impact contemporary irrigation management, I assume some historical continuity with ethnic Uzbeks and ethnic Kyrgyz. Thus, while I am aware of the complexity and dynamics of identity in Central Asia, the empirical portion of my dissertation examines and compares

irrigation outcomes in geographic areas associated with a large population of ethnic Uzbeks to areas that correspond to ethnic Kyrgyz communities.

Historical Overview of Irrigation Water Management

Rivers provide the means for settled life in Central Asia. As long as people have been in the area, the manipulation of the region's water for irrigation has been a critical concern. Evidence from early source material and archeology indicates that sedentary agriculture and gardening has been practiced in the oasis cities of Central Asia for thousands of years. The khans constructed extensive and complex irrigation systems to support the major cities that existed far from the mountains, including Bukhara, Samarkand, and Khiva (Ohara 2000; Thurman 2000).

Prior to the expansion of the Russian Empire into the area, political structures were known as khanates; Kokand, Bukhara, and Khiva are three that have a have a history of attempting human settlement and asserting control over the population. All khanates used certain broadly regional institutions to administer authority over irrigation water. The structures set in place for sedentary populations included mirabs (water masters), aksakals (white beards) and ashar (community labor). Although these water institutions took on new forms under the Russians and Soviets, they remain highly important for contemporary water management in Kyrgyzstan. Moreover, these institutional legacies represent one critical point of difference in the historical legacies for nomadic versus sedentary groups that will be discussed later in this chapter (Ohara 2000; Thurman 2000).

Pre-tsarist water management was hierarchically organized under the khans with mirabs and aksakals managing the daily operations of the system. The "mirab bashi" (head water master) controlled scheduling, managing water distribution and infrastructure maintenance at the main canal level while, at the secondary canal level, these tasks were the responsibility of local mirabs. Mirabs were elected by individual water-user communities – ketmen – and paid "in-kind" by a tax known as "kipsen," which was based on the population's satisfaction with the mirabs' work. In water scarce areas, there were more mirabs and a higher kipsen rate because it required greater effort to regulate water. The incentive structure created by kipsen and the election of mirabs by the

communities helped ensure the accountability of mirabs to local water users (Thurman 2000: 46-50).

The institution of the "aksakal" (white beards) is another key position in the administration of the local irrigation system. The term "aksakal" signifies both a leader (respected elder) and an older male. Aksakals were the leaders and decision-makers for the ketmen. Local aksakals supervised the overall process of irrigation in the community and resolved contentious issues; the "aryk aksakal" (canal aksakal) managed more specific sections of the canal system (Bichsel 2009: 70-2). Aksasals also held essential leadership positions in nomadic groups; although they were not responsible for irrigation management, they were respected elders with significant decision-making and conflict resolution powers (Geiss 2003). Thus, aksakals represent an important institutional link between sedentary and nomadic populations.

The third important institution is a form of community labor known as "ashar" (or "hasher"). Although it can be voluntary, "ashar" was often associated with the annual, non-voluntary maintenance of an irrigation system. The amount of ashar that an individual, family, or community contributed depended on the advantages received from the system. This made it similar to a tax. Hence, villages on or near rehabilitation sites were expected to contribute more labor or resources since they would reap the greatest benefits (Bichsel 2009: 73-5; Ohara 2000: 373).

In 1876, the Russian Empire took control of the Kokand Khanate and incorporated this area into Russian Turkestan. Although daily operations continued under customary management procedures, from 1876-1917, the Russian military government was officially responsible for irrigation management and introduced several important changes to the three traditional water institutions. Specifically, the "mirab bashi" and "ark aksakal" were integrated into the colonial system and became employees of the tsarist administration. This meant that these positions were no longer paid by water users through the kipsen system. As the mirabs became responsible to the military government and less accountable to local water users, the power balance between the mirabs and water users was fundamentally altered to the detriment of the latter. Also, ashar was integrated into the colonial system. Whereas traditional village-level ashar was not subject to major changes, attempts to implement large-scale ashar became riddled with

corruption (Thurman 2000). Therefore, while pre-colonial irrigation linked water users' duties and responsibilities (i.e. costs) to benefits from a successful system, the Russian system weakened the link between water users and the authorities in charge of water management decisions. As the state role and centralization of irrigation continued to grow during the Soviet period, this link between benefits and duties would further deteriorate (Thurman 2000).

Furthermore, imperial Russia considered the nomadic lifeway to be economically inefficient and socially primitive. In contrast to the work habits associated with sedentary agriculture, the deficiencies linked to animal husbandry and mobile pastoralism included depravity, laziness, and ignorance. The nomadic lifestyle did not coincide with the Russian Empire's economic objectives or view of governance in Central Asia– tying people to a specific territory was important for exerting control over colonial subjects. Ultimately, the large scale transformation (or destruction) of nomadic communities in Central Asia occurred under the Soviets who, in comparison to the colonial administration, had the bureaucratic apparatus and coercive force to more effectively realize their economic and governance plans (Campbell 2011).

Soviet era (1918-1991)

During the Soviet era, irrigation was administratively centralized and focused on river basin management among the five Central Asian republics of Kyrgyzstan, Kazakhstan, Uzbekistan, Tajikistan and Turkmenistan. For approximately 70 years, Moscow (in theory) organized, managed and subsidized the Central Asian irrigation system. The region represented the Soviet "cotton belt," and cotton cultivation required the development of an extensive, integrated and highly sophisticated irrigation system across the arid Central Asian states (Ul Hassan, Starkloff and Nizamedinkhodjaeva 2004).

Soviet policies sought to destroy the traditional institutions of Central Asian groups and completely redefine the population as socialist citizens. While the process of "civilizing" and "sedentarizing" the nomadic groups began under the Russian Empire, it accelerated rapidly with the Soviets. In particular, Soviet 'land reform' and

collectivization involved an aggressive process of forced relocation and sedentarization of Kyrgyz and Kazakh nomadic populations (Bichsel, 2009: 18; Ohara 2000: 375).

The Soviets also sought to remove water management from traditional institutions and eliminate customary law (Bichsel 2009: 72; Ohara 2000: 375). However, while the roles of the mirabs and aksakals were "officially" abolished, these village-level water authorities simply became subject to approval by Soviet officials, promoting government oversight and control in local affairs (Oneill 2003: 72-75). The institution of "ashar" became "subbotniki" – collective labor projects organized by the collective and state farms that took place on Saturdays. Therefore, the three water institutions were transformed in the Soviet period but survived and remained highly important.

From 1918-1991, the amount of irrigated land in Central Asia increased by approximately 4.9 million hectares (Ohara 2000: 369). Developments in technology enabled the Soviets to divert and store water from the region's two main rivers (Syr Darya and Amu Darya), and to extend canal systems into the foothills of the mountains (Bichsel 2009: 60-1). From 1950 to 1985, there was a 130% increase in irrigated areas associated with the Syr Darya and a 150% increase in the areas corresponding to the Amu Darya (Envsec 2005: 26). In 1991, 90% of the region's water was used to irrigate eight million hectares of land (Abdullaev et.al, 2008).

The Soviet legacy is critical to understanding irrigation management in contemporary Kyrgyzstan. The divergence between Western and local perceptions of the Soviet period reflect the dissonance in that legacy. A majority of the population in Southern Kyrgyzstan received an adequate and relatively constant water supply throughout much of the Soviet period (Ohara 2000: 376-7). Hence, the Soviets are associated with the provision of a stable water supply, as well as capital and technical expertise for the management of the irrigation system. Therefore, given the insecurity that many communities face today regarding the timing and quantity of water supplies, individuals often express a strong sense of nostalgia for the Soviet period (Bichsel 2009: 53-4).

In contrast, Western evaluations emphasize the inflexibility, inefficiencies and unsustainable nature of the Soviet system. Although irrigation schedules and water distribution were officially based on scientific norms, there was tremendous divergence

between planning and implementation. Indeed, the engineering feats that ensured a stable supply of water across Central Asia were ultimately based on severely depleting the region's water sources (Ohara 2000: 376-77; Sehring 2009: 70). By the 1930s and 40s, the efficiency of Soviet water management was estimated at 50% due to the constant supply of water and absence of incentives to coordinate water distribution (Thurman, 2000: 219). The large amount of water waste, in conjunction with furrow irrigation on uneven fields resulted in water-logging and the salinization of an estimated 40% of the land in the Ferghana Valley (Thurman 2000: 172). For example, towards the end of the Soviet era, approximately 16,000 cubic meters of water was used to grow one ton of cotton, although only 10,000 cubic meters was required. The extensive ecological damage from this highly inefficient water use caused significant land degradation and a reduction in crop yields (Thurman 2000: 240).

Moreover, scholars argue that the population of Central Asia developed a "Soviet mentality" concerning natural resource governance. The behavioral implications associated with this mentality pose serious challenges to post-Soviet irrigation reform. First, the constant supply of water through unsustainable means distorted the population's conception of water as a scarce resource that should be efficiently managed. Second, the Soviet's provision of the funding and expertise for the system motivated a culture of dependence that reduced the population's sense of ownership and responsibility for the system (see Ohara 2000; Sehring 2007; Thurman 2000).

Furthermore, Central Asian scholars emphasize the essential role that clintelism and patronage played in resource management during the Soviet era (Collins 2002; Cummings 2002; Geiss 2003; Ishiyama 2002; Sehring 2009). Although patronage and hierarchical social traditions were important in pre-Soviet society, Sehring (2009) argues that "the context of patronage changed in the Soviet Union and allowed self-interested resource exploitation on a much bigger scale" (p.71). By the 1930s, patronage networks at all levels of the irrigation system were crucial to securing access to resources, and corruption became a part of the informal rules for guaranteeing water delivery (Thurman 2000).

Specifically, since collectivization and forced settlement patterns resulted in state and collective farms that encompassed entire sedentary communities and/or nomadic kin

groups, networks based on kinship, as well as informal institutions such as mirabs, remained powerful and important for resource allocation (Sehring 2009: 87; Wegerich 2005).

Throughout the Soviet period, the problems linked to land degradation, inefficient water management and corruption grew increasingly challenging. By 1985, the irrigation system was in critical need of rehabilitation, and by 1990, the system was so dilapidated that the area of land under irrigation reverted back to the 1970s level (Bichsel 2009: 18).

Figure 2.1. Homemade water-gate (WUASP 2010)

Given the absence of a water-gate to regulate water, a water user demonstrates how the community uses stones, scrap metal and boards to control water flow.

Figure 2.2. Deteriorated canal (WUASP 2010)

A farmer points to a deteriorating section of a secondary irrigation canal.

Independent Kyrgyzstan

In 1991, the newly independent state of Kyrgyzstan was left with responsibility for the infrastructure within its borders, as well as a significant degree of control over the water originating in its territory. With the collapse of the Soviet Union, Moscow's financial backing for the system disappeared along with a significant number of ethnic Russians who held technical and management positions. Along with the history of corruption and substandard management practices, Kyrgyzstan inherited a dilapidated system and considerable technical problems, yet, it lacked the resources and expertise to manage and repair the system (Envsec 2005).

Therefore, following independence, the Kyrgyz government was unable to effectively support the operation and maintenance of its irrigation infrastructure. The

country quickly found itself fully dependent on, and indebted to, international donors for funding the necessary services and rehabilitation. Since the majority of the burden for irrigation management was quickly transferred to international aid agencies, scholars maintain that the culture of dependency, which developed under the Soviets, has been perpetuated by international development projects that are perceived as the new sources of funding and expertise (McGinnis 2000).

Irrigation Management Transfer

Under pressure from international donors, and in order to reduce the financial burden of irrigation governance on the national budget, Kyrgyzstan initiated a comprehensive reform of the irrigation sector in 1999. This process, known as Irrigation Management Transfer (IMT), entails the complete devolution and transfer of management, maintenance, and irrigation investment tasks from government institutions to private community-based farmers' organizations known as Water Users' Associations (WUAs) (World Bank, 2007).The other key component of the reform involves the introduction of irrigation service fees (ISF) that Water Users' Associations (WUAs) collect from the water users within their service areas. The irrigation service fee (ISF) is divided into two components: (a) a fee for water delivery and (b) a fee to cover the salaries for the WUA staff, taxes, daily operation expenses, rehabilitation costs, as well as payment for any donor credits/loans received.

Irrigation Management Transfer (IMT) is the international model for irrigation reform; since the 1960s, it has been implemented in over sixty countries. Irrigation Management Transfer (IMT) seeks to improve water governance through institutional reform, and it has ultimately replaced top-down technocratic approaches (Garces-Restrepo et. al, 2007: 1-6). While the core objective of IMT is more effective irrigation management, cost-recovery represents the primary impetus for the policy's adoption. The following excerpt from a speech by a World Bank official highlights the significance that cost-recovery concerns have played in this shift from centralized to local irrigation management:

> *The final necessary step has been to throw ourselves full force into developing Water Users' Associations. I must confess that in the old days I used to wonder why developing a strong centralized irrigation authority,*

> *which honestly and competently delivered water according to the schedules posted on the big billboards at junctions of country roads, wouldn't work better than mucking about with hundreds of cantankerous Water User Associations. I saw the debate between the two as largely ideological, which means philosophically appealing on the one hand to Indian Civil Servants in Lucknow, or on the other to some bearded anthropologist living in Bethesda. Well, when you have virtually no money, the debate is over. With no money we may as well forget about the impressive Malaysian Drainage and Irrigation Department of the 1970s. We need farmers' money, we need their shovels, we need them to operate gates and police their neighbors' abstractions, we need their oversight of contractors, and we need them to take over their irrigation systems* (Goldberg 2004).

The two key pieces of this irrigation reform – WUAs and irrigation service fees (ISF) -are expected to ensure cost-recovery, as well as more efficient and democratic water management. It is assumed that the participation and empowerment of water-users in local WUAs will create an incentive structure that motivates farmers to take on the high cost of irrigation management (Garces-Restrepo et.al, 2007: 1-6). Additionally, irrigation service fees (ISF) are seen as the main tool of WUAs for incentivizing cooperation, coordination and rational water use. A fundamental assumption behind IMT is the efficient and equitable use of water when it is expensive; the fees serve as a mechanism to both promote cost recovery and encourage economic water use by making it more costly for users to waste water.

In particular, ISF is anticipated to ensure a degree of dependence between downstream and upstream farmers. To support cost-sharing with downstream farmers, the ISF incentivizes upstream farmers to manage water more efficiently so that downstream farmers receive an adequate water supply and subsequently make a financial contribution to the WUA. Hence, in theory, upstream farmers will refrain from taking more than their allocated amount of water to guarantee that costs are more evenly distributed across farmers (Baxter 2008).

As summarized by an agronomist,

> If water costs can be defrayed by maximizing the number of members within the WUA, the head-end user will have a strong financial incentive to keep tail-end-users happy and contributing funds to the WUA (Baxter 2008)…If a head end farmer can obtain water at little to no cost (labor or money), he will have no interest in sharing water with downstream users,

> and he will have no interest in cooperating with a Water Users' Association. In fact, he may work to destroy cooperative efforts of downstream users to obtain water – water that he might lose control of (Baxter 2005).

Water Users' Associations

A Water Users' Association (WUA) is a non-governmental, non-profit association of farmers or water users that is charged with the operation and maintenance of the irrigation and drainage network within its territory. The boundaries of the overwhelming majority of Water Users' Associations (WUAs) in Kyrgyzstan correspond to the administrative boundaries of the district governments and former boundaries of the collective and state farms.[12] The World Bank On-Farm Irrigation Project (OIP) coordinates Irrigation Management Transfer (IMT) and the creation of WUAs in Kyrgyzstan. To date, over 500 WUAs have been established in Kyrgyzstan.

Since water resources are state property, WUAs are independent organizations that must purchase water from the Kyrgyz government (Kyrgyz Water Law 2000). The WUA must ascertain the amount of water needed for water users within its command area through demand aggregation. Specifically, before the irrigation season begins in the spring, each farmer is required to develop and sign a contract with the WUA for the total water needed; it is generally the responsibility of the WUA's mirabs (water masters) to collect these water requests. There are standards or norms as to the number of irrigations a particular crop should receive during the irrigation season, and these are reflected in the irrigation service fee (ISF). The WUA aggregates this information into one water contract and submits the contract to the district water department (RayVodKhoz). The RayVodKhoz delivers (or distributes) water to the WUA at a charge of 3 tyn[13] per cubic meter.[14] After water delivery, the mirabs distribute the water within the WUA. From about mid June through September, most of Southern Kyrgyzstan is on a "strict watering

[12] From an ecological perspective, this is problematic because water management systems should be based on hydrological principles and not administrative or territorial boundaries.

[13] One hundred tyn is equal to 1 Kyrgyz som and, given the current exchange rate, 45 Kyrgyz som equal one U.S. dollar.

[14] WUAs that do not receive water from the RayVodKhoz do not pay this fee; this includes WUAs that rely solely on a "natural" water source such as river.

schedule"[15] due to water scarcity, which requires additional water rotations to ensure the allocation of water throughout the service area (IWRM 2003).

In Kyrgyzstan, the members of a WUA are those individuals who own the land that they cultivate; individuals who rent land are legally restricted from WUA membership. WUA members must pay ISF, care for the equipment used or owned by the WUA, adhere to the irrigation schedule, and contribute to the costs of repair or replacement for any damaged equipment (IWRM 2003).

In theory, WUAs are designed to be community-based associations that operate in a democratic and transparent manner. The institutional model of the WUA requires a separation of power between the management and governing body. The unpaid positions of zonal representatives and Council members represent the "governance" side of the WUA and are the community's mechanisms of ownership and control.

WUAs are divided into "zones" based on the size and distribution of the population along the canals within their command area. Each zone elects zonal representatives, and the number of zonal representatives depends on the population within the zone. A zonal representative is responsible for representing their zone's interests in the WUA meetings and electing approximately ten Council members, a dispute resolution committee, and an audit committee.[16] The Council is the governing body of the WUA. It employs and supervises all salaried staff that manage the daily operation of the system. These management positions include the WUA director, mirabs, accountant and hydro-technician. The audit committee is in-charge of monitoring the financial transactions of the management. The dispute resolution committee mediates irrigation conflicts between farmers (IWRM 2003).

The General Assembly is the annual mandatory meeting of zonal representatives. During the Assembly, representatives evaluate the work of the WUA leadership, conduct elections and discuss the budget and rehabilitation plans that have been prepared by the staff of the WUA. Also, the budget for the following year must be adopted by at least

[15] However, in some areas, March, April and May represent the most water scarce months because the snow has not yet melted in the mountains.

[16] In WUAs with a small membership, the members will directly elect the Council members.

60% of the zonal representative;[17] by law, the budget should be posted prior to the meeting for review by all WUA members (Kyrgyz Water Law 2000).

WUAs can be characterized as a modern day form of the "ketmen" associations that organized resource management in sedentary communities prior to the Soviets. Furthermore, while many components of the WUA represent new structures for water management, the traditional institutions of mirabs and ashar have been formally incorporated into the WUA. In accordance with the historical function of mirabs, in a WUA, the mirab holds the keys (literally) to the water gates that control the flow of water into and throughout a WUA's canal system. They distribute water according to an irrigation schedule with specific dates and times for watering. Similar to the pre-colonial water management system, mirabs are once more responsible and accountable directly to the population that they serve through elections and the payment of ISF.

Figure 2.3. WUA committee meeting (WUASP 2010)

In relatively well-functioning WUAs, ashar has also re-emerged in a form that more closely approximates its pre-colonial past. Ashar is, once again, voluntary or non-voluntary labor at the local level for irrigation work that takes place at least once per year. It generally consists of cleaning the canals or repairing sections of the canals in the spring before the irrigation season. Furthermore, ashar has been integrated into the ISF system; a labor contribution represents one method for paying ISF.

Moreover, the institution of aksakal (white beard) remains highly significant in villages throughout Southern Kyrgyzstan. "Aksakals" are community leaders, mediators and judges, and although they do not have to be elderly, they represent the respected men of the community. Aksakals continue to play an important role in mediating irrigation conflicts in certain communities. However, unlike mirabs, aksakals no longer hold a prominent formal leadership role in irrigation management. In more developed

[17] In WUAs with a small membership, the members will participate directly in the General Assembly.

(institutionally strong) WUAs, aksakals have been integrated into the WUA structure through their election into the dispute resolution committees.

In theory, the institutional design of WUAs represents an appropriate solution to the irrigation management problems facing Southern Kyrgyzstan. They are designed to be democratic and community based with a system of checks and balances for the leadership. Also, they officially incorporate the respected traditions and institutions of mirabs, aksakals, and ashar.

Figure 2.4. Water-gate (WUASP 2010)

A WUA Director stands near a water-gate along a secondary canal. The mirabs regulate the flow of water by opening and closing these gates.

Figure 2.5. Field irrigation (WUASP 2010)

This picture illustrates irrigation at the field level.

Nevertheless, despite the predictions of better irrigation outcomes from IMT, the deterioration of the irrigation infrastructure has accelerated in the post-Soviet period (Bichsel 2006; Envsec 2005; WB 2003). Correspondingly, empirical studies have identified considerable variation in the effectiveness of WUAs, revealing the failure of most to collect irrigation service fees (ISF) and achieve their mandate to provide adequate, timely, and equitable water supplies to all water users within a command area (Abdullaev et. al, 2008; Mott MacDonald 2005; Sehring 2008).

To describe and illustrate these institutional weaknesses and failures, I prove a brief qualitative assessment of WUAs in Southern Kyrgyzstan along a set of institutional design principles developed by political scientist Elinor Ostrom (Ostrom 1990). These institutional design principles are often used as a standard for evaluating institutional capacity by common property resource scholars. This assessment is based on my field research that corroborates the studies undertaken by (Abdullaeva et. al, 2008;

Abdulmidohvna 2004; Sehring 2007; Ul Hassan, Starkloff and Nizamedinkhodjaeva 2004; Weigerich 2006; Zavgordnyaya 2006).

First, institutional design principle one – Clearly defined boundaries – declares that a stable common pool resource regime will exhibit "clearly defined boundaries" and the "effective exclusion of external un-entitled parties." In Kyrgyzstan, this means that water users should know the responsibilities and authority of the WUA management and have an understanding of the specific canals and irrigated land under the management of a WUA along with basic water use and property rights.

Nevertheless, basic knowledge about WUAs and irrigation management is conspicuously absent in a majority of communities throughout Southern Kyrgyzstan. In many cases, individuals either do not know of the existence of the WUA or they do not understand its role and purpose. Whereas the WUA leadership is usually relatively informed, the general population is often not aware that the WUA functions as an independent, self-sufficient and voluntary organization. Water users often do not understand their voting rights and capacity to participate in decision-making concerning irrigation management (Aimbaeva 2004).

Second, institutional design principle two – Proportional equivalence between costs and benefits – states that the rules and costs of resource appropriation should be based on the local ecological and social context. This principle does not hold in many WUAs. In Kyrgyzstan, there is often no guarantee that an individual will receive adequate and on-time supplies of water. In many cases, ISF payment or nonpayment does not correspond to predictable or sufficient water delivery. In areas where there are weak or failing WUAs, water users cannot rely on the WUA to order the correct amount of water and to effectively distribute this water across the entire service area. The poor condition of canals compounds this problem. Also, given the prevalence of water-theft in many areas, individuals who do not pay the WUA can still acquire water through illegal means, thereby reducing other users' incentives to adhere to water distribution rules. Thus, the cost of water and the rules governing water distribution are not often perceived to be fair and consistent.

Third, design principle three – Collective-choice arrangements – asserts that collective choice arrangements should be designed to allow the democratic participation

of a majority of resource users during rule creation and modification. By law, all WUAs are designed to operate in a democratic and transparent manner and should adhere to the required elections and meeting procedures. However, most community members are not aware of their status as WUA members, along with election and meeting procedures. Furthermore, the capacity of the WUA to actually adhere to the required election and meeting procedures is not feasible in many cases.

Fourth, design principle four – Monitoring – stresses the need for effective resource monitoring by individuals who are accountable to the appropriators in order to detect rule violations.[18] However, most WUAs in Southern Kyrgyzstan lack the capacity to effectively monitor their canals during the irrigation season. Mirabs are usually responsible for monitoring the extraction of water because it is not financially feasible to institute a water measuring system for individual farmers. However, given the size of most WUAs and the large number of small land plots in Kyrgyzstan, it is virtually impossible for a mirab to simultaneously monitor the water extractions of all farmers within his designated service zone. Moreover, the prevalence of ineffective and/or corrupt mirabs exacerbates this situation. During times of water scarcity, it is common for water allocation to be guided by bribery and personal contacts. Thus, many households in Kyrgyzstan choose to guard water gates and fields in order to detect violations in water extraction during periods of high water stress.

Fifth, institutional design principle five – Sanctions – requires clear rules with differentiated sanctions to reflect varying levels of rule violations along with the consistent sanctioning of defectors in order to halt rule violation. Among WUAs in Kyrgyzstan, the potential sanctioning methods include: reducing water supplies for individual canals, stopping water supplies for individual canals, imposing fines, delaying an individual's "irrigation turn" for misconduct, and community shaming. Nevertheless, effective sanctioning is notably absent among most WUAs due to their weak institutional capacity. In addition, there are social incentives for the WUA staff to avoid sanctioning offenders; kinship ties and intervention by village elders have been shown to limit or stop

[18] Monitoring is affected by the size of the area under supervision, distance between individual resource users, frequency of interactions between resource users, monitoring agents (or technology) and the homogeneity of resource activities by users.

the application of punishment to defectors. Also, the absence or weakness of monitoring in many WUAs throughout Southern Kyrgyzstan compounds the problem of sanctioning.

Sixth, institutional design principle six – Mechanisms of conflict resolution are cheap and of easy access – maintains that affordable and accessible conflict-resolution procedures and mechanisms must be in place in order to ensure cooperative outcomes. The financial and social costs associated with conflict over irrigation resources are high. These conflicts can arise in a variety of situations and circumstances including, water scarcity, water theft, unequal water distribution, and arbitrary or inequitable conflict resolution, etc. WUAs are legally required to have a "dispute resolution committee" that provides farmers with a platform for voicing their concerns and resolving tensions. Also, a competent WUA staff is expected to supply another avenue for mediating tensions. Yet, many WUAs lack a well-trained staff and formal committee for dispute resolution, thereby damaging the perception of the WUA as a legitimate institution for conflict resolution.

Seventh, institutional design principle seven – the self determination of the community is recognized by higher level authorities – highlights the importance of independent decision-making and rule creation at the local level without substantial interference by external authorities. Given the close relations between the local government authorities and leadership of the WUAs, this principle is met in many areas.

Eight, institutional design principle eight – organization through nested enterprises – represents a primary long-term objective of irrigation management transfer in Kyrgyzstan. Given the ecological hierarchy that defines WUAs along a canal system, the creation of "Federations" of WUAs is emphasized as an essential goal of irrigation management. Although several WUA Federations exist "on paper" in Kyrgyzstan, their capacity to function independently and according to the reform guidelines is highly questionable.

Conclusion

This chapter presented a brief historical overview of irrigation management in Central Asia and Southern Kyrgyzstan. It discussed Soviet policies, land reform and several institutions – ashar, mirabs and aksakals – that are important for understanding

contemporary water management in Southern Kyrgyzstan. Finally, the chapter provided important background information on Water Users' Associations (WUAs).

Chapter 3 explores the international, national, regional and local factors that create significant obstacles to irrigation management reform in Kyrgyzstan. It also introduces the Water Users' Association Support Program (WUASP) and describes its program theory and methods for improving the performance of WUAs.

Chapter 3

Background on Water Users' Associations and the Water Users' Association Support Program (WUASP)

This chapter describes the social, political and historical circumstances that undermine and constrain the Water User's Association Support Program's (WUASP) efforts to improve the performance of Water Users' Associations (WUAs). The first part of the chapter summarizes the main obstacles faced by WUAs and key explanations that have been put forward to explain their widespread failure to improve irrigation management outcomes. The second part of the chapter discusses the goals and methods of the Water Users' Association Support Program (WUASP).

Given the small body of rigorous research on WUAs in Southern Kyrgyzstan, for some parts of the discussion, I rely heavily on the work of a limited number of scholars and specialists who have significant expertise and experience in the region.

Section 1: Levels of Analysis

Overview

To understand the primary constraints and failures of WUAs in Kyrgyzstan, it is necessary to examine the local, regional and national factors that influence WUA performance. To begin, Kyrgyzstan's national level policy regarding water management is heavily influenced by the economic and political relationship between the countries of Central Asia. Although this research project is focused on irrigation outcomes at the local level, Kyrgyzstan's position as the upstream country in relation to Uzbekistan establishes a power dynamic that has serious negative implications for efficient and equitable local water management. National and international politics generate perverse incentives for the *efficient* management of water, thereby creating significant challenges to the successful implementation of irrigation reform.

At the regional level, Southern Kyrgyzstan contains dozens of canal systems with an inherent upstream/downstream dynamic between the WUAs located on each system; a WUA's location at the beginning, middle, or end of a system explains a significant portion of the variation in its water availability. This ecological hierarchy creates positions of power and dependence throughout the irrigation system. Moreover, significant technical and infrastructure issues impact the distribution of water between WUAs.

The local level is essentially defined by an upstream/downstream dynamic between water users within a WUA. Significantly, this ecological hierarchy *within* a WUA often reflects a social hierarchy which can raise an essential impediment to cooperation in cases where downstream farmers have no economic or social leverage to motivate the upstream farmers to distribute water fairly. Hence, several factors which influence this social or community dynamic and water management in general at the local level include: the residual effect of a Soviet mentality, the blue-print approach to implementing WUAs, and deep-rooted structural inequalities that were created, reinforced or exacerbated during land reform.

Interviews

Some of the information presented in this chapter comes from interviews completed during my field research. I conducted forty-three open and semi-structured interviews with individuals from a variety of organizations and geographic areas. In order to attain a broad-based understanding of water management in Kyrgyzstan, these interviews took place in Bishkek, Osh, Jalalabad and Batken with local farmers, academics, community members, village leaders, WUA representatives, as well as the staff of international organizations (IOs) and non-governmental organizations (NGOs). The interviews were conducted in Russian, English, or with the help of an interpreter if my interlocutor spoke Kyrgyz, Uzbek or Tajik. Hence, whereas I was capable of independently conducting interviews with development staff and respondents in cities, translation assistance was essential in rural areas during my discussions with farmers and the WUA staff.

The expert interviews were intended to collect data concerning how Bishkek and the development community perceive irrigation challenges in Kyrgyzstan. These interviews provide information about how water policy problems are framed – an international or domestic issue – along with the recommended solutions. My definition of "expert" was fairly broad. It included individuals whose profession required considerable involvement with water management issues; this ranged from individuals who held more technical positions, such as agronomists and engineers, to individuals primarily focused on national and international policy issues. These interviews were conducted in English and Russian.[19]

National/International-level factors

The water-energy nexus

Sehring (2009) argues that the Kyrgyz government is not committed to comprehensive irrigation reform and does not see irrigation service fees (ISF) as a legitimate mechanism for irrigation management. He maintains that Irrigation Management Transfer (IMT) was not introduced in Kyrgyzstan because the government shifted its priorities in favor of efficient water distribution. Instead, a budget crisis motivated the adoption of IMT (Sehring 2007: 283). Since the Kyrgyz government did not have the resources to allocate to its water sector budget, it quickly became heavily reliant on donor funding from the World Bank and Asian Development. By the mid 2000s, one government official estimated that donor funding accounted for 90% of the water sector budget. Furthermore, this funding is contingent on satisfying the basic guidelines of IMT, including the establishment of WUAs and introduction of irrigation service fees (ISF) (Sehring 2009: 138).

While international donors exert significant leverage on Kyrgyzstan's water sector, the Kyrgyz government retains control of regulating the cost of water delivery through adjustments in the price of ISF. Currently, the government sets the ISF at an

[19] The expert interviews were designed to provide important context and background information. They did not represent the empirical material for hypotheses testing. Thus, there was no deliberate selection process for the interviewees; the goal was to conduct as many interviews as possible in the time available to gain a better understanding of the issues at hand. This clearly raises the potential for a biased representation of experts. However, since research on water management in Central Asia relies almost entirely on expert interviews and case studies, I am able to compare and supplement my findings with previous scholarship.

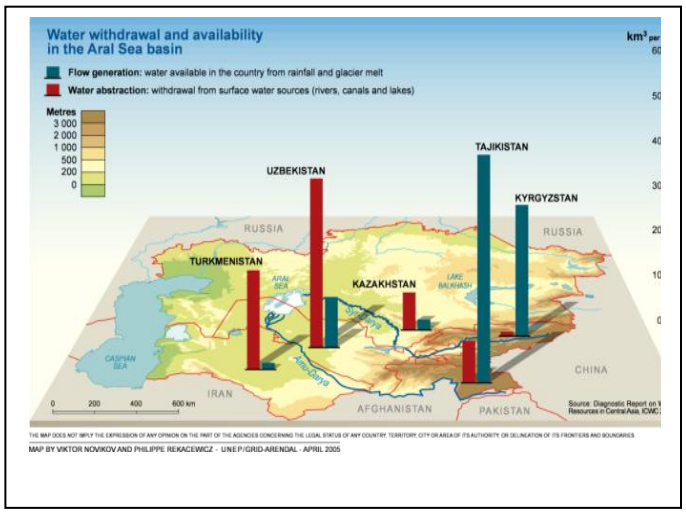
exceptionally low rate of 3 tyn per cubic measure. This rate is considered a "symbolic" fee by international consultants since it only covers about 20% of the cost recovery needs for the system (Sehring 2009: 125). Moreover, the government does not actively enforce sanctions for delinquent ISF payments by WUAs.

Sehring maintains that the low ISF rate is driven by the election considerations of officials in Parliament; water must remain cheap to keep farmers' votes (Sehring 2009: 125-7). This lack of dedication to efficient water management manifests itself in the continued delivery of water to farmers at a very low cost which does not provide water-users with an incentive to economize water use. "Cheap water" (or water delivery) threatens the success of irrigation reform by removing a fundamental pillar of IMT.

In addition to Sehring's claim, I put forth an argument that is encountered among the development community, regarding another national-level political consideration that has perverse implications for IMT. Drawing on interviews and informal conversations from my field research, I suggest that the economic and political process known as the "water-energy exchange nexus" between Kyrgyzstan and Uzbekistan provides Kyrgyzstan with a strong incentive to keep water cheap for farmers, even though they will waste it.

The "water-energy exchange nexus" refers to the exchange of water by upstream countries in Central Asia for energy resources from their downstream neighbors. According to a 1984 Soviet protocol, which remains the regional water policy, the upstream countries of Kyrgyzstan, Kazakhstan and Tajikistan are entitled to 17% of the water resources from the Syr Darya and Amu Darya rivers, whereas Uzbekistan and Turkmenistan are slated to receive 52% and 31% respectively. This means that the downstream country of Uzbekistan has the right to most of the water originating from Kyrgyzstan before it flows into the Aral Sea Basin. This privileged allotment is based on Uzbekistan's role as a primary cotton producer in the Soviet economy, in conjunction with Uzbekistan's almost complete dependence on water sources that begin outside its border (Envsec 2005: 21; Sehring 2009: 78)

Figure 3.1. Water withdrawal in Central Asia (Envsec 2005)



In accordance with the water-energy nexus, from April through September, Kyrgyzstan is expected to release 75% of the water reserves collected from its Toktogul reservoir. This is designed to ensure adequate water supplies for the downstream countries during the irrigation season. From October through March, Kyrgyzstan's abundant water resources and mountainous topography enable the generation of hydro-electricity through water releases. However, these winter releases are not to exceed 25% in order to prevent flooding in portions of Kazakhstan and Uzbekistan and to ensure adequate water supplies for these downstream countries in the following summer. In exchange for water during the summer, Uzbekistan and Kazakhstan are expected to supply Kyrgyzstan with much needed fuels during the winter months (Envsec 2005: 21-2).

Several factors have complicated this arrangement. Namely, the collapse of the Soviet Union led to the emergence of a small, poor and militarily weak Kyrgyz state in contrast to a large, regionally powerful and militarily strong Uzbek state. Kyrgyzstan has a population of approximately five million and the smallest economy in Central Asia; the country's 2009 gross domestic product (GDP) was 11.5 billion dollars. In comparison, Uzbekistan is characterized as a 'regional hegemon' with a population of 27 million, the largest armed forces in the region, and a official 2009 GDP of 71.5 billion dollars (Bond and Koch 2010: 543-4). Additionally, independent Kyrgyzstan is now solely responsible for the repair and upkeep of the reservoirs on its territory and must pay world prices for fossil fuels. Given Kyrgyzstan's dismal economic situation, it remains in a perpetual state of debt to Uzbekistan for natural gas supplies (Bond and Koch 2010: 545). Thus, Kyrgyzstan argues that the Soviet arrangement is no longer fair or financially viable; the cost of water versus the cost of gas and fossil fuels is not equal given the costs of

operating and maintaining the irrigation infrastructure. In one of my interviews, a Kyrgyz representative for the World Bank in Bishkek expressed the frustration felt on the Kyrgyz side.

> There is a problem with this idea of water as a commodity versus free resource in the political dimension with Uzbekistan… Why should the upstream pay for all of the problems when the main benefits accrue downstream? The situation is getting even worse because of the energy crisis that Kyrgyzstan faces in the winter….It is a simple model (equal payment of water for fuels) but they don't want to buy water and this is not because of economic reasons; they justify it because of past Soviet policies and religious[20] issues (WB 2008).

Water has become an increasingly central component in the political dynamic between Kyrgyzstan and Uzbekistan. In order to generate electricity for the winter, which reduces the need to purchase fuels from Uzbekistan, Kyrgyzstan has an incentive to save water during the summer and release more during the winter. Indeed, since 1993, Kyrgyzstan has frequently been accused of releasing too much water during the winter, which results in floods for Kazakhstan and Uzbekistan (Envsec 2005: 21-23). This flooding, as well as Kyrgyzstan's growing debt to these countries, provides Uzbekistan and Kazakhstan with two justifiable reasons for halting gas and coal deliveries to Kyrgyzstan in the winter (Bond and Koch 2010: 546).

The tension has continued to escalate in recent years with Uzbekistan's alleged construction of massive storage facilities for water and Kyrgyzstan's threats to build two more hydro-electric stations that would enable the country to generate additional electricity that could be sold or used for the country's needs (Kupatadze 2009).

Regardless of its status as a weak country, Kyrgyzstan's position as the upstream country provides it with control of critical water resources, as well as the capacity to use water as a strategic lever against Uzbekistan. Water is Kyrgyzstan's primary bargaining tool with Uzbekistan, and Kyrgyzstan's power is greatest when Uzbekistan is threatened by water scarcity. As a Kyrgyz representative infamously said during a session of Parliament: "We must stop fully the delivery of water to Uzbekistan during the vegetation period" (Kupatadze 1999). However, instead of engaging in a blatant and threatening act against a militarily strong country, Kyrgyzstan can simply increase Uzbek

[20] My informants often expressed the view that Islamic holds that water is a "Gift from God" and should be free.

water scarcity by inefficiently managing/wasting irrigation water. For example, this can be done by allowing its WUAs to use excess water resources without imposing additional costs or sanctions. During wet years with high flows, Water Users' Associations (WUAs) are charged the same amount as during the dry years. Thus, there is no incentive for farmers in Water Users' Associations (WUAs) to economize their water use. Since the Kyrgyz government does not charge WUAs for the actual water that they receive, water is cheap, thus encouraging WUAs to inefficiently manage irrigation water. According to one of my sources who will remain anonymous:

> The government does not charge the WUAs for the excess water delivered and thus encourages the WUAs to be inefficient and wasteful of water. The only reason for doing this is to deliberately harm the downstream countries.

Inexpensive water for the Kyrgyz farmers is detrimental to the domestic water situation for three reasons. First, Kyrgyzstan is impeding its own cost-recovery (Sehring, 2009). According to the same source above:

> In its efforts to harm Uzbekistan, Kyrgyzstan also forgoes income by not charging for water actually delivered to the WUAs; income that is desperately needed to operate and maintain the main delivery system.

Second, too much water is just as detrimental for crops as a shortage of water. Given the condition of drainage canals in Kyrgyzstan, excess water causes water logging and salinization, which subsequently inhibits plant growth and reduce overall crop yields (ICA, 2002, pp.8-10). Third, cheap water means that many WUAs get water on-demand, and this removes the incentive for the WUA to become a well managed organization (Baxter 2009: 18).

Regardless of the reasons for "cheap water," national level political changes are required to raise the ISF rate for WUAs. Thus, in examining variation in WUA performance, it is important to remain cognizant of the factors potentially hindering WUA success that are well beyond the capacity of a WUA or small-scale development project to change. As political scientist Elinor Ostrom (1990) emphasizes:

> Differences between those who have and those who have not extricated themselves from (collective action) problems may also have to do with factors outside the domain of those affected…some groups suffer from

> perverse incentives systems that are themselves the results of politics pursued by central authorities (21).

Regional Issues

Water measurement

Effective and equitable water management requires the measurement of water flows and withdrawals in order to distribute and allocate water according to certain irrigation norms. However, Kyrgyzstan lacks the resources to overcome the significant technical and infrastructure challenges facing its irrigation infrastructure. Specifically, similar to canals, the gauging stations designed to measure water flows and withdrawals are in very poor condition. In 2004, one researcher in Kyrgyzstan estimated that only 139 of the 545 water measuring stations in the entire Syr Darya basin were in working order (Sehring 2005: 80). Given the condition of the gauging stations, the ability of the regional water departments (RayVodKhoz) to measure water flows is highly questionable. The following field notes taken during a site visit by an American agronomist illustrate this problem with water measurement:

> It was obvious from my site visits that no one actually knows how much water is flowing down the Kojo-Kayir Canal. While there are 12 gauging stations, most of the stations are not functioning... The RayVodKhoz office has gauge charts for 8 of the 12 (stations)…the mirab for the RayVodKhoz has his own chart (different from the Rayvodkhoz charts) for a couple of the gauging stations that are sill operable. His charts show significantly less flow than the original gauging curves. The accuracy of (the mirab's) charts or the RayVodKhoz's charts is highly questionable. When asked how they come to a conclusion as to the actual flow, this was said to be 'based on experience and mutual consent regarding flows with the RayVodKhoz observers' (Baxter 2009).

In-kind payment of irrigation service fees

Water Users' Associations (WUAs) can pay their ISF for water delivery to the local water department (RayVodKhoz) using a combination of cash, labor and "in-kind" payments of crops. The discrepancy between the percentage of ISF that a WUA is *legally* allowed to pay through an "in-kind" payment and the *actual* percentage of ISF that most

WUAs pay in-kind is another factor argued to hinder the development of WUAs.[21] According to Kyrgyzstan's WUA law (2000), WUAs are allowed to pay 25% of their ISF to the RayVodKhoz in-kind; however, most WUAs in Kyrgyzstan pay 50-75% of their ISF through an in-kind payment (Baxter 2009: 5). Western analysis emphasizes the possibility of rent-seeking through high in-kind payments because the Director of the RayVodKhoz can potentially hold the crops until the market prices rise and/or sell these to the larger agricultural enterprises in Kyrgystan. However, many WUAs seem satisfied with the arrangement. From their perspective, this agreement eliminates the problems associated with storing, transporting and selling crops at local markets. Thus, it is perceived to be beneficial because many families in rural Kyrgyzstan do not have the resources to transport their crops, or they may find it risky to rely on selling the crops at the markets in order to receive cash (Abdulhamidovna 2009).

Local Level

Soviet mentality

When irrigation reform began in Kyrgyzstan, the population's perception of water as a free and unlimited resource represented a large obstacle to Irrigation Management Transfer (IMT). The consensus among both academics and international policy specialists was that this "Soviet mentality" had to be changed in order to promote water conservation and improve payment rates for irrigation service fees (ISF) (Temirkulov 2009; UNDP 2009; USAID 2009).

The following account illustrates how the behavioral implications attributed to this mentality introduced major challenges to the reform process and development work. The story was relayed to me by a Winrock staff member and is based on this individual's experience with Mercy Corps (an American NGO) during the early 2000s in Southern Kyrgyzstan.

> There was an isolated community of about 20 households in the middle of nowhere with no water. The cattle were so skinny because they had to walk such a long way to graze. So, we installed a pumping station for them, and one day someone called the NGO and said that there was a

[21] A portion of the ISF can be also be paid through a labor contribution. Labor has not yet been a problem because it comprises a small amount of the ISF contribution and the labor seems more efficient than the in-kind payments since it provides a direct improvement to the irrigation infrastructure.

> problem with the work that we had done and that they weren't getting any water. So the engineer went out there and called me and he said 'Do you know what they have done?' They have created a lake!' They had pumped out all of the water! They just kept the pump running day and night, and they proceeded to blame us. When he asked why they did not take care of the (rehabilitation) site and why they just let all the water out- they replied that they didn't think the water would ever run out. He explained that they needed to wait until the water filled up again underground before they would receive water (A 2008).

In an effort to change this mentality, public relations events and media campaigns have been introduced across the country and remain an important component of irrigation management reform (USAID 2009; World Bank 2009). The public relations campaign seeks to inform people that water is a scarce resource, and the ISF is a payment for the *delivery* of water, not water. Nonetheless, academics and representatives of the Bishkek policy circles maintain that this Soviet mentality persists and represents a major reason why rural populations do not conserve water and pay the ISF (Aimbaeva 2004; Sehring 2007; Temirkulov 2009; UNDP 2009; USAID 2009).

Despite these claims, my exploratory survey project and focus groups point to an important shift in the population's mentality regarding water conservation and ISF, although these results are not based on probability methods. The exploratory research was conducted in the winter of 2008/9 and included over one thousand respondents from over twenty-six different WUA communities across Jalalabad, Osh and Batken oblasts. Whereas many individuals still believe that *water* should be free, they believe that the *service* of water delivery requires a payment.

More specifically, a majority of respondents justified ISF on the basis of two factors. The first was that the staff of WUAs should receive compensation for their labor. The second reason was that improvements in the infrastructure required an ISF payment. Additionally, some respondents said water was government property that must be purchased, whereas a small number claimed that ISF payments will motivate people to value water more and use it in a more rational manner.

Thus, these findings do not support the claim that delinquent ISF payment is due to an entrenched Soviet mentality or belief that water is a "gift from God." People are willing to pay ISF for the labor and infrastructure required for water delivery. Moreover,

there is a similar response pattern among focus group and survey participants in the Water Users' Association Support Program (WUASP) and non-program respondents, as well as among individuals in Jalalabad, Osh and Batken provinces.

Two main implications emerge from these results. First, it appears that the public relations campaign has produced the desired results. Second, the continued use of the "Soviet mentality" argument may be diverting attention from more valid explanations for the lack of ISF payment.

Land Reform

In conjunction with its move to a free market system, Kyrgyzstan initiated land reform in 1991 under the guidance of international donors. In many communities, land reform may have had significant negative implications for contemporary natural resource governance by creating, reinforcing or exacerbating economic and social inequality.

Land reform involved the privatization of agricultural land through the dismantling of 422 collective and state farms. Initially, the first farms slated for re-organization were those deemed "unsuccessful" (Church and Roth 1996: 1-10). Land was assigned to individuals (private farmers) and families (peasant farming enterprises) on a competitive basis by local councils. These councils were generally comprised of the leadership of collective and state farms, and were endowed with tremendous power and responsibility during the process of land privatization through their control of the division and distribution of land and property shares (Church and Roth 1996: 16-22).

In particular, the councils distributed land on the basis of several factors including soil fertility, land size, number of state or collective farm members, and the professional training and capacity of the applicants (Church and Roth 1996: 12). Significantly, individuals with the 'professional training and capacity' to farm large tracts of land were also those individuals with the expertise and financial capability to separate from the state and collective farms (Church and Roth 1996: 93). Thus, the managers, specialists and administrators from the state and collective farms represented the group with clear advantages – financially and legally – for receiving the best and largest tracts of land.

Moreover, creating an independent farm during the initial stages of privatization entitled one to significant benefits. First, a presidential decree in 1992 stated that there

was to be *no limit* on land size requests for individuals leaving a state farm to establish their own farms. This gave independent farms the opportunity to apply for very large tracts of optimal land. Second, those willing to establish a farm received guaranteed market and state supports (Church and Roth 1996: 13). They were eligible for all necessary agricultural inputs – machinery, gas, seed, chemicals, etc. – at the wholesale prices available to state and collective farms (Church and Roth 1996: 95).

In 1994, due to significant budget pressures and a continued decline in agricultural productivity, there was a renewed reform effort to dismantle and restructure the state and collective farms. The directives that emerged during the second reform wave emphasized the right of *all* citizens to arable land and imposed a twenty hectare maximum farm size in intensive agricultural zones. Twenty-five percent of the land remained state property while seventy-five percent of the agricultural land of the former collective and state farms was divided among the members of these farms based on the numbers of the population and total land available (Church and Roth 1996: 11-15).[22] While all Kyrgyz citizens were guaranteed a plot of land and households received full private ownership for their home gardens, residents who had lived, but not worked, on the collective farm were legally slated to receive a significantly smaller tract of land. Farmers who received land in excess of these figures during the first wave of reforms were instructed to return it to the state, although it is doubtful this took place (Church and Roth 1996: 97).

In summary, during land reform, the leadership and management of the state and collective farms were responsible for allocating potentially large tracts of the best land to individuals within their farms. Accordingly, in the first years of reform, those capable of farming independently of the collective and state farms received significant advantages to ensure the success of their endeavor. These circumstances created the potential for highly uneven and unfair land distribution, along with increased economic inequality in many communities (Sehring 2005; Wegerich 1996).

Blue-print approach to implementing Water Users' Associations

[22] This means that areas with high population densities received much smaller land shares than low density areas.

I provide a brief overview of the general problems associated with a top-down approach to community-driven development in this section. In the context of WUAs, a blue-print approach implies their quick set-up, as well as a lack of time and resources devoted to institutional development and community-wide mobilization. For example, education and training efforts are focused on local political leaders and the residual leadership/management from Soviet era collective and state farms.

Top-down approaches for establishing WUAs are justified on the basis of efficiency and affordability; individuals who either have some irrigation and agricultural experience are further trained with the expectation that knowledge will "trickle down" to water users in a service area. Since most water users in Kyrgyzstan do not have much experience with irrigation or agriculture, the top-down method makes it feasible to establish hundreds of WUAs in a limited amount of time without substantial costs.

However, scholars question whether robust institutions for common property resource governance will emerge from development methods that rely on the trickle-down effect and "one-size fits-all" institutions. They argue that the blue-print approach is an inferior method for achieving a critical mass of cooperators and ensuring that the benefits of cooperation and participation are well understood by a community. Instead, the claim is that the approach increases the potential for elite capture and produces weak institutions that fail to incentivize cooperation (Baland and Platteau 1994; Seabright, 1994).

Indeed, most WUAs in Southern Kyrgyzstan remain very weak institutions that have failed to produce the projected improvements in irrigation management (Aimbaeva 2004; Sehring 2006).[23] The development program of interest for this research study – the Water Users' Association Program (WUASP) – represents a correction strategy for the blue-print approach. The program is designed to improve WUAs through institutional development, community-wide mobilization, and participatory rehabilitation.

Section 1 Summary

Section 1 provides information about the main factors hindering the performance of WUAs at the local, regional and national level. This information is important for understanding the obstacles facing the Water Users' Association Support Program

[23] See Chapter 2 for a more detailed discussion.

(WUASP) in its attempt to improve the performance of WUAs. While WUASP is focused on improving WUA capacity at the local level, it is important to remain cognizant of the macro-level factors that complicate and hinder the program's work. In the following section, I describe the goals and methods of WUASP.

Section 2: Methods and Goals of the Water Users' Association Support Program (WUASP)

According to the program objectives, the Water Users' Association Support Program (WUASP) seeks to strengthen Water Users' Associations (WUAs) so that farmers can operate, manage and make the necessary investment decisions for maintaining and improving their irrigation systems. The primary proximate goal of WUASP is to motivate behavioral change in priority target groups (water users and irrigation management staff) that will result in greater irrigation management cooperation.[24] The program's distal objective is to advance the economic condition of rural populations by improving a WUA's capacity to manage water. To achieve these aims, WUASP uses methods that emphasize social mobilization, institutional development and community-wide involvement in rehabilitation.

In Southern Kyrgyzstan, WUASP worked with twenty-eight of the region's 188 WUAs from 2004 – 2009.[25] The program was funded by the United States Agency for International Development (USAID) and implemented by Winrock International, an American NGO with significant experience in international development work related to agriculture and irrigation.

In Kyrgyzstan, WUASP was based in the city of Osh. It consisted of a country director, administrative assistant for the country director, three local engineers, three community mobilizers, one accountant, one finance specialist, one "public relations" specialist and five drivers. Also, American volunteers provided technical support at various stages of the program. Over the course of the program, the position of country director was held by three different people: a local Kyrgyz information technology

[24] WUASP also has a program component which is dedicated to informing policy makers at the national level regarding ways to improve irrigation management outcomes.
[25] In 2004, there were approximately 150 WUAs. From 2004-2009, the World Bank created several dozen WUAs, bringing the 2009 total to 188.

specialist, an American agronomist and a female Uzbek national who had worked with WUASP since its launch in the late 1990s in Uzbekistan. The engineers were all from Southern Kyrgyzstan. They included ethnic Kyrgyz men (and one woman), as well as one ethnic Russian. The engineers were educated in technical fields during the Soviet era and did not necessarily have a specialization in irrigation. The public relations specialist, grant manager, and accountant were ethnic Kyrgyz from Southern Kyrgyzstan; they were selected for their positions due to their proficiency in English and experience working with Western agencies. The two mobilizers and "development specialist" were Kyrgyz men who were chosen for the project based on their experience in irrigation or agriculture during the Soviet period and/or language skills. The mobilizers speak Kyrgyz, Uzbek and Russian, and one mobilizer is also fluent in Tajik. All of the drivers were Uzbek.

Several factors were explicit criteria in the selection of WUAs for the program.[26] First, although the treatment WUAs were not chosen on the basis of extremity, there had to be a problem with the WUA that could be solved through the introduction of management principles. For example, these problems might include disorganization or inactiveness among water users, as well as a general lack of understanding regarding the WUA and irrigation management. Also, there needed to be relatively significant infrastructure issues that could be addressed through emergency rehabilitation. Given the poor performance and substantial infrastructure issues that characterize most WUAs in Southern Kyrgyzstan, these were not difficult criteria. Ultimately, this meant WUASP tried to avoid selecting WUAs where other development programs were involved in heavy infrastructure projects, as well as successful WUAs or those on the verge of collapse.

Second, after WUASP initiated several WUA projects, subsequent WUASP selections took into account whether a WUA was located along the same canal as other WUAs in the program. This translates into a situation where treatment WUAs are clustered together, though not necessarily located next to one another. Third, WUASP did not select WUA with excessively high debt levels because this was viewed as an indicator of an unfavorable community dynamic. Fourth, there are cases where the

[26] The methodological implications for the selection criteria are explicitly addressed in empirical Chapters 5 and 6.

leadership of a WUA presented a petition to WUASP. Although this did not guarantee acceptance into the program, it increased a WUA's chance of being considered for the program. Finally, the WUA selections made by WUASP in 2008 were based largely on one requirement: the presence of large areas of unproductive land that could be brought back into production through infrastructure rehabilitation.

The three standard components of WUASP include emergency technical rehabilitation, institutional development of WUAs and social mobilization. According to the theory underlying WUASP, all WUA members and direct beneficiaries should have basic information and skills to solve the irrigation problems facing their community. Thus, social (or community) mobilization is the essential foundation for the project, and, in Kyrgyzstan, it ranged from three months to six months for WUAs selected for the program *before* 2008.[27] During this process, "mobilizers" are tasked with building good relationships and trust with the local community. This requires mobilizers to spend extended periods of time in villages and to interact with a sizeable portion of the population through discussions and trainings on (1) the substance and goals of WUAs (2) the Kyrgyz Law on WUAs (3) specific water problems faced by the community and (4) ways to improve local irrigation management. The pictures below show WUASP training sessions in three WUAs (WUASP, 2010).

Figure 3.2. WUASP training A

Figure 3.3. WUASP training B

Figure 3.4. WUASP training C

[27] For WUAs selected *after* 2008, the community mobilization process was drastically shorter – ranging from two weeks to one month. This difference for the 2008 selections can be attributed to a change in the donor (USAID) requirements. The WUASP program was scheduled to end in 2008; however, USAID provided a one year project extension with the stipulation that WUASP must bring several thousand hectares of land back into production. Therefore, WUASP changed its WUA selection criteria to include WUAs with large tracts of land that were no longer cultivated due to a lack of irrigation water. Given the one year time limit and extension requirement, WUASP focused almost entirely on rehabilitation work in the 2008 WUAs. Accordingly, I explore the implications and significance of this qualitatively different treatment for the WUAs selected in 2008 in Empirical Chapter 6 and Analysis Chapter 7.

In comparison to months of development support received by the treatment WUAs[28], the standard development help received by most WUAs in Kyrgyzstan includes a basic set of World Bank trainings and seminars that vary from one day to two weeks and are concentrated on the leadership of the Water Users' Association (i.e. the Director and Council members). According to the program guidelines, WUASP mobilizers initially focus their efforts on individual water users. Next, they organize groups of the most "active" water users for further education with the expectation that these active community members will continue the educational program throughout the community.

The institutional development phase of WUASP is simply a version of the social mobilization that is focused on the WUA staff. The WUASP mobilizers, community development specialist, engineers and grants manager help to ensure that elections are held and positions filled for the WUA's governance and management posts. WUASP conducts trainings with the WUA staff on topics ranging from national WUA laws to WUA governance procedures; it informs the staff of their responsibilities and teaches the leadership how to conduct the mandatory election/assembly procedures.

Once sufficient progress has been made with social mobilization and institutional development, WUASP initiates "cement and stone" emergency infrastructure projects. In Kyrgyzstan, the program allocated approximately 3 million som (86,000 USD) for the infrastructure work in each WUA. The emergency rehabilitation generally involves the reinforcement of old canals to improve the efficiency of water flow and the installation of new water-gates to promote greater control of water distribution and reduce unsanctioned water withdrawals. Given sufficient time and resources, these infrastructure projects can also include the construction of new canals or an office for the WUA.

WUASP's rehabilitation requires community participation and can be conceptualized as a more advanced phase of social mobilization and institutional development. First, a quorum of WUA members must select and vote on the irrigation repairs. Ideally, rehabilitation sites should be areas where there is the most extreme need, and they should also be dispersed across the beginning, middle and end of the canal. After the WUA members select the sites, WUASP engineers and the grant manager create a rehabilitation plan and budget. Several sites are usually eliminated due to budget

[28] This is not including the 2008 selections.

concerns; this requires another round of voting by WUA members. This process is designed to increase community participation in WUA decision-making and promote a sense of ownership for the WUA.

Once the sites are selected, WUASP guides the staff of the WUA through the procurement process for the rehabilitation grants. For each step of the actual rehabilitation process, the WUA is required to develop a budget and list of necessary supplies for each rehabilitation site before WUASP disperses the grant money. WUASP helps the WUA find product suppliers and demonstrates several methods for checking product quality. After each purchase, the grant manager reviews the receipts for the purchases *and* the actual supplies purchased. Besides ensuring accountability, this process is designed to help the WUA develop better accounting practices and business skills. Also, this conditional transfer of funds at each stage of the project has been suggested as a way to stop elite capture.

Finally, since WUASP grants are relatively small, contractors cannot be hired to complete the rehabilitation. Therefore, community members must implement most of the rehabilitation projects through voluntary community labor known as "ashar," which has a long history in Central Asia (see Chapter 2). WUASP engineers oversee the work and teach the WUA staff and water users how to complete fundamental tasks such as cement mixing/preparation, canal lining and water gate installation. In theory, the rehabilitation process is designed to impart fundamental knowledge and skills to local water users while creating a sense of ownership for the canal infrastructure.

Figure 3.5. Ashar (WUASP, 2010)

Here we see the use of ashar for canal rehabilitation, as well as the poor condition of the canal.

Figure 3.6. New water-gate (WUASP, 2010)

This is a ribbon-cutting ceremony for the celebration of a community's recently completed water-gate.

Conclusion

This chapter discussed the primary problems hindering the success of Water Users' Associations (WUAs) at the national, regional and local level. I also provided relevant background information on the Water Users' Association Support Program (WUASP). The following chapter presents hypotheses regarding WUASP's effect on WUA performance.

Chapter 4

Theory and Hypotheses

Background

This dissertation is an applied study that investigates the impact of an international development program on irrigation management outcomes in Southern Kyrgyzstan. The Water Users' Association Program (WUASP) seeks to improve irrigation management outcomes by (1) building the institutional capacity of Water Users' Associations (WUAs) (2) and fostering cooperation among water users. These goals are not mutually exclusive; a stronger WUA is expected to motivate greater cooperation in irrigation management, and improved collective action should enhance a WUA's capacity.

Collective action is defined as the pursuit of a goal, or set of goals, by more than one individual. A collective action dilemma arises when individuals in a group have a choice between participating in the provision of a resource or not participating ("free-riding") and thereby receiving benefits while other members of the group pay the costs (Olson 1965). The emergence of a collective action problem along an irrigation system is fostered by both the rivalry in water consumption between farmers and inability to prevent upstream farmers from taking unfair amounts of water. In particular, irrigation infrastructure and water are characterized as "common property resources" because they are public goods that are "non-excludable" and "rival." First, the incredibly high cost of regulating access to water means that it is often very difficult or impossible to exclude individuals within a group from using the resource.[29] Second, there is competition

[29] For example, this is not true in cases where the irrigation water is supplied through a pumping system to individual farmers. In that case, it is possible to exclude individual farmers from irrigation water by simply not pumping water onto their fields. If water-gates are in good condition, the flow of water along the main

among users because the use of one unit of the resource by one member of society reduces its availability for another (Hardin 1968).

The fundamental collective action problem that arises in an irrigation system is often initially centered on free-riding by farmers at the beginning of a canal system when there is an absence of incentives to cooperate and supply water to downstream farmers. Subsequently, users at the end of a system who do not receive an adequate water supply will also pursue non-cooperative strategies to secure their access to water. Thus, non-cooperative behavior by farmers located at the beginning of an irrigation system generates a cascade effect of free-riding. This dynamic leads to social costs, a decreased water supply, and reduced incentives to contribute to the upkeep and maintenance of the irrigation system. Eventually, the infrastructure deteriorates and water supply decreases to the detriment of all water users (DiGregorio and McCarthy 2004).

In order to understand how WUASP enhances the capacity of WUAs, it is necessary to achieve a better understanding of the program's influence on variables that have an effect on collective action in natural resource governance. In this chapter, I use theoretical arguments from the program theory guiding WUASP together with common property resource literature to develop hypotheses concerning the influence of the program affects the variables argued to promote collective action. In particular, I develop hypotheses about the program effect on four individual behavioral mechanisms, which function as precursors to improved collective action. Behavioral mechanisms represent micro or individual level processes linking the program to the performance outcomes of interest; these help to explain the presence or absence of variation in cooperative capacity and the performance of WUAs. The following mechanisms are explored in this study: (1) *knowledge* regarding the WUA and irrigation management, (2) *participation* in the WUA, (3) *attitudes* concerning WUA capacity and ownership roles, and (4) *social capital*. These hypotheses serve as the basis of my empirical analysis for Chapters 5 and 6.

Water Users' Associations and Collective Action Outcomes

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and secondary canals can be regulated at specific nodes along the system, though not between individual fields.

The mechanisms driving the collective action problems inherent in common property resource management are often framed in economic terms such as benefits, costs, risks and incentives. It is assumed that individuals will cooperate and coordinate in natural resource governance if the benefits outweigh the costs. These cost and benefit calculations are affected by a plethora of factors including: social norms, socio-economic features, user group and resource characteristics, the history of resource management and cooperation, informal rules and traditions, and the capacity of formal institutions (Ostrom, Garner and Walker 1994).

Common property resource scholarship's emphasis on the potential for institutional arrangements to alter individual's cost-benefit analysis in favor of cooperation is of particular significance for my project. Institutions are a coordination mechanism or "structured bargaining forum" that enables individuals to more efficiently organize their actions for the successful governance of natural resources. Effective institutions promote consistency of behavior and reduce the large transaction costs arising from the decentralized coordination of an activity within a group (Ostrom 1990; White and Runge 1994). Although common property resource scholars assert that there is no single best strategy to promote cooperation, research has shown that local institutions are often a significant advancement over other methods of resource governance (Ostrom 2009).

Accordingly, Water Users' Associations (WUAs) are formal institutions structured and implemented to constrain and shape interactions among water users (see Chapter 3). They are defined by a set of rules, specific organizational structure, and governance procedures. WUAs are supported, in theory, by a country's legal system. The assumption guiding existing policy discourses on irrigation reform is that the establishment of WUAs, in combination with the introduction of irrigation service fees (ISF), will motivate efficient and equitable irrigation management (Degnbol et. al, 2006). Theoretically, while WUAs represent the necessary institutional structure and democratic foundation for water governance, the ISF incentivizes efficient water distribution and ensures cost-recovery for the operation and maintenance of the system (Sehring 2008). Since farmers must pay a non negligible fee for water delivery, the assumption is that they will economize water use. Moreover, to avoid losing ISF contributions for water

delivery from downstream farmers, upstream users are expected to refrain from violating water-schedules, thereby proving an adequate supply of water for end-users (see Chapter 3). In addition, the democratic and transparent decision-making in the WUAs, in conjunction with the ISF, is anticipated to generate a sense of ownership for the system, as well as increase participation in natural resource governance. Since farmers must pay for their supply of water and cover the cost of system repairs and equipment, the assumption is that they will play a more active role in irrigation management and be more vigilant about monitoring the condition of irrigation infrastructure (see Chapter 3).

In Kyrgyzstan, the transfer of responsibility for irrigation management from the state to local WUAs exemplifies a community-driven development (CDD) approach. Important challenges have been raised about this approach to natural resource governance. In particular, the blue-print (or top-down) method used to implement many CDD projects is often a primary source of concern and criticism. The blue-print approach is characterized by rapid institutional set-up that is focused on a pre-existing set of community leaders. The claim is that this method generates weak institutions, opens the door for elite capture, and encourages a tradeoff between equity and efficiency.

Indeed, there is tremendous variation in the performance of WUAs; numerous WUAs are failing to achieve their mandates of equitable and efficient water distribution across a command area. Despite the predictions of better irrigation outcomes from IMT, the deterioration of the irrigation infrastructure has accelerated in the post-Soviet period (Bichsel 2006; Envsec 2005; ICA 2003). Correspondingly, empirical studies have identified considerable variation in the effectiveness of WUAs, revealing the failure of most to collect irrigation service fees (ISF) and achieve their mandate to provide adequate, timely, and equitable water supplies to all water users within a command area (Abdullaev et. al, 2008; Mott MacDonald 2005; Sehring 2008).

Despite these concerns, dominant policy and development discourses from the implementing agencies and donors continue to promote community-driven development as the necessary solution for improving development outcomes. Furthermore, the absence of rigorous independent impact assessments of most community-driven development projects contributes to the ambiguity regarding its effect (Platteau and Gasparat 2003).

Consequently, my program evaluation of WUASP allows us to gain useful insights into community-driven development through an investigation of the conditions under which CDD may promote more desirable development outcomes. Namely, WUASP represent a correction for the blue-print approach to establishing WUAs. The program is designed to foster the capacity of WUAs through international development, social mobilization and participatory rehabilitation efforts that are directed at all categories of water users (see Chapter 3).

In particular, according to the theory underlying WUASP, all WUA members and direct beneficiaries should have basic information and skills to solve the irrigation problems facing their community. Thus, social (or community) mobilization is the essential foundation for the project, and, in Kyrgyzstan, it ranged from three months to six months for WUAs selected for the program *before* 2008. Moreover, the institutional development phase of WUASP is simply a version of the social mobilization that is focused on the WUA staff. The WUASP mobilizers, community development specialist, engineers and grants manager help to ensure that elections are held and positions filled for the WUA's governance and management posts. WUASP conducts trainings with the WUA staff on topics ranging from national WUA laws to WUA governance procedures; it informs the staff of their responsibilities and teaches the leadership how to conduct the mandatory election/assembly procedures.

Furthermore, WUASP's rehabilitation requires community participation and can be conceptualized as a more advanced phase of international development and social mobilization. Specifically, the rehabilitation motivates irrigators to work collectively on physical capital investments in order to strengthen social cohesion, as well as a sense of self-governance. Also, WUASP implements a sequential and conditional release of funds for infrastructure repair. Thus, the program's methods have been cited as important ways to avoid elite capture and address many concerns associated with community-driven development (Baland and Platteau 1996; Sarker and Ioh 2001).

Given the community mobilization, institutional development and rehabilitation procedures undertaken in WUASP sites and their absence in control sites, I expect better collective action outcomes in WUASP-supported WUAs. Hence, the fundamental hypothesis tested in this dissertation is as follows:

→$H_{\text{Collective Action Outcomes}}$*: WUASP-supported WUAs exhibit better collective action outcomes than control WUAs that only received top-down development support.*

Section 1: Identifying and Testing the Mechanisms

In order to understand *how* the Water Users' Association Support Program (WUASP) can influence the performance of Water Users' Associations (WUAs), it is necessary to test several variables linking WUASP to cooperation in natural resource governance. Common property scholars have identified a multitude of factors that alter individual's costs and benefits for cooperation. These variables have both a direct and indirect effect[30] on collective action (Agrawal 2002). The expectation is that WUASP affects development outcomes through its direct or mediated effect on a subset of these variables.

This section describes how four individual behavioral mechanisms – *knowledge*, *participation*, *attitudes*, and *social capital* – can effect cooperation and how WUASP's methods are designed to influence each of these mechanisms. These four mechanisms are derived primarily from WUASP's program theory, which corresponds to the general theoretical framework guiding community development approaches. They also represent fundamental collective action variables of interest for common property resource scholars.

In general, WUASP's methods are anticipated to have a positive effect on each of these four mechanisms, thereby modifying individual's cost/benefit analysis in favor of cooperation. Enhanced cooperation is subsequently expected to promote distal development goals such as improved crop production and economic benefits for rural communities. In particular, WUASP can *directly* affect the mechanisms through community mobilization and rehabilitation work, or *indirectly* through institutional development. Although this study can test whether there is evidence of a particular behavioral change in program sites, it is beyond the scope of this project to specify and test a causal pathway that links WUASP to these four individual behavioral mechanisms

[30] In the empirical analysis, this indirect effect is also referred to as an interaction, mediated or heterogeneous treatment effect.

and collective action outcomes.[31] Indeed, collective action outcomes are influenced by complex interactions between these behavioral mechanisms.

In the second main section of this chapter, I move from a description of WUASP's effect on individual level behaviors to a discussion of important contextual variables that may mediate WUASP's effect on collective action outcomes. These potential mediating factors include a WUA's population and land size, economic inequality, social heterogeneity, and ecological scarcity.

A reminder about terminology: WUASP represents the "treatment," and the WUAs where WUASP was implemented represent the treatment groups or sites. Correspondingly, WUAs where WUASP was not implemented serve as "control" sites or groups.[32] For my discussion of the mechanisms, the control sites represent WUAs that only received basic World Bank institutional support. The treatment WUAs received both basic World Bank support and the WUASP treatment.

Knowledge

Scholars assert that knowledge is a critical pre-requisite for successful collective action because it ensures a more accurate understanding of the costs and benefits of cooperation (Hardin 1995). Moreover, better cooperation is expected in situations where resource users share a common understanding of how the resource system operates and how individual actions affect each other and the system (Ostrom 2009). Thus, water users should be cognizant of basic information regarding the important structural and individual-level factors that influence the governance of their community's irrigation water. Knowledge of a WUAs rules and decision-making procedures is predicted to encourage participation in meetings and increase understanding of the advantages associated with active involvement in an effective WUA.

Accordingly, WUASP seeks to improve water-users' knowledge of the WUA and irrigation management directly through social mobilization and the participatory rehabilitation process. The program can also indirectly improve knowledge through

[31] Therefore, in empirical Chapter 6, I attribute statistically significant discrepancies in the mechanism estimates for treatment versus control groups to a positive program association.

[32] Chapters 5 and 6 include more detailed discussions of how control WUAs were determined for the two research designs used in the dissertation.

institutional development that leads to a more informed management staff, zonal representatives and Council members. Given the community mobilization, institutional development and rehabilitation procedures undertaken in WUASP sites and their absence in control sites, I hypothesize that respondents in WUAs treated by WUASP will be more knowledgeable about the WUA and basic irrigation management in comparison to control respondents.

> $\rightarrow H_{Knowledge}$*: Respondents in WUAs treated by WUASP are more knowledgeable about the WUA and irrigation management than respondents in control WUAs that only received the top-down development support.*

Participation

Greater participation in a WUA is expected to increase knowledge and awareness of a resource system and the community dynamics influencing its management. Also, the participation of water users in decision-making regarding irrigation governance is predicted to increase their likelihood of following the rules and monitoring others (Ostrom and Nagendra 2007). Scholars claim that the dedication of time and energy in the WUA, in conjunction with participatory and transparent decision-making will create a sense of ownership for the WUA and irrigation infrastructure, thereby increasing investment in the organization and reducing the probability that individuals damage the irrigation structures (Sehring 2008).

Furthermore, active participation in natural resource governance encourages dialogue and face-to-face communication. Multiple common property resource studies have shown that communication alone can have a significant positive effect on collective action outcomes; the effect is particularly salient in repeated settings (Basurto and Ostrom 2009; Ostrom and Walker 1991; Ostrom et.al, 1994). In particular, there are multiple mechanisms linking communication to cooperation; communication can be used for moral suasion, and it helps build a sense of collective/group solidarity. Moreover, individuals can make conditional promises during face-to-face communication that provides an opportunity to build trust over time (Ostrom 1998).

Correspondingly, a primary WUASP objective is to increase community involvement in the WUA. During social mobilization, the program should inform water-

users of ways to become involved in the WUA, along with the benefits from active participation. Also, WUASP emergency rehabilitation procedures require community involvement for the selection of rehabilitation sites. Given the required vote from a quorum of WUA members for the selection of rehabilitation sites, we expect individuals to participate in WUA meetings and to vote for rehabilitation sites that have the most direct impact on their fields. Moreover, the community must also contribute labor for the sites because WUASP only provides small grants that cover the costs of materials. In theory, this process is structured to impart fundamental knowledge and skills to local water users while creating a sense of ownership for the canal infrastructure. This voluntary labor contribution is known as "ashar." As discussed in Chapter 2, ashar represents an important traditional institute for irrigation management in collective action. Thus, WUASP methods are drawing on and encouraging local and historical institutions.

By improving the institutional capacity of the WUA, the program can also have an important indirect effect on participation levels. Knowledge of election procedures and voting rights is of little use in cases where the WUA is too underdeveloped to allow members the opportunity to participate. Alternatively, an effective WUA should conduct the required election and assembly procedures to enable members to voice their preferences.

Finally, by increasing involvement in the WUA, we expect WUASP to motivate greater dialogue among water users. Communication is costly; however, WUASP absorbs this cost by investing the time and effort to create and maintain opportunities for face-to-face communication through educational trainings, elections, and meetings for the approval and planning of rehabilitation sites.

Given the community mobilization, institutional development and rehabilitation procedures undertaken in WUASP sites and their absence in control sites, I hypothesize that respondents in WUAs treated by WUASP will exhibit higher participation levels in comparison to the control groups.

> $\rightarrow H_{Participation}$*: Respondents in WUAs treated by WUASP are more active participants in the WUA than respondents in control WUAs that only received the top-down development support.*

Attitudes

The third mechanism I analyze is attitudes concerning two issues that influence cost/benefit calculations for cooperation. First, there is an assessment of community responsibility for the success of a local WUA. Second, there is an individual's perception of the benefits provided by their local WUAs.[33]

WUA ownership

To begin, there is an expectation that democratic and transparent decision-making in the WUA, along with the mandatory irrigation service fee (ISF) requirement, will create a sense of ownership for the WUA and infrastructure among water users. Accordingly, natural resource scholars maintain that the sustainability of common property regimes can be supported by this sense of ownership and responsibility. These sentiments are claimed to encourage participation in the organization, monitoring of the infrastructure, reductions in damage to the system and more consistent application of effective sanctions (Meinzen-Dick et. al, 2000; Ul Hassan et. al, 2004).

Accordingly, WUASP's social mobilization and participatory rehabilitation are anticipated to increase water users' awareness of their responsibility for the long-term success of the WUA. A more knowledgeable and informed population should display a greater sense of ownership and understanding of the community's responsibility for the WUA.

Advantages from an effective WUA

The second factor is water users' perceptions of the benefits associated with cooperation in natural resource governance, as well as involvement with the WUA. Individual rationality dictates that a water-user will only participate in a voluntary cooperative arrangement, such as a WUA, if it is perceived to be profitable or beneficial over time. Individuals must believe that the benefits of behaving cooperatively (i.e. participating in and adhering to the rules of WUAs) outweigh the costs of noncompliance and continuing a decentralized decision-making process. Consequently, effective institutions can motivate collective action by changing incentives for cooperation; they

[33] This is not an attempt to test the program effect on the institutional capacity of a WUA by aggregating up from the individual responses. Here I am simply focusing on individuals' perceptions of irrigation management.

can increase the perceived benefits of cooperation, while simultaneously raising the costs of noncompliance.

Thus, attitudes about the institutional capacity of a WUA can affect cost/benefit calculations for cooperation. If water users believe that the WUA is an effective institution with the capacity to ensure the fair and efficient distribution of irrigation water, they may refrain from non-cooperative behaviors such as bribery, water theft, or the destruction of irrigation infrastructure. Indeed, the vast body of empirical and theoretical common property resources scholarship highlights the importance of institutional effectiveness for collective action outcomes (see Chapter 3).

WUASP's methods of institutional development are designed to improve the capacity of WUAs to perform basic tasks. Moreover, by improving knowledge and participation, resource users are expected to understand more clearly the benefits associated with an effective WUA, including the provision of an adequate water supply, monitoring, sanctioning for rule violations, and conflict mediation.

Given the community mobilization, institutional development and rehabilitation procedures undertaken in WUASP sites, I hypothesize that respondents in treatment sites will exhibit greater confidence that their WUA provides benefits for their community as well as exhibit more responsibility for their local WUA.

> $\rightarrow H_{Attitudes:}$ *Respondents in WUAs treated by WUASP express more positive attitudes about the WUA and irrigation management in comparison to those in control sites.*

Social Capital

Community dynamics have a fundamental impact on the ability of user groups to solve collective action problems and develop institutional arrangements for natural resource governance. The study of "social capital" represents the attempt of applied researchers to systematize the effects of social and communal relations on cooperation. *Social capital* is the fourth and final mechanism under investigation in my dissertation.

There are multiple definitions of social capital. Putnam (1995) defines social capital as "features of social organization such as networks, norms and social trust that facilitate cooperation and coordination for mutual benefit" (p.67). Krishna (2004) defines

social capital as the "quality of human relations within some well-defined social group that enables members of this group to act in cooperation with one another for achieving mutual benefits" (p.2). Broadly speaking, social capital represents relationships between people that are characterized by trust, norms of reciprocity and social networks that can be mobilized for achieving individual or collective benefits (Krishna 2004; Coleman 1990) It is an intangible asset or value that arises from networks of social relationships; groups with a high degree of social capital can use it to acquire financial and human capital resources that subsequently promote cooperation and economic development (Coleman 1990; Putnam 1993).

Two of the key drivers of social capital are communication and repeated interactions in the context of a collaborative process (Wagner and Fernandez-Gimenez 2008). Communication helps promote understanding, which is a necessary condition for building respect. Repeated interactions can promote trust and reciprocity through reputational effects. Overall, relations of trust, reciprocity, understanding, respect, transparency, and predictability are all factors that generate social capital (Meizen-Dick, DiGregorio and McCarthy 2004: 204-206).

Common property resource scholars point to a strong association between social capital and successful collective action. In particular, empirical studies find that positive community dynamics explain a substantial amount of the variation in natural resource and development outcomes (Agrawal 1994; Krishna 2004). The claim is that social capital facilitates collective action by decreasing the costs of cooperation. It reduces the moral hazard and opportunism that characterize inter-personal dynamics (Quibria 2003) and minimizes transaction costs through the mechanisms of reciprocity, individual reputations and trust (Ostrom 2009). Hence, social capital is a subject of primary interest in collective action research because it is perceived to be a method for overcoming social dilemmas inherent in natural resource governance (Ostrom 2008).

Social norms, which represent one form of social capital, impact individual preferences and limit the range of accepted behaviors for self-interested individuals (Baland and Platteau 1996). More specifically, norms, such as fairness and reciprocity, are internal values or expectations about whether certain actions are right or wrong (Coleman 1987: 135). They imply certain behaviors or conduct that should be followed if

an individual seeks to avoid sanctioning or punishment by a community (Coleman 1988). Norms can reduce non-cooperative behavior if the penalties associated with their violation are costly and punishment is relatively certain. Effective punishments include social estrangement or exclusion that results in public humiliation, shame, as well as loss of prestige, status or respect (Krishna 2004; Ostrom 1998; Platteau 2008; Quibria 2003; Wagner and Fernandez-Gimenez 2008).

Ultimately, social capital enables actors to forego short run benefits for longer-term interests and mitigates many of the factors that contribute to the emergence of the free-rider dilemma (Ostrom et.al, 1994; Quibria 2003; Wagner, Fernandez-Gimenez 2008). Scholars argue that social capital is especially important for motivating successful collective action in cases where there is an absence of formal legal systems and/or well-defined legal property rights (Katz 2000). Specifically, historically based social capital can substitute for legal property rights; "it fosters a sense of ownership and respect for boundaries and provides the foundation for use rules, monitoring and enforcement mechanisms" (Katz 2000: 114).

Nevertheless, much debate surrounds the concept of social capital and its usage in collective action research. There are three primary problems. First, there is no single agreed upon definition of social capital; it remains a conceptually ambiguous term. This problem can be attributed to the abstract nature of social capital, which is used to refer to everything related to social embeddedness and/or social interactions (Ostrom 2007). Accordingly, the second issue is how to quantify or "operationalize" such an abstract concept. Developing a *valid* and *reliable* measure of social capital presents serious methodological challenges.

Third, there is a fundamental endogeneity problem related to social capital. Social capital manifests itself in many of the same behaviors attributed to successful collective action, but scholars often fail to make a clear distinction between social capital and collective action. In particular, social capital is often conceptualized as trust, norms of reciprocity and individual networks that provide individual and collective benefits. Hence, higher levels of social capital are argued to promote greater collective action. However, collective action can also generate trust, norms of reciprocity, etc; this means

that social capital is a potential outcome of collective action (Wagner and Ferdandez-Gimez 2008: 2).

Therefore, the problem is that the causes and effects of social capital feedback on each other so that the argument becomes circular; social capital is sometimes treated as the cause or independent variable when it is actually the dependent variable of interest. For example, Ostrom (2008) states that social capital is a way to understand how "cultural, structural and institutional aspects of small to large groups in a society interact and affect individual incentives and behavior." Thus, greater associational or institutional ties are purported to signal greater social capital. Yet, associational ties are also understood as a reflection of social capital that helps solve social dilemmas and reduce conflict. Thus, the question becomes: did the institution create the social capital or did the social capital create the institution? The most likely explanation is that there is a feedback effect between social capital and effective institutions, which means that it is extremely difficult (or impossible in some circumstances) to isolate the effect of social capital on economic and political change.

Without discounting the conceptual and methodological problems that characterize the analysis of social capital, empirical work by common property resource scholars, as well as my own research, highlights the crucial role that community dynamics play in explaining variation in collective action outcomes. While there remains tremendous room for improvement in the study of social capital, this dynamic must be addressed in common property resource scholarship. Furthermore, although my project is subject to the first two criticisms discussed above, I avoid much of the third major criticism by exploring the treatment effect on social capital with a completely different data source than the data-set used to investigate collective action outcomes.

Indeed, international development represents one area where scholars see an especially crucial need to develop a solid theory to explain how social capital affects individual behavior. In resource-poor Kyrgyzstan, most WUAs do not have the technical and financial capacity to adequately monitor water-theft and enforce sanctions for rule violations. In such areas, dialogue, social sanctioning and everyday social interactions are claimed to form an especially critical base for collective action. Given weaknesses in formal institutions, social norms and a community's sanctioning system can operate as

the informal institutions that maintain and support cooperation (Sehring 2003; Ul Hassan et.al, 2004). While aid agencies have spent billions of dollars on physical capital investments, there has been a gradual realization that an appropriate community dynamic is essential for reaching broader economic development goals. Thus, donors and implementing agencies have begun to emphasize the importance of building social infrastructure and trust prior to physical capital investments (Gibson, Williams, and Ostrom 2005; Woolcock 1998).

According to WUASP's program theory, the program's methods are designed to build or strengthen community relations. In particular, the program aims to promote greater participation in WUA governance, in conjunction with increasing community knowledge and awareness by information exchange. Moreover, social mobilization includes face-to-face communication through educational seminars, meetings and discussions. Consequently, repeated interactions and communication are important mechanisms for building trust and establishing community generated rules and norms for water management. In addition, the community involvement in the planning and implementation stages of emergency rehabilitation is designed to encourage repeated interactions that build "connectedness" within a collective framework. Overall, communication and repeated interactions through community mobilization and collaborative processes are argued to promote understanding, respect and, in the long run, trust and reciprocity (Baland and Platteau 1994). Finally, by developing institutional capacity, WUASP can help a WUA appeal to the social norms in its community. For example, WUASP has introduced "community shaming" boards that note cases of non-payment for irrigation service fees. Cooperation can be encouraged if defectors are made public in a system where social ostracism is costly.

Given the congruence between WUASP program methods and theoretical arguments about the factors that promote social capital, I hypothesize that the program will have a positive effect on social capital.

> $\rightarrow H_{Social\ Capital}$*: Respondents in WUAs treated by WUASP exhibit more cooperative communal behaviors regarding irrigation water in comparison to those in control sites.*

Section 2: Mediating Variables (size, heterogeneity, ecological scarcity)

In addition to investigating direct or average program effects, my project explores whether WUASP's effect on collective active outcomes was dependent on a WUA's size, economic and social heterogeneity, as well as ecological scarcity. Although the influence of resource scarcity is a less contentious issue, there remains a great deal of empirical and theoretical debate regarding these other three factors on cooperation in the common property resource literature (Ostrom 2009). My project provides an opportunity to test whether the program's effect depends on its interaction with these variables, thereby contributing to our understanding of how these factors mediate the influence of external actors in a field setting.

Size

Scholars continue to debate whether a small or large population size promotes successful collective action. Most studies suggest that a small group size encourages successful collective action because monitoring and sanctioning are less costly. Accordingly, monitoring and sanctioning can improve reputations and help to build or reinforce norms of reciprocity (Bardhan 2000; Dolsak and Ostrom 2003; Gebremedhin, Pender and Tesfay 2004; Olson 1965). Alternatively, Sethi and Somanathan (2008) argue that larger groups are linked to more successful collective action outcomes because there are more economic, material and human resources at the group's disposal; a greater resource base diminishes the possibility that fixed costs present an obstacle to organizing collective action. Also, a larger community, if sufficiently organized, could generate more political power for achieving their objectives (Bardhan 2000: 852).[34]

Combining the logic behind small and large populations, Agrawal and Goyal (2001) argue that there is a quadratic (or U-shaped) relationship between group size and cooperation; medium-sized groups are more likely to be successful than small or large groups. In particular, while a very small group size is hypothesized to make cooperation more difficult because of larger fixed costs, a large population size translates into increased communication, monitoring and sanctioning costs.

[34] The proportion of resource quantity to population of users is also an important factor to consider. A large population utilizing a smaller resource pool could generate a situation of scarcity that prompts higher levels of cooperation in comparison to situations with small populations and a more abundant resource.

Since WUASP works with WUAs that vary in population size, I am interested in exploring how population size mediates the program effect. Although the program may have a positive effect on a range of population sizes, I expect better outcomes in treatment WUAs with smaller populations for two main reasons. First, the program covers many of the fixed costs for organizing and motivating initial collective action; thus it addresses the primary challenge to coordination that is associated with small groups. Second, the program's methods and small staff size are best suited to produce a more immediate and pronounced impact in smaller communities. This is especially the case given the limited project time frame that makes it more difficult to organize and conduct trainings with larger communities.

→$H_{WUA\ population\ size}$*: Treatment WUAs with smaller populations exhibit better collective action outcomes in comparison to treatment groups with larger populations.*

I also test whether WUA land size plays a mediating role on the treatment effect. I expect greater program benefits in WUAs with a smaller land area because it will significantly reduce monitoring and communication costs.

→$H_{WUA\ land\ size}$*: Treatment WUAs with a smaller land size exhibit better collective action outcomes in comparison to larger treatment sites.*

Heterogeneity

Natural resources are managed by user groups characterized by variation along multiple dimensions, including ethnicity, wealth, gender, and caste (Agrawal and Gibson 1999). These group heterogeneities do not have a single or consistent effect on collective action (Agrawal 2002) and many questions remain concerning the role of economic and socio-cultural heterogeneity, especially in cases where economic and socio-cultural heterogeneity overlap (Agrawal 2008).

The theoretical argument for why heterogeneity has a negative impact on collective action outcomes is based on the assumption that it leads to variance in the distribution of costs and benefits for cooperation. In particular, variations in the value assigned to a resource can lead to disagreement over common goals concerning its management and use. Thus, heterogeneity can promote competition instead of

collaboration, as well as stifle the development of trust relationships (McCarthy, Dutilly-Diane and Drabo 2004). On the other hand, some scholars claim that heterogeneity may increase network capacity by diversifying both the contributions made to certain public goods and skill-sets used in natural resource management (Ostrom and Poteete 2004; Ruttan 2008). Generally, the key question is whether the heterogeneity in question coincides with a heterogeneity of goals regarding the resource (Ostrom 2009).

Economic heterogeneity

The common property resource literature is filled with case studies that highlight the perverse effects of economic inequality. Scholars argue that economic inequality leads to higher transaction costs and significant variation in individual's costs and benefits for cooperation because different economic or social strata may not derive similar values from access or the use of a good (Baland 1999; Ostrom 2007; Ruttan 2006). Indeed, empirical evidence supports the claim that large differences in economic assets can reduce cooperation (Bardhan 2000; Cardenas 2007; Dayton-Johnson 2000; Tang 1991).

However, groups or individuals with significant political or economic assets may help overcome the initial collective action dilemma by bearing the initial cost of organizing. If a few wealthy individuals can capture enough benefits, they may take on the large fixed costs of providing a public good, regardless of the actions of others. Thus, a privileged group with a large incentive to protect and maintain the commons can become the "critical" mass of participants needed to establish a regime for natural resource governance (McKean 1992).

To address this debate, my study investigates whether WUASP's effect on collective action outcomes was mediated by variation in economic heterogeneity. Due to the potential for highly unequal land distribution during land reform, I investigate the program's effect in WUAs that are characterized by varying levels of land inequality among farmers. More specifically, greater inequality is associated with the presence of relatively few large landholders relative to the majority population of water users.

An analysis of the interaction between the program and economic inequality is important for exploring the criticisms leveled against international development projects. In particular, common property resource scholars and anthropologists frequently raise

concerns about whether international development work has the intended impact on socially marginalized groups or if it sacrifices equity for efficiency gains. They stress the potential for certain groups to gain the most from development projects and for unequal benefits and advantages to worsen collective capacity by disrupting mutual relationships among resource users; inequality can be exacerbated if certain groups or individuals are able to capitalize on or monopolize the work/benefits of the external actors.

Moreover, collective action can be diminished if the development project is not a result of a community initiative and/or a program's implementation scheme clashes with the cultural context. Also, there is the threat that informal management techniques and networks, which are potentially more efficient at resource management, could be "crowded-out" by the external organizations (Gebremedhin et. al, 2004: 5). Finally, in the post-Soviet Central Asian context, there is a genuine threat that external involvement will perpetuate a culture of dependency (McGinnins 2000).

Indeed, some research on the impact of development projects offers evidence that privileged individuals or groups are able to gain more advantages. In many settings, the local elite is able to capitalize or monopolize common property institutions and make the most of the collective choice decisions (see Agrawal 2001; Ensminger 1990; Platteau, 2004). Thus, there is a potential for external actors to increase the asymmetry of interests and endowments among community members, crowd out informal networks, and replace local efforts at collective action (Gebremedhin et. al, 2004).

Furthermore, in the context of Kyrgyzstan, effective WUAs can reinforce domination by replicating power hierarchies and further disadvantaging vulnerable groups. Stronger institutions do not necessarily lead to more equitable outcomes. Therefore, the WUA can simply reflect the power dynamics in a community, and asymmetries of power can increase in cases where powerful social groups or political actors are able to capitalize on (or monopolize) the work of the WUA (Agrawal 2008; Gebremedhin et. al, 2004; Mosse 2008; Steins and Edwards 1999).

Nonetheless, according to WUASP's program theory, the project is designed to empower *all* water-users and militate against the threat of elite capture. Community-wide mobilization and institutional development are expected to raise the population's knowledge base and help create a strong WUA where individual interests are advanced

and protected. Participatory rehabilitation with required community involvement and voting should ensure that the benefits of the rehabilitation work are spread across the system. In addition, the conditional transfer of aid funds should diminish the threat of elite capture. Therefore, given the program methods and objective, I hypothesize that the program will not provide additional benefits to wealthy farmers or powerful groups.

→$H_{Economic\ heterogeneity}$*: There will be no difference in collective action outcomes among treatment WUAs with varying levels of economic heterogeneity.*

Furthermore, to help explain the program effect for economic heterogeneity, my investigation of the four individual behavioral mechanisms from Section 1 also includes an analysis of the WUASP effect on potentially "disadvantaged" social groups including women and water users at the end of the canal.

Given the program objectives and methods, I expect disadvantaged social groups in treatment WUAs will exhibit better outcomes on the four individual behavioral mechanisms (*knowledge*; *participation*, *attitudes*, and *social capital*) in comparison to their counterparts in control WUAs. Despite the potentially low baseline for these groups, I predict their change to be greater than control respondents but perhaps their overall level on each outcome to be lower than more advantaged groups.

→ $H_{FEMALE\ (knowledge,\ participation,\ attitudes,\ social\ capital)}$ *Female WUASP respondents perform better on the individual behavioral mechanisms in comparison to those in control sites.*

→ $H_{END\text{-}USERS\ (knowledge,\ participation,\ attitudes,\ social\ capital)}$ *WUASP respondents at the tail-end perform better on the individual behavioral mechanisms in comparison to those in control sites.*

Social heterogeneity

Socio-cultural heterogeneity is often posited to reduce cooperative capacity and have a more clearly negative effect than economic heterogeneity; differences in social norms may produce substantial variation in the incentives for cooperation among diverse groups (Bardhan and Dayton-Johnson 2002; McCarthy and Drabo 2004; Ruttan 2006). Nevertheless, the empirical evidence regarding the effects of social or ethnic heterogeneity does not reveal a consistent effect. While some studies find evidence of a

negative effect (Baland 2000, 2006; Dayton Johnson 2000), others have found ambiguous or insignificant results (Fujita et. al., 2000; Tang 1991).

My project investigates whether WUASP's impact on collective action varied in ethnically heterogeneous areas. In the context of Southern Kyrgyzstan, this means I compare the treatment effect in WUAs with a mix of ethnic Uzbek and ethnic Kyrgyz to WUAs with a more homogeneous Kyrgyz composition. I predict better collective action outcomes in ethnically heterogeneous communities in comparison to homogenous Kyrgyz communities. My claim is that it is not the heterogeneity per se that motivates better outcomes in communities with sizeable Uzbek populations. Instead, it is the Uzbeks' more extensive historical experience with agriculture and irrigation that explains why communities with an Uzbek population have an advantage in comparison to homogenous Kyrgyz communities. Thus, I suggest that, on average, Uzbeks organize, mobilize and cooperate more efficiently and effectively for irrigation management than ethnic Kyrgyz. This logic implies a linear relationship between ethnicity and irrigation management outcomes. As we move from homogeneous Kyrgyz communities to homogenous Uzbek communities, there should be a gradual improvement in collective action outcomes.

As discussed in Chapter 2, ethnic Uzbeks are associated with a much longer history of sedentary agriculture, whereas ethnic Kyrgyz are historically linked to a nomadic lifeway. Accordingly, natural resource scholars emphasize the importance of history for collective action outcomes (Ostrom 1992; Platteau 2008) because of the historical evolution of social capital, which is essential for cooperation. Social cohesion and social capital have evolved historically (Katz 2000). Thus, a group's culture and rules of behavior are intimately tied to their particular history (Baland and Platteau 1996), and behavioral conventions, such as norms of reciprocity and fairness, arise in an evolutionary way through common experience. Tradition and historical precedents shape expectations and beliefs about social interactions for the management of the commons (Ostrom 2007a: 198).

In the context of contemporary irrigation management in Southern Kyrgyzstan, ethnic Uzbeks' longer history with sedentary agriculture provides them with several advantages over Kyrgyz. Generally speaking, ethnic Uzbeks are more familiar with

irrigation and agriculture. In particular, Uzbek communities have greater experience with previous forms of the institutions that define contemporary agriculture in Kyrgyzstan. As discussed in Chapter 2, there is a certain degree of historical continuity between: (1) WUAs and pre-colonial local associations of water users in sedentary community known as ketmen (2) voluntary community labor (ashar) and (3) the position of mirabs (water masters) who control water distribution at the local level. Thus, I maintain that communities with a sizeable Uzbek population have been able to more easily adapt to post-Soviet irrigation management. I hypothesize that such areas will be able to learn quickly from WUASP and maximize their benefits from program involvement. However, since the positive benefits are attributable to the Uzbeks' 'skills' or advantages, this implies that ethnically homogenous Uzbek communities should exhibit the best collective action outcomes.

→$H_{Social\ Heterogeneity}$*: Treatment WUAs with ethnically heterogeneous communities will exhibit better collective action outcomes than treatment WUAs with a homogenous Kyrgyz population.*

Furthermore, to better explain why we see certain collective action outcomes for ethnic Kyrgyz and ethnic Uzbeks, I examine outcome for the four individual behavioral mechanisms from Section 1 among Kyrgyz and Uzbek respondents. Two hypotheses emerge from my argument discussed above. First, I hypothesize that Uzbek respondents in the program will exhibit better outcomes than Kyrgyz respondents in the program for the four mechanisms. Second, I predict that Kyrgyz respondents in ethnically heterogeneous program areas with outperform Kyrgyz respondents in ethnically homogeneous program areas.

→$H_{UZBEKS\ (knowledge,\ participation,\ attitudes,\ social\ capital)}$*: Ethnic Uzbek respondents in treatment sites will perform better than their Kyrgyz counterparts.*

→$H_{SOCIAL\ HETEROGENEITY\ (knowledge,\ participation,\ attitudes,\ social\ capital)}$*: Kyrgyz respondents in ethnically heterogeneous treatment sites will perform better than Kyrgyz in ethnically homogeneous communities.*

Ecological scarcity

Ecological scarcity is the final mediating variable that will be explored in my empirical analysis of the WUASP effect on collective action outcomes. Unlike size and

heterogeneity, the influence of ecological scarcity has not generated a large amount of debate in the common property resource literature. In contrast to cases of water abundance, greater cooperation is expected in cases where the scarcity of a resource generates substantial ecological and economic risks, in conjunction with relatively large benefits for group cooperation (Lansing 2006; Wade 1988). Water scarcity and a dependence on irrigation for a significant portion of one's livelihood are expected to promote better organization and cooperation. However, in cases of extreme water scarcity, cooperation may fail. Thus, the relationship between scarcity and cooperation may be quadratic.

Given the generally accepted claims of a U shaped relationship, I hypothesize that WUASP-supported WUAs with greater levels of ecological scarcity should motivate cooperation, except in cases of extreme water abundance or scarcity.

→$H_{Ecological\ Scarcity}$*: The relationship between scarcity and collective action outcomes in WUASP-supported WUAs is U shaped.*

Conclusion

This chapter situates my project within the large body of scholarship on collective action concerning natural resource governance. In this chapter, I develop hypotheses about the program effect on four individual behavioral mechanisms that link WUASP to collective action outcomes; *knowledge*, *participation*, *attitudes* and *social capital* are the mechanisms of interest in this study. In addition, I present several hypotheses regarding the mediating role of population size, land size, economic and social heterogeneity, as well as ecological scarcity on the treatment effect. In the following chapter, I present the results of the empirical analysis for WUASP's effect on collective action outcomes.

Chapter 5

Outcomes

Overview of the Results

The research question guiding this study is whether the bottom-up program methods of the Water Users' Association Support Program (WUASP) motivated better collective action outcomes in Water Users' Associations (WUAs). Common property resource scholarship corroborates the program theory guiding WUASP regarding the factors that enhance cooperation over natural resource governance. Thus, I hypothesize that the program's methods of social mobilization, institutional development and participatory rehabilitation positively affect proximate individual behavioral mechanisms such as *knowledge*, *participation*, *attitudes* and *social capital*. Given a positive program effect on these mechanisms, the expectation is better collective action outcomes for WUAs involved in WUASP.

To answer the research question, I conduct a rigorous impact evaluation of the Water Users' Association Support Program (WUASP) in Southern Kyrgyzstan. Survey data is used to examine the association between the program and the four mechanisms of interest, and panel data is used to test the program's impact on WUA performance indicators, which proxy for collective action outcomes. I use interviews, case studies and focus-group conversations collected during my field research to illustrate and corroborate the empirical results.

Overall, the results indicate that, on average, WUASP did have a statistically significant and positive effect on several WUA performance outcomes. There is evidence that WUASP's involvement in a WUA increased community participation and irrigation service fee contributions, as well as improved a WUA's institutional capacity and irrigation infrastructure. Moreover, there is some evidence that the program improved

these outcomes through the expected process. In particular, there is strong evidence of a positive association between the program and results for *knowledge*, *participation*, and *attitudes*. This includes a significant positive program association with all four behavioral mechanisms among ethnic Uzbek program respondents.

Nevertheless, there are important empirical results that do not support my predictions for the treatment effect on the mechanisms of interest. With the exception of survey respondents in the ethnically heterogeneous WUASP-supported WUA, the program either had no effect on *social capital* or it actually *worsened* communal relations. Accordingly, there is no evidence of a difference in the outcomes for these mechanisms among women and water users at the end of the canals in treatment versus control sites.

Furthermore, I investigated whether ecological risk, population size, land size, as well as economic and social heterogeneity mediated the treatment effect on collective action outcomes. The results provide some support for my hypotheses concerning the interaction effects of these variables with WUASP. First, there is evidence that treatment WUAs with larger Uzbek populations have higher irrigation service fee payments. While this result indicates that the program achieved a better result on this outcome in social heterogeneous WUAs versus ethnically homogenous Kyrgyz communities, it also implies that the greatest program benefits were achieved in homogeneous Uzbek communities.

Next, while there is evidence of an additional program benefit for water-delivery payments in WUAs with a smaller land size, my analysis of the interaction between WUASP and WUA land size does not offer consistent support for my hypothesis of additional program benefits in *smaller* WUAs. Specifically, larger treatment sites exhibit better results for infrastructure and development indicators than smaller sites. Also, the program achieves better outcomes for on-time water delivery payments in more populous WUAs. Furthermore, among WUASP-supported WUAs, there is a quadratic (U shaped) relationship between population size and institutional development, as well as the proportion of the WUA budget dedicated to rehabilitation and WUA staff salaries. Put differently, those WUAs with middle range populations exhibit additional program benefits for these two outcomes in comparison to WUAs with small or very large populations.

Moreover, my analysis of the interaction between water scarcity and WUASP provides an important empirical confirmation for natural resource scholarship concerning a quadratic relationship between collective action outcomes and scarcity. Specifically, additional program benefits are found in treatment WUAs facing a "middling level" of ecological scarcity – not WUAs with extreme water abundance or scarcity – for tariff, water delivery payments, as well as operation, maintenance and rehabilitation payments.

Finally, my investigation of economic heterogeneity does not provide support for my hypothesis that there will be no difference in collective action outcomes among treated WUAs with varying levels of economic heterogeneity. Instead, there is evidence of additional program benefits in WUAs with more equal land holdings among water users for tariff levels and institutional development. On the other hand, there are additional WUASP benefits for canal infrastructure improvements in areas with a greater discrepancy between the land holdings.

Table 5.1 summarizes the average WUASP results for both mechanisms and outcomes. Table 5.2 summarizes the mediated program results for the mechanisms, and Table 5.3 summarizes the mediated WUASP results for collective action outcomes.

Table 5.1 Average WUASP effects

Evidence of a positive average WUASP effect?	*MECHANISMS*			
	Knowledge	**Participation**	**Attitudes**	**Social Capital**
	YES	YES	YES	NO
	WUA PERFORMANCE OUTCOMES			
	Institutional Development	**WUA development problems/member activeness**	**Canal infrastructure improvements**	**Financial Indicators**
	YES	YES	YES	YES

Table 5.2. Mediated WUASP effect on mechanisms

Evidence of a positive, mediated WUASP effect?		*MECHANISMS*			
		Knowledge	Participation	Attitudes	Social Capital
	Kyrgyz in the ethnically heterogeneous WUA	*NO*	*NO*	*YES*	*YES*
	Groups with greater historical experience with agriculture and irrigation management?	*YES*	*YES*	*YES*	*YES*

	(i.e. Uzbek communities)				
	Disadvantaged groups within a WUA?(end-users and women)	*NO*	*NO*	*NO*	*NO*

Table 5.3 Mediated WUASP effect on outcomes

		OUTCOMES			
		Institutional Development	**WUA development problems/member activeness**	**Canal infrastructure improvements**	**Financial Indicators**
Evidence of a positive mediated WUASP effect on outcomes?	Size	YES	YES	YES	YES
	Scarcity	NO	NO	NO	YES
	Economic heterogeneity	YES	NO	YES	YES
	Social heterogeneity	NO	NO	NO	YES

Roadmap

In this chapter, I use panel data to examine the Water Users' Association Support Program's (WUASP) impact on common property resource *outcomes.* The analysis investigates the average WUASP effect on Water Users' Associations' (WUA) performance indicators that proxy for collective action outcomes. It also seeks to determine if the program effect is mediated by a WUA's population and land size, ecological scarcity, as well as economic heterogeneity and social heterogeneity.

The subsequent chapter will explore the mechanisms linking WUASP to collective action outcomes in order to explain *why* we see certain outcomes. In particular, Chapter 6 uses case studies, focus groups and the results from an exploratory survey research project to provide context and help illustrate my claims concerning the empirical results.

Research Methods and Data

Panel data analysis

In the context of this study, internal validity refers to confidence in one's assessment of the actual program impact on the variables of interest. Due to the non-random assignment of WUAs to the program, there is a serious threat of "selection bias"

to the validity of the study results. Selection bias means that the program selected WUAs that were *systematically different* from WUAs that were not selected for the program. In particular, we are concerned that WUASP selected WUAs that were performing better on certain outcome variables of interest to the program evaluation. Indeed, empirical analysis indicates that, *on average*, the twenty-eight WUASP-supported WUAs had smaller populations, lower debt levels, and development levels in the range of three to five.[35] Therefore, we cannot simply compare the performance of WUASP-supported WUAs after the introduction of the program to the performance of non-WUASP-supported WUAs.

In order to isolate the true program effect given selection bias, an interrupted panel design and fixed effects regression methods are employed for the empirical analysis of WUA performance outcomes. The use of an interrupted panel design and fixed effects methods allows me to partially compensate for selection bias by observing how outcomes in individual WUAs changed before and after the introduction of WUASP. *Since the WUA is compared to itself, consistent differences between WUASP-supported WUAs and non-WUASP-supported WUAs do not affect the outcome.* This means that we are focused on analyzing changes that occur *within* the time trends of WUASP-supported WUAs for indicators of interest after the program began working in the WUA (Stock and Watson 2007: 349-372*).*

Thus, in analyzing the program effect on debt, we are looking at pre and post treatment debt levels in WUASP-supported WUAs in order to determine whether the program influenced these levels. In addition, we are comparing pre and post trends across the treatment and control groups to verify that any change in treatment WUAs is not the result of aggregate overall time trends (i.e. WUASP happens to implement the year before an amazingly good year for rainfall). Thus, we are left with the possibility that WUASP-supported WUAs are different from control WUAs in a way that changes over time. For example, having more social capital initially might cause a WUA not only to

[35]This is supported by anecdotal evidence regarding World Bank On-Farm Irrigation Program (OIP) incentives, which may have motivated WUAs to reduce debt levels in order to improve their chances for selection into WUASP. Furthermore, the World Bank On-Farm Irrigation Program (OIP) and WUASP interface about which Water Users' Associations would be more appropriate for WUASP resulted in the selection of WUAs that met the qualifications for the World Bank but were perhaps deemed too small by the World Bank program to justify the large scale infrastructure projects.

have lower debt to begin with, but also to lower its debt more rapidly than it would otherwise. This threat is addressed by comparing trends in WUASP-supported WUAs before they are treated to WUAs that are never treated to ensure such an effect is not present. Taken together, these methods help counter the selection bias present in this "natural experiment."

Hence, by using fixed effects methods, it is possible to control for all possible characteristics of the WUAs in the study *that do not vary over time*. Thus, fixed effects help to overcome an omitted variables problem in panel data. Put differently, a fixed effect regression enables one to control for unobserved heterogeneity between WUAs as long as the effects of that heterogeneity are time-invariant. Consequently, fixed effect methods are the best option for the analysis of the program effect because between WUA variation is most likely explained by unmeasured individual WUA-specific traits that correlate with our outcomes of interest (Allison 2009).[36] Although fixed effects do not allow me to estimate the effects of time invariant covariates, I include interactions between the program and stable variables – such as ethnicity, population size, land size, economic inequality, and water scarcity – to test for heterogeneous treatment effects.

An interrupted panel design is feasible for this project due to the availability of economic and budget data for all WUAs in Southern Kyrgyzstan from 2004 through 2009, together with the implementation of WUASP among 28 of these WUAs at various intervals *within* this time period. I acquired the data from the World Bank On-Farm Irrigation Project (OIP), which has been collecting a mixture of yearly, quarterly and monthly data for all WUAs in Kyrgyzstan since 2000.[37] In Kyrgyzstan, primary data collection and outcomes measurement by the World Bank reduces concerns about the

[36] However, it is difficult to calculate longer term pre-treatment trends with fixed effects. In addition to fixed effects regression, I also analyzed the panel data using an event studies approach. The event studies allowed me to look at the regression coefficients on the outcomes of interest at time points before and after the treatment to determine if there were positive trends before the treatment. A main problem with the event studies approach is that if a positive trend begins upon entry into the program, the analysis might attenuate the program effect; this means a positive but small program effect could be masked. Indeed, for the event studies approach, there is no evidence of a statistically significant average program effect for any of the ten outcomes. On the other hand, the use of a fixed effects regression approach yields some evidence of a statistically significant positive program effect for four of the ten outcomes. Since I found no evidence of pre-treatment trends in the event studies (except in the case of Tariff), I believe that the event studies may be masking the small but positive program effect that we see for the four outcomes that yielded a statistically significant outcome in the fixed effect approach.

[37] For most WUAs and variables of interest, the data ranges from 2004-2009; however, some variables have been measured since 2000.

accuracy of the data for two reasons. First, it decreases the likelihood that the WUA altered the data. Second, it ensures more accurate statistics because most WUAs do not have the capacity for data collection and recording. The World Bank staff determined or collected all variables directly from the WUAs except the irrigation service fee (ISF) payment information for water delivery, which is initially gathered by the local water department (Rayvodkhoz).[38]

Although fixed effects can be used to isolate the program effect, an important concern for my project is the small number of WUAs involved in WUASP. In particular, the program worked with twenty-eight WUAs in Southern Kyrgyzstan. However, two of these WUAs must be excluded from the analysis. In one case, there is no pre-treatment data on the WUA since it was created by WUASP, and the other WUA was involved in the World Bank heavy infrastructure project several years prior to its selection into WUASP. The small treatment N requires greater attention to the standard errors for my coefficient estimates. This is especially the case with my analysis of heterogeneous treatment effects. In some cases, large standard errors for coefficients relatively far from zero may indicate that there is not enough power in my models to make compelling arguments concerning the program impact.

Furthermore, out of the twenty-six WUAs that can be included in the statistical analysis, eight WUAs were selected for the program in 2008 which means that there is only one year of post-treatment data. Moreover, for WUAs selected in 2008, the community mobilization process was drastically shorter – ranging from two weeks to one month. The empirical work for the project outcomes takes these differences into account by running statistical models with the inclusion and exclusion of these 2008 selections, which I refer to as the "2008 cohort".[39] Accordingly, I explore the implications and

[38] The budget data that is collected from the WUAs is the most likely to be compromised or inaccurate since a WUA might have incentives to report higher payment levels in order to gain access to rehabilitation programs like the World Bank or WUASP. Although there is always the possibility that information from the local water departments regarding payment for water delivery may also have been tampered with because of corruption, I argue that there is less of an opportunity and incentive to alter the water-delivery data. First, it would be more difficult to tamper with the data due to the multiple parties involved in the water delivery process. Second, I maintain that the Rayvodkhoz's main mechanism for rent-seeking is the in-kind payment of ISF, which does not require any data manipulation for them to reap additional benefits.

[39] By removing a significant portion of the treatment group, the inferences from my results no longer represent an assessment of the average effect of the treatment on the treated. Therefore, when discussing

significance of this qualitatively different treatment for the 2008 cohort in Chapters 6 and 7.

Dependent Variables

I created nine performance indicators for Water Users' Associations (WUAs). These can be divided into four categories: institutional capacity, development problems, financial indicators and infrastructure improvements. The indicators are as follows.

Institutional Capacity

Institutional development (2004-2009): A measure of the number of World Bank development milestones completed by a WUA (discrete ordinal variable). There are seven World Bank milestones or levels that a WUA must complete to become eligible for large-scale rehabilitation credits from the World Bank. The completion of each milestone requires documentation from the WUA leadership and membership, and the milestones are intended to represent increasingly difficult tasks for the WUA to complete. They range from the official formation and legal registration of the WUA (Milestone 1) to documentation that the General Assembly or assembly of representatives of the WUA have agreed to contribute 25% of the costs for World Bank rehabilitation (Milestone 7). More developed WUAs are expected to have completed a greater number of milestones because the milestones require an organized leadership that is capable of holding the necessary election/meeting procedures and collecting sufficient funds from its members.

Development Problems

Development problems: The World Bank's assessment of resource, technical and human capital problems in a WUA (count variable). I use this variable as a proxy for the development problems faced by a Water Users' Association (WUA). I expect WUASP involvement in a WUA to help reduce these development problems.

Member activeness: The World Bank's assessment of the activeness of a WUA's Council and zonal representatives, as well as the ease of securing irrigation service fee (ISF) payments from members (count variable). I use this variable as a proxy for the activeness of a WUA's leadership and membership. The expectation is that more

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outcomes for only those WUAs that receive water from the local water department, it is important to remain aware that this only applies to a subset of the treatment group.

successful WUAs are characterized by both an active leadership and members that pay their fees in a timely manner.

Financial indicators

Tariff: The inflation adjusted charge for water delivery, operation and maintenance, rehabilitation and staff salary (continuous variable). This rate is set at a WUA's annual meeting. Given the nascent state of WUA development and significant rehabilitation required in most WUAs, tariff rates should be increasing in more successful WUAs for the period under study.[40]

Operation and maintenance (O & M) and rehabilitation budget: The proportion of a WUA's budget allocated for O & M and rehabilitation (continuous variable). For successful WUAs within the study period, we expect this to increase over the years because the current funds for staff salaries and rehabilitation are too low to support many WUAs. WUAs that perform well and provide good water management services to their water users should find it easier to increase budget allocations for staff salaries and/or rehabilitation.

Operation and maintenance (O & M) and rehabilitation payment: The proportion of O & M and rehabilitation expenses paid by a WUA (continuous variable). For successful WUAs, I expect the proportion of the planned expenses for O & M and rehabilitation to be paid at a higher rate. For example, the leadership of an effective WUA should be able to collect close to 100% of the expenses necessary to cover the planned O & M and rehabilitation in a given year. Alternatively, "good" leaders could motivate or coerce water users to pay.

Water delivery payment: The proportion of water delivery fees paid by a WUA to the local water department (continuous variable). We expect a higher collection rate in successful WUAs because water users will most likely refuse to pay for water that they do not receive. This means that the WUA needs to efficiently distribute water across its service area. It is important to emphasize that this measure, along with the following measure, only applies to WUAs that have a portion of their water delivered. Thus, it excludes 20% of my WUA sample that relies completely on a natural water source. Since

[40] We would expect this to level off at some point in the future.

it excludes several of the treatment WUAs, inference about the treatment effect for this indicator is restricted to those WUAs that have water delivered.[41]

On-time water delivery payment: A measure of on-time water delivery payment (continuous). It is an average of the quarterly proportion of debt paid to the government for a WUA's water delivery from the local water ministry. I expect more successful WUAs to pay all or a larger proportion of their debt each quarter. Whereas the "water delivery" payment outcome tells us if the WUA ultimately paid off their debt, this measure provides information about whether the WUA was able to collect funds consistently throughout the year to pay off the quarterly debt. Once again, the inference about a program effect is restricted to a subset of WUAs because this indicator only applies to WUAs that have water delivered.

Infrastructure condition

Canal Infrastructure: The World Bank's measure of the condition of a WUA's canal system (continuous). It approximates the proportion of a WUA's canal infrastructure that is in satisfactory condition. I expect WUASP's rehabilitation to improve the condition of canal infrastructure in treatment WUAs. Furthermore, since the program's methods teach WUAs how repair and maintain the infrastructure independent of WUASP, treatment sites should exhibit even greater improvements in their infrastructure over time.[42]

Independent Variables

Besides a program indicator, three time-variant controls are included in several of the model specifications for the analysis of average program effects. I control for WUA involvement in the World Bank large rehabilitation program[43] and a WUA Director's

[41] Due to the lack of measurement capabilities on many of the main canals, the ability to accurately measure (or to measure at all) is highly questionable. Also, this measure should be interpreted as an approximation even though the World Bank provides detailed measurements of the water requested and received.

[42] The first year that canal condition was measured and/or reported is 2006; this means that pre-treatment data is missing for 2004 and 2005. Given a conservative assumption that the program did not *worsen* the infrastructure, the outcomes for this variable may attenuate the program effect. Specifically, if a WUA's canal condition was .6 in 2004/2005, but was given a 2006 measure of .7 due to WUASP's rehabilitation efforts in 2005, the outcome would be biased against this positive program effect.

[43] In one specification for each model, I remove the WUAs that received the large-scale World Bank projects to check for any major differences in the results.

educational background.[44] Also, there is one model specification for each outcome with a proxy for water scarcity; it is a measure of the actual water received as a proportion of the water originally requested by the WUA from the local water department.[45] Assuming no strategic behavior in requests, the expectation is that a "water-rich" WUA will receive all or more of the water requested and vice versa.[46] Since this measure involves the use of water delivery data from the water departments, it faces the same restriction discussed above for the two "water delivery" outcomes; it only applies to WUAs that have a portion of their water delivered and excludes about 20% of the WUAs that rely completely on a natural water source. It is important to focus on this subset in one model specification because WUAs that are completely dependent on a natural source have a very different relationship with the local water department and are not subject to the "ecological hierarchy" that defines most WUAs along a canal system. In addition, they are often located in more remote or peripheral geographic areas.

In order to explore whether ecological risk, WUA size, economic heterogeneity and social heterogeneity mediate the WUASP effect, I interact measures of these variables with the program indicator. For population size, I use a measure of the number of beneficiaries in a WUA; this is an estimate of the population within a WUA's service area. I also explore whether the treatment effect was mediated by variation in the number of hectares within a WUA. For social heterogeneity, I use demographic data from a 1999 Census conducted by the United Nations to construct a measure of the ethnic composition of each WUA.[47] Next, I develop a proxy for economic inequality by creating a measure of inequality in land holdings among water users in a community. The measure represents

[44] This is a dummy variable to indicate whether the director has an educational background in agriculture. This could proxy for continuity from the Soviet era collective and state farm leadership.

[45] The mirabs in a WUA are responsible for determining how much water the WUA needs for a given irrigation season. They aggregate the water requests for water users and submit the total to the water department.

[46] This will often correspond to a WUA's location along a canal system. WUAs at the beginning of a canal will generally receive all (or more) of the water requested, whereas a WUA at the end of the canal will often not receive its requested share of water because of the inefficient use from WUAs at the beginning of the canal and less than ideal condition of the canals.

[47] I have concerns about the accuracy of the Census data for two reasons. First, Southern Kyrgyzstan has experienced large-scale migration since the collapse of the Soviet Union. We cannot exclude the possibility that there have been significant changes in the ethnic make-up of communities. Second, during my field research, I discovered several gross discrepancies between the census data and actual ethnic compositions of several communities. For treatment WUAs, I was able to cross-reference and/or correct the UN data with the estimates from Winrock leaders and information collected from the WUA director's that I interviewed.

the proportion of 'individual farmers' in a WUA relative to the proportion of land owned by individual farmers.[48] Finally, to examine whether ecological risk mediated the WUASP effect, I use the proxy measure discussed above for water scarcity. Since model specifications that include this last interaction restrict the analysis to WUAs that receive water from the local water department, inferences from these results can only be applied to a subset of treatment WUAs.

Empirical Results and Discussion

Average program effects

During the first three months of my field research, I shadowed the Water Users' Association Support Program's (WUASP) field team and conducted a series of interviews with the leadership of the Water Users' Associations (WUA) involved in the program. Following this phase of the research, I was relatively confident that WUAs involved in WUASP were more successful than WUAs receiving basic development support from the World Bank's On-Farm Irrigation Project (OIP). WUASP's program theory and methods involve substantial community mobilization and participation in comparison to the blue-print approach used to establish and support most WUAs. In theory, the project seems to represent an appropriate solution for many of the problems facing WUAs in Southern Kyrgyzstan.

My interviews with WUA leaders and several focus group transcripts from WUASP communities provided evidence of positive program results. There was a general consensus among the Winrock staff and WUA Directors that WUASP communities were more active, knowledgeable, better organized and felt more ownership and responsibility regarding water and irrigation infrastructure. Moreover, my field observations provided evidence that important outcomes had been achieved including

[48] Similar to the ethnicity measure, this measure is also problematic for several reasons. First, aside from 'individual farmers', a WUA can also contain cooperative farms that can be another significant source of inequality. Although I have data on the number of cooperative farms and the amount of land that they occupy in a WUA, I do not know the exact number of families that comprise each cooperative farm. Thus, I cannot construct a better inequality measure that takes account of unequal land holdings in a WUA that result from both individual farmers and cooperative farms. Second, WUAs do not define their membership in a consistent manner. For example, some WUAs include individuals who own garden plots as members while others do not. This means that my measure for the proportion of individual farmers in a WUA may not be an accurate construct.

increased irrigation service fee (ISF) collection rates, improvements in canal infrastructure, greater efficiency in water regulation, and more cooperative behaviors.

Indeed, the results of the panel data analysis indicate a positive overall program effect for four of the nine outcomes: institutional development, ISF payments, canal infrastructure, and WUA member participation. However, there is an absence of a treatment impact on the overall resource, technical and human capital problems faced by WUAs. Furthermore, while there is evidence of increased payment for O & M and rehabilitation fees, there is not strong and consistent evidence of a WUASP effect for the other four financial indicators.

More specifically, we find a 4.77% increase in the payment of irrigation service fees for O & M and rehabilitation. Although this is a small substantive effect, WUASP's capacity to motivate some benefits for this indicator is important. While payment for water may be easier to collect and justify, payment of these "additional" costs for staff salaries and rehabilitation may indicate greater support and trust of the WUA's work. On the other hand, this is an "average" performance measure; therefore, we cannot determine whether this increase was broadly distributed across community members of if may have been driven by larger contributions from a subset of water users who disproportionately benefit from the treatment.

For institutional development, we see that the treatment motivated approximately a half step increase in a WUA's achievement of the World Bank's development milestones. While I expected a slightly larger policy effect, this result points to a more organized WUA staff and may also reflect greater participation by WUA members and zonal representatives. Since "member activeness" was estimated with a fixed-effects Poisson model, the interpretation of the coefficient is not very straightforward. Here we see a .191 decrease in the log odds ratio of a one unit increase in member passivity with WUASP-supported WUAs. This represents a nontrivial positive practical policy effect.
Finally, we see a 1.51% improvement in the irrigation infrastructure for treatment WUAs. As previously discussed, given the absence of 2004/2005 data for this indicator, analysis of this outcome only assesses the change in a WUA's infrastructure from 2006-2009. Thus, it does not measure program benefits for WUAs that experienced improvements

from rehabilitation in 2005 and 2006. Consequently, these results may attenuate the program effect for this indicator.[49]

Table 5.4 below provides the regression results and appendix 1.A. contains the regression results for all model specifications. For continuous outcomes, I use a fixed effects linear model, whereas a fixed effects Poisson model is used for the two count outcomes.

Table 5.4 Regression results for average WUASP effects

	Financial Indicators				
VARIABLES	Tariff	Water delivery payment[50]	On-time payment	O & M/rehab budget	O & M/rehab payment
2001.year	-0.234*				
	(0.135)				
2002.year	0.0491				
	(0.135)				
2003.year	0.315**				
	(0.131)				
2004.year	0.339*				
	(0.188)				
2005.year	0.665***		-0.0679**	-0.0212	-0.197***
	(0.200)		(0.0272)	(0.0207)	(0.0322)
2006.year	1.402***		-0.0656***	0.0206	-0.154***
	(0.195)		(0.0239)	(0.0217)	(0.0348)
2007.year	2.097***		0.0645**	0.0542**	-0.135***
	(0.190)		(0.0271)	(0.0216)	(0.0360)
2008.year	2.522***		0.0601*	0.116***	-0.194***
	(0.228)		(0.0309)	(0.0220)	(0.0372)
2009.year	2.639***		0.0985***	0.129***	-0.188***
	(0.232)		(0.0293)	(0.0211)	(0.0367)
Post WUASP	**0.192**	**-0.0953**	**-0.0478**	**0.0117**	**0.0477***
	(0.448)	**(0.0612)**	**(0.0681)**	**(0.0218)**	**(0.0250)**
World Bank	0.976**	0.0684	-0.0907*	0.0148	-0.000574
	(0.403)	(0.104)	(0.0523)	(0.0263)	(0.0704)
Constant	3.346***	0.858***	0.471***	0.509***	0.852***
	(0.138)	(0.0220)	(0.0195)	(0.0237)	(0.0260)
Observations	1,444	826	832	828	955
R-squared	0.349	0.001	0.090	0.239	0.095
WUAs	180	147	145	145	179

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[49] Moreover, for an interesting comparison, we see that the coefficient on the World Bank WUAs that received the large rehabilitation support only indicates a 3.18% improvement for irrigation infrastructure. The same logic applies in this case; improvements made before 2006 are not captured in this analysis.

[50] In contrast to the other eight outcomes, the autocorrelation test for "water delivery payment" was negative. Hence, for this outcome, I do not include a control for year.

VARIABLES	Institutional capacity	Development problems	Member activeness	Canal Infrastructure
2005.year	0.384***	0.00231	0.0128	-0.00226***
	(0.0735)	(0.0458)	(0.0636)	(0.000852)
2006.year	1.014***	-0.0356	0.0679	-0.00364***
	(0.107)	(0.0470)	(0.0638)	(0.00130)
2007.year	1.052***	-0.0883*	0.0284	-0.0293***
	(0.109)	(0.0480)	(0.0650)	(0.00507)
2008.year	1.196***	-0.0837*	-0.0121	-0.00890*
	(0.113)	(0.0491)	(0.0674)	(0.00525)
2009.year	1.260***	-0.0757	-0.00218	-0.00404
	(0.115)	(0.0491)	(0.0673)	(0.00519)
Post WUASP	0.434*	-0.0526	-0.191*	0.0151*
	(0.225)	(0.0770)	(0.106)	(0.00901)
World Bank	-0.517***	-0.0161	-0.194	0.0318***
	(0.188)	(0.124)	(0.188)	(0.0120)
Constant	3.306***			0.660***
	(0.0756)			(0.00274)
Observations	1,085	1,061	1,061	1,086
R-squared	0.354			0.073
	181	177	177	181

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Heterogeneous program effects

While the statistical analysis of *average* WUASP effects corroborates several theoretical expectations and field observations regarding the program effect on a WUA's performance, my field research, along with findings from common property research point to a strong possibility of heterogeneous treatment effects. Put differently, given important contextual factors that vary across WUAs – size, water scarcity, social and economic heterogeneity – the treatment effect is not expected to be consistent across WUAs.

Land and population size

In Chapter 4, I hypothesized that WUAs with small populations and land sizes would exhibit additional treatment benefits. However, with the exception of water delivery payments, WUAs with a smaller population or land size did not exhibit additional program benefits. Contrary to my hypothesis, we see an additional treatment benefit for "middle" and large WUAs. In particular, WUASP-supported WUAs with a "middle-range" population size exhibit better institutional development outcomes and

allocate a greater proportion of their budget to rehabilitation and staff salaries. These empirical results support Agrawal and Goyal's (2001) argument that there is a quadratic relationship between population size and collective action outcomes. In particular, when the population is small, the fixed costs to successful cooperation are too large; however, when the population is small, transaction costs become too large in a heavily populated area. Furthermore, there is evidence of additional program benefits for institutional development and canal infrastructure in treatment sites with a larger land size.

Ecological scarcity

Theoretical and empirical work on collective action in natural resource management claims that ecological risk translates into economic risks that can provide a greater impetus for cooperation. Hence, areas experiencing a relatively significant degree of ecological risk will be more likely to develop cooperative arrangements in order to mitigate these risks. On the other hand, in cases of extreme scarcity, cooperation may completely breakdown. Thus, I predicted a quadratic relationship between scarcity and collective action in treatment sites.

Indeed, the panel data analysis indicates that WUASP's effect on collective action outcomes is dependent on ecological constraints and that there is a quadratic relationship between water scarcity and collective action outcomes. In particular, the program's methods were able to motivate greater financial contributions for tariff, water delivery payment, as well as O & M and rehabilitation payments in areas facing "middling" levels of water scarcity.

Social heterogeneity

In Chapter 4, I hypothesized that communities with a sizeable Uzbek population have been able to more easily adapt to post-Soviet irrigation management. Given the potential for Uzbek communities to have greater experience with previous forms of the institutions that characterize contemporary agriculture in Kyrgyzstan, I expect such areas will be able to learn quickly from WUASP and maximize their benefits from program involvement. The empirical results provide some evidence to support the claim that WUASP achieved superior results in WUAs with sizeable Uzbek populations. The panel

data analysis indicates that WUASP sites with more Uzbeks have higher O & M and rehabilitation payments. This impact on a key financial indicator is important because the long-term viability of the WUA depends on increasing water-users contributions for irrigation service fees to cover staff and rehabilitation expenses.

Economic heterogeneity

Finally, I predicted the absence of variation in collective action outcomes in treatment sites with varying levels of economic heterogeneity. Since WUASP methods are designed to empower all water users and avoid elite capture of a WUA, I expect WUASP to level the playing field. However, contrary to my expectation, the results indicate that treatment sites with a more equal distribution of land among water users acquired additional program benefits for institutional development and tariff level. Alternatively, there is evidence that WUASP sites with *less* equal land distribution have a better outcome for improvements in canal infrastructure.

Table 5.5 below provides the regression results for the tests of heterogeneous treatment effects. For size and ecological scarcity, I include additional interaction terms in order to test the hypotheses of a quadratic relationship among WUASP-supported WUAs. Since I test the interaction of the program with five dependent variables for nine different outcomes, I only provide the outcomes where the coefficient on the interaction term was significant. The regression results for all outcomes and model specifications can be found in appendix 1.B.

Table 5.5. Heterogeneous WUASP effects

	Social hetero.	**Economic hetero.**			**Ecological scarcity**		
VARIABLES	O & M/rehab payment	Tariff	Inst. Dev	Canal Infr.	Tariff	Water delivery payment	O & M rehab payment
Post WUASP	0.0281	-1.417	-0.336	0.0486***	-5.401***	-0.313	-0.225***
	(-0.0293)	(-1.146)	(-0.3)	(-0.0151)	(-1.846)	(-0.41)	(-0.0693)
Post WUASP # main effect+	**0.133****	**2.636***	**1.462****	**-0.0509*****	9.216**	0.938	0.493***
	(-0.0654)	**(-1.354)**	**(-0.576)**	**(-0.0186)**	(-3.846)	(-0.68)	(-0.12)
Post WUASP #scarcity^2					**-2.925****	**-0.684****	**-0.230*****
					(-1.367)	**(-0.322)**	**(-0.0413)**
World Bank	0.00478	0.605*	-0.464**	0.0365***	0.955	0.0761	0.0149
	(-0.0765)	(-0.31)	(-0.208)	(-0.0132)	(-0.621)	(-0.0989)	(-0.0265)
Scarcity	0.0137			0.00119	-0.548	-0.212	0.0382

	(-0.0371)			(-0.00574)	(-0.893)	(-0.515)	(-0.0574)
scarcity squared					0.213	0.401	-0.0125
					(-0.302)	(-0.28)	(-0.0201)
Year							
Year # main effect+	Reported in appendix I.B.						
Constant	0.842***	3.408***	3.378***	0.664***	4.385***	0.721***	0.496***
	(-0.0367)	(-0.127)	(-0.08)	(-0.00656)	(-0.522)	(-0.231)	(-0.0381)
Observations	824	1,338	990	827	862	822	828
R-squared	0.119	0.391	0.388	0.124	0.289	0.076	0.248
WUAs	144	165	165	138	144	145	145

Robust standard errors in parenthesis
*** p<0.01, ** p<0.05, * p<0.1
+ethnicity, land inequality, scarcity, land size and population size

	Landsize			**Population size**		
VARIABLES	Water delivery payment	Dev. problems	Canal Infra.	On-time payment	Inst. Dev	O & M rehab budget
Post WUASP	0.0719	0.168	0.00152	-0.156*	-0.251	-0.0682
	(-0.105)	(-0.124)	(-0.0116)	(-0.0806)	(0.380)	(0.0425)
WUASP#main effect	**-0.000135****	**-0.000192****	**1.23e-05***	**1.58e-05*****	0.000169*	1.59e-05*
	(-6.18E-05)	**(-8.73E-05)**	**(-6.32E-06)**	**(-5.55E-06)**	(9.51e-05)	(8.48e-06)
WUASP# pop size^2					**-5.19e-09***	**-4.79e-10***
					(3.11e-09)	**(2.68e-10)**
World Bank	0.094	-0.0727	0.0306**	-0.0943*	-0.482**	0.0442
	(-0.114)	(-0.121)	(-0.0127)	-0.0528	(0.191)	(0.0307)
Scarcity	0.723***	0.0312	-0.00124	-0.00902	-0.130	0.00735
	(-0.261)	(-0.059)	(-0.00554)	(-0.0334)	(0.0938)	(0.0214)
Year						
year#main effect+	Reported in appendix I.B.					
year# population size ^ 2						
Constant	0.291		0.663***	0.478***	3.828***	0.506***
	-0.216		-0.00643	-0.0344	(0.109)	(0.0239)
Observations	822	867	867	831	867	828
R-squared	0.086		0.088	0.102	0.346	0.267
WUAs	145	145	145	145	145	145

Robust standard errors in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

+ethnicity, land inequality, scarcity, land size and population size

Conclusion

To summarize, WUASP did have a positive effect on the performance of WUAs. Moreover, for many outcomes, the program's success was mediated or determined by several contextual variables. The following chapter explores several mechanisms that may link WUASP to these positive outcomes. I also explore the circumstances under which the program may have effectively promoted broader cooperation objectives in contrast to enhancing the capacity and benefits for elites and privileged groups.

Chapter 6

Mechanisms

This chapter fulfills the dissertation's second major research objective by examining the *processes* linking WUASP to common property resource outcomes. This chapter seeks to explain *how* the program positively affected certain performance indicators and *why* the program may have successfully motivated broader collective action objectives under certain circumstances, but failed under others.

Overview

My program evaluation provides strong evidence that WUASP was a clear improvement upon the blue-print approach for supporting and establishing WUAs. The panel data analysis indicates that WUASP improved the average performance outcomes for financial, institutional, infrastructure and development indicators. Additionally, the treatment effect was mediated by a WUA's population and land size, ecological scarcity, as well as economic and social heterogeneity. Hence, the results offer some evidence that community-driven development (CDD) will yield much more desirable results if it is supported through bottom-up methods. Nevertheless, this claim is not without important qualifications.

In particular, I conclude based on my research that the program's ability to encourage broader cooperation, such as equitable water distribution and participation in the rehabilitation projects, was mediated by a community dynamic that allowed the program benefits to be shared by a larger segment of the population. In my study, I located a pattern of this positive community dynamic in WUAs with sizeable ethnic Uzbek populations and relative economic equality between water users. Moreover, in areas where the community dynamic was highly unfavorable for large scale cooperation

due to extreme social inequality, the program may have represented a catalyst for coordination among a subset of the more powerful community members to the detriment of average water users.

I argue that WUASP was not able to build the social infrastructure necessary for enhancing community-wide cooperation for two reasons. First, there are entrenched structural problems with inequality in some communities. Second and related to the first, WUASP's version of "social mobilization" was not capable of fundamentally altering the social relations in such communities. Thus, the program was only able to generate community-wide collective action outcomes in WUAs with an established history of irrigation management or in communities that lacked an imbalance of wealthy farmers and so already enjoyed some degree of social cohesion. Due to implementation limitations and failures, the program may have exacerbated inequality in communities characterized by severe equity problems.

Therefore, while the treatment motivated improvements in the performance of WUAs, some of these benefits might have come at the price of a tradeoff between efficiency and equity in irrigation management. Thus, despite WUASP's advantages and success, some of the same limitations and criticisms of the blue-print approach remain, and researchers must exhibit caution when equating improved WUA performance with the fulfillment of broader collective action objectives.

Roadmap

In this chapter, I use survey data to test for an association between WUASP and outcomes on four individual behavioral mechanisms: *knowledge*, *participation*, *attitudes* and *social capital*. Beyond an investigation of overall WUASP effects, I explore the treatment effects for socially or economically disadvantaged groups by comparing outcomes for the mechanisms in program versus control respondents for women and water users located at the end of the canal system (tail-enders or end-users). In addition, I seek to examine the program's influence on these four mechanisms among ethnic Uzbek versus ethnic Kyrgyz respondents. My hypothesis is that the program has a more pronounced effect among Uzbeks in comparison to Kyrgyz, because of Uzbek's more

extensive history with irrigation and agriculture, in comparison to ethnic Kyrgyz.[51] Finally, I compare the results for ethnic Kyrgyz in an ethnically heterogeneous program site to the results for ethnic Kyrgyz in homogeneous program WUAs. This provides a means to investigate the influence of social heterogeneity.

After presenting the empirical results for the mechanisms, I discuss several of the main implementation problems and inequality issues that hinder WUASP's ability to achieve its objectives among a broader treatment population.

Data and Methodology

Focus groups and preliminary survey research project

Before discussing the quantitative methods, I describe the qualitative methods used to inform the statistical analysis in this chapter. First, I conducted forty-three open and semi-structured interviews in Bishkek, as well as Osh, Jalalabad and Batken oblasts. These interviews were with government officials, non-governmental organizations, international organizations, local farmers, academics, community members, village leaders, and the leadership and staff of WUAs.[52]

Also, I implemented a focus group project and exploratory survey research project from December 2008 – January 2009. Data from my interviews and initial fieldwork were used to create three survey instruments to collect information on ethnic relations, trust, conflict levels, assessments of WUA effectiveness, and overall community relations. During the focus groups, participants discussed the functioning of WUAs, various water management issues, and equality of water distribution in their communities.

In particular, I contracted the Foundation for Tolerance International (FTI), a local Kyrgyz NGO, to conduct the focus groups and implement the exploratory survey project in Osh, Jalalabad and Batken oblasts among (1) local government leaders (2) village elders (aksakals) and (3) villagers. I roughly matched twenty-eight treatment and control villages throughout these oblasts on the basis of geographic and demographic

[51] As I discuss in this chapter's methods section, my research design does not allow me to separate the program effect from the "Uzbek" effect. However, the empirical analysis taken as a whole provides some evidence to address this research question.

[52] I conducted interviews either in Russian or English, or with the help of an interpreter if my interlocutor spoke Kyrgyz, Uzbek or Tajik.

indicators. Within these communities, surveys were distributed to several aksakals, community leaders, and 25 to 50 individuals. Judgment and convenience sampling methods were used to select focus group participants and survey respondents; these non-probability sampling methods were necessary due to financial considerations. This pilot survey provided the basis for the large N probability survey completed in December 2009-January 2010.

I did not attend the focus group discussions or participate in the exploratory survey research to avoid introducing bias. The focus groups were digitally recorded to minimize the risk of data falsification. In contrast, there were few ways to ensure the quality of the exploratory survey research. Therefore, I rely more heavily on the focus group results in my analysis.

Large N Survey Project

In this chapter, a survey post-test with non-equivalent comparison group is the primary research design used to test the mechanisms linking the Water Users' Association Support Program (WUASP) to collective action outcomes. The survey project represents an individual level survey that utilized a multi-stage sampling design. A random sample of 1160 land parcels was surveyed from six Water Users' Associations (WUAs) in Southern Kyrgyzstan. The project was implemented by a team of 18 local Kyrgyz and Uzbek survey researchers and completed during an eight week period from December 2009-January 2010.

Phase 1: Matching

In the first stage of the survey research, longitudinal data on budget, institutional capacity and contextual factors was used to match three treatment WUAs to three control WUAs. The inclusion of a control group by matching techniques represents a correction strategy for selection bias. Specifically, matching is an attempt to compensate for the non-experimental implementation of the program. The use of control WUAs that are matched to treatment WUAs using "pre-treatment" data helps to improve estimates of the program effect by controlling for variables that may have affected the outcomes of interest (Shadish, Cook and Campbell 2002: 179; Posavac and Carey 2001: 193-201).

The accuracy of matching is increased by good measurements of variables that potentially predicted the selection of WUAs into WUASP. Thus, the goal of the matching

procedure is to include all variables that played a role in the WUASP selection process *and* that are related to the dependent variables. It is also important to note that although matching may help to alleviate or eliminate some bias, considerable bias can still remain because matching is based on *observables.* This leaves the threat of *unobserved* correlation in the errors between the control and treatment groups unaddressed (Shadish, Cook and Campbell 2002: 161-170, 503).

The overall matching objective was to select the three best matched pairs while also achieving some variation in the size, location and ethnic composition of the WUAs.[53] Unfortunately, only six WUA were selected for the study due to time and budget constraints. Three WUASP-supported WUAs that had also received basic World Bank institutional development assistance were matched with three control WUAs that *only* received basic World Bank institutional development support. Kyzyl Koshchy, Ykbol and Tal Bulak represent the treatment WUAs, whereas Jar Ooz, Nur Bulak Bashat, and Vorukh Ali represent the corresponding control WUAs.

The matching database included pre-treatment measures from World Bank OIP data on economic indicators, institutional development indicators, land and member sizes, beneficiaries, crop composition, demographic data, canal location, water availability, and the condition of the canal system. However, there was an absence of good quality pre-treatment measures on the specific individual behavioral mechanisms that the survey was designed to measure, including *knowledge*, *participation*, *attitudes* and *social capital* (i.e. trust levels and conflict levels over water resources, etc.).[54]

Finally, United Nation's census data from 1999 was used to determine the ethnic composition of the administrative districts for the WUAs because it represented the most

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[53] GENMATCH was used only to narrow the field of controls that might match to an *individual* treatment. Since WUASP selected WUAs at different times, this study matched using a one-by-one procedure with the set of pre-treatment variables from that year or the previous year (if the WUA was chosen at the beginning of some year) to calculate the propensity score and to include in the balancing criteria for GENMATCH. This produced a group of four or five matches for each potential control. Subsequently, the best matches from this reduced set were selected based on budget/location concerns. For example, control WUAs bordering treatment WUAs were eliminated as potential matches because of the threat of information spillover between leaders and/or residual benefits from better irrigation management.

[54] Additionally, there was a lack of accurate figures for WUA members. WUA members pay dues and have a vote in the WUA; they represent the legal owners of land tracts. WUA "beneficiaries" include anyone who benefits from or is serviced by the WUA in addition to members. Thus, the decision was made to match on land size although this means that for two WUA pairs, we have a discrepancy between the sizes of WUA membership.

recent demographic data from a relatively reliable source. These ethnicity measures were then used for the matching process, and the primary objective was the selection of an ethnically heterogeneous WUA pair. However, despite the census data report of a large percentage of ethnic Uzbeks in the district where WUA Nur Bulak Bashat is located, this area is characterized by a homogenous Kyrgyz community.[55] Thus, a mixed Uzbek/Kyrgyz WUA was matched to a Kyrgyz WUA. This significantly complicates my analysis of the role of ethnicity because all of the ethnic Uzbeks are located in a treatment sites, thereby making it impossible to isolate program versus "ethnicity" effects among the Uzbeks in Ykbol.

Phase 2: Sampling

For the second phase of the survey project, a random sample of 1160 land plots (or tracts) in six WUAs was selected to survey. In particular, after the six WUAs were selected, WUASP community mobilizers collected a list of the land tracts that had been divided up within a WUA following the land reform in Kyrgyzstan. These lists of land tracts contain the heads of households and/or original legal owners of the land, and they comprise the sample frames from which random samples were drawn.[56]

Moreover, there was a 100% response rate because the parameters for respondent selection were relaxed to include "heads of households" or those individuals who took primary care of the land in cases where the original owner was no longer available due to death or migration.[57] Given the lack of updated records and high migration rates in Kyrgyzstan, it would not have been feasible to attain adequate response rates in cases where the respondent was required to be the owner noted on the official member list. In cases where the original head of household was not available, the survey team was

[55] This could be due to a mass migration of Uzbeks from the area since the WUA is located near the Uzbek border or problems with the 1999 census project.

[56] In particular, numbers from 1 to N were assigned to each tract (N is the number of land parcels). R's "sample" command was used to select a sample of size n+x (where n was the optimal size based on the power calculations and budget, and x was a set of spares that were never actually used). The numbers produced corresponded to land tracts on the list to be surveyed. The power calculations themselves were driven primarily by budget and time concerns due to the limited money and time to complete interviews. Originally the number of interviews for each WUA was divided evenly between the six. However, since some matched WUAs had less land tracts, we did censuses.

[57] This means that the sampling was not complicated because there was no need to resample non-respondents.

instructed to locate and interview the individual who was currently in charge of the land or who shared responsibilities for managing the land.[58]

Phase 3: Implementation

The survey instrument was designed to collect data on relevant predictors and the individual behavioral mechanisms of interest – *knowledge*, *participation*, *attitudes* and *social capital*. (A more detailed discussion of the independent and dependent variables is provided below.) Thus, it included questions related to household awareness of WUA governance procedures, basic knowledge of WUAs, involvement in WUAs, behavioral changes of interest, assessments of WUA effectiveness, general community relations regarding irrigation management, and payment of irrigation service fees. The survey consisted of 39 questions and required approximately 45 minutes to complete; it was derived from the surveys used during my 2008/2009 pilot study. The survey instrument is located in appendix 2.A.

The survey project was implemented by a team of 18 local Kyrgyz and Uzbek survey researchers during an eight week period from December 2009-January 2010.[59]

Dependent Variables

The survey data is used to test for an association between WUASP and the four individual behavioral mechanisms that were developed and discussed in Chapter 4. The individual behavioral mechanisms represent abstract concepts that were operationalized for testing purposes through the use of survey questions and/or indexes comprised of multiple survey questions. Specifically, the survey questions were grouped into four

[58] In cases where the original member on the list was located and interviewed, we can be relatively confident that the individual was legally the WUA member. In cases where there was a new caretaker for the land, we assume that they have taken on the roles and responsibilities of the previous/original owner. However, they may not be considered a legal member of the WUA since they do not own the land. In situations where the legal member has migrated or passed away, there does not seem to be any practical difference in the roles or expectations of the family members that have taken over the land. However, in cases where families rent their entire plot of land to an outside actor, the practical implications may be specific to the WUA. While Sehring (2008) pointed to the disenfranchisement of renters in Northern Kyrgyzstan, I did not find this in my field research.

[59] The project was managed by a local Uzbek woman who had a great deal of experience with short-term contract work for international organizations and researchers. In order to minimize any potential bias from a lack of understanding, the survey was translated into Russian, Kyrgyz and Uzbek for respondents and interviewer. A Linguistics PhD Candidate at Indiana University completed the English to Kyrgyz survey translation, and the Kyrgyz staff of WUASP in Osh city helped refine the survey. Professional Uzbek and Russian translators converted the document from English to Russian and from Russian to Uzbek.

categories – measures of knowledge/awareness, participation/activeness, attitudes about and irrigation management outcomes, and social capital/community relations over irrigation resources.[60]

Independent Variables

The predictors used in my models include: program, sex, ethnicity, size of irrigated land, WUA membership status, ecological zone, age of respondent, canal location, and whether respondents rent, instead of own, the land. Also, the model specifications included interactions between program and key predictor variables, such as location, sex, membership and ecological zone, to investigate whether the program effect was mediated by these variables.

The ecological zone variable is an attempt to control for water availability between farms, as well as differences in soil conditions. Respondents were coded into three zones, depending on their primary crops. Zone 1 indicates that respondents cultivate crops such as corn, wheat and food for livestock. These crops require the least amount of water, and in some circumstances, can grow and survive as purely rain-fed crops. Zone 2 designates land where soil/water conditions support vegetables and fruit. Zone 3 includes areas where soil/water conditions enable rice cultivation. In Kyrgyzstan, the three zones also correspond to the "profit potential" of these crop categories with rice representing the most profitable crop and Zone 1 the least.

For canal location, respondents were asked to provide the approximate location – beginning, middle, or end – of their irrigated land within a WUA's service area. This variable controls for variations in water availability within a WUA. Furthermore, since the ecological hierarchy along an irrigation canal generally mirrors a social hierarchy, this variable is also an attempt to determine the treatment effect on the disadvantaged group of end-users.

The question used to determine membership status asked respondents if they were a member of the WUA, and it included three response categories (yes, no, do not know). It is important to emphasize that this is a measure of respondents' personal assessment of

[60] Several proxy measures were created for each individual behavioral mechanism and the aggregate results of all of the proxy measures represent our "final measurement" for that mechanism. For example, nine survey questions that measured respondents' knowledge and awareness of basic WUA information represent the nine proxy measures for knowledge. The hypothesis test for 'knowledge' is determined by examining the aggregate results for all nine proxy measures.

their membership status and not their actual *legal* membership status. Therefore, it is highly possible that we have cases where individuals have a legal right to WUA membership but are not aware that they qualify for membership.

Modeling technique

Regression analysis was used to analyze the survey data. For categorical outcomes, logistic or multinomial logistic regression was used to investigate the predictors of interest. For continuous index measures, ordinary least squares regression (OLS) was selected as the appropriate modeling technique.[61] The use of a clustered standard errors option in the model specification adjusts the variance estimate for correlation between respondents within the WUAs. This option assumes that observations were independent across the six WUAs (six clusters) but not necessarily within the cluster, thereby allowing for unobserved characteristics to be correlated across individuals. Put differently, this enables me to model the potential for individuals within each WUA to be similar in ways not measured in the study.[62]

Discussion

The survey data analysis suggests a positive association between the Water Users' Association Support Program (WUASP) and three of the mechanisms linking the program to better collective action outcomes – *knowledge*, *participation* and *attitudes*. Specifically, there is greater community awareness and member participation in treatment sites – critical project goals. Moreover, certain categories of program respondents express more positive (or desired) attitudes regarding: their right to water given the payment of

[61]Two different modeling techniques were considered for analysis—hierarchical linear modeling (linear mixed models (LMM)) and ordinary least squares (OLS). First, OLS with clustered standard errors is more appropriate for my project since I simply want to control for the clusters and not assess the clustered effect. Furthermore, given the assumptions inherent in the two techniques, OLS was determined to be the correct strategy. In particular, the hierarchical modeling strategy requires a stronger assumption about the form of the correlation between respondents in the same WUA and is founded on the assumption of a normally distributed random effect. Given the small number of WUAs, assumptions were likely violated in my study because I have little reason to assume that these six WUAs represent a normally distributed random effect; an N approaching or greater than 30 would have made this a more tenable assumption. Therefore, OLS was chosen as the modeling technique because it represents a more conservative approach that does not require an assumption about the underlying form of the correlation.

[62] Since we have only six clusters, the bias in standard error might not necessarily be upwards. However, in theory, when the numbers of the clusters increases to a sufficient number, the clustered standard errors are necessarily more conservative. Since it is more conservative, it will tend to over-correct for correlation. Therefore, we are more confident that the results of our statistical models are significant.

irrigation service fees, community responsibility for the WUA, and perception of the WUA's institutional capacity. However, despite these positive results for three mechanisms, the results for *social capital* suggest that WUASP methods either had no effect on community relations surrounding irrigation water management or actually worsened them. In program sites, there is more evidence of tension over irrigation water and uncooperative behaviors, including "water-stealing" and canal vandalism.

Regarding the outcomes for specific sub-groups, the statistical results for *knowledge*, *participation*, and *attitudes* show very little evidence of a positive program effect for women and end-users. For *social capital*, there is not just an absence of a statistically significant difference between program and control respondents in these two groups; the results actually show relatively large effects for various categories of *control* respondents. For example, females and end-users in *control* sites are 13% more likely than their program counterparts to state that water is distributed fairly.

In contrast to the results for disadvantaged groups, the statistical analysis points to evidence of better outcomes for each of the four mechanisms among respondents in Ykbol WUA – the ethnically heterogeneous WUA. However, it is important to note that the absence of Uzbek respondents in control sites eliminates my ability to isolate the Uzbek versus program effect.

In the following sections, I link these empirical results to relevant field observations and discuss the program methods that generate positive outcomes for *knowledg*e, *participation* and *attitudes*. I then put forward an argument to explain why we do not see similar results for *social capital* and disadvantaged groups. Regression output is only provided for the interactions of interest; a discussion of the index measures and complete regression output for each of the models can be found in appendix 2.B – 2.C.

Mechanism I: Knowledge/Awareness

During each of my interviews in WUASP-supported sites, WUA Directors emphasized the program's impact on community awareness. They also drew a connection between greater awareness and the achievement of WUA objectives. Directors explicitly linked awareness to a greater sense of ownership and responsibility for the irrigation infrastructure, which subsequently helped to increase the collection of irrigation service

fees (ISF) and decrease uncooperative behavior. For example, the Director of Boz Aryk WUA spoke directly to the importance of mobilization and its impact on ownership: "Fifty percent of success is awareness; you should mobilize people. They have to understand the ownership; they should feel the ownership of the canal." The Director of Ak Bulak WUA noted the improvement in irrigation service fee (ISF) collection rates: "Earlier, the mirabs had to visit the households but now they (water users) bring the money to us and it is the middle of the season and we have already collected about 50%. Responsibility has increased."

The leadership turnovers that followed WUASP trainings on the rights and responsibilities of water users were another important theme to emerge during the interviews. In particular, education and social mobilization sought to inform the population about the rights of WUA members to elect the WUA's Council members and to teach people that the Council members have the authority to hire and manage the WUA director and other paid staff, such as mirabs and accountants. As a WUASP coordinator said, "Most people think that the WUA is part of the government. Once they find out more about the WUAs, the first thing that they do is usually replace the management" (JB 2008). This assertion was affirmed during my interviews. For example, according to the Directors in two WUAs:

> Our WUA was set up in 2004 and no one knew what was going on and who had rights to the water. They (WUA members) thought that the director of the WUA held total control. After Winrock, the situation became clearer and they (WUA members) changed managers through elections (Director, Ak Bulak WUA).

> People started having meetings and realized that the Council was the supreme power. At the beginning, they only respected the director and the mirabs, but after the trainings, they realized that the council was superior (Director, Isa Mariyam WUA).

The regression results corroborate my qualitative findings concerning a positive program association with *knowledge* and *awareness* outcomes. As expected, communities exposed to WUASP's educational trainings and formal/informal meetings about the WUA are more informed than communities that did not receive the additional education. For six of the nine survey questions used to assess *knowledge*, program respondents are clearly more knowledgeable and informed than their control counterparts. For the

remaining three questions, we find a mix of positive control and treatment results. More specifically, individuals in treatment sites are more likely to know the name of their WUA Director and zonal representative, as well as their WUA's election and meeting procedures. Also, individuals in WUASP-supported sites feel more informed about the: timing of WUA meetings, WUA budget, responsibilities associated with WUA membership, water-delivery schedules, and benefits of WUA membership.

This program effect for *knowledge* is not just positive and statistically significant; it also represents a practical or policy relevant effect. Depending on the question and respondent category, the likelihood of WUASP respondents answering a knowledge question correctly or feeling completely informed about an issue in comparison to control respondents ranges from 10% to 57%, with an average in the upper twenties.

Table 6.1. Regression results for *knowledge* measures

	Logit						**Multinomial**	
	Q7	Q10	Q12	Q15	Q17a	Q17d	Q17b (2)	Q17c (1)
WUASP	1.466*	1.237	0.838	1.588**	1.858**	4.447***	1.368**	2.274***
	(0.890)	(0.946)	(1.052)	(0.680)	(0.843)	(0.922)	(0.594)	(0.802)
WUASP#mem.	-1.291	-2.486***	-0.731	-0.975	-1.864**	-1.435*	-2.425***	-1.538**
	(1.407)	(0.883)	(0.877)	(0.932)	(0.850)	(0.750)	(0.683)	(0.780)
WUASP#uncer.	0.260	-0.524	0.787	3.150***	0.0265	-1.334***	-1.552***	-15.08***
	(0.808)	(1.040)	(0.575)	(0.978)	(0.303)	(0.359)	(0.310)	(1.598)
WUASP#middle	0.569**	0.947***	0.0848	-0.711	0.293	-0.499*	0.995***	1.026**
	(0.232)	(0.301)	(0.178)	(0.483)	(0.213)	(0.256)	(0.215)	(0.411)
WUASP#end	-0.0719	0.363	-0.821**	-1.751***	0.695	-0.633	0.367	-0.218
	(0.298)	(0.577)	(0.387)	(0.414)	(0.772)	(0.638)	(0.584)	(0.564)
WUASP#1.sex	0.494	0.839*	-1.199***	-0.426	-0.905**	-2.057*	-1.288***	-0.717
	(0.583)	(0.481)	(0.368)	(0.451)	(0.410)	(1.152)	(0.189)	(0.455)
WUASP#Zone1	1.028***	0.852	0.989	-0.0869	0.497***	-0.601***	0.370	-0.326
	(0.360)	(0.612)	(0.808)	(0.308)	(0.169)	(0.171)	(0.343)	(0.423)
WUASP#Zone2	0.0955	0.871**	1.598**	0.947***	-1.374***	-3.284***	-2.989***	-3.012***
	(0.266)	(0.433)	(0.690)	(0.301)	(0.494)	(0.592)	(0.395)	(0.813)
Constant	0.418	1.839***	1.682**	-0.374	-2.578***	-6.476***	-2.419***	-1.687
	(0.621)	(0.572)	(0.697)	(0.577)	(0.762)	(0.757)	(0.810)	(1.153)
Observations	1,131	1,131	1,123	1,131	1,127	1,114	1,129	1,128

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Mechanism II: Participation/Activeness

As expected, the quantitative analysis provides evidence of greater participation in WUASP-supported WUAs. There is strong statistical support for a positive treatment effect on participation in meetings, elections, as well as the overall time that individuals dedicate to the WUA. The outcomes for the participation index measure indicate a substantively large and positive difference for treatment respondents who are members, those uncertain about their membership status, as well as respondents located at the beginning and middle of the canal. More specifically, respondents in these four categories exhibit either an entire point increase, or close to an entire point increase, on the five point scale. Furthermore, WUASP respondents in ecological zone 3, together with respondents uncertain of their membership status, are approximately 15% more likely to have voted for a zonal representative.

Indeed, throughout my field research, the WUA staff and leaders maintained that WUASP's methods helped motivate greater community involvement through a variety of mechanisms. As the Director of Shaidan Kara Unger asserted, "the biggest change was the attitude in each of the zones. People became more active in all of the zones." The project was claimed to have improved the WUA staff's skills for organizing or mobilizing the population; WUASP had "improved inter-personal skills" and "helped us to work better with the people." As the former director of Shaidan Kara Unger WUA said, "we know our area well but we didn't know how to communicate with people about the WUA, motivate people and train and select leaders." As discussed above, institutional development and social mobilization ensured that WUA members understood their rights and responsibilities and that the WUA held the required elections and meetings to enable water users to express their leadership preferences.

Moreover, the program's participatory rehabilitation process requires an engaged and active WUA leadership and community in order to successfully complete the work. First, the process for approving irrigation sites for rehabilitation requires a meeting involving a quorum of members or zonal representatives. Next, the WUA leadership has to take responsibility for purchasing the materials necessary for rehabilitation and organizing the population for the required labor contribution. Since WUASP grants are relatively small, they help a WUA cover the costs of most of the materials required for a rehabilitation site, but labor must be provided by the community unless water users

contribute additional funds for hiring workers. Consequently, the leadership emphasized that the multiple meetings and discussions during the project helped to increase people's understanding of how the WUA functions; this subsequently motivated many people to become involved in the rehabilitation projects by contributing funds and providing labor.

Table 6.2. Regression results for *participation* measures

	Logit	**OLS**
	Q13	PARTIC
WUASP	-0.0597	-1.323***
	(0.634)	(0.235)
WUASP#mem.	-1.702**	0.929**
	(0.711)	(0.348)
WUASP#uncer.	1.958***	-0.0148
	(0.459)	(0.353)
WUASP#middle	0.425	-0.0766
	(0.273)	(0.122)
WUASP#end	0.0176	0.586***
	(0.397)	(0.133)
WUASP#1.sex	-1.337***	0.274
	(0.423)	(0.395)
WUASP#Zone1	0.109	0.215
	(0.600)	(0.253)
WUASP#Zone2	1.204**	0.113
	(0.536)	(0.0726)
Constant	1.745**	-0.545
	(0.786)	(0.315)
Observations	1,123	1,101
R-squared		0.415

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Mechanism III: Attitudes

As expected, WUASP respondents express attitudes about irrigation management and the WUA's institutional capacity that suggest a potential for better collective action outcomes. The statistical analysis suggests a positive association in WUASP-supported WUAs for the six attitudinal measures. WUASP respondents provide a more favorable evaluation of the WUA's staff and irrigation management. Also, individuals in treatment sites are more confident that non-cooperative behavior will be punished and that they will receive adequate water given their irrigation service fee (ISF) payment. Finally, program

respondents are more likely to state that their community is responsible for the success of the WUA.

Furthermore, these results are substantively large. The positive treatment effect for the four indexes used to measure *attitudes* ranges from .36 to 1.32 on the four and five point scales. Additionally, in program sites, respondents who are uncertain of their membership status, as well as respondents in ecological zone 3 are more than 30% likely to accept responsibility and ownership for the WUA, and members are 12% more likely to provide the highest performance evaluation of their WUA.

Given the corresponding improvements in *knowledge* and *participation* in WUASP sites, the results for *attitudes* seem to support theoretical assertions that awareness and activeness can promote the desired changes. Once again, interviews with WUA directors revealed the important effect that the program had on responsibility and ownership, factors deemed crucial for attitudinal and behavioral change. According to the Director of Uch Korgon WUA, "You have to understand that we were under the USSR for 70 years and there was no initiative. This is their association and they needed to understand that this was their responsibility."

Significantly, participatory rehabilitation is expected to motivate positive attitudes concerning institutional capacity and community responsibility for the WUA. The rehabilitation consists of WUASP grants that are usually combined with community labor and sometimes even supplemented by community finances. The primary, concrete benefit of emergency rehabilitation is to improve water distribution, especially in downstream areas. The assumption is that increased water flows for end-users will motivate greater irrigation service fee (ISF) payments and labor contributions. When discussing the benefits of the Winrock program, many Directors explicitly noted the link between grants and increased ISF collection. For example, as the Director of Kara Dobo WUA explained,

> The upper-users have always planted the same crops, but since the program, the downstream farmers have more water and more crops. Earlier, a lot of water was lost and the canals were not clean. So, we built water-gates to help direct the water better and reinforced some parts of the canals with concrete, and the time for water to reach the irrigation points changed from about one hour to thirty minutes. There was no change with the fee payment among upstream farmers but the downstream farmers

> have increased their payment…We used to always owe money to the government before, but now, there is no debt. For example it is only July and approximately 70% of the ISF has been paid.

Next, these rehabilitation projects grants are expected to have significant short or long term effects on the trust dynamic between the population and the WUA's management and leadership. Taking part in the labor or seeing tangible results of the rehabilitation work is predicted to increase the payment of ISF. Greater financial support from the community may be promoted in cases where the community has seen two or three cycles of the WUA cleaning and lining canals and installing water-gates. Third, involvement in the rehabilitation process is expected to enhance the community's sense of ownership for the infrastructure. According to a WUASP engineer, "When they build it themselves, they start to have an understanding of this as their own. The behaviors change along with the idea that they must pay for water and the infrastructure. Correspondingly, the Director of Kara Dobo WUA stated, "Before, the water and infrastructure were owned by the Soviets, but now they (the community) have constructed water-gates and lined the canals on their own through "ashar";[63] now they own it" (Director Kara Dobo WUA).

Nevertheless, for three of the six attitudinal indicators, these positive results in WUASP-supported sites are restricted to WUA members, as well as respondents in ecological zone 3, which corresponds to the treatment WUA with an ethnically heterogeneous population. The potential implications for this limited program effect are discussed later in this chapter.

Table 6.3. Regression results for *attitude* measures

	OLS				**Logit**	**Multinomial**
	STAFF	PUNISH	IRMAN	ISF	Q16	Q22(1)
WUASP	0.249	-0.411	0.492*	0.625	0.260	-0.439
	(0.403)	(0.242)	(0.238)	(0.412)	(0.368)	(0.732)
WUASP#mem.	0.740	-0.246	0.136	0.745*	-0.373	-0.499
	(0.427)	(0.488)	(0.306)	(0.308)	(0.456)	(0.808)
WUASP#uncer.	0.0317	-0.533	-0.169	-0.00816	1.436***	1.647**
	(0.248)	(0.302)	(0.312)	(0.397)	(0.503)	(0.643)
WUASP#middle	-0.635	-0.0936	-0.613	-0.475	0.318	-

[63] Asharn refers to voluntary community labor. Please see Chapter 2 for a more detailed discussion

	(0.407)	(0.256)	(0.343)	(0.273)	(0.329)	-
WUASP#end	-0.308	-0.117	-0.779*	-0.437	0.150	-
	(0.398)	(0.231)	(0.313)	(0.350)	(0.362)	-
WUASP#1.sex	-0.0147	0.273	0.399	-0.307	-0.724	-0.293
	(0.304)	(0.282)	(0.411)	(0.242)	(0.491)	(0.844)
WUASP#Zone1	-0.204	0.464**	0.202	-0.340	-0.811**	-0.195
	(0.391)	(0.174)	(0.344)	(0.256)	(0.344)	(0.848)
WUASP#Zone2	-2.163***	-1.428***	-1.580***	-1.297***	1.290***	18.71***
	(0.335)	(0.228)	(0.300)	(0.205)	(0.309)	(1.158)
Constant	-0.503**	0.466	-0.733**	-0.948	0.623	0.0534
	(0.195)	(0.373)	(0.230)	(0.493)	(0.469)	(1.069)
Observations	1,106	1,107	1,104	1,105	1,130	1,101
R-squared	0.437	0.487	0.436	0.205		

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Mechanism IV: Social Capital

In contrast to the positive program results seen for the other three mechanisms, there is a notable lack of a positive program association with the nine *social capital* outcomes tested. Moreover, there is not just an absence of a statistically significant difference between program and control; the results actually show substantial effects for various categories of *control* respondents. Among program respondents, there were more reports of behaviors and community dynamics that are detrimental to the long term success and development of the WUA, including "water-stealing," vandalism of canals and tension over irrigation water. Control respondents also report higher levels of trust, as well as better community relations and more cooperative behaviors over irrigation water. Accordingly, multiple categories of control respondents are much less likely to report that divisions in economic/social status, religion or ethnicity are related to conflict over irrigation water. Finally, control respondents are more likely to report that water is distributed fairly and that irrigation management outcomes are equitable across the WUA. These results provide some evidence that WUASP programmatic methods either failed to motivate or worsened a community's communal relations regarding irrigation water.

Furthermore, these are large substantive effects. For example, on a five point index scale, the smallest effect is .33, while the largest is a 1.57 point difference. The

exception to this is the results for ecological zone 3, which is located in the ethnically heterogeneous Ykbol WUA. In Ykbol, we find better assessments of trust and community relations over irrigation management, as well as more reports of cooperative behavior and stronger norms of community shaming, although we also find that ethnic and religious divisions are related to conflict over irrigation water.

Consequently, these results highlight concerns raised by common property resource scholars and anthropologists regarding the potential negative effects of development projects. In particular, WUASP may be replicating and further enforcing the divide between disadvantaged and more socially powerful groups by disproportionately benefiting the latter. In order to describe *why* we fail to see a positive association between WUASP and the critical proximate objective of *social capital*, I put forth two key explanations later in this chapter that relate to the significant structural inequality in some communities and implementation problems with the program.

Table 6.4. Regression results for *social capital* measures

	OLS					**Logit**
	COOP	TRUST	ECONSTAT	RELETHN	FAIR	Q39a
WUASP	-1.981***	0.948***	-1.208***	-1.224***	-1.825***	0.889***
	(0.286)	(0.194)	(0.263)	(0.302)	(0.320)	(0.240)
WUASP#mem.	1.244**	-0.233	1.143**	0.525	0.875**	0.141
	(0.442)	(0.396)	(0.347)	(0.338)	(0.297)	(0.487)
WUASP#uncer.	1.885**	-0.472	-0.321	-0.256	-0.0372	1.612***
	(0.667)	(0.331)	(0.164)	(0.131)	(0.607)	(0.462)
WUASP#middle	0.443	-0.364	0.412	0.142	0.515	-0.633
	(0.263)	(0.239)	(0.332)	(0.176)	(0.380)	(0.503)
WUASP#end	0.388	-0.343	0.429	0.349*	0.255	-0.202
	(0.450)	(0.296)	(0.270)	(0.156)	(0.304)	(0.436)
WUASP#1.sex	-0.632*	0.150	-0.502**	0.0379	0.143	-0.945***
	(0.258)	(0.296)	(0.155)	(0.163)	(0.340)	(0.344)
WUASP#Zone1	0.434	0.191	-0.295*	0.339**	0.103	0.375
	(0.482)	(0.204)	(0.132)	(0.0968)	(0.192)	(0.280)
WUASP#Zone2	1.853**	-1.851***	0.212	0.620***	0.572**	0.243
	(0.473)	(0.316)	(0.170)	(0.0836)	(0.186)	(0.172)
Constant	1.55***	-.697***	1.16***	1.20***	1.10***	1.841***
	(.235)	(.154)	(.25)	(.092)	(.198)	(0.415)
Observations	1097	1130	1119	1122	1105	1,121
R-squared	.4176	.3689	.3686	.3435	.3357	

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Multinomial					
	Q19e(2)	Q33d(1)	Q33d(2)	Q34(2)	Q34(3)
WUASP	-0.260	1.524	0.982*	0.644	1.740*
	(0.503)	(1.098)	(0.530)	(0.527)	(0.917)
WUASP#mem.	-	0.332	-1.481***	-	-
	-	(0.652)	(0.484)	-	-
WUASP#uncer.	-	-2.577***	-2.607**	-	-
	-	(0.612)	(1.162)	-	-
WUASP#middle	-	-	-	-0.944**	-1.624**
	-	-	-	(0.374)	(0.659)
WUASP#end	-	-	-	-0.0487	-0.693
	-	-	-	(0.570)	(0.649)
WUASP#1.sex	-	-	-	0.720***	0.845**
	-	-	-	(0.255)	(0.412)
WUASP#Zone1	-0.133	-2.864**	-1.998***	-0.221	-1.918
	(0.444)	(1.170)	(0.559)	(0.519)	(1.397)
WUASP#Zone2	-2.308***	-1.046	-1.574***	-1.367***	-4.387***
	(0.780)	(0.901)	(0.316)	(0.486)	(0.830)
Constant	2.281***	-0.960	-0.456	-3.324***	-3.989***
	(0.360)	(1.132)	(0.608)	(0.586)	(0.907)
Observations	1,130	1,130	1,130	1,118	1,118

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Results for Ykbol WUA, women and tail-enders

For *knowledge*, *participation* and *attitudes*, I find consistently positive program effects for males, WUA members and respondents located at the beginning and middle of the canal. However, the statistical results show very little evidence of a positive program effect for disadvantaged groups in WUASP sites; there is not a statistically significant difference between program and control respondents in these groups for the majority of proxy measures. Similar to the results for *social capital*, the lack of positive outcomes for disadvantaged groups raise questions concerning whether the program's benefits extended beyond local elites or the most advantaged groups.

In Kyrgyzstan, and across the developing world, women play a critical role in agriculture. In Southern Kyrgyzstan, women are actively involved in the planting, watering and harvesting of crops. Yet, in most WUAs, they comprise a trivial proportion of the leadership, staff and zonal representatives. Moreover, since land was distributed to

the male head of household during land reform, they are often legally excluded from WUA membership.

According to WUASP program theory, the project is designed to empower women. In addition to the educational trainings, the project works to ensure that institutional barriers to female participation are removed. However, the program evaluation provides little evidence of a positive association between the treatment and outcomes for women. For *knowledge*, female respondents in treatment WUAs are more than 50% likely to successfully identify the Director of their WUA than their control counterparts. Alternatively, females in *control* sites are 32% *more* likely to feel informed about water delivery schedules; 13% *more* likely to say that water is distributed fairly; and 4% *less* likely to say that people damage water-gates. Moreover, females in control sites are less likely to state that divisions in economic and social status are linked to tensions over irrigation water.

For end-users, the results suggest an important, positive treatment association with *participation*; those in WUASP-supported WUAs score .23 higher on the four point participation measure. This outcome is significant at the 99% level, although it is not a large substantive effect. However, the only other evidence of a positive treatment effect is found for a *knowledge* question where program respondents are 10% more likely to feel informed about their WUA's governance procedures. In contrast, end-users in control sites are 13% more likely to say that water is distributed fairly and substantially less likely to claim that divisions in religion and ethnicity are linked to tension over irrigation water. Finally, the results of the other twenty measures tested for *knowledge*, *participation, attitudes* and *social capital* suggest no difference between treatment and control respondents at the end of the canals.

The results for end-users provide the strongest evidence of a tradeoff between equity and efficiency in WUASP sites. In particular, the overwhelming majority of WUAs in Southern Kyrgyzstan experience the most significant infrastructure and water scarcity problems in their downstream canal locations. The ecological hierarchy that often motivates free-riding by upstream farmers and sub-par results for downstream farmers generally reflects a social hierarchy in WUAs; upstream farmers represent the wealthier or more socially powerful individuals, whereas downstream plots were

distributed to the poorest or least influential community members. Although the social dimension was never openly discussed, WUASP was well aware of the disproportionate infrastructure and water scarcity problems faced by downstream farmers. Thus, the lack of a program effect or positive *control* effect for end-users is highly problematic.

Hence, the improvements that we find for the first three mechanisms are restricted to certain population categories. The improvements for *knowledge* and *participation* are generally restricted to males, WUA members and water users at the beginning of the canal. Despite the positive program effects for *knowledge*, the restricted set of program beneficiaries may explain why a large percentage of respondents in program sites still lack basic knowledge. Among survey respondents, twenty percent of program respondents do not know the name of the WUA or their zonal representative, and approximately *half* do not know the selection procedure for the WUA director. Twenty-three percent of program respondents feel "*completely uninformed*" about water delivery schedules and the responsibilities of WUA membership; thirty-four percent feel "*completely uninformed*" about WUA meetings and the benefits of membership; and fifty-six percent of program respondents feel "*completely uninformed*" about the WUA budget.

Furthermore, if we take a closer look at *attitudes*, we see that the positive program results are concentrated in ecological zone 3 which only includes respondents from Ykbol—the majority Uzbek WUA (The significance of Ykbol and WUAs with sizeable Uzbek categories is discussed below). In contrast, improvements are notably lacking in these categories for women and tail-enders. In WUASP sites, although women are more knowledgeable about some basic WUA info and tail-enders are slightly more likely to participate in the WUA, there is not consistent evidence to support the claim that WUASP methods have a significant positive impact on these groups.

I also investigated the program effect on respondents in the ethnically heterogeneous WUA – Ykbol – versus the ethnically homogenous program sites. From the beginning of my field research, cultural differences between the ethnic Kyrgyz and ethnic Uzbek populations emerged as an important theme in irrigation management. Both Kyrgyz and Uzbek respondents contrasted the nomadic history of the Kyrgyz with the Uzbeks' longer history of settled agriculture and experience with formal and informal

institutions for the management of irrigation. Moreover, Uzbeks are generally associated with greater success in agricultural endeavors.

Accordingly, in treatment sites with sizeable Uzbek populations, qualitative findings consistently indicate greater equity in water distribution. There was a general consensus among focus group and survey respondents that water was distributed fairly and that the population could depend on the WUA's commitment to water distribution through water-schedules. The WUASP staff maintained that it was generally easier to organize the Uzbeks, and relayed stories about the strength of community shaming in these communities, although they also asserted that results attained in some homogeneous Kyrgyz communities could be just as good as those in majority Uzbek areas.

Given the lack of Uzbek respondents in the control WUAs, there is no way to determine whether better outcomes for the four mechanisms in Ykbol are indicative of an Uzbek versus program effect. Thus, I grapple with this question in a less straight-forward manner. First, I restrict the observations to include only those individuals in program sites and examine outcomes for Uzbeks and Kyrgyz. If there is no difference between Uzbeks and Kyrgyz in program sites, this provides some evidence for the argument that WUASP affects these groups differently or that there is an "Uzbek" effect. Next, I further restrict the analysis to individuals within Ykbol and examine differences between the Uzbeks and Kyrgyz in this WUA. If the Uzbeks in Ykbol perform better on the four individual behavioral mechanisms, this represents some evidence in favor of a purely "Uzbek effect" or heterogeneous program effect for the Uzbeks. Finally, I investigate differences between Kyrgyz in Ykbol and Kyrgyz in homogeneous program sites to examine the effects of social heterogeneity. These empirical results are summarized in the four tables below, which provide the predicted probabilities from the regression analysis. The complete regression output is available in appendix 2.C.

Table 6.5. *Knowledge* results for the analysis of social heterogeneity and Uzbek outcomes

	Results for all treatment respondents	**Results within Ykbol**	**Results for Kyrgyz in homogeneous versus heterogeneous sites**
Meetings	Positive Uzbek effect: males (.17)***, females (.4) ***, beg (.26) ***, mid (.35) ***, end (.29) ***, Zone 1 (.36) ***, Zone 2 (.23) ***, Zone 3 (.26) ***	Positive Uzbek effect: Zone 1 (.28) ***, Zone 3 (.24) ***	No difference
Benefits	Positive Uzbek effect: males (.22) ***, females (.27) ***, beg (.23) ***, mid (.33) ***, end (.22) ***, Zone 1 (.35) ***, Zone 2 (.18) ***, Zone 3 (.21) ***	Positive Uzbek effect:2.13***	No difference
Responsibilities	Positive Uzbek effect: males (.27) ***, females (.37) ***, beg (.35) ***, mid (.32) ***, end (.3) ***, Zone 1 (.39) ***, Zone 2 (.09)**, Zone 3 (.39) ***	Positive Uzbek effect: 2.31***	No difference
Budget	Positive Uzbek effect: males (.13) ***, females (.26) ***, beg (.19) ***, mid (.29) ***, end (.14) ***, Zone 1 (.34) ***, Zone 2 (.10)*, Zone 3 (.15) ***	Positive Uzbek effect: Zone 1 (.27)**, Zone 3 (.09)**	No difference
Schedules	Positive Uzbek effects: males (.27)***, females (.40)***, beg (.38)***, mid (.37)***, end (.26)***, Zone 1 (.48)***, Zone 3 (.28)***	Positive Uzbek effect (1.48)***	Positive homog. effects: beg (.15)**

Among program respondents and within Ykbol, the results suggest that ethnic Uzbeks are much more knowledgeable and informed about the WUA and irrigation management than Kyrgyz. We see no evidence of a positive *knowledge* effect for Kyrgyz in Ykbol versus Kyrgyz in homogeneous program sites. For *participation* outcomes among WUASP respondents, the analysis indicates that Uzbeks at the beginning of the canal are more active participants than their Kyrgyz counterparts. However, while there is no difference between Uzbeks and Kyrgyz in Ykbol, Kyrgyz in Ykbol are less likely to participate than Kyrgyz in other treatment sites. Thus, for *knowledge* and *participation*, we see little evidence of a positive influence from social heterogeneity among Kyrgyz and Uzbeks. The positive results for Uzbeks may be attributable to a heterogeneous treatment effect on theUzbeks and/or a purely Uzbek effect.

Table 6.6. *Participation* results for the analysis of social heterogeneity and Uzbek outcomes

	Results for all treatment respondents	**Results within Ykbol**	**Results for Kyrgyz in homogeneous versus heterogeneous sites**
Participation	Positive Uzbek effects: beg (.11)**	No difference	Positive homog. effects: beg (.91)***, mid (.89)***, end (.58)***
Voting?	Positive Kyrgyz effects: males (.30) ***, females (.11) ***, beg (.25) ***, end (.20) ***, Zone 1 (.24) ***, Zone 2 (.24)**, Zone 3 (.13)***	Positive Kyrgyz effects: end (.25)**	Positive homog. effects: beg (.30)***, mid (.29)***, end (.18)***

In contrast, for *attitudes* and *social capital*, we find evidence of positive effects for social heterogeneity. In particular, in WUASP-supported sites, Uzbek respondents have much better outcomes for attitudes than Kyrgyz. However, for four of the six attitudinal measures, we find no difference (or even better Kyrgyz results) between Uzbeks and Kyrgyz in Ykbol. Significantly, for all attitudinal questions, we find better outcomes for Kyrgyz in Ykbol in comparison to Kyrgyz in ethnically homogeneous sites.

The results for *social capital* are similar to the findings for *attitudes*. Once again, in treatment sites, Uzbeks have much better outcomes for *social capita*l than Kyrgyz respondents. Nevertheless, for six of the eight social capital measures, we find no difference (or even better Kyrgyz results) between Uzbeks and Kyrgyz in Ykbol or better results for Kyrgyz. Finally, for six of the eight social capital measures, I also find better outcomes for Kyrgyz in Ykbol in comparison to Kyrgyz in homogeneous treatment sites.

Table 6.7. *Attitudes* results for the analysis of social heterogeneity and Uzbek outcomes

	Results for all treatment respondents	**Results within Ykbol**	**Results for Kyrgyz in homogeneous versus heterogeneous sites**
Staff eval	Positive Kyrgyz effects: Zone 3 (.14)***	Positive Kyrgyz effects: Zone 3 (.92) ***	Positive hetero. effects: beg (.89)***, mid (.96)***, end (.95)***
Sanction?	Positive Uzbek effects: males (.58) ***, females (.85) ***, beg (.68) ***, mid (.90) ***, end (.56) ***, Zone 1 (1.22)*, Zone 2 (.51)*, Zone 3 (.40)**	No difference	Positive hetero. effects: mid (1.51)***, end (.67)***
WUA eval?	Positive Uzbek effects (Outcome 1): .mem05*** Positive Kyrgyz effects (Outcome 1): non mem(.06)*** Positive Uzbek effects Outcome 3: mem .14***, non-mem .20*** uncertain .20***	No difference	NA

Irrigation outcome?	Positive Uzbek effects: males (.48)***, females (.99)*, beg (.71)**, mid (.86)**, Zone 1 (1.05)**, Zone 2 (.95)*, Zone 3 (.20)**	Positive Kyrgyz effects: Zone 1 (.42)*	Positive hetero. effects: beg (1.35)***, mid (1.42)***, end (1.44)***
ISF?	Positive Uzbek effects: males (.25) ***, beg (.39) ***, mid (.27) ***, Zone 2 (.50)**, Zone 3 (.36)*	Positive Uzbek effects: Zone 3 (.34)*	No difference
Own/resp.?	Positive Uzbek effects: males (.26) ***, females (.26) ***, beg (.37) ***, mid (.24) ***, end (.17)*, Zone 1 (.15) ***, Zone 2 (.40) ***, Zone 3 (.27) ***	Positive Uzbek effects: Zone 3 (.18)*	Positive hetero. effects: beg (.34)***, mid (.26)**

Table 6.8. *Social Capital* results for the analysis of social heterogeneity and Uzbek outcomes

	Results for all treatment respondents	**Results within Ykbol**	**Results for Kyrgyz in homogeneous versus heterogeneous sites**
Trust	Positive Uzbek effects: males (.90) ***, females (.50) ***, beg (1.05) ***, mid (1.03) ***, end (.85) ***, Zone 1 (1.25) ***, Zone 2 (1.33) ***, Zone 3 (.41) ***	Positive Uzbek main effect -.31*	Positive hetero. effects: beg (1.96)***, mid (1.59)***, end (1.0)***
Econ/social divisions	Positive Uzbek effects: females (.40)*, end (.53) ***, Zone 3 (.46) ***	No difference	Positive hetero. effects: mid (.11)***
Ethnic/religious divisions	Positive Kyrgyz effects: males (.83) ***, females (.30)**, beg (.82) ***, mid (.63) ***, end (.24)**, Zone 1 (.66) ***, Zone 2 (.61) ***, Zone 3 (.41) ***	Positive Kyrgyz main effect -.38**	Positive homo. effects: beg (.65)***, mid (.83)***, end (.66)***
Solve conflicts	Positive Uzbek effects: females (.16)**, mid (.18) ***, Zone 2 (.17) ***, Zone 3 (.15)**	No difference	Positive hetero. effects: beg (.23)** Positive homo. effects: mid (.27)***
Community shaming	Positive Kyrgyz effects (Outcome 1): Zone 1 (.16)***, Zone 3 (.11)* Positive Uzbek effects (Outcome 3): Zone 2 (.14)**, Zone 3 (.13)**, males (.13) ***, mid (.13) ***, non-mem(.29)***	No difference	Positive hetero 2.01***
Cooperation	Positive Uzbek effects: males (1.43) ***, females (2.10) ***, beg (1.90) ***, mid (1.68) ***, end (1.69) ***, Zone 1 (2.27) ***, Zone 2 (1.90) ***, Zone 3 (1.05) ***	Positive Uzbek effects: females (1.19) ***	Positive hetero effect: beg (1.79)***, mid (1.59)***, end (2.19)***
Infrastructure damage	Positive Uzbek effects (Outcome 1): Zone 1 (.32) ***, Zone 3 (.06) ***, females (.15)*, beg (.09)*, end (.13)**	No difference	Positive hetero. effect for outcome 3: 1.14***
Fair water dist.	Positive Uzbek effects: males (.75) ***	Positive Kyrgyz effects: females (1.56)***	Positive hetero. effects: mid (.66)***, end (.76)***

Mediating Factors

As the results of the collective action outcomes analysis in Chapter 5 indicate, WUASP did have a positive effect on WUA performance indicators. Moreover, the empirical results for this chapter suggest that WUASP motivated these positive outcomes through its positive effect on *knowledge*, *participation*, and *attitudes*, although this dissertation cannot directly test the link between the mechanisms and outcomes. Nevertheless, the quantitative analysis also implies that the program did not have consistent effects across population groups and it was not capable of building social capital assets in all circumstances. The improvements in *knowledge*, *participation* and *attitudes* are generally limited to the advantaged groups and Ykbol WUA, and the positive results for *social capital* are further limited to Ykbol.

These findings suggest a distinction between WUASP's effect on WUA performance outcomes and WUASP's impact on community-wide cooperation for irrigation resource management; positive performance outcomes for WUAs may not necessarily reflect improved collective action among a broad population of water users in a service area. Although WUASP motivated significant improvements in the institutional capacity of WUAs, my research suggests WUASP helped promote broad-based cooperation and collective action objectives in WUAs that already had the necessary social foundation for cooperation.

The social capital is generated by and reflected in a positive community dynamic is a prerequisite for cooperative behavior such as equitable water distribution and voluntary participation in rehabilitation efforts. Given the lack of resources and institutional weaknesses that plague irrigation management in Southern Kyrgyzstan, a certain level of social cohesion helps diminish the emergence of a free-rider dilemma between upstream and downstream water users by substantially raising the costs for destroying equitable water distribution schemes. However, despite WUASP's methods and goals, it was not capable of improving community dynamics for irrigation water management.

Thus, community-wide cooperation was dependent on the program's involvement in WUAs where this foundation already existed. During my field research, I identified a pattern of this community dynamic in WUAs with a sizeable Uzbek population or

absence of significant economic inequality. Qualitative findings from field observations, interviews, the exploratory survey project, focus groups and WUASP's informal evaluations indicate that the program benefits were especially wide-spread in these WUAs.

Thus, a certain degree of economic or social equality and/or an established history of cooperation in irrigation management may be key factors for determining this positive community dynamic. I suggest the program's achievement of broader objectives required a relative balance of power between water users in a community before the program began. This balance could be achieved in situations where there was not significant economic inequality; this may correspond to WUAs without a significant number of farmers with large land-holdings relative to the size of most water users' land plots. I also believe that this balance could be achieved in cases where the population could minimize the financial power of the wealthy through informal mechanisms of community control, such as "community shaming." For example, the general success of Uzbek communities may be due to their longer history of cooperation and governance over irrigation water resources; this may have generated stronger mechanisms of social control.

In the following sections, I put forward two complementary explanations for why WUASP failed to generate social capital and how the program may have actually undermined social cohesion in some WUAs. First, significant entrenched structural inequalities, which were exacerbated during land reform, define many communities in Kyrgyzstan. Thus, limitations in WUASP's capacity, together with the relatively short-term nature of the project, significantly reduced its odds of success in such areas. Second, there were fundamental implementation issues that prompt questions regarding the extent to which WUASP consistently followed its extensive social mobilization objectives. As is often the case in international development, this gap between planned and actual implementation was generally driven by the standard problems encountered in development work, including a perverse incentive structure from donor funding requirements.

Factor 1: Inequality in land distribution—the "farmers"

As discussed in Chapter 2, the land reform process in Kyrgyzstan had the potential to reproduce and increase social inequalities in rural communities. During the

early stages of land reform, the capacity to farm large tracts of land independent of the state or collective farms was limited to individuals with appropriate expertise and/or financial security. Moreover, individuals who petitioned for their land earlier usually received better land that was located at the beginning of the canal. Furthermore, the reforms required land to be distributed on a competitive basis by a committee of individuals with the greatest knowledge of agriculture and irrigation. Thus, those who distributed the land and those who received optimal land represented individuals in privileged positions in the collective/state farms, such as directors, engineers, and government employees (Wegerich 1996: 250; Sehring 2005: 18).

Although the average individual and household in rural Southern Kyrgyzstan relies on agriculture for their livelihood, they generally do not refer to themselves as "farmers." As I discovered during the course of my field research, the term "farmer"(*"fermer")*[64] is generally applied to individuals with large tracts of land. Hence, communities where the term farmer was frequently encountered in my focus groups, interviews and surveys often coincided with WUAs experiencing extreme cooperation and irrigation management problems.

Moreover, in cases where there was a large power imbalance between the farmers and other water users, WUASP was must less effective and/or blatantly contributed to the imbalance by giving the powerful even more control over water. To illustrate this point about equitable land distribution, I provide the reader with some context from the field concerning Kyzyl Koschy WUA, a WUASP-supported WUA. Kyzyl Koshchy represented a serious burden for the project staff and seemed to be a 'failing' WUA. The general problems found in Kyzyl Koshchy emerge throughout my field research in cases of "under-performing" treatment WUAs.

Kyzyl Koshchy WUA is a small WUA with a population of 99% Kyrgyz and large degree of water scarcity among end-users. Kyzyl Koshchy is characterized by significant social/economic problems between farmers with large landholdings and water users with small land plots. In December 2006, WUASP began working in Kyzyl Koshchy. The program dedicated an entire year to "social mobilization" in the WUA, and

[64] This is a relatively new word borrowed from English mostly in the post-Soviet period. The widespread use of this term is especially interesting, since it has replaced the Russian term for agricultural producers.

the rehabilitation work, which began in August 2007, was not finished until June 30, 2009. According to WUASP evaluations of Kyzyl Koshchy, "the WUA required constant monitoring from the WUASP side and the community would not make the necessary labor contribution to complete the rehabilitation work." WUASP assessed this as a "very weak" WUA, due to the lack of activity on the part of the population. As one staff member succinctly stated, "We just couldn't get them to mobilize" (A 2010).

Indeed, despite the program's efforts, Kyzyl Koshchy seems to be failing as a WUA. According to my interview project in the winter of 2008, the local leadership and aksakals of Joosh Ayil Okmotu were clearly unsatisfied with the work of the WUA, describing it as "highly ineffective." An aksakal said, "People 'always' violate the water distribution rules and many people do not pay the (ISF) fees….The men fight it out while the women stand by the water."According to the head of the Ayil Okmotu:

> Water is often scarce here and the WUA doesn't serve any useful purpose for the population…The water is not delivered on-time and the WUA works badly. Those who do not pay the ISF or damage the canals and water-gates do not receive any form of punishment….The management of water should be transferred to the Ayil Okmotu.

My preliminary survey research and focus group project points to a serious problem of inequitable water distribution. In my exploratory survey project, 75 residents of Kyzyl Koshchy were surveyed from February 11-13, 2009 using convenience sampling, and among these respondents, 50 individuals said that water was distributed unfairly because wealthy farmers bribe the mirabs and control the water supply. Several quotes from the survey responses illustrate this claim:

> (KYKO 18)The farmers have a lot of money and they have cars. They can shut off the water.
> (KYKO 19) The farmers get water first, and then us.
> (KYKO 32) The farmers bribe the mirabs and receive a lot of water and other people in the village only receive a little water.
> (KYKO 63) We even stand in line day and night for water, and the farmers get water without waiting in line. It is not fair.

Similar to the case of Kyzyl Koshchy WUA, Toichubek Check WUA, another WUASP-supported WUA, presented a series of challenges for WUASP during the rehabilitation phase of the program. Specifically, the community was "inactive" and plagued by an extreme power imbalance between wealthy farmers, including the WUA

Director, and the rest of the community. In fact, WUASP's rehabilitation work was used by the WUA's Director to further his own interests. According to a WUASP staff member:

> The population is not active; the director has too much power. They installed an outlet to water 10 hectares of the Director's land. Winrock should have caught this mistake. They installed 2 outlets and these were only used to water 10 hectares of the director's land and 6 hectares for the neighbor of the Director who is a Director of another WUA. The people told Winrock about this problem but nothing was done. They are frightened of the director. He has too much power and he has relatives who sit on the Council so even if some of the council representatives want to vote him out, it will be impossible (A, 2010).[65]

Therefore, in some cases, WUASP's achievement of efficiency gains among select population groups may have been at the expense of equitable outcomes for irrigation management. WUASP's involvement in areas with significant social or economic inequality may be to the detriment of average water users and serve to exacerbate a community-wide collective action dilemma. Specifically, the program may help solve a coordination problem among the wealthy and/or powerful individuals and families by motivating them to identify or cooperate more effectively with the subset of the community that shares their economic interest. In situations where WUASP acts as a coordinating mechanism for the farmers in "unequal" communities, a strong WUA and organized group of farmers in control of that WUA may lead to the suppression of the average water-users' interests. As has often been a concern of anthropologists and common property resource scholars, WUASP methods could be helping the powerful to better organize and extract resources from the population.

Factor 2: Social mobilization versus rehabilitation

Another important question is how effective a relatively short term project like WUASP can be at literally transforming the "social structure" of a community. Although it is highly unlikely that WUASP could fundamentally alter the social inequalities in these communities, we expect the "social mobilization" and bottom-up methods to result

[65] Toichubek Chek is bordered on either side by two other WUASP WUAs—Myrza Suu to the left and Kashka Suu to the right. I believe that the "neighbor" in this situation is the director of one of these two WUASP WUAs. Not surprisingly, Myrza Suu and Kashka Suu are two other highly challenging WUAs for WUASP.

in positive changes for some groups. More to the point, we certainly would not expect to find examples of what happened in Toichubek Chek WUA, with the particularly disturbing fact that "people told Winrock about this problem but nothing was done."

I believe that there are two related factors which explain the "Toichubek Chek situation." First, the "social mobilization" described in the program theory and to me in the initial interviews with the WUASP staff is not actually what always occurs in the field. Second, the demands from the donor and Winrock headquarters place an extremely large amount of pressure on the Winrock staff in Osh to quickly spend money and show results. To fulfill these demands, the Osh staff naturally puts a premium on the rehabilitation work. Thus, the social mobilization becomes centered on mobilizing the population in order to complete the rehabilitation and not empowering average water users.

The implementation problems seen in my field research are certainly not new. Anthropologists have done an especially thorough job of describing and analyzing the problems inherent in development work. In particular, David Mosse's ethnography of aid policy and practice explores many of the problems that I encountered in the field. In describing the development model, Mosse says that "a multitude of contradictory interests and cross-purposes get translated into a single technically-rational, politically and ambitious project model" (Mosse 2008: 45). However, given the drive for concrete results in a relatively short period of time, despite lofty goals and good intentions, when it comes to the actual implementation, the social and historic setting and larger political/economic/social analysis can be the first considerations to be dropped. For Mosse, "the project became something quite different than what was intended" (Mosse 2008:129). In some respects, this was the case with WUASP, given the overwhelming focus on rehabilitation during the time that I shadowed the staff, and almost complete dismissal of social mobilization during the final year. In this section, I will illustrate and elaborate on this issue with observations from the field.

During my first months conducting interviews with the WUASP staff, the mobilizers and development expert frequently discussed the extensive time that they spent in each WUA during the social mobilization. Yet, as the staff grew comfortable with me and/or annoyed with my insistent questions, their responses changed. In the

second phase of my research, the extensive social mobilization that had originally been directed at a large percent of the "water users" had changed to something more along the lines of 'we talk to the most active farmers and leadership because it would clearly be too time consuming to go throughout the community.' Indeed, when Winrock holds "seminars" and trainings, the attendance seemed to range between twenty to thirty participants for WUAs, which technically have an average membership of 1000. If WUASP is focused on the "most active farmers and leadership" it becomes more difficult to differentiate its mobilization from a top-down approach.

Over the course of my field research, it was not abnormal for a meeting concerning the approval of rehabilitation sites to "fail" in program sites. This meant that the meeting did not have a quorum of representatives for the population, and it had to be rescheduled because a quorum was necessary for approving rehabilitation sites. In cases where a quorum was not reached, the WUASP mobilizers would try and help the WUA leadership gather enough people for the next meeting so that the rehabilitation efforts could move forward. During one of my visits to Batken, I attended a failed meeting in Uch Korgon WUA.[66] What follows represents an excerpt from my field notes[67]:

> *We are in an auditorium in Uch Korgon. The director and council chairman are on the stage along with the Winrock staff. The community is sitting in the seats in front of the stage. I am in the very back of the room. There are five women sitting in the front. A Winrock representative tells me that the overwhelming majority of the population is Tajiks with a few Kyrgyz and Uzbeks. The meeting is being held in Uzbek, and some Winrock staff are speaking in Kyrgyz. Winrock announces that there is not a quorum and therefore they cannot confirm the irrigation sites for rehabilitation. At this point, a Winrock staff member on stage points to me and a Winrock staff member translates for me that he is telling the audience "this young woman came all the way here from the United States to watch how you work. This should be two-sided. We (Winrock) can't do all the work." A woman stands up and begins speaking in (what seems to me) an agitated tone to everyone on stage. A Winrock staff member explains/translates for me that the woman is angry because she and eight other people from her zone have come to this meeting because they really*

[66] Uch Korgon was selected for the Winrock program because the WUA Director was very active in gathering irrigation service fee (ISF) funds and paying off the WUA's debt to the government for water delivery. When Uch Korgon initially petitioned itself for program selection, it was rejected by Winrock due to the large debt. A high level of debt was a criterion that the program used to eliminate WUAs because it was believed to serve as a proxy for an "inactive community." However, after the initial rejection, the director spent a year collecting fees and the WUA was eventually accepted.

[67] I have changed the names to "Winrock staff member."

> *need help. They are at the end of the canal and she says that it is not fair to her zone that all the other zones are not well represented. The Winrock staff member adds that "it is always those at the end of the canal that come to all the meetings and those without problems who do not." Winrock staff then explains to me that this meeting has failed. Uch Korgon is the biggest WUA that Winrock is working with and the leadership could not get a quorum today so they need another week to get all the people organized. Winrock will come back next Tuesday.*

The WUASP coordinator expressed frustration about the effort that the staff exerted in such situations, "We are supposed to be training these organizations to be self sufficient. We should not be going out there and organizing these WUAs for them" (JB 2008). Nevertheless, once a WUA was selected by WUASP and time/effort was invested, it did not seem likely that the WUA would be dropped from the program. As one staff member said:

> Once we start off in a specific WUA, it is better to put the effort in and send the mobilizers in for a day or two to get the people to gather. They go to everyone and force them to come to the general meetings. They have to force them—otherwise they don't get a meeting (A 2010).

Because of the donor and funding requirements, despite a program theory based on the fundamental importance of "social mobilization," I believe that this critical pillar of the program is frequently lost. In contrast to what is regurgitated by the staff in interviews and the narrative found in WUASP policy documents, a WUA's progress and success is ultimately judged on how quickly and efficiently it completes the rehabilitation work; the overwhelming concern is how the rehabilitation is going. The majority of the staff meetings I attended were dedicated to questions regarding the number of sites under rehabilitation, how many were ready to start, and how many had finished. Successful WUAs were those that were getting their rehabilitation work completed without too many problems, whereas the "black sheep" WUAs were those that were not completing their rehabilitation tasks. "Social mobilization" is not a primary goal of the program in and of itself. Instead, it represents a tool to help ensure that the rehabilitation is actually completed. The drive to complete the rehabilitation means that social mobilization gets lost in the project implementation and the "activeness" of the community during rehabilitation becomes conflated with "social mobilization."

By the final year of the project, social mobilization seemed to have completely disappeared from staff discussions. This was because of funding requirements associated with a project extension introduced by USAID. The 2009 project extension was contingent on bringing abandoned land back into cultivation. WUASP was required to bring over 4000 hectares of land back into production and subsequently, utilize 400,000 USD in one year. Thus, the selection of WUAs in 2008 was heavily influenced by how much of their land could be brought back into cultivation by a series of rehabilitation projects. I did not detect any attention to potential equity issues and discussions about who would benefit from the rehabilitation. WUASP was focused on the "numbers" (money spent and hectares being rehabilitated) and how quickly the rehabilitation could be implemented.[68] Consequently, these 2008 WUAs received a *very* different treatment than previous WUAs. Social mobilization was reduced to a 2-3 week period. The entire staff, including Country Coordinator, spent most of the time in the fields trying to push through the rehabilitation efforts.

Conclusion

Regarding the mechanisms that link the program to better outcomes, the research finds that, on average, the treatment populations are more knowledgeable, active and express more positive attitudes about the WUA performance and irrigation management outcomes in their communities. Nevertheless, the program's 'social mobilization' did not build social capital assets and improve communal relations; in some instances, it may have worsened them. Thus, the success of WUASP in motivating broad-based collective action was contingent on program involvement in communities that already had a foundation of 'good' communal relations. My research found evidence of this community dynamic in WUAs with significant Uzbek populations and/or relative equity in land-holdings among a population.

The following chapter explores the theoretical and methodological implications of the dissertation, along with several ideas for future research.

[68] The "redistribution" or government owned land represented the largest tracts of contingent land that had gone out of cultivation. This land was the poorest quality land and it could be rented out by the local government.

Chapter 7

Implications

This research project seeks to determine whether, how and to what extent an external actor can improve collective action outcomes in irrigation water management. My research indicates that the Water Users' Association Support Program (WUASP) did have a positive effect on the lives of thousands of water users in Southern Kyrgyzstan, and in some cases, these effects were significant. Overall, WUASP was able to improve the performance of WUAs and irrigation management outcomes. Additionally, the research finds that the program results were mediated by size, economic and social heterogeneity, as well as ecological scarcity. Furthermore, the empirical analysis suggests a positive program association with the mechanisms of *knowledge*, *participation* and *attitudes*. I claim that these represent some of the critical factors linking WUASP to better outcomes, although a direct test of this linkage is not feasible for my study.

However, the quantitative results do not provide evidence of a positive program effect for women or water users located at the end of a canal. Moreover, the program failed to generate a positive community dynamic over irrigation water management. Thus, I conclude based on my research findings that WUASP was not capable of motivating broad-based collective action in communities with a weak foundation for cooperation. Instead, in cases of significant social inequality, while WUASP may have promoted efficiency gains among the elite or privileged groups, the program either had no effect or may have inadvertently worsened equity issues by increasing the gap between powerful and powerless water users.

This study has important implications for collective action theories, methodological approaches to the study of collective action, and development work on

irrigation water management in Central Asia. First, the dissertation conducted a rigorous quantitative analysis of variables of interest for collective action research, and the empirical results both confirm and refute common property theories about the effects of these variables. Second my methodological approach to the study in natural resource management highlights the essential need for both aggregate and individual level data. Specifically, it is my contention that researchers should exercise caution when using aggregate measures as proxies for "collective action" without an understanding of the micro-level processes at work. Third, regarding the practical implications for development projects in the post-Soviet context, the positive WUASP results provide evidence that a community-driven development approach will achieve more desirable outcomes. However, the evaluation suggests that despite the advancements, WUASP failed to address some significant criticisms of the blue-print approach, such as eliminating the potential for elite capture and providing benefits to a community's most vulnerable groups.

Practical/Policy Implications

There are multiple policy implications that emerge from my research. I have many suggestions regarding how to help Water Users' Associations (WUAs) achieve their fundamental mandate of providing adequate, timely and equitable water supplies to *all* water users within a command area.

Whereas most WUAs have been rapidly set-up with little attention to social mobilization and institutional development, WUASP represents a correction strategy for this blue-print approach to establishing and supporting WUAs. WUASP's program theory emphasizes the importance of education and institutional capacity for promoting better collective action outcomes. The program's bottom-up approach, which supports the mobilization of human capital within local communities through training and educational programs, is clearly an improvement over the one-size fits all approach to development. Nevertheless, the results of my dissertation also highlight concerns that development projects can privilege efficiency gains over equity and open the door for elite capture.

However, before dismissing community-driven development, it is important to note my field observations regarding discrepancies between the program theory and implementation in the field. While WUAs in the program received a much more extensive bottom-up development approach than that received by the overwhelming majority of WUAs in Kyrgyzstan, the pronounced 'social mobilization' was still often directed at the most active farmers and leadership of the WUA and not the general population of water users. This means that we cannot discount the benefits of a more genuine bottom-up approach in cases where it is actually implemented according to design. Although I believe that the structural obstacles in many Kyrgyz communities require a much longer and more intense program than even an ideal version of WUASP could provide, there is no empirical evidence to substantiate my claims. Therefore, the question of whether comprehensive bottom-up development methods could achieve the predicted results for community-driven development remains open.

Nevertheless, there is little reason to expect that water users will behave cooperatively in cases where WUAs are defined by extreme structural inequalities that restrict the fair distribution of water to a large number of users. There needs to be a greater impetus to change than a one or two year development program can provide; the solution to deeply embedded social inequalities extends well beyond a relatively small-scale and short term project like WUASP. Even if bottom-up methods are implemented according to design and this results in a well-informed majority of water users, the influence of 'powerful actors' may not be easily minimized. Although the population may be informed of their rights to elect new leadership for the WUA, fear of powerful actors could reduce their desire or capacity to take forceful direct action against individuals who control or have close connections with the WUA. As my research suggests, wealthy farmers have the financial means to control the flow of water by opening and closing water-gates, regardless of the consent of the WUA. Compounding this problem is an absence of a strong external independent actor or legal system that can support a group or individual's claims for greater justice and equality in water distribution. As anthropologist David Mosse argues, "In societies with power asymmetries, there is no guarantee that increased information will ensure that rules will

be put into force. Even when individuals are cognizant of rule violations, their social position may restrict them from pursuing sanctions for defectors" (Mosse, 2008: 89).

Development projects can improve the performance of WUAs, as my impact assessment shows. However, a greater impact can be achieved if two changes are made. First, projects should undertake an honest assessment of what they are capable of completing, given significant historical and structural problems in treatment sites, limited resources, and a limited time-frame. To avoid doing more harm than good, this may ultimately mean that some development work should remain focused in areas where conditions are most favorable, thereby eliminating some communities in need of help.

Towards the end of my field research, a staff member involved in social mobilization told me that it was impossible to mobilize a large portion of the water users in a community. An information campaign led by the mobilizers was seen as too time-consuming and not an appropriate use of resources. Although it is clearly not feasible for a three man crew to hold conversations with all water users in the project, I believe that large-scale information campaigns can be completed in developing countries in an affordable manner. In particular, the cost of my survey project, which involved a 30-45 minute survey in 120 to 230 households for six WUAs, was approximately 700.00 USD per WUA. Thus, a survey firm could be hired to affordable rates to gather and/or disseminate information, and the information collected from an exploratory survey project could help a development project like WUASP determine where its efforts would yield the greatest benefits to the population. For example, the results of my large N and exploratory survey project provided abundant evidence of significant problems in certain communities. In selecting treatment sites, a project should focus on WUAs where there is evidence of an appropriate community dynamic concerning irrigation management to avoid involvement in cases where the project can do more harm than good, such as Toichebek Chek and Kyzyl Koshchy.

Second, international agencies should implement their projects according to the program design and/or in the best possible manner. This is especially problematic given donor requirements and the lack of human capital/qualified staff in developing countries. The major impetus for change with this issue must come from a re-evaluation of the incentive structure created by donors. As the country director for Mercy Corps in

Kyrgyzstan stated, **"**There are implementation problems; time is always a factor with aid. The donor system has short time horizons but development happens slowly. Bureaucracy is a huge problem. You have to get the money out the door, and there is no time to really implement the project" (Mercy Corps, 2008). The problems that arise from this requirement that money be spent immediately are well-known and openly discussed in the development community, but there seems to be no progress with the policy.

In addition to the time constraints, there was a strict set of control mechanisms in place that dictated how WUASP was to utilize the funds. The purpose of these measures was to minimize corruption and encourage accountability; however, in Kyrgyzstan, they created large obstacles to implementation by restricting flexibility of action and forcing a frenzied approach to the project. More importantly, WUASP's objectives and questions shifted from 'how can we make the biggest impact in community X' to 'what is the quickest and most efficient way for us to spend these resources in community X.'

Moreover, the problems associated with funding exacerbated by the types of performance indicators required by donors. For almost two decades, the aid management regime has demanded concrete data about the *impact* of aid projects on fundamental economic development indicators. However, at least for development projects associated with WUAs throughout Central Asia, I have found no evidence of sophisticated program evaluations capable of meeting these requests for reliable quantitative evidence of program impacts. Implementing agencies, such as WUASP, do not have the capacity or resources to accurately collect data and conduct impact assessments, and USAID's constant demands for information concerning WUASP's economic impact shift the staff's focus away from WUASP's core competencies. Specifically, USAID required performance reports without any direction/training for the WUASP staff in Osh or concern for the validity and usefulness of the data that was actually collected. Consequently, WUASP mobilizers were required to collect "economic data" from water users for the quarterly reports, although this data was worthless from a program evaluation standpoint, and, from my perspective, represented a very inefficient use of staff time and skills. The demand for rigorous program indicators could not and should not be fulfilled by WUASP. The program staff did not have the skills or resources to

conduct a rigorous program evaluation and given general concerns of biased in-house evaluations, I believe that evaluation by an outside party is the most desirable alternative.

Thus, these two requirements – the rapid dispersal of aid funds and proof from the implementing agencies of their economic impact – incentivized WUASP to focus on infrastructure to the detriment of "genuine" social mobilization. A good example is the program extension for 2009 that involved the selection of WUAs on the basis of the amount of land that could be brought back into cultivation. According to the terms of the project extension, WUASP had to spend approximately 400,000 USD in one year for these WUAs. Thus, for the final project year, the staff directed its energy towards emergency rehabilitation to the detriment of social mobilization objectives. Given the close of the project following the completion of this rehabilitation work, I doubt the feasibility of assessing whether the land was actually brought back into cultivation or which segments of the community actually benefited from the rehabilitation.

In particular, the case of WUASP-support WUA Omursuu provides a good example of how these requirements can both lead to short-sighted and unsustainable projects, as well as restrict a community's ability to maximize the effectiveness of aid. WUA Omursuu is located in a remote part of Leilek rayon in Batken province. According to a staff member, despite the crucial help that WUASP provided to Omursuu, its work is only a temporary fix to a much greater infrastructure problem. In particular, Omursuu is located in a glacial outwash; this means that people are farming in an active flood plain with constant floods and rapidly deteriorating dikes. The WUA has 750 hectares of land that it continues to lose due to the environmental situation and condition of the dikes. Although WUASP dedicated significant time and resources to WUA Omursuu, the project simply delayed a significant or complete lose of land for farming that could occur within the next decade, given the absence of major infrastructural change.

In addition, WUASP's funding protocol restricted Omursuu's ability to maximize the effectiveness of aid funds for several rehabilitation projects. Specifically, Omursuu had gathered enough funds from the community to buy a pipeline and install it themselves. They also decided to use WUASP funding to help construct a wall that would save approximately 30 hectares of land. Although the community's initiative in gathering funds and constructing the wall seemed to be a positive indicator of collective

action from my perspective, the WUASP staff was incredibly frustrated with the decision because it did not coincide with USAID funding regulations.

Furthermore, during the course of my field research, there was evidence of ubiquitous human capital and staff problems that exacerbated and created considerable obstacles for the project implementation. I encountered many different forms of this problem during my time in the field. I provide one example here to illustrate the problem. In the fifth and final year of the project, the two engineers who had been there during the third and fourth years of the project were replaced by engineers who had worked for the project in the earlier years.[69] The circumstances surrounding the dismissal were relatively unclear for me, and I did not push for more information. While in one case there were concerns about competency, in the other case there may have been a problem with corruption. The impression garnered from several staff members was that these two individuals should have been fired much earlier and that their dismissal improved the overall staff chemistry. More importantly, there were conflicts between these two individuals and the leadership of several WUAs. In certain cases, poor rehabilitation work and incorrect use of construction materials was initially blamed on the WUA, however, it later became apparent that it was actually the responsibility of these engineers. One staff member voiced the opinion that the program could have had a "bigger impact" if these two individuals were replaced earlier. Given a staff of ten with highly specialized staff roles, there are substantial consequences when any two individuals do not fulfill their duties.

Staffing is the responsibility of the implementing agency. In Southern Kyrgyzstan, WUASP was primarily staffed by Kyrgyz citizens; however, the position of Country Director was held by expatriates during a majority of the project. Although WUASP had staff members who performed exceptionally throughout the course of the project, the absence of a large pool of qualified individuals in Kyrgyzstan for certain positions and the short time-frame of WUASP, made it more difficult to find good employees for some positions and dismiss the bad ones. Using American or "Western" expatriates to fill the role of Country Director is very costly. In my opinion, the largest

[69] The circumstances surrounding the initial dismissal of one of these individuals were also quite sketchy, and therefore, I did not fully understand why they were re-hired. Perhaps it was due to project time constraints, the familiarity of the individual with the project and lack of other qualified individuals.

drawback of a foreign director revolves around language and trust issues in the rural communities. Even with very good translators, valuable information is lost or cannot be obtained because of the way a foreigner is perceived by the population *and* local staff members.[70]

Finally, the two primary objectives associated with the establishment of WUAs and introduction of irrigation service fees (ISF) are cost-recovery for the irrigation system and efficient water usage and distribution. Although successful WUAs may promote equitable irrigation management and cost-recovery for the system, unless the national level policy changes, WUAs and irrigation service fees will not be sufficient for ensuring efficient irrigation management. Successful collective action at the local level does not necessarily translate into efficient outcomes and vice versa. Even if WUAs are institutionally developed with high levels of cooperation, the government's continued supply of cheap water to WUAs will perpetuate wasteful water distribution and highly inefficient management.

Empirical results of interest for common property resource scholarship

The results of the quantitative analysis provide important empirical support for common property resource theories about the influence of collective action variables of interest. To begin, theoretically, both relative and absolute conceptions of scarcity have an important impact on collective action outcomes. My quantitative analysis offers evidence to support the claim that there is a quadratic or U shaped relationship between absolute ecological scarcity and collective action outcomes. Furthermore, my qualitative findings support claims concerning the importance of relative scarcity for cooperative outcomes.

I maintain that in WUAs with considerable social inequality, the effect of scarcity, combined with feelings of injustice over who receives the scarce water resources, drives uncooperative behavior. An important point is that the perception of *why* the water is scarce is what ultimately matters for determining cooperation in the face

[70] Although the last Country Director was a citizen of Uzbekistan, the language and cost concerns did not apply.

of significant scarcity. If water users believe that scarcity in their community is due to wealthy farmers who control the flow of water at the beginning of the canal, then it becomes rational for them to secure access to scarce water resources through uncooperative means. Conversely, if they believe water is scarce due to the climate, the incentive and justification for deviant behavior is reduced.

The empirical results provide somewhat mixed support for the hypothesis that economic heterogeneity (in the form of economic inequality) is detrimental to cooperation. I find better outcomes in treatment sites for financial contributions and institutional development in more economically homogeneous areas. However WUASP-support WUAs with greater heterogeneity have better outcomes for canal infrastructure. Indeed, my theory concerning the effect of inequality on rehabilitation predicts substantially better outcomes in homogeneous sites because WUASP's participatory rehabilitation requires large scale community involvement in the process. In situations where there is a poor community dynamic due to inequality, it will be difficult to motivate the community to contribute labor to the rehabilitation and to care for the canal. Hence, in areas where the community will not organize for voluntary labor, wealthy farmers may be able to subsidize the costs of rehabilitation by hiring temporary labor.

Moreover, there is also not a single, straightforward result concerning the relationship between size and collective action outcomes; the influence of size depends on the outcome under investigation. While there is a U shaped relationship between size and institutional development, as well as the proportion of a WUA's budget dedicated to rehabilitation and staff salaries, WUASP-supported WUAs with *larger* populations are more likely to pay for water on-time. Furthermore, WUASP-supported WUAs with a *smaller* land size have better overall water delivery payments, whereas those with a larger land size have less resource/technical/human capital problems and greater improvements in canal infrastructure.

Finally, my research finds evidence of positive program effects in ethnically heterogeneous communities. While some researchers have posited that ethnic and socio-cultural heterogeneity reduces cooperative capacity and social cohesion (Bardhan and Dayton-Johnson 2002; Ruttan 2006, 2008), my research suggests otherwise and supports the findings of Poteete and Ostrom (2004). The mechanism results for *attitudes* and

social capital show positive results for Kyrgyz in heterogeneous WUAs. Furthermore, I find a better outcome for an important financial indicator among heterogeneous WUAs in comparison to treatment WUAs with ethnically homogeneous Kyrgyz populations. Nevertheless, this argument in favor of a positive social heterogeneity effect is limited to the comparison between ethnically homogenous Kyrgyz WUAs versus heterogeneous WUAs. If the comparison or inferences are between heterogeneous WUAs and homogeneous Uzbek communities, then I expect better results for homogeneous Uzbek communities due to the "skill set" that they bring the program and irrigation management in general in their communities. Thus it is not the heterogeneity per se that motivates better outcomes but the trickle down benefits from the Uzbeks to the Kyrgyz. This is supported by the panel data analysis; however, the mechanisms could only be tested in heterogeneous versus homogeneous Kyrgyz communities.

Methodological Implications

This work calls for a mixed methods approach to research on collective action concerning common property resources. My dissertation highlights the challenges inherent in using aggregate data to measure concepts such as cooperation and collective action. Given the inherent complexity of collective action research, I believe that rigorous research on cooperation regarding common property resources requires the integration of ethnographic and quantitative research methods.

Consequently, in an attempt to bridge the gap between econometric and anthropological approaches, I employed a quantitative approach that was complemented and supported by qualitative research methods. I used econometric analysis of panel data, a large N survey project and qualitative data collected from nine months of field research which included case studies, focus groups and field notes from participant observation.

Each data source proved to be critical for producing more accurate answers to the research question. In particular, without the panel data, there would have been no way to conduct a rigorous test of the program effect, and without the survey data, it would not be possible to explore arguments about the program effect on behavioral mechanisms. The qualitative data provided the foundation and context for interpreting and explaining the

quantitative results. For example, the panel data results of the heterogeneous treatment effects for the WUASP/equality interaction might have been interpreted to mean a more general positive program effect on cooperation or collective action, whereas the survey results and qualitative findings indicate that the program benefits were limited and may have improved the performance of WUAs in some areas to the detriment of community-wide cooperation.

Future Research

To improve upon the current research, my goal is to acquire the 2010 Census results for Kyrgyzstan in order to obtain better demographic data on the ethnic composition of communities. I also plan to apply propensity score and matching methods to the panel data analysis for a different approach to investigating overall and heterogeneous treatment effects.

For my future research objectives, I intend to conduct an analysis of WUAs located in both Southern and Northern Kyrgyzstan. The focus of the research project will be a program evaluation of the World Bank heavy infrastructure project and a more in-depth examination of the influence time-invariant covariates such as WUA size, water scarcity, and ethnicity. In addition to using fixed and random effects regression methods for the analysis of the country-wide data set, I plan to apply a structural equation modeling approach to the data analysis. Structural equation modeling (SEM) is a more flexible or general approach than regression and allows variables to function as both independent and dependent variables. This SEM approach may help me to determine a more accurate relationship between the variables of interest. I was not able to use an SEM approach for data analysis in my dissertation because the evaluation only utilized southern data which did not provide a large enough data-set to apply the SEM approach.

Appendix 1.A. Average Water Users' Association Support Program (WUASP) effects

VARIABLES	Tariff	Tariff	Water delivery	Water delivery	Water delivery	Water delivery	Water delivery
2001.year	-0.234*	-0.205					
	(0.135)	(0.134)					
2002.year	0.0491	0.0886					
	(0.135)	(0.131)					
2003.year	0.315**	0.337***					
	(0.131)	(0.125)					
2004.year	0.339*	0.433***					
	(0.188)	(0.160)					
2005.year	0.665***	0.752***					
	(0.200)	(0.184)					
2006.year	1.402***	1.475***					
	(0.195)	(0.181)					
2007.year	2.097***	2.149***					
	(0.190)	(0.179)					
2008.year	2.522***	2.624***					
	(0.228)	(0.216)					
2009.year	2.639***	2.685***					
	(0.232)	(0.224)					
Post WUASP	0.192	0.282	-0.0953	-0.0590	-0.0532	-0.119*	-0.0675
	(0.448)	(0.400)	(0.0612)	(0.0942)	(0.0739)	(0.0674)	(0.0706)
World Bank	0.976**	0.940**	0.0684	0.0684	0.0606	0.0684	0.0607
	(0.403)	(0.403)	(0.104)	(0.104)	(0.0911)	(0.101)	(0.0894)
Scarcity					0.705***		0.703***
					(0.261)		(0.253)
Dir. Education						-0.138	-0.0814
						(0.170)	(0.117)
Constant	3.346***	3.273***	0.858***	0.859***	0.276	0.926***	0.318*
	(0.138)	(0.124)	(0.0220)	(0.0238)	(0.215)	(0.0869)	(0.174)
Observations	1,444	1,376	826	780	822	823	819
R-squared	0.349	0.379	0.001	0.000	0.057	0.003	0.058
WUA	180	171	147	139	145	146	144

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	On-time payment	On-time payment	On-time payment	On-time payment	On-time payment
2005.year	-0.0679**	-0.0685**	-0.0680**	-0.0686**	-0.0687**
	(0.0272)	(0.0272)	(0.0272)	(0.0272)	(0.0273)
2006.year	-0.0656***	-0.0665***	-0.0656***	-0.0648***	-0.0648***
	(0.0239)	(0.0251)	(0.0240)	(0.0237)	(0.0238)
2007.year	0.0645**	0.0672**	0.0617**	0.0654**	0.0625**
	(0.0271)	(0.0282)	(0.0272)	(0.0269)	(0.0270)
2008.year	0.0601*	0.0611*	0.0601*	0.0615**	0.0615**
	(0.0309)	(0.0316)	(0.0307)	(0.0308)	(0.0306)
2009.year	0.0985***	0.0986***	0.0987***	0.101***	0.101***
	(0.0293)	(0.0298)	(0.0291)	(0.0291)	(0.0288)
Post WUASP	-0.0478	-0.0465	-0.0481	-0.0440	-0.0443
	(0.0681)	(0.0886)	(0.0685)	(0.0679)	(0.0683)
World Bank	-0.0907*	-0.0913*	-0.0901*	-0.0918*	-0.0912*
	(0.0523)	(0.0525)	(0.0522)	(0.0531)	(0.0530)
Scarcity			-0.00643		-0.00592
			(0.0330)		(0.0337)
Dir. Education				0.0301	0.0296
				(0.0408)	(0.0412)
Constant	0.471***	0.470***	0.476***	0.456***	0.462***
	(0.0195)	(0.0203)	(0.0339)	(0.0267)	(0.0414)
Observations	832	785	831	829	828
R-squared	0.090	0.095	0.090	0.092	0.091
WUA	145	137	145	144	144

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Total prop payment	Total prop payment	Total prop payment	Total prop payment	Total prop payment
2005.year	-0.0741**	-0.0670*	-0.0824**	-0.0745**	-0.0822**
	(0.0351)	(0.0369)	(0.0368)	(0.0356)	(0.0372)
2006.year	-0.0610**	-0.0584*	-0.0783**	-0.0637**	-0.0798**
	(0.0307)	(0.0324)	(0.0316)	(0.0311)	(0.0320)
2007.year	-0.0307	-0.0344	-0.0610**	-0.0317	-0.0615**
	(0.0295)	(0.0311)	(0.0286)	(0.0299)	(0.0290)
2008.year	-0.0391	-0.0399	-0.0557*	-0.0411	-0.0561*
	(0.0312)	(0.0324)	(0.0311)	(0.0315)	(0.0315)
2009.year	-0.0531*	-0.0501	-0.0717**	-0.0541*	-0.0721**
	(0.0305)	(0.0314)	(0.0296)	(0.0302)	(0.0298)
Post WUASP	-0.0308	-0.0278	-0.0142	-0.0353	-0.0135
	(0.0259)	(0.0365)	(0.0271)	(0.0271)	(0.0267)
World Bank	-0.0210	-0.0205	-0.0197	-0.0197	-0.0191
	(0.0549)	(0.0551)	(0.0549)	(0.0551)	(0.0549)
Scarcity			0.173***		0.174***
			(0.0502)		(0.0495)
Dir. Education				-0.0267	0.00202
				(0.0390)	(0.0331)
Constant	0.787***	0.782***	0.655***	0.800***	0.653***
	(0.0224)	(0.0232)	(0.0446)	(0.0304)	(0.0427)
Observations	958	906	831	951	828
R-squared	0.016	0.013	0.062	0.017	0.062
WUA	179	170	145	177	144

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	O & M/rehab budget	O & M/rehab budget	O & M/rehab budget	O & M/rehab budget	O & M/rehab budget
2005.year	-0.0178	-0.0263	-0.0212	-0.0172	-0.0207
	(0.0193)	(0.0200)	(0.0207)	(0.0194)	(0.0209)
2006.year	0.0229	0.0185	0.0206	0.0233	0.0212
	(0.0202)	(0.0213)	(0.0217)	(0.0204)	(0.0219)
2007.year	0.0551***	0.0463**	0.0542**	0.0555***	0.0546**
	(0.0201)	(0.0212)	(0.0216)	(0.0202)	(0.0216)
2008.year	0.107***	0.102***	0.116***	0.108***	0.117***
	(0.0205)	(0.0214)	(0.0220)	(0.0206)	(0.0221)
2009.year	0.119***	0.112***	0.129***	0.119***	0.129***
	(0.0199)	(0.0205)	(0.0211)	(0.0200)	(0.0213)
Post WUASP	0.00920	0.0184	0.0117	0.00849	0.0108
	(0.0209)	(0.0267)	(0.0218)	(0.0209)	(0.0219)
World Bank	0.00985	0.0141	0.0148	0.00951	0.0146
	(0.0258)	(0.0262)	(0.0263)	(0.0258)	(0.0264)
Scarcity			0.00956		0.00915
			(0.0215)		(0.0217)
Dir. Education				-0.00217	-0.00474
				(0.0144)	(0.0162)
Constant	0.573***	0.579***	0.509***	0.573***	0.512***
	(0.0138)	(0.0143)	(0.0237)	(0.0150)	(0.0253)
Observations	955	903	828	948	825
R-squared	0.216	0.215	0.239	0.216	0.239
WUA	179	170	145	177	144

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	O & M/rehab payment	O & M/rehab payment	O & M/rehab payment	O & M/rehab payment	O & M/rehab payment
2005.year	-0.197***	-0.184***	-0.212***	-0.199***	-0.213***
	(0.0322)	(0.0337)	(0.0340)	(0.0325)	(0.0343)
2006.year	-0.154***	-0.148***	-0.170***	-0.157***	-0.172***
	(0.0348)	(0.0373)	(0.0360)	(0.0351)	(0.0364)
2007.year	-0.135***	-0.130***	-0.163***	-0.136***	-0.164***
	(0.0360)	(0.0387)	(0.0361)	(0.0363)	(0.0363)
2008.year	-0.194***	-0.191***	-0.215***	-0.196***	-0.216***
	(0.0372)	(0.0389)	(0.0384)	(0.0375)	(0.0387)
2009.year	-0.188***	-0.179***	-0.204***	-0.188***	-0.205***
	(0.0367)	(0.0383)	(0.0384)	(0.0370)	(0.0388)
Post WUASP	0.0477*	0.0381	0.0592**	0.0464*	0.0606**
	(0.0250)	(0.0350)	(0.0267)	(0.0252)	(0.0268)
World Bank	-0.000574	-0.00385	0.00811	0.000682	0.00913
	(0.0704)	(0.0714)	(0.0755)	(0.0705)	(0.0755)
Scarcity			0.0124		0.0133
			(0.0371)		(0.0373)
Director educ.				-0.00781	0.00622
				(0.0265)	(0.0281)
Constant	0.852***	0.840***	0.844***	0.856***	0.841***
	(0.0260)	(0.0273)	(0.0365)	(0.0306)	(0.0408)
Observations	955	903	828	948	825
R-squared	0.095	0.087	0.116	0.096	0.117
WUAs	179	170	145	177	144

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Canal Infrastructure	Canal Infrastructure	Canal Infrastructure	Canal Infrastructure	Canal Infrastructure
2005.year	-0.00226***	-0.00258***	-0.00279***	-0.00229***	-0.00272**
	(0.000852)	(0.000938)	(0.00106)	(0.000869)	(0.00108)
2006.year	-0.00364***	-0.00420***	-0.00430***	-0.00368***	-0.00421***
	(0.00130)	(0.00144)	(0.00151)	(0.00133)	(0.00154)
2007.year	-0.0293***	-0.0317***	-0.0352***	-0.0296***	-0.0353***
	(0.00507)	(0.00527)	(0.00624)	(0.00515)	(0.00632)
2008.year	-0.00890*	-0.00977*	-0.0129*	-0.00902*	-0.0128*
	(0.00525)	(0.00530)	(0.00664)	(0.00540)	(0.00676)
2009.year	-0.00404	-0.00471	-0.00778	-0.00400	-0.00747
	(0.00519)	(0.00523)	(0.00642)	(0.00537)	(0.00661)
Post WUASP	0.0151*	0.0193*	0.0171**	0.0153*	0.0175**
	(0.00901)	(0.0106)	(0.00709)	(0.00884)	(0.00709)
World Bank	0.0318***	0.0327***	0.0301**	0.0319***	0.0300**
	(0.0120)	(0.0120)	(0.0122)	(0.0120)	(0.0122)
Scarcity			-0.00131		-0.00113
			(0.00550)		(0.00556)
Dir. Education				0.000852	0.00295
				(0.00558)	(0.00621)
Constant	0.660***	0.661***	0.663***	0.660***	0.662***
	(0.00274)	(0.00284)	(0.00636)	(0.00396)	(0.00782)
Observations	1,086	1,032	867	1,073	862
R-squared	0.073	0.081	0.084	0.074	0.085
WUA	181	172	145	179	144

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, *
p<0.1

VARIABLES	Institutional capacity	Institutional Capacity	Institutional capacity	Institutional capacity	Institutional capacity
2005.year	0.384***	0.420***	0.297***	0.380***	0.288***
	(0.0735)	(0.0761)	(0.0780)	(0.0753)	(0.0789)
2006.year	1.014***	1.044***	0.927***	1.003***	0.921***
	(0.107)	(0.110)	(0.122)	(0.108)	(0.122)
2007.year	1.052***	1.076***	0.956***	1.035***	0.944***
	(0.109)	(0.113)	(0.125)	(0.110)	(0.125)
2008.year	1.196***	1.233***	1.066***	1.173***	1.046***
	(0.113)	(0.115)	(0.130)	(0.112)	(0.129)
2009.year	1.260***	1.294***	1.120***	1.231***	1.092***
	(0.115)	(0.117)	(0.133)	(0.115)	(0.132)
Post WUASP	0.434*	0.706**	0.519**	0.408*	0.482*
	(0.225)	(0.316)	(0.240)	(0.231)	(0.247)
World Bank	-0.517***	-0.539***	-0.526***	-0.501***	-0.513***
	(0.188)	(0.190)	(0.182)	(0.190)	(0.185)
Scarcity			-0.127		-0.151
			(0.0986)		(0.0979)
Dir. Education				-0.258	-0.318*
				(0.163)	(0.174)
Constant	3.306***	3.302***	3.830***	3.448***	4.024***
	(0.0756)	(0.0771)	(0.111)	(0.108)	(0.144)
Observations	1,085	1,031	867	1,073	862
R-squared	0.354	0.371	0.329	0.357	0.337
WUA	181	172	145	179	144

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Development problems	Development problems	Development problems	Development problems	Development problems
2005.year	0.00231	0.00145	0.000829	0.00297	0.000946
	(0.0458)	(0.0476)	(0.0518)	(0.0462)	(0.0521)
2006.year	-0.0356	-0.0369	-0.0175	-0.0328	-0.0172
	(0.0470)	(0.0490)	(0.0531)	(0.0474)	(0.0535)
2007.year	-0.0883*	-0.0861*	-0.101*	-0.0757	-0.0909*
	(0.0480)	(0.0502)	(0.0547)	(0.0484)	(0.0551)
2008.year	-0.0837*	-0.0824	-0.0850	-0.0704	-0.0821
	(0.0491)	(0.0502)	(0.0561)	(0.0496)	(0.0566)
2009.year	-0.0757	-0.0739	-0.0800	-0.0619	-0.0707
	(0.0491)	(0.0502)	(0.0561)	(0.0496)	(0.0568)
Post WUASP	-0.0526	-0.0230	-0.0256	-0.0631	-0.0323
	(0.0770)	(0.0988)	(0.0811)	(0.0774)	(0.0814)
World Bank	-0.0161	-0.0170	0.00745	-0.0248	0.00331
	(0.124)	(0.124)	(0.129)	(0.124)	(0.129)
Scarcity			0.0234		0.0181
			(0.0692)		(0.0694)
Dir. Education				-0.00199	-0.00838
				(0.0667)	(0.0755)
Constant					
Observations	1,061	1,007	867	1,049	862
R-squared					
WUA	177	168	145	175	144

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Activeness	Activeness	Activeness	Activeness	Activeness
2005.year	0.0128	0.0130	0.00955	0.0148	0.0118
	(0.0636)	(0.0664)	(0.0707)	(0.0643)	(0.0712)
2006.year	0.0679	0.0760	0.0288	0.0727	0.0325
	(0.0638)	(0.0668)	(0.0717)	(0.0645)	(0.0724)
2007.year	0.0284	0.0393	-0.0254	0.0405	-0.0136
	(0.0650)	(0.0683)	(0.0734)	(0.0658)	(0.0742)
2008.year	-0.0121	-0.00235	-0.0638	0.00191	-0.0563
	(0.0674)	(0.0690)	(0.0765)	(0.0684)	(0.0774)
2009.year	-0.00218	0.00152	-0.0618	0.0124	-0.0490
	(0.0673)	(0.0690)	(0.0766)	(0.0684)	(0.0779)
Post WUASP	-0.191*	-0.168	-0.105	-0.190*	-0.107
	(0.106)	(0.138)	(0.112)	(0.107)	(0.112)
World Bank	-0.194	-0.201	-0.142	-0.202	-0.148
	(0.188)	(0.188)	(0.197)	(0.188)	(0.197)
Scarcity			0.0207		0.0187
			(0.0902)		(0.0906)
Dir. Education				0.0771	0.0417
				(0.0899)	(0.101)
Constant					
Observations	1,061	1,007	867	1,049	862
R-squared					
WUA	177	168	145	175	144

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix 1.B. Heterogeneous WUASP effects – WUA population size

VARIABLES	Tariff	Water delivery	Water delivery	On-time payment	On-time payment
2001.year	-0.216				
	(0.222)				
2002.year	0.139				
	(0.247)				
2003.year	0.380				
	(0.239)				
2004.year	0.259				
	(0.352)				
2005.year	0.587*			-0.0831	-0.0830
	(0.344)			(0.0524)	(0.0525)
2006.year	1.271***			-0.0998**	-0.0998**
	(0.352)			(0.0418)	(0.0416)
2007.year	1.641***			0.0674	0.0611
	(0.378)			(0.0485)	(0.0488)
2008.year	1.677***			0.0605	0.0604
	(0.423)			(0.0555)	(0.0555)
2009.year	1.999***			0.0587	0.0594
	(0.451)			(0.0523)	(0.0525)
WUASP	0.540	-0.0427	0.0578	-0.154*	-0.156*
	(0.704)	(0.0772)	(0.111)	(0.0796)	(0.0806)
Het pop size	-2.93e-05	-1.08e-05	-1.70e-05	1.57e-05***	1.58e-05***
	(5.04e-05)	(1.32e-05)	(1.54e-05)	(5.52e-06)	(5.55e-06)
World Bank	0.862**	0.144	0.161	-0.0946*	-0.0943*
	(0.361)	(0.126)	(0.115)	(0.0529)	(0.0528)
2001.year#c.popcur1	-2.22e-06				
	(1.96e-05)				
2002.year#c.popcur1	-1.03e-05				
	(1.73e-05)				
2003.year#c.popcur1	-9.09e-06				
	(1.53e-05)				
2004.year#c.popcur1	2.74e-06				
	(1.87e-05)				
2005.year#c.popcur1	2.23e-06	-1.22e-05**	-1.16e-05*	1.54e-06	1.53e-06
	(1.92e-05)	(5.86e-06)	(5.91e-06)	(3.32e-06)	(3.33e-06)
2006.year#c.popcur1	7.82e-06	-1.39e-05**	-1.55e-05***	3.36e-06	3.37e-06
	(1.88e-05)	(5.34e-06)	(5.57e-06)	(3.06e-06)	(3.06e-06)
2007.year#c.popcur1	4.22e-05*	-2.01e-05	-2.32e-05*	-4.00e-07	-5.84e-08
	(2.30e-05)	(1.30e-05)	(1.28e-05)	(3.59e-06)	(3.60e-06)
2008.year#c.popcur1	8.21e-05**	8.50e-06	6.96e-06	0	2.43e-08

	(3.44e-05)	(7.74e-06)	(7.70e-06)	(4.34e-06)	(4.34e-06)
2009.year#c.popcur1	6.05e-05*	-6.49e-06	-8.96e-06*	3.72e-06	3.70e-06
	(3.64e-05)	(5.23e-06)	(5.39e-06)	(4.14e-06)	(4.16e-06)
Scarcity			0.733***		-0.00902
			(0.258)		(0.0334)
Constant	3.401***	0.926***	0.329	0.471***	0.478***
	(0.161)	(0.0473)	(0.213)	(0.0196)	(0.0344)
Observations	1,444	826	822	832	831
R-squared	0.363	0.037	0.096	0.102	0.102
WUAs	180	147	145	145	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Total prop payment	Total prop payment	O & M/rehab budget	O & M/rehab budget	O & M/rehab payment
2005.year	-0.114**	-0.140**	0.0166	-0.294***	-0.333***
	(0.0572)	(0.0601)	(0.0335)	(0.0584)	(0.0628)
2006.year	-0.0496	-0.0778	0.0630*	-0.216***	-0.255***
	(0.0515)	(0.0524)	(0.0337)	(0.0605)	(0.0622)
2007.year	-0.0171	-0.0563	0.0871**	-0.178***	-0.231***
	(0.0510)	(0.0479)	(0.0349)	(0.0663)	(0.0666)
2008.year	-0.0681	-0.0981**	0.140***	-0.256***	-0.302***
	(0.0522)	(0.0496)	(0.0364)	(0.0661)	(0.0695)
2009.year	-0.0374	-0.0608	0.146***	-0.233***	-0.263***
	(0.0548)	(0.0509)	(0.0362)	(0.0692)	(0.0742)
WUASP	-0.0287	0.00325	-0.00910	0.0382	0.0596
	(0.0345)	(0.0351)	(0.0315)	(0.0406)	(0.0441)
Het pop size	-3.33e-07	-2.27e-06	2.56e-06	2.28e-06	1.45e-06
	(2.76e-06)	(2.89e-06)	(2.60e-06)	(3.80e-06)	(3.89e-06)
World Bank	-0.0175	-0.0170	0.0188	-0.00582	0.00102
	(0.0569)	(0.0578)	(0.0270)	(0.0715)	(0.0768)
2005.year#c.popcur1	3.78e-06	5.21e-06	-3.42e-06	9.10e-06*	1.10e-05**
	(5.01e-06)	(5.16e-06)	(2.34e-06)	(4.95e-06)	(5.18e-06)
2006.year#c.popcur1	-1.19e-06	-1.67e-07	-3.85e-06*	5.86e-06	7.67e-06
	(4.50e-06)	(4.72e-06)	(2.30e-06)	(5.38e-06)	(5.52e-06)
2007.year#c.popcur1	-1.44e-06	-4.87e-07	-3.00e-06	3.85e-06	6.02e-06
	(4.62e-06)	(4.65e-06)	(2.40e-06)	(5.68e-06)	(5.79e-06)
2008.year#c.popcur1	2.95e-06	3.83e-06	-2.14e-06	5.85e-06	7.75e-06
	(4.36e-06)	(4.32e-06)	(2.46e-06)	(5.20e-06)	(5.38e-06)
2009.year#c.popcur1	-1.66e-06	-1.11e-06	-1.51e-06	4.00e-06	5.17e-06
	(4.19e-06)	(4.23e-06)	(2.58e-06)	(5.75e-06)	(6.02e-06)
Scarcity		0.175***	0.00888		0.0140
		(0.0491)	(0.0210)		(0.0368)
Constant	0.787***	0.653***	0.508***	0.857***	0.845***
	(0.0222)	(0.0438)	(0.0237)	(0.0257)	(0.0362)

Observations	958	831	828	955	828
R-squared	0.023	0.071	0.245	0.103	0.129
WUAs	179	145	145	179	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Institutional capacity	Institutional capacity	Development problems	Development problems
2005.year	0.492***	0.345***	0.00205	-0.00133
	(0.111)	(0.122)	(0.0737)	(0.0909)
2006.year	1.334***	1.205***	-0.0716	-0.0239
	(0.167)	(0.211)	(0.0751)	(0.0923)
2007.year	1.371***	1.250***	-0.116	-0.149
	(0.171)	(0.219)	(0.0768)	(0.0959)
2008.year	1.513***	1.360***	-0.124	-0.137
	(0.179)	(0.235)	(0.0795)	(0.101)
2009.year	1.560***	1.386***	-0.113	-0.134
	(0.179)	(0.235)	(0.0795)	(0.101)
WUASP	0.0837	0.161	-0.0163	0.0263
	(0.298)	(0.313)	(0.110)	(0.118)
Het pop size	4.18e-05	4.02e-05	-4.59e-06	-5.98e-06
	(4.13e-05)	(4.11e-05)	(1.19e-05)	(1.21e-05)
World Bank	-0.417**	-0.472***	-0.0349	-0.00269
	(0.183)	(0.179)	(0.126)	(0.130)
2005.year#c.popcur1	-1.13e-05	-4.06e-06	1.13e-08	1.06e-07
	(7.48e-06)	(7.64e-06)	(6.68e-06)	(7.46e-06)
2006.year#c.popcur1	-3.40e-05***	-2.55e-05*	4.16e-06	5.43e-07
	(1.20e-05)	(1.37e-05)	(6.79e-06)	(7.58e-06)
2007.year#c.popcur1	-3.45e-05***	-2.76e-05*	3.27e-06	4.78e-06
	(1.24e-05)	(1.43e-05)	(6.97e-06)	(7.83e-06)
2008.year#c.popcur1	-3.35e-05**	-2.67e-05*	4.56e-06	4.86e-06
	(1.34e-05)	(1.57e-05)	(7.07e-06)	(8.06e-06)
2009.year#c.popcur1	-3.17e-05**	-2.41e-05	4.24e-06	5.08e-06
	(1.34e-05)	(1.56e-05)	(7.07e-06)	(8.05e-06)
Scarcity		-0.123		0.0217
		(0.0950)		(0.0695)
Constant	3.297***	3.821***		
	(0.0754)	(0.109)		
Observations	1,085	867	1,061	867
R-squared	0.368	0.340		
WUAs	181	145	177	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Activeness	Activeness	Canal infrastructure	Canal infrastructure
2005.year	0.0155	0.00734	-0.00163*	-0.00310**
	(0.104)	(0.124)	(0.000853)	(0.00122)
2006.year	0.0946	0.0194	-0.00211	-0.00411**
	(0.103)	(0.125)	(0.00129)	(0.00171)
2007.year	0.0636	-0.0411	-0.0196***	-0.0296***
	(0.105)	(0.128)	(0.00731)	(0.0107)
2008.year	0.0312	-0.0714	-0.0118	-0.0234**
	(0.109)	(0.137)	(0.00751)	(0.0114)
2009.year	0.0429	-0.0812	-0.0126*	-0.0256**
	(0.109)	(0.137)	(0.00756)	(0.0111)
WUASP	-0.159	-0.0292	0.0103	0.0160*
	(0.154)	(0.164)	(0.0111)	(0.00955)
Het pop size	-6.02e-06	-1.10e-05	8.48e-07	6.45e-07
	(1.64e-05)	(1.66e-05)	(7.07e-07)	(7.41e-07)
World Bank	-0.175	-0.146	0.0320***	0.0296**
	(0.190)	(0.199)	(0.0121)	(0.0123)
2005.year#c.popcur1	-4.51e-07	5.41e-10	-6.17e-08	2.69e-08
	(9.26e-06)	(1.02e-05)	(8.11e-08)	(8.07e-08)
2006.year#c.popcur1	-3.18e-06	7.97e-07	-1.65e-07	-3.57e-08
	(9.28e-06)	(1.03e-05)	(1.37e-07)	(1.42e-07)
2007.year#c.popcur1	-4.07e-06	1.63e-06	-1.04e-06*	-5.61e-07
	(9.53e-06)	(1.06e-05)	(6.01e-07)	(7.30e-07)
2008.year#c.popcur1	-5.03e-06	6.15e-07	2.92e-07	9.29e-07
	(9.81e-06)	(1.11e-05)	(7.12e-07)	(8.70e-07)
2009.year#c.popcur1	-5.22e-06	1.80e-06	8.90e-07	1.60e-06*
	(9.81e-06)	(1.11e-05)	(6.79e-07)	(8.37e-07)
Scarcity		0.0229		-0.000442
		(0.0906)		(0.00560)
Constant			0.660***	0.662***
			(0.00273)	(0.00642)
Observations	1,061	867	1,086	867
R-squared			0.086	0.101
WUAs	177	145	181	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

WUA population size squared

VARIABLES	Tariff	Water delivery	Water delivery
2001.year	-0.290		
	(0.255)		
2002.year	0.108		
	(0.296)		
2003.year	0.460		
	(0.306)		
2004.year	0.227		
	(0.476)		
2005.year	0.667		
	(0.461)		
2006.year	1.078**		
	(0.486)		
2007.year	1.368***		
	(0.494)		
2008.year	0.864*		
	(0.507)		
2009.year	0.887*		
	(0.527)		
WUASP	0.583	0.00604	0.165
	(0.868)	(0.118)	(0.174)
Het pop size	1.04e-06	-3.94e-05	-5.93e-05
	(0.000167)	(3.32e-05)	(3.87e-05)
Het pop size2	-1.60e-09	1.41e-09	1.88e-09
	(6.32e-09)	(1.18e-09)	(1.31e-09)
World Bank	0.748**	0.0818	0.109
	(0.367)	(0.143)	(0.131)
2001.year#c.popcur1	1.63e-05		
	(3.77e-05)		
2002.year#c.popcur1	-3.34e-06		
	(3.82e-05)		
2003.year#c.popcur1	-3.21e-05		
	(3.97e-05)		
2004.year#c.popcur1	-1.08e-07		
	(5.98e-05)		
2005.year#c.popcur1	-2.95e-05	-7.63e-06	-8.32e-06
	(6.15e-05)	(1.92e-05)	(1.90e-05)
2006.year#c.popcur1	4.37e-05	-1.21e-05	-1.16e-05
	(6.44e-05)	(1.70e-05)	(1.71e-05)
2007.year#c.popcur1	9.72e-05	2.38e-05	1.83e-05
	(6.56e-05)	(3.01e-05)	(3.00e-05)
2008.year#c.popcur1	0.000271***	2.88e-05	2.21e-05
	(7.64e-05)	(2.34e-05)	(2.31e-05)
2009.year#c.popcur1	0.000326***	5.59e-06	-3.67e-06
	(8.04e-05)	(1.81e-05)	(1.73e-05)
2001.year#c.popsize2	-6.45e-10		
	(1.18e-09)		
2002.year#c.popsize2	-1.56e-10		
	(1.26e-09)		
2003.year#c.popsize2	1.04e-09		
	(1.28e-09)		
2004.year#c.popsize2	5.18e-10		
	(1.78e-09)		

2005.year#c.popsize2	1.69e-09	-2.08e-10	-1.46e-10
	(1.84e-09)	(7.65e-10)	(7.60e-10)
2006.year#c.popsize2	-9.53e-10	-0	-1.61e-10
	(1.99e-09)	(6.45e-10)	(6.64e-10)
2007.year#c.popsize2	-1.68e-09	-2.28e-09	-2.15e-09
	(2.02e-09)	(1.97e-09)	(1.97e-09)
2008.year#c.popsize2	-6.95e-09***	-1.03e-09	-7.65e-10
	(2.49e-09)	(9.46e-10)	(9.40e-10)
2009.year#c.popsize2	-9.95e-09***	-5.99e-10	-2.49e-10
	(2.71e-09)	(7.07e-10)	(6.96e-10)
Scarcity			0.730***
			(0.261)
Constant	3.397***	0.907***	0.316
	(0.155)	(0.0587)	(0.218)
Observations	1,444	826	822
R-squared	0.381	0.050	0.108
Number of wua_id	180	147	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	On-time payment	On-time payment	Total prop payment	Total prop payment
2005.year	-0.0610	-0.0610	-0.295***	-0.335***
	(0.0703)	(0.0704)	(0.0709)	(0.0730)
2006.year	-0.0895	-0.0892	-0.160**	-0.204***
	(0.0592)	(0.0589)	(0.0635)	(0.0649)
2007.year	0.127*	0.120*	-0.127**	-0.155**
	(0.0663)	(0.0666)	(0.0621)	(0.0603)
2008.year	0.0815	0.0809	-0.189***	-0.206***
	(0.0765)	(0.0765)	(0.0670)	(0.0653)
2009.year	0.0392	0.0396	-0.159**	-0.175**
	(0.0737)	(0.0742)	(0.0733)	(0.0687)
WUASP	-0.137	-0.138	-0.00234	0.0382
	(0.105)	(0.106)	(0.0483)	(0.0500)
Het pop size	1.11e-05	1.14e-05	-3.56e-06	-8.28e-06
	(2.73e-05)	(2.73e-05)	(1.12e-05)	(1.19e-05)
Het pop size2	1.63e-10	1.57e-10	6.46e-11	1.67e-10
	(9.33e-10)	(9.33e-10)	(3.75e-10)	(3.97e-10)
World Bank	-0.0890	-0.0887	-0.0463	-0.0442
	(0.0549)	(0.0548)	(0.0608)	(0.0622)
2005.year#c.popcur1	-3.37e-06	-3.38e-06	4.35e-05***	4.72e-05***
	(9.34e-06)	(9.36e-06)	(1.31e-05)	(1.34e-05)
2006.year#c.popcur1	1.03e-06	9.54e-07	2.25e-05**	2.67e-05**
	(9.39e-06)	(9.34e-06)	(1.12e-05)	(1.13e-05)
2007.year#c.popcur1	-1.35e-05	-1.30e-05	2.20e-05**	2.02e-05*
	(1.01e-05)	(1.02e-05)	(1.09e-05)	(1.11e-05)
2008.year#c.popcur1	-4.76e-06	-4.63e-06	2.88e-05**	2.62e-05**
	(1.27e-05)	(1.27e-05)	(1.13e-05)	(1.15e-05)
2009.year#c.popcur1	7.85e-06	7.84e-06	2.44e-05**	2.25e-05**
	(1.30e-05)	(1.30e-05)	(1.13e-05)	(1.12e-05)
2005.year#c.popsize2	1.81e-10	1.81e-10	-1.46e-09***	-1.53e-09***
	(2.82e-10)	(2.82e-10)	(4.23e-10)	(4.28e-10)
2006.year#c.popsize2	8.43e-11	8.77e-11	-8.53e-10**	-9.64e-10**
	(3.07e-10)	(3.07e-10)	(3.77e-10)	(3.77e-10)
2007.year#c.popsize2	4.82e-10	4.77e-10	-8.40e-10**	-7.33e-10*
	(3.26e-10)	(3.28e-10)	(3.81e-10)	(3.88e-10)
2008.year#c.popsize2	1.76e-10	1.72e-10	-9.31e-10**	-7.91e-10**
	(4.57e-10)	(4.57e-10)	(3.64e-10)	(3.73e-10)
2009.year#c.popsize2	-1.54e-10	-1.54e-10	-9.38e-10***	-8.36e-10**
	(4.74e-10)	(4.75e-10)	(3.52e-10)	(3.63e-10)
Scarcity		-0.00656		0.179***
		(0.0343)		(0.0493)
Constant	0.470***	0.476***	0.795***	0.654***
	(0.0197)	(0.0350)	(0.0219)	(0.0443)
Observations	832	831	958	831
R-squared	0.106	0.106	0.043	0.095
Number of wua_id	145	145	179	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	O & M/rehab budget	O & M/rehab payment	O & M/rehab payment
2005.year	0.112**	-0.442***	-0.499***
	(0.0470)	(0.0849)	(0.0921)
2006.year	0.160***	-0.326***	-0.375***
	(0.0438)	(0.0812)	(0.0848)
2007.year	0.184***	-0.319***	-0.378***
	(0.0465)	(0.0898)	(0.0910)
2008.year	0.231***	-0.381***	-0.431***
	(0.0504)	(0.0974)	(0.108)
2009.year	0.249***	-0.375***	-0.413***
	(0.0469)	(0.102)	(0.113)
WUASP	-0.0682	0.0791	0.103
	(0.0425)	(0.0600)	(0.0673)
Het pop size	1.59e-05*	-4.64e-06	-5.30e-06
	(8.48e-06)	(1.12e-05)	(1.20e-05)
Het pop size2	-4.79e-10*	2.22e-10	2.04e-10
	(2.68e-10)	(3.66e-10)	(3.86e-10)
World Bank	0.0442	-0.0405	-0.0347
	(0.0307)	(0.0747)	(0.0803)
2005.year#c.popcur1	-2.37e-05***	4.13e-05***	4.65e-05***
	(7.85e-06)	(1.39e-05)	(1.47e-05)
2006.year#c.popcur1	-2.43e-05***	2.92e-05**	3.28e-05**
	(7.63e-06)	(1.36e-05)	(1.40e-05)
2007.year#c.popcur1	-2.35e-05***	3.45e-05**	3.72e-05**
	(8.15e-06)	(1.44e-05)	(1.45e-05)
2008.year#c.popcur1	-2.09e-05***	3.21e-05**	3.44e-05**
	(7.94e-06)	(1.59e-05)	(1.70e-05)
2009.year#c.popcur1	-2.29e-05***	3.46e-05**	3.65e-05**
	(7.29e-06)	(1.63e-05)	(1.76e-05)
2005.year#c.popsize2	7.25e-10***	-1.18e-09**	-1.28e-09**
	(2.45e-10)	(4.75e-10)	(4.93e-10)
2006.year#c.popsize2	7.29e-10***	-8.32e-10*	-8.93e-10*
	(2.44e-10)	(4.74e-10)	(4.84e-10)
2007.year#c.popsize2	7.36e-10***	-1.11e-09**	-1.12e-09**
	(2.74e-10)	(4.99e-10)	(4.96e-10)
2008.year#c.popsize2	6.63e-10***	-9.38e-10*	-9.43e-10*
	(2.34e-10)	(5.34e-10)	(5.58e-10)
2009.year#c.popsize2	7.60e-10***	-1.11e-09**	-1.11e-09*
	(2.15e-10)	(5.53e-10)	(5.83e-10)
Scarcity	0.00735		0.0140
	(0.0214)		(0.0383)
Constant	0.506***	0.865***	0.850***
	(0.0239)	(0.0262)	(0.0375)
Observations	828	955	828
R-squared	0.267	0.118	0.146
Number of wua_id	145	179	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Institutional capacity	Institutional capacity	Development problems	Development problems
2005.year	0.448***	0.252	-0.00402	-0.00922
	(0.141)	(0.160)	(0.0965)	(0.124)
2006.year	1.364***	1.169***	-0.129	-0.0583
	(0.222)	(0.303)	(0.0994)	(0.127)
2007.year	1.385***	1.212***	-0.122	-0.160
	(0.224)	(0.309)	(0.100)	(0.131)
2008.year	1.514***	1.334***	-0.133	-0.142
	(0.240)	(0.351)	(0.104)	(0.141)
2009.year	1.548***	1.343***	-0.123	-0.146
	(0.240)	(0.351)	(0.104)	(0.141)
WUASP	-0.299	-0.251	0.0834	0.112
	(0.367)	(0.380)	(0.147)	(0.157)
Het pop size	0.000157*	0.000169*	-3.98e-05	-3.70e-05
	(9.32e-05)	(9.51e-05)	(3.60e-05)	(3.73e-05)
Het pop size2	-4.60e-09	-5.19e-09*	1.49e-09	1.33e-09
	(3.08e-09)	(3.11e-09)	(1.46e-09)	(1.51e-09)
World Bank	-0.414**	-0.482**	-0.0395	-0.00613
	(0.194)	(0.191)	(0.127)	(0.132)
2005.year#c.popcur1	1.53e-06	1.83e-05	1.18e-06	1.47e-06
	(2.77e-05)	(3.04e-05)	(1.95e-05)	(2.24e-05)
2006.year#c.popcur1	-4.05e-05	-1.62e-05	2.04e-05	8.82e-06
	(3.78e-05)	(4.62e-05)	(2.00e-05)	(2.29e-05)
2007.year#c.popcur1	-3.80e-05	-1.95e-05	5.08e-06	7.67e-06
	(3.84e-05)	(4.69e-05)	(2.02e-05)	(2.35e-05)
2008.year#c.popcur1	-3.30e-05	-2.01e-05	6.82e-06	5.83e-06
	(3.94e-05)	(5.08e-05)	(2.06e-05)	(2.45e-05)
2009.year#c.popcur1	-2.81e-05	-1.37e-05	6.81e-06	7.74e-06
	(4.02e-05)	(5.14e-05)	(2.06e-05)	(2.44e-05)
2005.year#c.popsize2	-5.36e-10	-8.67e-10	-0	-0
	(1.04e-09)	(1.12e-09)	(7.86e-10)	(8.57e-10)
2006.year#c.popsize2	2.19e-10	-3.89e-10	-6.84e-10	-3.25e-10
	(1.25e-09)	(1.44e-09)	(8.09e-10)	(8.75e-10)
2007.year#c.popsize2	1.50e-10	-2.85e-10	-8.13e-11	-1.23e-10
	(1.27e-09)	(1.46e-09)	(8.12e-10)	(8.90e-10)
2008.year#c.popsize2	-0	-2.60e-10	-8.90e-11	-0
	(1.23e-09)	(1.47e-09)	(8.19e-10)	(9.08e-10)
2009.year#c.popsize2	-1.59e-10	-4.05e-10	-1.02e-10	-9.99e-11
	(1.26e-09)	(1.50e-09)	(8.19e-10)	(9.07e-10)
Scarcity		-0.130		0.0276
		(0.0938)		(0.0701)
Constant	3.296***	3.828***		
	(0.0751)	(0.109)		
Observations	1,085	867	1,061	867
R-squared	0.371	0.346		
Number of wua_id	181	145	177	145

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Activeness	Activeness	Canal infrastructure	Canal infrastructure
2005.year	0.0104	-0.00454	0.000432	-0.00118
	(0.140)	(0.173)	(0.00111)	(0.00172)
2006.year	0.0889	-0.0302	0.000806	-0.00158
	(0.139)	(0.176)	(0.00153)	(0.00240)
2007.year	0.0842	-0.0673	-0.00626	-0.0130
	(0.141)	(0.179)	(0.00922)	(0.0150)
2008.year	0.0467	-0.108	-0.00562	-0.0203
	(0.148)	(0.195)	(0.00892)	(0.0157)
2009.year	0.0787	-0.0999	-0.0127	-0.0318**
	(0.148)	(0.194)	(0.00881)	(0.0149)
WUASP	-0.0587	0.0647	0.00585	0.0118
	(0.207)	(0.220)	(0.0104)	(0.0125)
Het pop size	-4.37e-05	-4.38e-05	2.19e-06	2.22e-06
	(5.14e-05)	(5.31e-05)	(2.80e-06)	(2.61e-06)
Het pop size2	1.68e-09	1.44e-09	-5.72e-11	-6.81e-11
	(2.16e-09)	(2.22e-09)	(1.06e-10)	(8.92e-11)
World Bank	-0.167	-0.153	0.0343***	0.0310**
	(0.192)	(0.201)	(0.0118)	(0.0120)
2005.year#c.popcur1	3.33e-07	2.16e-06	-5.88e-07*	-4.02e-07
	(2.85e-05)	(3.18e-05)	(3.06e-07)	(3.63e-07)
2006.year#c.popcur1	-2.02e-06	1.26e-05	-9.16e-07**	-6.20e-07
	(2.85e-05)	(3.24e-05)	(3.98e-07)	(4.39e-07)
2007.year#c.popcur1	-1.00e-05	7.98e-06	-4.47e-06**	-4.27e-06*
	(2.89e-05)	(3.29e-05)	(1.74e-06)	(2.31e-06)
2008.year#c.popcur1	-9.67e-06	9.03e-06	-1.31e-06	1.70e-07
	(2.99e-05)	(3.49e-05)	(1.65e-06)	(2.31e-06)
2009.year#c.popcur1	-1.58e-05	5.70e-06	8.90e-07	2.89e-06
	(2.97e-05)	(3.47e-05)	(1.56e-06)	(2.14e-06)
2005.year#c.popsize2	-0	-7.37e-11	0	0
	(1.15e-09)	(1.22e-09)	(0)	(0)
2006.year#c.popsize2	-0	-4.67e-10	0	0
	(1.15e-09)	(1.24e-09)	(0)	(0)
2007.year#c.popsize2	2.48e-10	-2.59e-10	1.35e-10**	1.39e-10**
	(1.17e-09)	(1.26e-09)	(5.58e-11)	(6.89e-11)
2008.year#c.popsize2	2.02e-10	-3.30e-10	6.29e-11	0
	(1.20e-09)	(1.32e-09)	(5.43e-11)	(6.73e-11)
2009.year#c.popsize2	4.56e-10	-1.45e-10	-0	-0
	(1.19e-09)	(1.30e-09)	(5.12e-11)	(6.16e-11)
Scarcity		0.0291		-0.000119
		(0.0917)		(0.00571)
Constant			0.659***	0.662***
			(0.00267)	(0.00641)
Observations	1,061	867	1,086	867
R-squared			0.092	0.110
Number of wua_id	177	145	181	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 1.C. Heterogeneous WUASP effects – WUA land size

VARIABLES	Tariff	Water delivery	Water delivery
2005.year	-2.465***		
	(0.378)		
2006.year	-1.904***		
	(0.380)		
2007.year	-0.992***		
	(0.337)		
2008o.year	-0.671**		
	(0.326)		
2009.year	-0.138		
	(0.253)		
WUASP	0.512	-0.0446	0.0719
	(1.007)	(0.0708)	(0.105)
hetlsize	-0.000213	-9.30e-05	-0.000135**
	(0.000439)	(6.01e-05)	(6.18e-05)
World Bank	1.171**	0.0703	0.0940
	(0.580)	(0.123)	(0.114)
2004.year#c.landsize	0.000908***		
	(0.000259)		
2005.year#c.landsize	0.000725***	-4.42e-05	-4.30e-05
	(0.000251)	(4.25e-05)	(4.16e-05)
2006.year#c.landsize	0.000600**	-5.57e-05	-7.19e-05*
	(0.000253)	(3.96e-05)	(4.04e-05)
2007.year#c.landsize	0.000880***	-6.23e-05	-8.99e-05
	(0.000271)	(6.48e-05)	(6.31e-05)
2008.year#c.landsize	0.000708**	0.000123**	0.000108*
	(0.000313)	(5.95e-05)	(5.81e-05)
2009.year#c.landsize	0.000901***	-7.29e-06	-2.93e-05
	(0.000315)	(4.24e-05)	(4.14e-05)
Scarcity			0.723***
			(0.261)
Constant	4.773***	0.876***	0.291
	(0.435)	(0.0458)	(0.216)
Observations	1,078	826	822
R-squared	0.269	0.028	0.086
Number of wua_id	180	147	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	On-time payment	On-time payment	Total prop payment	Total prop payment
2005.year	-0.126**	-0.126**	-0.150**	-0.177**
	(0.0522)	(0.0521)	(0.0680)	(0.0681)
2006.year	-0.0640	-0.0642	-0.0872	-0.114**
	(0.0532)	(0.0531)	(0.0570)	(0.0531)
2007.year	0.0526	0.0460	-0.0469	-0.0657
	(0.0557)	(0.0561)	(0.0576)	(0.0525)
2008o.year	-0.0356	-0.0358	-0.0382	-0.0671
	(0.0637)	(0.0635)	(0.0599)	(0.0561)
2009.year	0.0288	0.0292	-0.0493	-0.0790
	(0.0644)	(0.0633)	(0.0633)	(0.0538)
WUASP	-0.0868	-0.0881	-0.0563	-0.00411
	(0.102)	(0.101)	(0.0419)	(0.0392)
Hetlsize	3.45e-05	3.53e-05	1.84e-05	-8.21e-06
	(6.33e-05)	(6.29e-05)	(2.50e-05)	(2.19e-05)
World Bank	-0.0984*	-0.0980*	-0.0243	-0.0250
	(0.0510)	(0.0509)	(0.0562)	(0.0569)
2005.year#c.landsize	3.77e-05	3.76e-05	5.01e-05	6.15e-05*
	(2.74e-05)	(2.74e-05)	(3.55e-05)	(3.45e-05)
2006.year#c.landsize	-1.36e-06	-1.19e-06	1.78e-05	2.35e-05
	(3.01e-05)	(3.02e-05)	(3.04e-05)	(2.84e-05)
2007.year#c.landsize	6.99e-06	9.59e-06	1.11e-05	2.96e-06
	(3.30e-05)	(3.37e-05)	(3.49e-05)	(3.35e-05)
2008.year#c.landsize	6.44e-05*	6.45e-05*	-1.30e-06	7.60e-06
	(3.69e-05)	(3.70e-05)	(3.29e-05)	(3.17e-05)
2009.year#c.landsize	4.65e-05	4.63e-05	-3.26e-06	4.85e-06
	(3.69e-05)	(3.67e-05)	(3.41e-05)	(3.02e-05)
Scarcity		-0.00553		0.177***
		(0.0325)		(0.0486)
Constant	0.473***	0.478***	0.789***	0.653***
	(0.0197)	(0.0344)	(0.0231)	(0.0438)
Observations	832	831	958	831
R-squared	0.103	0.102	0.022	0.071
Number of wua_id	145	145	179	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	O & M/rehab budget	O & M/rehab payment	O & M/rehab payment
2005.year	-0.00711	-0.272***	-0.301***
	(0.0404)	(0.0676)	(0.0709)
2006.year	0.0580	-0.208***	-0.239***
	(0.0367)	(0.0670)	(0.0668)
2007.year	0.0817**	-0.185***	-0.213***
	(0.0387)	(0.0687)	(0.0667)
2008o.year	0.121***	-0.178**	-0.204**
	(0.0406)	(0.0785)	(0.0822)
2009.year	0.136***	-0.236***	-0.270***
	(0.0392)	(0.0754)	(0.0770)
WUASP	0.0136	0.0172	0.0446
	(0.0383)	(0.0467)	(0.0506)
hetlsize	-1.31e-06	2.33e-05	1.15e-05
	(1.89e-05)	(2.36e-05)	(2.54e-05)
World Bank	0.0207	-0.00941	-0.00428
	(0.0261)	(0.0694)	(0.0746)
2005.year#c.landsize	-9.26e-06	4.93e-05	5.82e-05
	(1.68e-05)	(3.47e-05)	(3.62e-05)
2006.year#c.landsize	-2.50e-05	3.64e-05	4.56e-05
	(1.56e-05)	(3.29e-05)	(3.30e-05)
2007.year#c.landsize	-1.84e-05	3.45e-05	3.34e-05
	(1.83e-05)	(3.33e-05)	(3.20e-05)
2008.year#c.landsize	-3.25e-06	-1.38e-05	-8.27e-06
	(1.86e-05)	(3.92e-05)	(4.11e-05)
2009.year#c.landsize	-4.69e-06	3.30e-05	4.54e-05
	(1.93e-05)	(3.79e-05)	(3.87e-05)
Scarcity	0.0115		0.0152
	(0.0213)		(0.0375)
Constant	0.506***	0.856***	0.845***
	(0.0242)	(0.0275)	(0.0373)
Observations	828	955	828
R-squared	0.243	0.104	0.126
Number of wua_id	145	179	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Institutional capacity	Institutional capacity	Development problems	Development problems
2005.year	0.505***	0.310**	0.0181	0.00410
	(0.135)	(0.143)	(0.0791)	(0.0979)
2006.year	1.429***	1.247***	-0.102	-0.0625
	(0.186)	(0.229)	(0.0818)	(0.0991)
2007.year	1.486***	1.299***	-0.113	-0.136
	(0.188)	(0.232)	(0.0836)	(0.102)
2008o.year	1.585***	1.342***	-0.126	-0.127
	(0.195)	(0.244)	(0.0876)	(0.108)
2009.year	1.604***	1.336***	-0.127	-0.140
	(0.196)	(0.244)	(0.0871)	(0.107)
WUASP	0.505	0.535	0.111	0.155
	(0.383)	(0.403)	(0.135)	(0.145)
hetlsize	-6.10e-05	-2.79e-05	-0.000140	-0.000152
	(0.000212)	(0.000210)	(9.53e-05)	(0.000101)
World Bank	-0.369*	-0.443**	-0.0483	-0.0151
	(0.191)	(0.188)	(0.128)	(0.133)
2005.year#c.landsize	-9.31e-05	-1.20e-05	-1.27e-05	-2.67e-06
	(7.48e-05)	(8.12e-05)	(5.29e-05)	(6.21e-05)
2006.year#c.landsize	-0.000315***	-0.000219*	5.45e-05	3.32e-05
	(0.000113)	(0.000129)	(5.56e-05)	(6.30e-05)
2007.year#c.landsize	-0.000331***	-0.000238*	2.18e-05	2.71e-05
	(0.000115)	(0.000132)	(5.73e-05)	(6.47e-05)
2008.year#c.landsize	-0.000301**	-0.000193	3.65e-05	3.18e-05
	(0.000127)	(0.000146)	(6.14e-05)	(6.98e-05)
2009.year#c.landsize	-0.000267**	-0.000153	4.38e-05	4.46e-05
	(0.000125)	(0.000142)	(6.05e-05)	(6.85e-05)
Scarcity		-0.102		0.0282
		(0.0958)		(0.0697)
Constant	3.292***	3.801***		
	(0.0746)	(0.110)		
Observations	1,085	867	1,061	867
R-squared	0.373	0.340		
Number of wua_id	181	145	177	145

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Activeness	Activeness	Canal infrastructure	Canal infrastructure
2005.year	0.0120	0.00465	-0.00156	-0.00190
	(0.109)	(0.131)	(0.00200)	(0.00279)
2006.year	0.0860	-0.00821	-0.00180	-0.00182
	(0.111)	(0.132)	(0.00219)	(0.00290)
2007.year	0.0602	-0.0571	-0.0188**	-0.0286**
	(0.113)	(0.133)	(0.00905)	(0.0125)
2008o.year	0.00310	-0.125	-0.00460	-0.0120
	(0.120)	(0.144)	(0.00780)	(0.0112)
2009.year	0.0413	-0.0958	-0.00218	-0.00980
	(0.119)	(0.143)	(0.00780)	(0.0107)
WUASP	-0.00808	0.127	0.0134	0.00152
	(0.185)	(0.197)	(0.0162)	(0.0116)
hetlsize	-0.000155	-0.000193	1.24e-06	1.23e-05*
	(0.000129)	(0.000136)	(1.16e-05)	(6.32e-06)
World Bank	-0.178	-0.158	0.0333***	0.0306**
	(0.192)	(0.201)	(0.0123)	(0.0127)
2005.year#c.landsize	-4.35e-07	2.76e-06	-5.60e-07	-5.88e-07
	(6.95e-05)	(8.23e-05)	(1.70e-06)	(2.18e-06)
2006.year#c.landsize	-1.66e-05	2.57e-05	-1.43e-06	-1.62e-06
	(7.36e-05)	(8.25e-05)	(1.98e-06)	(2.45e-06)
2007.year#c.landsize	-2.75e-05	2.32e-05	-7.86e-06	-4.43e-06
	(7.55e-05)	(8.44e-05)	(6.41e-06)	(7.74e-06)
2008.year#c.landsize	-1.35e-05	4.60e-05	-3.31e-06	-6.18e-07
	(8.28e-05)	(9.27e-05)	(5.41e-06)	(6.49e-06)
2009.year#c.landsize	-3.71e-05	2.48e-05	-1.48e-06	1.39e-06
	(8.22e-05)	(9.19e-05)	(5.96e-06)	(7.02e-06)
Scarcity		0.0268		-0.00124
		(0.0907)		(0.00554)
Constant			0.659***	0.663***
			(0.00272)	(0.00643)
Observations	1,061	867	1,086	867
R-squared			0.076	0.088
Number of wua_id	177	145	181	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

WUA land size squared

VARIABLES	Tariff	Water delivery	Water delivery
2005.year	-1.910***		
	(0.532)		
2006.year	-1.236**		
	(0.514)		
2007.year	-0.406		
	(0.469)		
2008.year	-0.164		
	(0.442)		
2009o.year	0.215		
	(0.312)		
WUASP	0.941	-0.167	0.0232
	(1.544)	(0.162)	(0.208)
Hetlsize	-0.000881	7.48e-05	-6.67e-05
	(0.00138)	(0.000254)	(0.000273)
hetlsize2	1.90e-07	-3.44e-08	-1.06e-08
	(2.61e-07)	(5.43e-08)	(5.66e-08)
World Bank	1.161**	0.0823	0.108
	(0.579)	(0.124)	(0.117)
2004.year#c.landsize	0.000711		
	(0.000797)		
2005.year#c.landsize	0.000359	-0.000151	-0.000176
	(0.000779)	(0.000116)	(0.000115)
2006.year#c.landsize	0.000356	-0.000187*	-0.000223**
	(0.000773)	(9.62e-05)	(9.69e-05)
2007.year#c.landsize	0.000757	-0.000192	-0.000240
	(0.000826)	(0.000153)	(0.000148)
2008.year#c.landsize	0.00104	0.000110	8.22e-05
	(0.000937)	(0.000136)	(0.000133)
2009.year#c.landsize	0.00135	-0.000100	-0.000146
	(0.000975)	(0.000108)	(0.000102)
2004.year#c.landsize2	4.88e-08		
	(1.46e-07)		
2005.year#c.landsize2	9.44e-08	4.19e-08	5.23e-08
	(1.42e-07)	(3.31e-08)	(3.25e-08)
2006.year#c.landsize2	6.39e-08	5.13e-08*	5.93e-08**
	(1.44e-07)	(2.69e-08)	(2.54e-08)
2007.year#c.landsize2	3.18e-08	5.08e-08	5.88e-08
	(1.55e-07)	(4.44e-08)	(4.15e-08)
2008.year#c.landsize2	-9.87e-08	3.73e-09	8.74e-09
	(1.92e-07)	(4.00e-08)	(3.81e-08)
2009.year#c.landsize2	-1.29e-07	3.62e-08	4.54e-08
	(1.90e-07)	(3.60e-08)	(3.24e-08)
Scarcity			0.730***
			(0.261)
Constant	4.357***	0.900***	0.315
	(0.824)	(0.0554)	(0.218)
Observations	1,078	826	822
R-squared	0.272	0.032	0.091
WUAs	180	147	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Institutional capacity	Institutional capacity	Development problems	Development problems
2004.year				
2005.year	0.641***	0.293	-0.0339	0.00891
	(0.207)	(0.234)	(0.112)	(0.147)
2006.year	1.690***	1.418***	-0.198*	-0.133
	(0.259)	(0.356)	(0.117)	(0.152)
2007.year	1.729***	1.476***	-0.144	-0.148
	(0.260)	(0.358)	(0.118)	(0.153)
2008.year	1.796***	1.442***	-0.161	-0.135
	(0.268)	(0.374)	(0.121)	(0.158)
2009o.year	1.794***	1.407***	-0.137	-0.116
	(0.276)	(0.385)	(0.121)	(0.159)
WUASP	0.532	0.514	0.0128	0.0627
	(0.578)	(0.658)	(0.214)	(0.233)
hetlsize	-9.91e-05	-1.49e-06	1.84e-05	-9.28e-06
	(0.000654)	(0.000736)	(0.000281)	(0.000298)
hetlsize2	1.10e-08	-3.51e-09	-4.36e-08	-3.82e-08
	(1.42e-07)	(1.50e-07)	(7.04e-08)	(7.25e-08)
World Bank	-0.348*	-0.434**	-0.0474	-0.0150
	(0.193)	(0.190)	(0.128)	(0.133)
2005.year#c.landsize	-0.000296	9.43e-06	7.23e-05	-9.07e-06
	(0.000214)	(0.000241)	(0.000141)	(0.000174)
2006.year#c.landsize	-0.000712**	-0.000451	0.000214	0.000137
	(0.000281)	(0.000356)	(0.000149)	(0.000179)
2007.year#c.landsize	-0.000699**	-0.000478	7.20e-05	4.54e-05
	(0.000281)	(0.000358)	(0.000149)	(0.000180)
2008.year#c.landsize	-0.000621**	-0.000329	9.20e-05	4.39e-05
	(0.000295)	(0.000375)	(0.000153)	(0.000185)
2009.year#c.landsize	-0.000556*	-0.000251	5.83e-05	1.02e-05
	(0.000304)	(0.000386)	(0.000152)	(0.000186)
2005.year#c.landsize2	5.25e-08	-5.56e-09	-2.37e-08	1.49e-09
	(4.55e-08)	(4.95e-08)	(3.63e-08)	(4.37e-08)
2006.year#c.landsize2	1.07e-07	5.81e-08	-4.59e-08	-2.83e-08
	(6.92e-08)	(7.81e-08)	(3.94e-08)	(4.48e-08)
2007.year#c.landsize2	9.91e-08	6.03e-08	-1.48e-08	-5.42e-09
	(6.80e-08)	(7.83e-08)	(3.92e-08)	(4.49e-08)
2008.year#c.landsize2	8.61e-08	3.39e-08	-1.53e-08	-2.91e-09
	(7.21e-08)	(8.11e-08)	(4.16e-08)	(4.73e-08)
2009.year#c.landsize2	7.72e-08	2.42e-08	-3.32e-09	9.56e-09
	(7.17e-08)	(8.11e-08)	(4.07e-08)	(4.67e-08)
Scarcity		-0.0954		0.0241
		(0.0968)		(0.0701)
Constant	3.290***	3.794***		
	(0.0748)	(0.110)		
Observations	1,085	867	1,061	867
R-squared	0.376	0.342		
WUAs	181	145	177	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Activeness	Activeness	Canal infrastructure	Canal infrastructure
2004.year				
2005.year	0.00830	-0.000866	-0.000826	0.00145
	(0.158)	(0.193)	(0.00376)	(0.00569)
2006.year	0.0782	-0.0719	-8.40e-05	0.00290
	(0.158)	(0.197)	(0.00392)	(0.00594)
2007.year	0.0725	-0.102	0.00186	-0.000844
	(0.160)	(0.198)	(0.0114)	(0.0180)
2008.year	0.0545	-0.129	0.00265	-0.00261
	(0.165)	(0.207)	(0.00963)	(0.0158)
2009o.year	0.0883	-0.107	0.00193	-0.00503
	(0.166)	(0.210)	(0.00905)	(0.0143)
WUASP	-0.0446	0.135	0.0345	0.00545
	(0.295)	(0.318)	(0.0254)	(0.0163)
hetlsize	-9.21e-05	-0.000205	-2.98e-05	6.80e-06
	(0.000382)	(0.000404)	(2.91e-05)	(1.73e-05)
hetlsize2	-1.99e-08	1.02e-09	8.13e-09	1.73e-09
	(9.33e-08)	(9.56e-08)	(5.24e-09)	(3.41e-09)
World Bank	-0.179	-0.160	0.0340***	0.0314**
	(0.192)	(0.201)	(0.0124)	(0.0127)
2005.year#c.landsize	5.89e-06	1.13e-05	-1.61e-06	-5.19e-06
	(0.000188)	(0.000224)	(4.83e-06)	(6.76e-06)
2006.year#c.landsize	-3.14e-06	0.000119	-4.11e-06	-8.12e-06
	(0.000194)	(0.000228)	(5.23e-06)	(7.24e-06)
2007.year#c.landsize	-4.67e-05	9.01e-05	-3.94e-05***	-4.21e-05**
	(0.000197)	(0.000231)	(1.37e-05)	(1.90e-05)
2008.year#c.landsize	-9.84e-05	5.17e-05	-1.43e-05	-1.34e-05
	(0.000202)	(0.000238)	(1.19e-05)	(1.65e-05)
2009.year#c.landsize	-0.000115	4.07e-05	-7.69e-06	-5.24e-06
	(0.000204)	(0.000242)	(1.13e-05)	(1.56e-05)
2005.year#c.landsize2	-1.86e-09	-2.25e-09	2.72e-10	1.16e-09
	(4.56e-08)	(5.47e-08)	(9.92e-10)	(1.35e-09)
2006.year#c.landsize2	-4.04e-09	-2.43e-08	7.59e-10	1.63e-09
	(4.97e-08)	(5.55e-08)	(1.05e-09)	(1.39e-09)
2007.year#c.landsize2	5.05e-09	-1.75e-08	8.66e-09**	9.50e-09**
	(5.01e-08)	(5.61e-08)	(3.34e-09)	(4.14e-09)
2008.year#c.landsize2	2.50e-08	-1.10e-09	2.93e-09	3.18e-09
	(5.22e-08)	(5.83e-08)	(2.48e-09)	(3.18e-09)
2009.year#c.landsize2	2.30e-08	-3.75e-09	1.61e-09	1.62e-09
	(5.29e-08)	(5.95e-08)	(2.41e-09)	(2.98e-09)
Scarcity		0.0247		-0.000178
		(0.0913)		(0.00550)
Constant			0.659***	0.662***
			(0.00270)	(0.00645)
Observations	1,061	867	1,086	867
R-squared			0.089	0.098
WUAs	177	145	181	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 1.D. Heterogeneous WUASP effects – WUA ecological scarcity

VARIABLES	Tariff	Tariff	Water delivery	Water delivery
2005.year	0.245	0.234		
	(0.155)	(0.155)		
2006.year	1.100***	1.098***		
	(0.163)	(0.163)		
2007.year	1.850***	1.857***		
	(0.205)	(0.207)		
2008.year	2.428***	2.440***		
	(0.284)	(0.285)		
2009.year	2.492***	2.458***		
	(0.304)	(0.303)		
WUASP	-2.273**	-5.401***	0.373	-0.313
	(1.027)	(1.846)	(0.298)	(0.410)
hetscarcity	2.734*	9.216**	-0.527*	0.938
	(1.391)	(3.846)	(0.307)	(0.680)
hetscarcity2		-2.925**		-0.684**
		(1.367)		(0.322)
World Bank	0.944	0.955	0.0603	0.0761
	(0.620)	(0.621)	(0.0910)	(0.0989)
propwatrec	-0.0114	-0.548	0.740***	-0.212
	(0.280)	(0.893)	(0.272)	(0.515)
Scarcity2		0.213		0.401
		(0.302)		(0.280)
Constant	4.109***	4.385***	0.250	0.721***
	(0.268)	(0.522)	(0.223)	(0.231)
Observations	862	862	822	822
R-squared	0.284	0.289	0.059	0.076
WUAs	144	144	145	145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	On-time payment	On-time payment	Total prop payment	Total prop payment
2005.year	-0.0681**	-0.0684**	-0.0822**	-0.0819**
	(0.0272)	(0.0272)	(0.0368)	(0.0369)
2006.year	-0.0656***	-0.0655***	-0.0778**	-0.0782**
	(0.0240)	(0.0240)	(0.0316)	(0.0317)
2007.year	0.0616**	0.0610**	-0.0602**	-0.0571**
	(0.0273)	(0.0275)	(0.0286)	(0.0288)
2008.year	0.0603*	0.0596*	-0.0572*	-0.0540*
	(0.0309)	(0.0311)	(0.0312)	(0.0313)
2009.year	0.0987***	0.0989***	-0.0714**	-0.0741**
	(0.0291)	(0.0293)	(0.0296)	(0.0290)
WUASP	-0.0566	-0.0629	0.0659	-0.0649
	(0.120)	(0.203)	(0.0703)	(0.0953)
hetscarcity	0.0105	0.0256	-0.0986	0.180
	(0.137)	(0.363)	(0.0777)	(0.158)
hetscarcity2		-0.00900		-0.128**
		(0.126)		(0.0620)
World Bank	-0.0901*	-0.0906*	-0.0198	-0.0169
	(0.0522)	(0.0523)	(0.0548)	(0.0568)
propwatrec	-0.00709	0.0369	0.179***	-0.0315
	(0.0345)	(0.0903)	(0.0526)	(0.102)
Scarcity2		-0.0185		0.0893*
		(0.0372)		(0.0527)
Constant	0.476***	0.455***	0.650***	0.754***
	(0.0344)	(0.0504)	(0.0463)	(0.0487)
Observations	831	831	831	831
R-squared	0.090	0.090	0.063	0.073
WUAs	145	145	145	145

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	O & M/rehab budget	O & M/rehab budget	O & M/rehab budget	O & M/rehab payment
2005.year	-0.0213	-0.0221	-0.212***	-0.211***
	(0.0207)	(0.0208)	(0.0340)	(0.0342)
2006.year	0.0205	0.0204	-0.170***	-0.170***
	(0.0217)	(0.0218)	(0.0360)	(0.0361)
2007.year	0.0541**	0.0539**	-0.163***	-0.161***
	(0.0216)	(0.0214)	(0.0361)	(0.0362)
2008.year	0.117***	0.116***	-0.215***	-0.213***
	(0.0220)	(0.0220)	(0.0386)	(0.0385)
2009.year	0.129***	0.127***	-0.204***	-0.204***
	(0.0212)	(0.0212)	(0.0385)	(0.0386)
WUASP	-0.00601	-0.225***	0.0639	0.0712
	(0.0704)	(0.0693)	(0.0590)	(0.0898)
hetscarcity	0.0217	0.493***	-0.00583	-0.0233
	(0.0856)	(0.120)	(0.0632)	(0.156)
hetscarcity2		-0.230***		0.0126
		(0.0413)		(0.0545)
World Bank	0.0149	0.0149	0.00811	0.00965
	(0.0263)	(0.0265)	(0.0756)	(0.0764)
propwatrec	0.00815	0.0382	0.0128	-0.115
	(0.0219)	(0.0574)	(0.0393)	(0.0810)
Scarcity2		-0.0125		0.0539*
		(0.0201)		(0.0295)
Constant	0.510***	0.496***	0.843***	0.906***
	(0.0241)	(0.0381)	(0.0378)	(0.0518)
Observations	828	828	828	828
R-squared	0.239	0.248	0.116	0.119
WUAs	145	145	145	145

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Institutional capacity	Institutional capacity	Development problems
2005.year	0.296***	0.296***	0.000563
	(0.0779)	(0.0777)	(0.0518)
2006.year	0.918***	0.913***	-0.0151
	(0.121)	(0.121)	(0.0532)
2007.year	0.944***	0.947***	-0.0993*
	(0.125)	(0.125)	(0.0547)
2008.year	1.086***	1.090***	-0.0873
	(0.130)	(0.130)	(0.0562)
2009.year	1.117***	1.109***	-0.0783
	(0.133)	(0.132)	(0.0563)
WUASP	-0.547	-0.550	0.0586
	(0.364)	(0.608)	(0.371)
hetscarcity	1.258***	1.237	-0.0717
	(0.432)	(1.140)	(0.737)
hetscarcity2		0.0365	-0.0382
		(0.371)	(0.344)
World Bank	-0.525***	-0.515***	0.00299
	(0.182)	(0.183)	(0.129)
propwatrec	-0.192*	-0.732***	0.145
	(0.111)	(0.201)	(0.179)
Scarcity2		0.226***	-0.0471
		(0.0723)	(0.0682)
Constant	3.882***	4.151***	
	(0.120)	(0.135)	
Observations	867	867	867
R-squared	0.340	0.344	
WUAs	145	145	145

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Activeness	Activeness	Canal infrastructure	Canal infrastructure
2005.year	0.00951	0.00886	-0.00280***	-0.00280***
	(0.0707)	(0.0708)	(0.00106)	(0.00106)
2006.year	0.0292	0.0309	-0.00436***	-0.00440***
	(0.0717)	(0.0718)	(0.00151)	(0.00149)
2007.year	-0.0246	-0.0255	-0.0352***	-0.0352***
	(0.0735)	(0.0735)	(0.00623)	(0.00623)
2008.year	-0.0652	-0.0664	-0.0128*	-0.0127*
	(0.0766)	(0.0767)	(0.00668)	(0.00666)
2009.year	-0.0618	-0.0592	-0.00780	-0.00785
	(0.0766)	(0.0768)	(0.00641)	(0.00647)
WUASP	-0.0420	0.0674	0.0100	0.0105
	(0.260)	(0.495)	(0.00997)	(0.0179)
hetscarcity	-0.0763	-0.301	0.00839	0.00714
	(0.284)	(0.947)	(0.00942)	(0.0352)
hetscarcity2		0.0946		0.000794
		(0.413)		(0.0129)
World Bank	-0.142	-0.146	0.0301**	0.0302**
	(0.197)	(0.197)	(0.0122)	(0.0121)
propwatrec	0.0252	0.157	-0.00175	-0.00626
	(0.0916)	(0.242)	(0.00559)	(0.0157)
Scarcity2		-0.0521		0.00189
		(0.0892)		(0.00455)
Constant			0.663***	0.666***
			(0.00639)	(0.0110)
Observations	867	867	867	867
R-squared			0.084	0.084
WUAs	145	145	145	145

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix 1.E. Heterogeneous WUASP effects – WUA social heterogeneity

VARIABLES	Tariff	Water delivery	Water delivery
2001.year	-0.241*		
	(0.142)		
2002.year	0.0623		
	(0.144)		
2003.year	0.306**		
	(0.140)		
2004.year	0.327*		
	(0.193)		
2005.year	0.661***		
	(0.208)		
2006.year	1.382***		
	(0.203)		
2007.year	2.064***		
	(0.206)		
2008.year	2.432***		
	(0.234)		
2009.year	2.623***		
	(0.253)		
WUASP	0.0365	-0.00951	0.0520
	(0.609)	(0.0565)	(0.0827)
Hetethnic	0.629	-0.418	-0.471
	(0.940)	(0.280)	(0.323)
World Bank	0.977**	0.0746	0.0739
	(0.409)	(0.106)	(0.0926)
2001.year#c.ethnicu	-0.0107		
	(0.0593)		
2002.year#c.ethnicu	-0.0634		
	(0.0804)		
2003.year#c.ethnicu	0.0121		
	(0.106)		
2004.year#c.ethnicu	-0.000712		
	(0.129)		
2005.year#c.ethnicu	-0.0304	-0.0727	-0.0853
	(0.205)	(0.0662)	(0.0714)
2006.year#c.ethnicu	0.0406	-0.0889	-0.135**
	(0.112)	(0.0551)	(0.0647)
2007.year#c.ethnicu	0.0836	-0.160	-0.203
	(0.109)	(0.163)	(0.171)
2008.year#c.ethnicu	0.108	0.0991	0.0749
	(0.317)	(0.129)	(0.124)
2009.year#c.ethnicu	0.0260	-0.0292	-0.0971*
	(0.233)	(0.0468)	(0.0518)
Scarcity			0.729***
			(0.261)
Constant	3.357***	0.872***	0.276

	(0.145)	(0.0249)	(0.214)
Observations	1,436	822	818
R-squared	0.352	0.009	0.068
WUA	179	146	144

Robust standard errors in parentheses
***p<.01, **p<.05,* p<.10

VARIABLES	On-time payment	On-time payment	Total prop payment	Total prop payment
2005.year	-0.0605**	-0.0607**	-0.0635	-0.0704*
	(0.0301)	(0.0302)	(0.0390)	(0.0412)
2006.year	-0.0741***	-0.0742***	-0.0443	-0.0594*
	(0.0260)	(0.0261)	(0.0331)	(0.0338)
2007.year	0.0603*	0.0569*	-0.0125	-0.0437
	(0.0306)	(0.0308)	(0.0319)	(0.0306)
2008.year	0.0661*	0.0660*	-0.0244	-0.0394
	(0.0339)	(0.0339)	(0.0338)	(0.0334)
2009.year	0.0896***	0.0897***	-0.0356	-0.0506
	(0.0316)	(0.0314)	(0.0332)	(0.0321)
WUASP	-0.0403	-0.0408	-0.0417	-0.0266
	(0.0861)	(0.0867)	(0.0340)	(0.0358)
Hetethnic	-0.0332	-0.0322	0.0417	0.0478
	(0.132)	(0.133)	(0.0565)	(0.0642)
World Bank	-0.0906*	-0.0899*	-0.0253	-0.0247
	(0.0516)	(0.0515)	(0.0556)	(0.0553)
2005.year#c.ethnicu	-0.0252	-0.0251	-0.0393	-0.0419
	(0.0185)	(0.0185)	(0.0290)	(0.0297)
2006.year#c.ethnicu	0.0306	0.0310	-0.0538**	-0.0583**
	(0.0249)	(0.0252)	(0.0258)	(0.0252)
2007.year#c.ethnicu	0.0237	0.0256	-0.0651**	-0.0589**
	(0.0381)	(0.0389)	(0.0258)	(0.0227)
2008.year#c.ethnicu	-0.0150	-0.0148	-0.0491*	-0.0526**
	(0.0368)	(0.0368)	(0.0253)	(0.0238)
2009.year#c.ethnicu	0.0277	0.0281	-0.0623***	-0.0742***
	(0.0253)	(0.0254)	(0.0237)	(0.0247)
Scarcity		-0.00612		0.178***
		(0.0336)		(0.0501)
Constant	0.472***	0.477***	0.786***	0.651***
	(0.0196)	(0.0344)	(0.0225)	(0.0447)
Observations	826	825	953	826
R-squared	0.095	0.094	0.021	0.068
WUAs	144	144	178	144

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	O & M/rehab budget	O & M/rehab budget	O & M/rehab budget	O & M/rehab payment
2005.year	-0.0202	-0.192***	-0.208***	0.409***
	(0.0229)	(0.0345)	(0.0365)	(0.0798)
2006.year	0.0163	-0.141***	-0.159***	1.069***
	(0.0242)	(0.0375)	(0.0387)	(0.115)
2007.year	0.0509**	-0.118***	-0.149***	1.113***
	(0.0237)	(0.0390)	(0.0387)	(0.118)
2008.year	0.112***	-0.180***	-0.204***	1.279***
	(0.0243)	(0.0409)	(0.0424)	(0.122)
2009.year	0.127***	-0.173***	-0.189***	1.343***
	(0.0232)	(0.0394)	(0.0413)	(0.123)
WUASP	0.0285	0.0226	0.0281	0.263
	(0.0275)	(0.0279)	(0.0293)	(0.285)
Hetethnic	-0.0744	0.104	0.133**	0.665
	(0.0471)	(0.0645)	(0.0654)	(0.865)
World Bank	0.0157	-0.00421	0.00478	-0.529***
	(0.0268)	(0.0713)	(0.0765)	(0.187)
2005.year#c.ethnicu	-0.00302	-0.0181	-0.0121	-0.0911
	(0.0188)	(0.0290)	(0.0298)	(0.0584)
2006.year#c.ethnicu	0.0139	-0.0428	-0.0365	-0.210**
	(0.0163)	(0.0334)	(0.0315)	(0.0870)
2007.year#c.ethnicu	0.00912	-0.0581	-0.0432	-0.256**
	(0.0161)	(0.0374)	(0.0317)	(0.101)
2008.year#c.ethnicu	0.0138	-0.0446	-0.0350	-0.326***
	(0.0167)	(0.0407)	(0.0376)	(0.123)
2009.year#c.ethnicu	0.00886	-0.0504	-0.0481	-0.324***
	(0.0189)	(0.0310)	(0.0301)	(0.118)
Scarcity	0.00881		0.0137	
	(0.0217)		(0.0371)	
Constant	0.510***	0.850***	0.842***	3.315***
	(0.0240)	(0.0262)	(0.0367)	(0.0755)
Observations	824	951	824	1,079
R-squared	0.241	0.099	0.119	0.363
WUAs	144	178	144	180

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Institutional capacity	Institutional capacity	Development problems
2005.year	0.319***	0.00273	0.00201
	(0.0859)	(0.0520)	(0.0602)
2006.year	0.986***	-0.0544	-0.0282
	(0.134)	(0.0529)	(0.0612)
2007.year	1.020***	-0.111**	-0.127**
	(0.137)	(0.0537)	(0.0626)
2008.year	1.154***	-0.104*	-0.107*
	(0.144)	(0.0548)	(0.0641)
2009.year	1.207***	-0.0990*	-0.106*
	(0.146)	(0.0548)	(0.0642)
WUASP	0.396	-0.0687	-0.0511
	(0.299)	(0.0982)	(0.102)
Hetethnic	0.451	0.0282	0.0823
	(0.947)	(0.227)	(0.235)
World Bank	-0.548***	-0.0196	0.00807
	(0.182)	(0.124)	(0.129)
2005.year#c.ethnicu	-0.0674	0.000101	-0.00392
	(0.0508)	(0.124)	(0.126)
2006.year#c.ethnicu	-0.181**	0.0951	0.0455
	(0.0840)	(0.118)	(0.123)
2007.year#c.ethnicu	-0.212**	0.113	0.0989
	(0.0908)	(0.120)	(0.123)
2008.year#c.ethnicu	-0.279**	0.120	0.104
	(0.111)	(0.120)	(0.122)
2009.year#c.ethnicu	-0.274**	0.118	0.101
	(0.107)	(0.120)	(0.122)
Scarcity	-0.120		0.0228
	(0.0969)		(0.0697)
Constant	3.839***		
	(0.112)		
Observations	861	1,055	861
R-squared	0.337		
WUAs	144	176	144

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Activeness	Activeness	Canal infrastructure	Canal infrastructure
2005.year	0.0134	0.0116	-0.00220**	-0.00296***
	(0.0717)	(0.0821)	(0.000881)	(0.00112)
2006.year	0.0682	0.0244	-0.00344**	-0.00443***
	(0.0715)	(0.0826)	(0.00133)	(0.00157)
2007.year	0.0218	-0.0444	-0.0277***	-0.0343***
	(0.0724)	(0.0839)	(0.00523)	(0.00669)
2008.year	-0.0244	-0.0910	-0.00800	-0.0123*
	(0.0747)	(0.0870)	(0.00546)	(0.00717)
2009.year	-0.0136	-0.0900	-0.00402	-0.00832
	(0.0749)	(0.0873)	(0.00544)	(0.00699)
WUASP	-0.233*	-0.147	0.00602	0.0159*
	(0.134)	(0.139)	(0.0106)	(0.00901)
Hetethnic	0.136	0.149	0.0336	0.00257
	(0.312)	(0.324)	(0.0263)	(0.0109)
World Bank	-0.197	-0.144	0.0314***	0.0296**
	(0.188)	(0.197)	(0.0120)	(0.0122)
2005.year#c.ethnicu	-0.000428	-0.00648	9.82e-06	0.000714
	(0.169)	(0.181)	(0.000656)	(0.000596)
2006.year#c.ethnicu	0.00437	0.0227	-0.000579	0.000727
	(0.167)	(0.178)	(0.00127)	(0.000754)
2007.year#c.ethnicu	0.0325	0.0762	-0.00436	0.000331
	(0.169)	(0.177)	(0.00462)	(0.00585)
2008.year#c.ethnicu	0.0891	0.137	-0.000427	0.00142
	(0.164)	(0.171)	(0.00417)	(0.00433)
2009.year#c.ethnicu	0.0641	0.119	0.00231	0.00444
	(0.167)	(0.174)	(0.00405)	(0.00479)
Scarcity		0.0203		-0.00195
		(0.0908)		(0.00550)
Constant			0.659***	0.663***
			(0.00274)	(0.00640)
Observations	1,055	861	1,080	861
R-squared			0.074	0.081
WUAs	176	144	180	144

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 1.F. Heterogeneous WUASP effects – WUA economic heterogeneity

VARIABLES	Tariff	Water delivery	Water delivery
2001.year	-0.445		
	(0.293)		
2002.year	-0.155		
	(0.239)		
2003.year	0.209		
	(0.257)		
2004.year	-0.0632		
	(0.415)		
2005.year	0.143		
	(0.409)		
2006.year	1.357***		
	(0.401)		
2007.year	2.121***		
	(0.452)		
2008.year	3.497***		
	(0.578)		
2009.year	3.720***		
	(0.596)		
Post WUASP	-1.417	-0.109	0.0474
	(1.146)	(0.0667)	(0.159)
Het equal	2.636*	-0.115	-0.295
	(1.354)	(0.163)	(0.264)
World Bank	0.605*	0.0905	0.0885
	(0.310)	(0.116)	(0.106)
2001.year#c.equal	0.530		
	(0.366)		
2002.year#c.equal	0.422		
	(0.292)		
2003.year#c.equal	0.234		
	(0.315)		
2004.year#c.equal	0.755		
	(0.496)		
2005.year#c.equal	0.959**	-0.252**	-0.245**
	(0.474)	(0.103)	(0.103)
2006.year#c.equal	0.231	-0.147	-0.156
	(0.465)	(0.0992)	(0.102)
2007.year#c.equal	0.0513	-0.151	-0.174
	(0.550)	(0.179)	(0.175)
2008.year#c.equal	-1.403**	0.251	0.247
	(0.708)	(0.164)	(0.162)
2009.year#c.equal	-1.595**	-0.0703	-0.101
	(0.696)	(0.0953)	(0.0923)
Scarcity			0.744***

			(0.266)
Constant	3.408***	0.895***	0.288
	(0.127)	(0.0506)	(0.230)
Observations	1,338	788	784
R-squared	0.391	0.028	0.087
WUAs	165	140	138

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	On-time payment	On-time payment	Total prop payment	Total prop payment
2005.year	-0.0671	-0.0667	0.112	0.113
	(0.0520)	(0.0520)	(0.0872)	(0.0917)
2006.year	-0.0884**	-0.0869*	-0.0247	-0.0562
	(0.0446)	(0.0449)	(0.0659)	(0.0673)
2007.year	-0.0378	-0.0327	-0.0177	-0.0231
	(0.0559)	(0.0562)	(0.0615)	(0.0617)
2008.year	-0.0458	-0.0444	0.0478	-0.00105
	(0.0612)	(0.0604)	(0.0689)	(0.0701)
2009.year	0.138**	0.141**	0.0563	-0.0132
	(0.0613)	(0.0601)	(0.0672)	(0.0633)
post WUASP	0.102	0.0996	-0.0366	0.0359
	(0.114)	(0.116)	(0.0514)	(0.0540)
hetequal	-0.268	-0.264	-0.0120	-0.100
	(0.191)	(0.192)	(0.0814)	(0.0865)
World Bank	-0.0776	-0.0776	-0.00103	0.00375
	(0.0481)	(0.0481)	(0.0584)	(0.0575)
2005.year#c.equal	-0.00526	-0.00611	-0.316***	-0.335***
	(0.0783)	(0.0783)	(0.118)	(0.122)
2006.year#c.equal	0.0328	0.0307	-0.0878	-0.0695
	(0.0730)	(0.0732)	(0.0984)	(0.0952)
2007.year#c.equal	0.167*	0.154*	-0.0650	-0.0949
	(0.0853)	(0.0863)	(0.0951)	(0.0886)
2008.year#c.equal	0.153	0.151	-0.160	-0.109
	(0.0978)	(0.0973)	(0.100)	(0.0960)
2009.year#c.equal	-0.0762	-0.0794	-0.208**	-0.123
	(0.0956)	(0.0948)	(0.0965)	(0.0884)
Scarcity		-0.00938		0.187***
		(0.0344)		(0.0497)
Constant	0.474***	0.482***	0.797***	0.649***
	(0.0189)	(0.0339)	(0.0233)	(0.0438)
Observations	794	793	897	792
R-squared	0.110	0.108	0.047	0.102
WUAs	138	138	165	138

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	O & M/rehab budget	O & M/rehab payment	O & M/rehab payment
2005.year	-0.0156	-0.141*	-0.135*
	(0.0465)	(0.0750)	(0.0796)
2006.year	-0.00121	-0.0664	-0.0633
	(0.0474)	(0.0774)	(0.0819)
2007.year	0.0652	-0.0562	-0.0258
	(0.0465)	(0.0728)	(0.0749)
2008.year	0.111**	-0.0410	-0.0486
	(0.0502)	(0.0813)	(0.0869)
2009.year	0.0993**	-0.0976	-0.133
	(0.0482)	(0.0780)	(0.0826)
post WUASP	-0.00800	0.0364	0.0610
	(0.0372)	(0.0402)	(0.0456)
hetequal	0.0439	0.0229	0.00809
	(0.0563)	(0.0698)	(0.0768)
World Bank	0.0121	0.000111	0.0106
	(0.0288)	(0.0726)	(0.0788)
2005.year#c.equal	-0.00311	-0.111	-0.145
	(0.0609)	(0.116)	(0.121)
2006.year#c.equal	0.0465	-0.178	-0.213*
	(0.0602)	(0.119)	(0.120)
2007.year#c.equal	-0.0106	-0.183	-0.270**
	(0.0620)	(0.117)	(0.111)
2008.year#c.equal	0.0195	-0.279**	-0.301**
	(0.0637)	(0.124)	(0.126)
2009.year#c.equal	0.0628	-0.185	-0.149
	(0.0620)	(0.126)	(0.130)
Scarcity	0.00664		0.0209
	(0.0216)		(0.0402)
Constant	0.504***	0.870***	0.850***
	(0.0240)	(0.0270)	(0.0390)
Observations	789	894	789
R-squared	0.253	0.122	0.149
WUAs	138	165	138

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Institutional capacity	Institutional capacity	Development problems	Development problems
2005.year	-0.0461	-0.0831	0.00594	0.00689
	(0.123)	(0.120)	(0.0971)	(0.107)
2006.year	0.465**	0.368*	-0.00618	0.0442
	(0.190)	(0.198)	(0.0986)	(0.108)
2007.year	0.526***	0.419**	-0.0313	0.000689
	(0.196)	(0.206)	(0.100)	(0.110)
2008.year	0.637***	0.517**	-0.0255	0.00356
	(0.197)	(0.206)	(0.105)	(0.117)
2009.year	0.707***	0.627***	-0.0241	-7.55e-05
	(0.206)	(0.221)	(0.105)	(0.117)
post WUASP	-0.336	-0.258	-0.178	-0.193
	(0.300)	(0.320)	(0.145)	(0.153)
hetequal	1.462**	1.486**	0.216	0.294
	(0.576)	(0.637)	(0.220)	(0.235)
World Bank	-0.464**	-0.490**	-0.0284	-0.0120
	(0.208)	(0.198)	(0.125)	(0.130)
2005.year#c.equal	0.728***	0.665***	-0.00508	-0.00949
	(0.229)	(0.229)	(0.142)	(0.161)
2006.year#c.equal	0.934***	0.938***	-0.0514	-0.0988
	(0.309)	(0.325)	(0.144)	(0.163)
2007.year#c.equal	0.869***	0.893***	-0.0948	-0.160
	(0.320)	(0.340)	(0.147)	(0.167)
2008.year#c.equal	0.927***	0.938***	-0.0913	-0.142
	(0.317)	(0.336)	(0.153)	(0.174)
2009.year#c.equal	0.882***	0.821**	-0.0854	-0.123
	(0.325)	(0.347)	(0.152)	(0.174)
Scarcity		-0.105		0.000946
		(0.0942)		(0.0716)
Constant	3.378***	3.809***		
	(0.0800)	(0.115)		
Observations	990	827	978	827
R-squared	0.388	0.366		
WUAs	165	138	163	138

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Activeness	Activeness	Canal infrastructure	Canal infrastructure
2005.year	0.0111	0.00851	-0.00275	-0.00346
	(0.134)	(0.147)	(0.00179)	(0.00216)
2006.year	0.0159	0.0178	-0.00570**	-0.00671**
	(0.135)	(0.148)	(0.00278)	(0.00324)
2007.year	0.0244	0.0176	-0.0602***	-0.0685***
	(0.136)	(0.150)	(0.0138)	(0.0159)
2008.year	-0.0398	-0.0440	-0.0371***	-0.0463***
	(0.146)	(0.162)	(0.0137)	(0.0157)
2009.year	-0.0180	-0.0291	-0.0233*	-0.0288*
	(0.145)	(0.163)	(0.0138)	(0.0161)
posttreat	-0.201	-0.175	0.0265	0.0486***
	(0.199)	(0.210)	(0.0178)	(0.0151)
hetequal	0.00101	0.101	-0.0143	-0.0509***
	(0.311)	(0.332)	(0.0272)	(0.0186)
postwbstart	-0.188	-0.155	0.0387***	0.0365***
	(0.190)	(0.198)	(0.0128)	(0.0132)
2005.year#c.equal	0.00535	0.00487	-0.000433	-3.14e-05
	(0.198)	(0.223)	(0.00248)	(0.00301)
2006.year#c.equal	0.0784	0.0267	0.00174	0.00312
	(0.197)	(0.224)	(0.00341)	(0.00392)
2007.year#c.equal	0.00204	-0.0590	0.0457***	0.0535**
	(0.201)	(0.228)	(0.0175)	(0.0208)
2008.year#c.equal	0.0479	-0.0116	0.0389**	0.0479**
	(0.211)	(0.241)	(0.0173)	(0.0207)
2009.year#c.equal	0.0230	-0.0331	0.0253	0.0276
	(0.211)	(0.242)	(0.0181)	(0.0217)
Scarcity		0.00945		0.00119
		(0.0940)		(0.00574)
Constant			0.659***	0.664***
			(0.00284)	(0.00656)
Observations	978	827	990	827
R-squared			0.107	0.124
WUAs	163	138	165	138

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 2.A. Final Survey Instrument

1. Rayon: _____ 2. Village: _____

3. Date of Birth: day_____ month_____ year _____

4. Sex: ☐ Male ☐ Female

5.Nationality/Ethnicity_____

6. How many people are in your household, including yourself? _____
(Please count all individuals who live in this dwelling for three or more months out of the year.)

7. What is the name of your local Water Users' Association?
_____ ☐ Don't know

8. Are you a member of the local Water Users' Association?
☐ Yes ☐ No ☐ Don't know

9. In general, do you consider yourself to be active in the Water Users' Association, such as by attending meetings or by volunteering your time in other ways?

☐ Very Active (leader/zonal representative/mirab/staff) ☐ Active (but not a leader, staff, etc.)
☐ Somewhat active ☐ Not very active
☐ Inactive (no participation)

10. What is the name of the director of your local Water Users' Association?
_____ ☐ Don't know

Each irrigated area under the management of a Water Users' Association is divided into zones and has a "zonal representative."

11. Which zone is your irrigated land located in?_____☐ Don't know

12. What is the name of your zonal representative?
_____☐ Don't know

13. Have you ever voted for a zonal representative? ☐ Yes ☐ No

14. How many times in the past 12 months did you attend a "zonal meeting" to discuss irrigation issues?
☐ Once ☐ Twice ☐ Three times or more ☐ Never

15. How is the Director of the Water Users' Association selected?

☐ Leadership of the Ayil Okmotu selects the Director

☐ The WUA Council hires the Director
☐The previous Director appoints his successor
☐ Don't know

16. In your opinion, which of the following groups is most responsible for the long term success of the Water Users' Association?
☐ Kyrgyz Government ☐ The World Bank ☐ The community and members of the WUA
☐ The Local Government ☐ Farmers with large land holdings

17. Thinking about your local Water Users' Association and the services it provides, please indicate how informed you feel about the following items? Please mark an X in the box that best applies.

	Completely informed	Somewhat informed	Somewhat uninformed	Not at all informed
a. Schedule and location for WUA meetings (ex. Posted schedules, agendas, etc.)	☐	☐	☐	☐
b. The benefits of WUA membership	☐	☐	☐	☐
c. The responsibilities of WUA membership	☐	☐	☐	☐
d. Information on the WUA budget	☐	☐	☐	☐
e. Schedules for water delivery	☐	☐	☐	☐

18. How is your irrigation service fee determined? Please mark all that apply.

☐ Volume of water received ☐ Based on crops ☐ Amount of hectares irrigated ☐ Don't know

19. Thinking about your payment of the irrigation service fee, please indicate to what degree you agree or disagree with the following statements. Please mark an X in the box that best applies.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a. My payment of ISF ensures my right to water	☐	☐	☐	☐	☐
b. My payment of ISF ensures that I will receive on-time water delivery	☐	☐	☐	☐	☐
c. My household will be fined by the WUA if we do not pay the ISF.	☐	☐	☐	☐	☐
d. My household will not receive irrigation water if we do not pay the ISF.	☐	☐	☐	☐	☐
e. My household will be shamed by the community if we do not pay the ISF.	☐	☐	☐	☐	☐
f. The aksakals will hold my household accountable if we do not pay the ISF.	☐	☐	☐	☐	☐

20. Thinking about your local community and Water Users' Association, please indicate to what degree you agree or disagree with the following statements. Please mark an X in the box that best applies.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a. Water is delivered on-time	☐	☐	☐	☐	☐
b.Water is distributed in-line or by a schedule	☐	☐	☐	☐	☐
c.There is enough water for irrigation	☐	☐	☐	☐	☐
d. The Mirabs do a good job	☐	☐	☐	☐	☐
e. Beside the mirabs, the WUA personnel does a good job	☐	☐	☐	☐	☐

21. Have you ever been involved in discussions with zonal representatives OR the WUA leadership about the budget for Operation and Maintenance? ☐ Yes ☐ No

22. In general, how satisfied are you with the work of your community's WUA?
☐ Very satisfied ☐ Satisfied ☐ Neutral ☐ Unsatisfied ☐ Very unsatisfied

23. What is the size (in hectares) of your irrigated field area? _____

24. Do you rent your land? ☐ Yes ☐ No

25. What were the most important crops planted by your household during this past spring and summer?
_____

26. In this community, where are your irrigated lands located with regards to the source of irrigation water?
☐ Head (Beginning) ☐ Middle (Middle ☐ Tail (End)

27. Did you make any profit from your crop yields this year? ☐ Yes ☐ No

28. In comparison to spring and summer of 2008, did your household experience an increase in land under cultivation during spring and summer of 2009? ☐ Yes ☐ No

29. Besides winter wheat, did you plant any late season (or second) crops? ☐ Yes
☐ No

30. In comparison to spring and summer of 2008, did your overall crop yields increase or decrease during spring and summer of 2009?
☐ Increased significantly
☐ Increased a little
☐ Remained the same
☐ Decreased a little
☐ Decreased significantly

31. In comparison to spring and summer of 2008, was there an increase in the amount of irrigation water available for your crops in the spring and summer of 2009?

☐ Increased significantly
☐ Increased a little
☐ Remained the same
☐ Decreased a little
☐ Decreased significantly

32. If you had **unlimited** water for irrigation, how many times would you irrigate your fields during the following months?

Month	April	May	June	July	August
Number of irrigations					

33. Thinking about your local community, please indicate in your opinion, how often the following events occur. Please mark an X in the box that best applies.

	Very Often	Often	Occasionally	Rarely	Never
a. People violate water schedules by taking water out of turn	☐	☐	☐	☐	☐
b. There are tensions over irrigation water	☐	☐	☐	☐	☐
c. People damage the canals	☐	☐	☐	☐	☐
d. People damage the water gates	☐	☐	☐	☐	☐

34. In your opinion, how fairly is irrigation water distributed among farmers in your village?

☐ Very fair ☐ Fair ☐ Not fair or unfair ☐ Unfair ☐ Very Unfair

35. Thinking about your local community and Water Users' Association, please indicate to what degree you agree or disagree with the following statements. Please mark an X in the box that best applies.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a. Farmers who own large land plots get more water than farmers with smaller plots of land.	☐	☐	☐	☐	☐
b. People often take water by force	☐	☐	☐	☐	☐
c. Water is distributed by acquaintance, such as kin or clan	☐	☐	☐	☐	☐
d. Farmers who own large land plots get water first.	☐	☐	☐	☐	☐
e. People who pay bribes get water first	☐	☐	☐	☐	☐

36. If there is a very dry period with very little water for irrigation, who would deal with the situation?
_____

37. Thinking about your local community, please indicate to what degree you agree or disagree with the following statements. Please mark an X in the box that best applies.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a. The relationships among people in this village/neighborhood are generally harmonious.	☐	☐	☐	☐	☐
b. In this village, people generally trust each other to follow the schedules for crop watering during the irrigation season.	☐	☐	☐	☐	☐
c. Everyone in this community has equal access to irrigation water	☐	☐	☐	☐	☐

38. Differences often exist between people living in the same village/neighborhood. Thinking about your own village/neighborhood, please indicate to what degree you agree or disagree with the following statements. Please mark an X in the box that best applies.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a. Differences in size of landholdings tend to cause irrigation water problems.	☐	☐	☐	☐	☐
b. Differences in social status tend to cause irrigation water problems.	☐	☐	☐	☐	☐
c. Differences in religious beliefs tend to cause irrigation water problems.	☐	☐	☐	☐	☐
d. Differences in ethnicity tend to cause irrigation water problems.	☐	☐	☐	☐	☐

39. If tensions arise between people over irrigation water, how are these tensions usually settled?

	People work it out between themselves	Family/household members intervene	Aksakals mediate	WUA leaders mediate	Religious leaders mediate	Leaders from the Ayil Okmotu mediate
Yes	☐	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐	☐

Commentary (Any additional comments, statements or feedback from the respondent?)

Observations/comments from Interviewer

Interviewer: _____ Date: _____

Appendix 2.B. IBM results for WUASP, women and end-users in table format

The Tables for each of the individual behavioral mechanisms provides a summary of the significant interaction categories and their difference in estimated marginal means (demms) for the IBM I proxy measures along with their corresponding significance levels (i.e. 90%, 95%, 99%). There are three columns for each table. The first column includes the proxy measure under investigation. The second column summarizes the respondent categories where we find evidence of statistically significant positive and/or negative effects between program versus control respondents for the individual proxy measures. The respondent category is listed and the demm and significance level of the difference is parenthetically noted after the category. For example, Q7 asks respondents to name the WUA. In the second column of the table below I have written "begin(.45)***." This means that program respondents located at the beginning of the canal are 45% more likely than control respondents at the beginning of the canal to know the name of their WUA. The three asterisks (***) indicate that this is significant at the 99% level. The third column assesses whether or not the results provide support for the proxy measure/alternative hypotheses listed in column 1. The presence of a majority of significant and positive program effects leads me to reject the null hypothesis in favor of the alternative hypotheses. Finally, the row at the bottom of the table indicates whether or not we have overall support for the primary hypothesis under consideration.

Average WUASP Results for *knowledge*

Alternative Hypotheses	Evidence for positive program effects?	Support?
WUASP respondents are more likely to know the name of the WUA. (Q7)	Positive program effects: begin(.45)***; mid(.55)***; zone 1(.39)***; zone 2(.57)***; zone 3(.43)***	YES
WUASP respondents are more likely to know the director of the WUA. (Q10)	Positive program effects: members (.28)***; males(.24)***; females(.52)***, begin(.30)***; mid(.51)***; zone1(.29)***; zone 3(.46)***	YES
WUASP respondents are more likely to know their zonal representative. (Q12)	Positive program effects: uncertain(.55)***; males(.30)***; begin(.33)***; zone 3 (.39)***	YES
WUASP respondents are more aware of WUA governance procedures. (Q15)	Positive program effects: members(.21)**; uncertain(.55)***; begin(.42)***; end(.10)***; zone 1(.23)***; zone 3(.33)***	YES
WUASP respondents are more informed about WUA meetings. (Q17a)	Positive program effects: members(.33)**; uncertain(.23)***; males(.28)***; zone 1(.26)***; zone 2(.30)***	YES
WUASP respondents feel more informed about the benefits of WUA membership. (Q17b)	Positive control effects: (outcome 2) non-members (.21)*; begin(.14)**; zone 3(.22)*** & zone 3 for outcome 3(.17)**	YES
WUASP respondents feel more informed about the responsibilities of WUA membership (q17c)	Positive program effects: (outcome 1) members(.25)*** Positive control effects: (outcome 1) zone 2(.12)**; zone 3(.17)**	NO
WUASP respondents feel more informed about the WUA budget. (Q17d)	Positive program effects: members(.38)***; males(.17)***; zone 1(.15)**; zone 2(.10)**	YES
WUASP respondents feel more informed about water delivery schedules. (Q17e)	(1)Positive program effects: members(.22)***; middle(.22)** (2) Positive control effects: begin(.37)***; females(.32)***zone 1(.12)**	YES
$H_{KNOWLEDGE}$: Respondents in WUAs treated by WUASP are more knowledgeable about the WUA and irrigation management.		**YES**

Average WUASP Results for *participation*

Hypotheses	Evidence for positive program effects?	Support
WUASP respondents are more active participants in the WUA. (PARTIC index)[71]	Positive program effects: members (-1.03)***; uncertain(-.93)***; begin (-.815)***; middle(-.88)***; end(-.23)***	YES
WUASP respondents are more likely to have voted for their zonal representative. (Q13)	Positive program effects: uncertain(.15)***; zone 3(.15)** Positive control effect: non-members(.29)***	YES
$H_{PARTICIPATION}$: Respondents in WUAs treated by WUASP are more active participants in the WUA.		**YES**

[71] The PARTIC_C index was created from two questions. One question asked respondents to assess their activeness in the WUA based on their attendance at meetings and the overall amount of time that they dedicate to the WUA. The second questions asked respondents to indicate how many times they had attended a "zonal meeting" in the past year to discuss irrigation issues. The average inter-item correlation for the index is .7587 and the scale reliability coefficient is .8628. In order to assess the magnitude of the program effect for index outcomes, it is important to note the index score's range and whether or not a lower score represents positive or negative effect. For example, the PARTIC index ranges from -3.42 to 1.14 with an overall mean of 0. A *lower* PARTIC_C index score indicates a more active participant in the WUA. Therefore, in table above where I present the demm results for PARTIC_C, the "member(-1.03)" demm score indicates that program members score one point *lower* on the index score than control members which is a positive and large program effect.

Average WUASP Results for *attitudes*

Hypotheses	Evidence for positive program effects?	Support ?
WUASP respondents provide a higher evaluation of the work of the WUA personnel. (STAFF)[72]	Positive program effect: middle(-.87)**; zone 3(-1.02)***	YES
WUASP respondents express a higher degree of certainty than non-cooperative behaviors will be punished. (PUNISH)[73]	Positive program effects: members(-.79)***; uncertain(-1.32)*; zone 1(-.55)***; zone 3(-2.02)***	YES
WUASP respondents provide a better performance evaluation for their WUA. (Q22)	Positive program effect (outcome 1): members(.12)**	YES
WUASP respondents perceive more efficient irrigation management outcomes.(IRMAN)[74]	Positive program effects: zone 3(-1.32)***	YES
WUASP respondents have a stronger association between ISF payment and water rights. (ISF index)[75]	Positive program effects: members(-.36)*; zone 3(-.87)***	YES
WUASP respondents are more likely to accept responsibility & ownership for the WUA. (Q16)	Positive program effect: uncertain(.31)**; zone 3(.31)***	YES
$H_{ATTITUDES}$: Respondents in WUAs treated by WUASP express more positive attitudes about the WUA and irrigation management in comparison to those in control sites.		**YES**

[72] The STAFF index is based on two questions regarding respondents' satisfaction level with the work of the *mirabs (*"water masters") and with the work of WUA personnel other than the mirabs. The average inter-item correlation is .9218 and the scale reliability coefficient is .9593. The index has a mean of 1.386 and ranges from -2.087 to 2.93. A lower score on the index indicates that the respondent is more satisfied with the work of the WUA personnel.

[73] The PUNISH_C index is comprised of three questions that attempt to assess how likely respondents found the threat of punishment by aksakals and the WUA for ISF non-payment. Although the question is specifically about punishment, it implicitly provides information on how well the WUA monitors defection. The average inter-item correlation for the index is .6872 and the scale reliability coefficient is .8683. The index has a mean of 1.547 and ranges from -2.483 to 3.0547. A lower score on the index indicates that respondents feel more strongly that uncooperative behavior will be punished.

[74] The IRMAN index is based on two questions about whether or not water was delivered on-time and by a schedule. The average inter-item correlation is .83 and the scale reliability coefficient is .904. The index has a mean of 1.35 and ranges from -2.12 to 1.963. A lower score indicates that respondents feel more strongly that the WUA is efficiently managing irrigation water.

[75] The ISF index is based on two questions. The first question asks respondents how strongly they agree with the statement that irrigation service fee (ISF) payments ensure the right to water. The second question asks respondents how strongly they agree with the statement that ISF payments ensure on-time delivery of irrigation water. The average inter-item correlation for the index is .83 and the scale reliability coefficient is .91.The ISF index has a mean of 1.35 and ranges from -1.76 to 3.66. A lower score on the index indicates that the respondent holds a stronger belief that their ISF payment entitles them to adequate and on-time water delivery.

Average WUASP Results for *social capital*

Hypotheses	Evidence for positive program effects?	Support?
There are better community relations in treatment WUAs. (TRUST_REC)[76]	Positive program effect: zone 3(1.15)*** Positive control effect: zone 1(.76)*	NO
Divisions in economic and social status are not linked to tensions over irrigation water in WUASP WUAs. (ECON_STATUS)	Positive control effects: members(1.22)***; uncertain(1.57)***; males(.67)***; females(1.28)***; zone 1(.68)***; zone 2(.56)***; zone 3(.75)***	NO
Divisions in religion and ethnicity are not linked to tensions over irrigation water in WUASP WUAs. (REL_ETH)	Positive control effects: begin(.80)***;end(.48)***; zone 1(.96)***; zone 2 (.65)***; zone 3(.33)***	NO
Individuals in WUASP WUAs are more likely to solve tensions over irrigation water on their own. (Q39a)	Positive program effect: uncertain(.42)**; males(.28)***	YES
There is a stronger norm of community shaming for uncooperative behavior in WUASP WUAs. (Q19e)	No evidence of program effect for outcome 1; Positive program effect outcome 2(zone 3): (.08)* Positive control effect outcome 2(zone 1)(.08)***; zone 2(.14)**	NO
There is evidence of more cooperative behaviors in WUASP sites in comparison to control sites. (COOP_C) [77]	Positive program effect: zone 3(.83)*** Positive control result: members(1.31)***; zone 1(.79)*	NO

[76]The TRUST_REC index is based on two questions. One question asks respondents how strongly they agree that people generally trust each other to follow the schedules for crop watering during the irrigation season in their village. The second question asks them if community members have equal access to irrigation water. The average inter-item correlation is .7985 and the scale reliability coefficient is .888. The index has a mean of 1.34 and ranges from -2.189 to 2.398. A lower TRUST_REC index score indicates a higher assessment of trust and reciprocity.

[77] The COOP_NEW_C index was designed to investigate the perception of cooperative behavior between the populations within the treatment and control WUAs. It was created from four questions about the perceived presence (or absence) of specific "non-cooperative" behaviors that are argued to be hindrances to the long term success of the WUA. In particular, respondents were asked about the incidence rates of such acts as canal vandalism, "water stealing", taking water out-of-turn and general "tensions" or non-cooperative behavior over irrigation water. The average inter-item correlation is .68 and the scale reliability coefficient is .895. The mean of the COOP_NEW_C index is 1.75 and the index ranges from -2.53 to 3.30. Lower COOP_NEW_C index scores represent the perception of less cooperative community behavior.

There is less evidence of individuals damaging water gates in WUASP sites. (Q33d)	Positive control effect(outcome 1): females(.04)**; zone 1(.01)* ;zone 3(.01)* Positive program effect (outcome 2): non-members(.24)***; uncertain(.15)*; zone 2(.26); zone 3(.16)***	YES
WUASP respondents perceive more equitable irrigation management outcomes.(FAIR)[78]	No positive program effect Positive control effects: members(.70)***; uncertain (1.46)***; zone 1(.35)***; zone 2(1.50)***; zone 3(.94)***	NO
Q34(fair distribution)	No positive program effect Positive control effects: members(.15)***; end(.13)***; females(.13)***; zone 1(.09)**	NO
$H_{SOCIAL\ CAPITAL}$:Respondents in WUAs treated by WUASP exhibit more cooperative communal behaviors regarding irrigation water.		**NO**

[78] The FAIR_C index is based on three questions about whether or not water is distributed equitably among land parcels regardless of kin, land size and the payment of bribes. A higher score means that respondents believe that irrigation water is distributed more equally among land parcels.

Appendix 2.C.1. Regression output for the mechanisms – WUASP

KNOWLEDGE

	Logit					
VARIABLES	Q7	Q10	Q12	Q15	Q17a	Q17d
rent	0.118	-0.299	-0.128	0.359*	-0.532	-0.627
	(0.227)	(0.361)	(0.396)	(0.218)	(0.505)	(0.822)
program	1.466*	1.237	0.838	1.588**	1.858**	4.447***
	(0.890)	(0.946)	(1.052)	(0.680)	(0.843)	(0.922)
1.location	-1.042**	-1.088**	-0.548**	0.0184	-0.340**	0.315
	(0.504)	(0.525)	(0.241)	(0.401)	(0.140)	(0.235)
2.location	-0.293	0.341	0.0860	0.976**	-0.663	-0.513
	(0.362)	(0.548)	(0.234)	(0.434)	(0.412)	(0.379)
1.sex	-1.004***	-0.711***	-0.231	-0.869**	-0.492***	0.421
	(0.244)	(0.187)	(0.254)	(0.412)	(0.154)	(0.357)
1.ethnic	-0.0382	0.812*	-0.376	0.217	1.329*	0.554
	(0.400)	(0.476)	(0.439)	(0.238)	(0.693)	(0.429)
1.cropsX	0.470***	0.516	0.492	0.233***	-0.391***	0.0769
	(0.0984)	(0.369)	(0.384)	(0.0800)	(0.124)	(0.0745)
2.cropsX	0.0992	-0.139	-0.516	-0.823***	0.961***	3.270***
	(0.160)	(0.101)	(0.419)	(0.220)	(0.360)	(0.759)
agec	-0.0108	0.00271	-0.00235	-0.00600	0.00989*	0.0142
	(0.0121)	(0.0190)	(0.0103)	(0.0129)	(0.00570)	(0.0113)
logsizec	0.304	0.205	-0.137	-0.104	-0.168	-0.137
	(0.223)	(0.134)	(0.117)	(0.280)	(0.132)	(0.267)
1.wuapair	0.551	-2.078***	-1.928***	-0.940***	0.610	1.999***
	(0.362)	(0.322)	(0.639)	(0.308)	(0.393)	(0.258)
2.wuapair	-0.000197	0.228	0.628	-0.810***	4.081***	5.972***
	(0.413)	(0.231)	(0.670)	(0.249)	(0.598)	(0.733)
2.member	-0.609	0.282	-0.338	-0.713	-0.943**	-1.748***
	(1.096)	(0.413)	(0.567)	(0.801)	(0.392)	(0.432)
3.member	-2.658***	-2.371***	-2.160***	-2.813**	-1.808***	-0.492
	(0.779)	(0.458)	(0.677)	(1.256)	(0.629)	(0.570)
program#2.member	-1.291	-2.486***	-0.731	-0.975	-1.864**	-1.435*
	(1.407)	(0.883)	(0.877)	(0.932)	(0.850)	(0.750)
program#3.member	0.260	-0.524	0.787	3.150***	0.0265	-1.334***
	(0.808)	(1.040)	(0.575)	(0.978)	(0.303)	(0.359)
1.program#1.location	0.569**	0.947***	0.0848	-0.711	0.293	-0.499*
	(0.232)	(0.301)	(0.178)	(0.483)	(0.213)	(0.256)
1.program#2.location	-0.0719	0.363	-0.821**	-1.751***	0.695	-0.633
	(0.298)	(0.577)	(0.387)	(0.414)	(0.772)	(0.638)

1.program#1.sex	0.494	0.839*	-1.199***	-0.426	-0.905**	-2.057*
	(0.583)	(0.481)	(0.368)	(0.451)	(0.410)	(1.152)
1.program#1.cropsX	1.028***	0.852	0.989	-0.0869	0.497***	-0.601***
	(0.360)	(0.612)	(0.808)	(0.308)	(0.169)	(0.171)
1.program#2.cropsX	0.0955	0.871**	1.598**	0.947***	-1.374***	-3.284***
	(0.266)	(0.433)	(0.690)	(0.301)	(0.494)	(0.592)
2.member#1.location	0.377	0.425	-0.240	0.617	0.622**	-0.130
	(0.750)	(0.522)	(0.582)	(0.448)	(0.297)	(0.341)
2.member#2.location	-0.318	-0.795*	-0.324	-0.617	0.134	0.108
	(0.509)	(0.414)	(0.258)	(0.477)	(0.747)	(0.497)
3.member#1.location	1.531*	0.567*	1.545*	0.422	-0.995***	-2.141
	(0.898)	(0.343)	(0.833)	(1.069)	(0.379)	(1.609)
3.member#2.location	-0.155	-0.505*	0.630	-0.470	-0.0881	-1.226
	(0.621)	(0.303)	(1.034)	(1.231)	(1.139)	(1.132)
1.ethnic#1.sex	-0.304	-1.367***	0.589	0.468	1.420***	1.895
	(0.679)	(0.509)	(0.408)	(0.314)	(0.313)	(1.202)
1.ethnic#1.location	-0.245	-0.00142	0.505**	0.115	0.270	0.712***
	(0.189)	(0.572)	(0.207)	(0.251)	(0.264)	(0.190)
1.ethnic#2.location	0.534***	-0.437	1.239***	-0.0675	-0.184	1.141*
	(0.203)	(0.300)	(0.250)	(0.190)	(0.507)	(0.665)
Constant	0.418	1.839***	1.682**	-0.374	-2.578***	-6.476***
	(0.621)	(0.572)	(0.697)	(0.577)	(0.762)	(0.757)
Observations	1,131	1,131	1,123	1,131	1,127	1,114

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

	Multinomial					
VARIABLES	Q17b (outcome 1)	Q17b (outcome 2)	Q17b (outcome 3)	Q17c (out 1)	Q17c (out 2)	Q17c (out 3)
rent	-1.373	-0.379	-0.201	-0.750	-0.452	0.345
	(1.087)	(0.563)	(0.373)	(0.873)	(0.701)	(0.239)
program	1.988***	1.368**	0.790*	2.274***	0.465	0.954
	(0.493)	(0.594)	(0.475)	(0.802)	(0.718)	(0.719)
1.location	-0.929***	-0.616***	-0.374*	-1.435***	-0.568**	0.473
	(0.172)	(0.130)	(0.224)	(0.234)	(0.234)	(0.622)
2.location	-0.706*	-0.776***	-0.171**	-0.779**	-0.582**	0.587
	(0.399)	(0.125)	(0.0870)	(0.370)	(0.279)	(0.376)
1.sex	-0.0881	-0.590***	0.0586	-0.441*	-0.163	-0.122
	(0.392)	(0.166)	(0.424)	(0.249)	(0.341)	(0.722)
1.ethnic	0.718	0.823	-0.827	0.320	0.798	-0.552*
	(0.798)	(0.720)	(0.641)	(0.786)	(0.866)	(0.311)
1.cropsX	-0.269	-0.183	0.389	0.514*	-0.288	-0.169
	(0.556)	(0.132)	(0.262)	(0.281)	(0.339)	(0.162)
2.cropsX	2.643***	1.165***	1.081**	1.032	1.273	1.058*
	(0.396)	(0.174)	(0.455)	(1.037)	(0.831)	(0.551)
agec	0.0239***	0.00956	-0.000923	0.0115	-0.00423	-0.0121
	(0.00898)	(0.00891)	(0.00854)	(0.0155)	(0.00910)	(0.0159)

logsizec	-0.180	0.207	0.376	0.0900	0.162	0.111
	(0.264)	(0.288)	(0.256)	(0.350)	(0.477)	(0.288)
1.wuapair	1.345**	2.180***	1.529***	2.250*	2.515**	0.893
	(0.551)	(0.589)	(0.452)	(1.303)	(1.189)	(0.649)
2.wuapair	3.986***	4.117***	1.138***	3.815***	2.599***	-0.682*
	(0.468)	(0.677)	(0.389)	(0.760)	(0.819)	(0.407)
2.member	-2.498***	-0.748*	-1.522***	-0.347	-1.329***	-2.133***
	(0.308)	(0.419)	(0.526)	(0.675)	(0.433)	(0.578)
3.member	-17.65***	-2.379***	-2.123***	-1.414	-1.461	-2.828***
	(0.721)	(0.241)	(0.787)	(1.156)	(0.892)	(0.887)
program#2.member	-0.586	-2.425***	0.0676	-1.538**	0.0652	0.163
	(0.538)	(0.683)	(0.667)	(0.780)	(0.414)	(0.697)
program#3.member	14.06***	-1.552***	0.575	-15.08***	-1.058	0.524
	(0.841)	(0.310)	(1.010)	(1.598)	(0.911)	(1.032)
1.program#1.location	0.328	0.995***	0.315	1.026**	0.980	-0.465
	(0.278)	(0.215)	(0.383)	(0.411)	(0.613)	(0.850)
1.program#2.location	0.114	0.367	-0.0219	-0.218	0.463	-0.711*
	(0.634)	(0.584)	(0.322)	(0.564)	(0.449)	(0.430)
1.program#1.sex	-2.121***	-1.288***	-1.638**	-0.717	-0.691*	-0.678
	(0.768)	(0.189)	(0.777)	(0.455)	(0.379)	(0.750)
1.program#1.cropsX	0.860*	0.370	0.451	-0.326	0.363	0.775*
	(0.471)	(0.343)	(0.285)	(0.423)	(0.689)	(0.426)
1.program#2.cropsX	-2.794***	-2.989***	-1.794***	-3.012***	-4.181***	-2.922***
	(0.403)	(0.395)	(0.461)	(0.813)	(0.829)	(0.510)
1.ethnic#1.sex	2.022***	1.501***	1.343*			
	(0.573)	(0.186)	(0.717)			
1.ethnic#1.location	0.648**	-0.208	-0.238	0.366	-0.285	0.538
	(0.271)	(0.525)	(0.393)	(0.572)	(0.620)	(0.693)
1.ethnic#2.location	-0.0407	-0.0299	-0.131	-0.910***	-1.430***	-0.834***
	(0.414)	(0.489)	(0.323)	(0.320)	(0.579)	(0.289)
Constant	-2.135**	-2.419***	-0.325	-1.687	-0.397	0.122
	(0.933)	(0.810)	(0.503)	(1.153)	(0.834)	(0.790)
Observations	1,129	1,129	1,129	1,128	1,128	1,128

	Multinomial		
VARIABLES	Q17e(out. 1)	Q17e(out. 2)	Q17e(out. 3)
rent	-0.956	-0.351	0.0881
	(0.903)	(0.633)	(0.309)
program	1.284**	0.0999	0.557

	(0.517)	(0.350)	(0.562)
1.location	-0.956*	-0.783	0.580**
	(0.567)	(0.598)	(0.243)
2.location	-0.881***	-0.952***	0.626***
	(0.188)	(0.212)	(0.0849)
1.sex	-1.013***	0.0956	-0.353
	(0.382)	(0.377)	(0.540)
1.ethnic	0.657	0.124	-1.096*
	(0.804)	(0.569)	(0.570)
1.cropsX	0.738	0.608	0.318
	(0.510)	(0.685)	(0.441)
2.cropsX	0.0399	0.272	0.386
	(0.414)	(0.428)	(0.311)
agec	0.0153**	0.00220	-0.00963*
	(0.00616)	(0.00934)	(0.00526)
logsizec	-0.274	0.214	-0.0361
	(0.195)	(0.335)	(0.179)
1.wuapair	0.867*	1.179**	-1.548***
	(0.518)	(0.471)	(0.158)
2.wuapair	3.987***	1.853***	-2.165***
	(0.409)	(0.281)	(0.398)
2.member	-1.341**	-1.490***	-0.278
	(0.527)	(0.444)	(0.570)
3.member	-4.312***	-1.630**	-0.577
	(0.317)	(0.742)	(0.879)
program#2.member	-1.130**	-0.322	-0.772
	(0.505)	(0.463)	(0.615)
program#3.member	1.539***	-0.803	-0.324
	(0.475)	(0.809)	(0.875)
1.program#1.location	0.802	0.784	-0.465
	(0.566)	(0.684)	(0.504)
1.program#2.location	-0.471	0.642*	-0.833***
	(0.584)	(0.341)	(0.205)
1.program#1.sex	-0.563	-1.572**	-1.182
	(0.763)	(0.797)	(1.100)
1.program#1.cropsX	-0.162	0.351	1.303
	(0.763)	(0.922)	(1.202)
1.program#2.cropsX	-0.301	-1.337***	-0.347
	(0.350)	(0.335)	(0.516)
1.ethnic#1.sex	1.335*	1.027	0.495
	(0.732)	(0.820)	(0.970)
1.ethnic#1.location	0.296	0.0481	0.636
	(0.317)	(0.313)	(0.554)
1.ethnic#2.location	0.0675	-0.234	1.046***
	(0.444)	(0.323)	(0.182)
Constant	-1.088	0.524	0.916
	(0.907)	(0.724)	(0.575)
Observations	1,130	1,130	1,130

Robust standard errors in parentheses
***p<.001, **p<.05, *p<.01

PARTICIPATION

	Logit	OLS
VARIABLES	Q13	PARTIC
rent	-0.0148	0.370**
	(0.519)	(0.120)
1.program	-0.0597	-1.323***
	(0.634)	(0.235)
1.location	-1.079**	0.342
	(0.460)	(0.188)
2.location	-0.735***	-0.145
	(0.277)	(0.180)
1.sex	-0.272	0.488*
	(0.333)	(0.207)
1.ethnic	-1.037***	0.0194
	(0.337)	(0.0509)
1.cropsX	0.660***	-0.0687
	(0.150)	(0.239)
2.cropsX	-0.179	-0.0580
	(0.582)	(0.0886)
agec	0.0111	-0.00381
	(0.00829)	(0.00388)
logsizec	-0.0345	0.0192
	(0.177)	(0.0775)
1.wuapair	-2.549***	0.424**
	(0.693)	(0.108)
2.wuapair	0.716*	-0.356***
	(0.383)	(0.0874)
2.member	-1.305**	0.808
	(0.539)	(0.402)
3.member	-3.050**	1.056**
	(1.203)	(0.281)
1.program#2.member	-1.702**	0.929**
	(0.711)	(0.348)
1.program#3.member	1.958***	-0.0148
	(0.459)	(0.353)
1.program#1.location	0.425	-0.0766
	(0.273)	(0.122)
1.program#2.location	0.0176	0.586***
	(0.397)	(0.133)
1.program#1.sex	-1.337***	0.274
	(0.423)	(0.395)
1.program#1.cropsX	0.109	0.215
	(0.600)	(0.253)
1.program#2.cropsX	1.204**	0.113
	(0.536)	(0.0726)
2.member#1.location	0.722	-0.409
	(0.693)	(0.246)

2.member#2.location	0.578	0.0630
	(0.505)	(0.252)
3.member#1.location	0.267	-0.287
	(1.189)	(0.310)
3.member#2.location	-0.264	0.189
	(1.059)	(0.238)
1.ethnic#1.sex	-0.217	-0.00522
	(0.457)	(0.240)
1.ethnic#1.location	1.183***	-0.0984
	(0.277)	(0.131)
1.ethnic#2.location	-0.0262	-0.235
	(0.329)	(0.120)
Constant	1.745**	-0.545
	(0.786)	(0.315)
Observations	1,123	1,101
R-squared		0.415
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

ATTITUDES

	OLS				Logit
VARIABLES	STAFF	PUNISH	IRMAN	ISF	Q16
Rent	0.0124	0.117	0.0411	-0.0722	-0.284
	(0.103)	(0.147)	(0.0923)	(0.105)	(0.247)
1.program	0.249	-0.411	0.492*	0.625	0.260
	(0.403)	(0.242)	(0.238)	(0.412)	(0.368)
1.location	0.391	0.111	0.469	0.371	0.339
	(0.253)	(0.147)	(0.282)	(0.322)	(0.418)
2.location	0.519*	0.399	1.221***	0.559	-0.183
	(0.255)	(0.206)	(0.287)	(0.354)	(0.432)
1.sex	0.0416	0.0673	-0.0861	0.149	0.114
	(0.105)	(0.0705)	(0.0723)	(0.0765)	(0.395)
1.ethnic	-0.881*	-0.809**	-0.720*	-0.592**	1.919***
	(0.430)	(0.241)	(0.335)	(0.168)	(0.495)
1.cropsX	-0.337	-0.184	-0.527*	0.294**	0.178*
	(0.225)	(0.116)	(0.221)	(0.0980)	(0.0960)
2.cropsX	0.773	0.471	0.431	1.033***	-0.561
	(0.503)	(0.376)	(0.449)	(0.164)	(0.430)
agec	-0.00303	-0.000376	0.000843	-0.00305	-0.000988
	(0.00336)	(0.00116)	(0.00324)	(0.00415)	(0.00764)
logsizec	0.314**	0.108	0.247*	0.0870	-0.138
	(0.121)	(0.0794)	(0.102)	(0.0502)	(0.189)
1.wuapair	1.089	-0.455	0.306	0.395**	-0.635
	(0.576)	(0.368)	(0.584)	(0.141)	(0.389)
2.wuapair	-0.696*	-1.988***	-0.325	0.0546	0.628
	(0.299)	(0.260)	(0.252)	(0.229)	(0.420)
2.members	0.208	0.991	0.545	0.434	-0.688
	(0.305)	(0.522)	(0.339)	(0.256)	(0.687)
3.members	-0.0485	0.701**	-0.112	0.504	-1.064*
	(0.300)	(0.272)	(0.363)	(0.325)	(0.622)
1.program#2.members	0.740	-0.246	0.136	0.745*	-0.373
	(0.427)	(0.488)	(0.306)	(0.308)	(0.456)
1.program#3.members	0.0317	-0.533	-0.169	-0.00816	1.436***
	(0.248)	(0.302)	(0.312)	(0.397)	(0.503)
1.program#1.location	-0.635	-0.0936	-0.613	-0.475	0.318
	(0.407)	(0.256)	(0.343)	(0.273)	(0.329)
1.program#2.location	-0.308	-0.117	-0.779*	-0.437	0.150
	(0.398)	(0.231)	(0.313)	(0.350)	(0.362)
1.program#1.sex	-0.0147	0.273	0.399	-0.307	-0.724
	(0.304)	(0.282)	(0.411)	(0.242)	(0.491)
1.program#1.cropsX	-0.204	0.464**	0.202	-0.340	-0.811**
	(0.391)	(0.174)	(0.344)	(0.256)	(0.344)
1.program#2.cropsX	-2.163***	-1.428***	-1.580***	-1.297***	1.290***
	(0.335)	(0.228)	(0.300)	(0.205)	(0.309)
2.members#1.location	0.322*	-0.0849	0.235	-0.194	-0.304
	(0.156)	(0.228)	(0.182)	(0.253)	(0.539)
2.members#2.location	0.160	-0.335	0.230	0.0379	0.0752

	(0.207)	(0.182)	(0.226)	(0.189)	(0.619)
3.members#1.location	0.0780	-0.0541	0.398	-0.405	-0.428
	(0.368)	(0.298)	(0.588)	(0.407)	(0.587)
3.members#2.location	0.187	-0.515	0.342	-0.149	-0.637
	(0.309)	(0.290)	(0.423)	(0.383)	(0.803)
1.ethnic#1.sex	0.0288	-0.302	-0.370	0.184	0.0630
	(0.319)	(0.294)	(0.392)	(0.226)	(0.234)
1.ethnic#1.location	-0.0153	-0.209	-0.169	0.0452	-0.711**
	(0.243)	(0.249)	(0.184)	(0.114)	(0.287)
1.ethnic#2.location	0.269	0.227	-0.0798	0.646*	-1.222***
	(0.214)	(0.123)	(0.232)	(0.261)	(0.430)
Constant	-0.503**	0.466	-0.733**	-0.948	0.623
	(0.195)	(0.373)	(0.230)	(0.493)	(0.469)
Observations	1,106	1,107	1,104	1,105	1,130
R-squared	0.437	0.487	0.436	0.205	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

	Multinomial		
VARIABLES	Q22 (outcome 1)	Q22 (out. 2)	Q22 (out. 4)
Rent	-0.298	0.0941	0.0973
	(0.781)	(0.317)	(0.219)
1.program	-0.439	-1.476**	-0.647*
	(0.732)	(0.595)	(0.392)
1.location	-1.818***	-0.328	-0.907**
	(0.197)	(0.326)	(0.390)
2.location	-2.723***	-0.957***	-0.128
	(0.615)	(0.244)	(0.820)
1.sex	0.512	0.857***	0.534***
	(0.497)	(0.211)	(0.0708)
1.ethnic	15.69***	16.22***	15.62***
	(0.875)	(0.635)	(1.772)
1.cropsX	0.999*	0.847***	-0.250*
	(0.525)	(0.202)	(0.141)
2.cropsX	-16.12***	-1.478*	-0.500**
	(0.815)	(0.778)	(0.223)
Agec	0.0267	0.00442	0.00151
	(0.0167)	(0.0142)	(0.0140)
Logsizec	-0.488*	-0.277	0.451**
	(0.267)	(0.211)	(0.228)
1.wuapair	-0.537	-1.290	1.623***
	(0.600)	(0.856)	(0.271)
2.wuapair	2.403***	-0.479	-1.009***
	(0.422)	(0.443)	(0.310)
2.member	-0.768	-1.797***	-2.186***
	(0.737)	(0.649)	(0.521)
3.member	-2.030	-2.054**	-2.544**
	(1.810)	(0.977)	(1.008)
1.program#2.member	-0.499	1.460***	2.196***
	(0.808)	(0.474)	(0.465)
1.program#3.member	1.647**	2.194**	0.149
	(0.643)	(1.015)	(0.469)
1.program#1.sex	-0.293	-1.338***	0.129
	(0.844)	(0.314)	(0.474)
1.program#1.cropsX	-0.195	-0.648	-0.759***
	(0.848)	(0.467)	(0.293)
1.program#2.cropsX	18.71***	3.431***	-2.251***
	(1.158)	(0.478)	(0.218)
1.ethnic#1.sex	0.0571	0.639**	-1.111**
	(0.797)	(0.323)	(0.465)
1.ethnic#1.location	-14.20***	-15.12***	-30.49***
	(1.389)	(1.425)	(1.884)
1.ethnic#2.location	-14.61***	-15.74***	-14.94***

	(1.378)	(1.103)	(2.027)
2.member#1.location	0.120	-0.0247	2.112***
	(0.710)	(0.576)	(0.639)
2.member#2.location	0.654	-0.0700	1.554***
	(0.578)	(0.644)	(0.603)
3.member#1.location	-0.245	0.287	3.170***
	(2.041)	(1.624)	(0.603)
3.member#2.location	-14.66***	-0.103	2.424**
	(1.729)	(1.297)	(1.069)
Constant	0.0534	3.579***	-0.430
	(1.069)	(0.510)	(0.735)
Observations	1,101	1,101	1,101

Robust standard errors in parentheses
***p<.01, **p<.05,*p.1

SOCIAL CAPITAL

	OLS					Logit
VARIABLES	COOP	TRUST	ECSTAT	RELETHC	FAIR	Q39a
2.q24	0.283*	-0.000297	0.0302	-0.113	0.0214	-0.529**
	(0.129)	(0.0934)	(0.123)	(0.0762)	(0.0839)	(0.233)
1.program	-1.981***	0.948***	-1.208***	-1.224***	-1.825***	0.889***
	(0.286)	(0.194)	(0.263)	(0.302)	(0.320)	(0.240)
1.location	-0.444*	0.131	-0.402	-0.114	-0.424	1.131***
	(0.177)	(0.135)	(0.287)	(0.135)	(0.297)	(0.239)
2.location	-0.723*	0.535**	-0.665**	-0.244**	-0.456*	1.061*
	(0.295)	(0.186)	(0.207)	(0.0661)	(0.187)	(0.616)
1.sex	0.156	-0.0738	0.241**	-0.0151	-0.0109	0.182
	(0.225)	(0.154)	(0.0830)	(0.0624)	(0.107)	(0.136)
1.ethnic	1.382**	-1.318***	0.0217	-0.658**	0.426	0.377
	(0.406)	(0.327)	(0.215)	(0.211)	(0.268)	(0.297)
1.cropsX	0.289	-0.190	0.0700	-0.124	0.0560	-0.0682
	(0.273)	(0.163)	(0.141)	(0.0863)	(0.0688)	(0.199)
2.cropsX	-0.314	0.779	0.133	-0.343***	-0.157	0.418***
	(0.678)	(0.535)	(0.279)	(0.0829)	(0.288)	(0.156)
agec	-0.00513***	-0.00149	-0.00339	1.24e-05	-0.00243	0.000139
	(0.000974)	(0.00264)	(0.00409)	(0.00268)	(0.00294)	(0.00679)
logsizec	-0.0879	0.311**	0.141	0.124	0.0931	-0.440***
	(0.0691)	(0.0839)	(0.0867)	(0.0943)	(0.103)	(0.142)
1.wuapair	-0.874	0.481	-0.548*	-0.897***	-0.314	-1.669***
	(0.850)	(0.562)	(0.258)	(0.0783)	(0.303)	(0.198)
2.wuapair	0.0945	-0.343	0.543***	0.190	0.900***	-3.180***
	(0.337)	(0.319)	(0.0898)	(0.0978)	(0.137)	(0.0728)
2.member	-2.088***	0.588*	-1.458***	-0.373**	-1.032**	0.300
	(0.415)	(0.263)	(0.279)	(0.111)	(0.262)	(0.551)
3.member	-1.676**	0.736*	0.0138	-0.135	-0.353	-0.353
	(0.467)	(0.325)	(0.224)	(0.154)	(0.264)	(0.542)
1.program#2.member	1.244**	-0.233	1.143**	0.525	0.875**	0.141
	(0.442)	(0.396)	(0.347)	(0.338)	(0.297)	(0.487)
1.program#3.member	1.885**	-0.472	-0.321	-0.256	-0.0372	1.612***
	(0.667)	(0.331)	(0.164)	(0.131)	(0.607)	(0.462)
1.program#1.location	0.443	-0.364	0.412	0.142	0.515	-0.633
	(0.263)	(0.239)	(0.332)	(0.176)	(0.380)	(0.503)
1.program#2.location	0.388	-0.343	0.429	0.349*	0.255	-0.202
	(0.450)	(0.296)	(0.270)	(0.156)	(0.304)	(0.436)
1.program#1.sex	-0.632*	0.150	-0.502**	0.0379	0.143	-0.945***
	(0.258)	(0.296)	(0.155)	(0.163)	(0.340)	(0.344)
1.program#1.cropsX	0.434	0.191	-0.295*	0.339**	0.103	0.375
	(0.482)	(0.204)	(0.132)	(0.0968)	(0.192)	(0.280)
1.program#2.cropsX	1.853**	-1.851***	0.212	0.620***	0.572**	0.243
	(0.473)	(0.316)	(0.170)	(0.0836)	(0.186)	(0.172)
2.member#1.location	0.234	0.390*	-0.0416	-0.0497	-0.0695	-0.784**
	(0.225)	(0.164)	(0.208)	(0.124)	(0.176)	(0.348)

2.member#2.location	0.174	0.0577	0.157	-0.0672	-0.0555	-0.738
	(0.305)	(0.108)	(0.112)	(0.118)	(0.149)	(0.613)
3.member#1.location	1.300**	-0.233	-0.156	-0.0389	0.473	-1.041*
	(0.398)	(0.281)	(0.217)	(0.235)	(0.345)	(0.588)
3.member#2.location	0.0765	-0.0923	-0.0375	0.00638	0.0735	-0.645
	(0.346)	(0.205)	(0.148)	(0.191)	(0.256)	(0.725)
1.ethnic#1.sex	0.632**	-0.00921	0.398*	0.378*	-0.665	1.209*
	(0.205)	(0.247)	(0.176)	(0.148)	(0.489)	(0.650)
1.ethnic#1.location	-0.201	0.134	0.318**	0.0722	0.139	0.306
	(0.178)	(0.154)	(0.122)	(0.175)	(0.249)	(0.613)
1.ethnic#2.location	0.0765	0.0186	0.819***	0.671***	0.200	-1.076***
	(0.381)	(0.190)	(0.154)	(0.157)	(0.239)	
Constant						1.841***
	(0.235)	(0.149)	(0.256)	(0.0990)	(0.201)	(0.415)
Observations						1,121
R-squared						

Robust standard errors in parentheses
***p<.001,**p<.05,*p<0.1

			Multinomial		
VARIABLES	Q34 (outcome 2)	Q34 (outcome 3)	Q19e (outcome 2)	Q19e (outcome 3)	Q19e (outcome 4)
Rent	0.373***	0.139	0.226	0.111	0.0870
	(0.110)	(0.481)	(0.221)	(0.226)	(0.523)
1.program	0.644	1.740*	-0.260	0.138	-0.595
	(0.527)	(0.917)	(0.503)	(0.837)	(0.739)
1.location	1.260***	0.979**	0.167	-0.221	0.411
	(0.346)	(0.475)	(0.402)	(0.475)	(0.649)
2.location	1.599***	1.447***	0.894***	1.270***	1.684
	(0.462)	(0.458)	(0.166)	(0.308)	(1.211)
1.sex	-0.298	-0.152	0.327**	0.0947	0.859***
	(0.206)	(0.278)	(0.134)	(0.122)	(0.162)
1.ethnic	0.361	0.131	-0.0866	-1.528*	-0.951
	(0.355)	(2.302)	(0.255)	(0.917)	(0.747)
1.cropsX	-0.00427	-0.642	0.387	0.321**	0.348
	(0.149)	(0.793)	(0.308)	(0.143)	(1.127)
2.cropsX	0.215	0.445	1.753***	2.346**	2.170**
	(0.521)	(0.617)	(0.669)	(1.097)	(0.996)
Agec	0.00408	0.0117	-0.00581***	-0.0142*	-0.00896
	(0.00819)	(0.0178)	(0.00200)	(0.00803)	(0.0104)
Logsizec	-0.220	0.0680	-0.121	-0.120	-0.233
	(0.163)	(0.330)	(0.137)	(0.165)	(0.364)
1.wuapair	1.119***	1.469*	-2.113***	-0.245	1.724
	(0.410)	(0.882)	(0.595)	(1.008)	(1.257)
2.wuapair	0.244	-0.941*	-2.672***	-2.481***	-0.675
	(0.276)	(0.546)	(0.376)	(0.887)	(0.977)

2.member	0.970***	0.760***	1.650***	1.854***	2.717**
	(0.337)	(0.178)	(0.418)	(0.383)	(1.244)
3.member	0.281	0.0562	0.903	1.307*	0.857
	(0.550)	(0.298)	(0.833)	(0.692)	(1.350)
1.program#1.location	-0.944**	-1.624**			
	(0.374)	(0.659)			
1.program#2.location	-0.0487	-0.693			
	(0.570)	(0.649)			
1.program#1.sex	0.720***	0.845**			
	(0.255)	(0.412)			
1.program#1.cropsX	-0.221	-1.918	-0.133	0.483	-0.157
	(0.519)	(1.397)	(0.444)	(0.433)	(1.340)
1.program#2.cropsX	-1.367***	-4.387***	-2.308***	-4.025***	-4.531***
	(0.486)	(0.830)	(0.780)	(1.058)	(1.070)
1.ethnic#1.sex	-0.798***	-1.363***			
	(0.295)	(0.215)			
1.ethnic#1.location	0.483*	0.0658			
	(0.257)	(2.567)			
1.ethnic#2.location	0.300	0.515			
	(0.313)	(2.663)			
2.member#1.location			0.538	1.398**	1.020
			(0.640)	(0.606)	(0.722)
2.member#2.location			-1.149**	-0.644	-1.071
			(0.511)	(0.559)	(1.332)
3.member#1.location			-0.792	-0.271	0.463
			(0.680)	(0.860)	(1.032)
3.member#2.location			-2.107***	-1.428**	-2.330*
			(0.472)	(0.580)	(1.337)
Constant	-3.324***	-3.989***	2.281***	0.285	-3.099**
	(0.586)	(0.907)	(0.360)	(0.604)	(1.398)
Observations	1,118	1,118	1,130	1,130	1,130

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Q33d (outcome 1)	Multinomial Q33d (outcome 2)	Q33d (outcome 3)
Rent	-0.706***	-0.285	-0.138
	(0.247)	(0.351)	(0.316)
1.program	1.524	0.982*	0.259
	(1.098)	(0.530)	(0.464)
1.location	-0.335	0.804*	0.715***
	(0.402)	(0.477)	(0.250)
2.location	0.523	0.385	0.331**
	(0.380)	(0.456)	(0.163)
1.sex	0.478	0.235	-0.0648

	(0.651)	(0.456)	(0.361)
1.ethnic	-13.97***	0.614	-0.915***
	(1.405)	(0.477)	(0.211)
1.cropsX	-0.980***	0.436**	-0.0624
	(0.319)	(0.217)	(0.386)
2.cropsX	0.514	1.094***	0.979***
	(0.499)	(0.205)	(0.165)
Agec	0.0264**	0.0101	0.00608
	(0.0103)	(0.00620)	(0.00530)
Logsizec	0.0115	-0.127	-0.200
	(0.304)	(0.216)	(0.246)
1.wuapair	-2.162**	-1.412***	-1.655***
	(0.980)	(0.227)	(0.121)
2.wuapair	-1.021	-1.107**	-1.323***
	(1.147)	(0.551)	(0.176)
2.member	0.339	1.199	0.892
	(0.464)	(0.771)	(0.689)
3.member	-11.71***	2.899**	3.440***
	(0.798)	(1.390)	(1.007)
1.program#2.q8	0.332	-1.481***	-0.450
	(0.652)	(0.484)	(0.789)
1.program#3.q8	-2.577***	-2.607**	-3.163***
	(0.612)	(1.162)	(0.966)
1.program#1.cropsX	-2.864**	-1.998***	-0.289
	(1.170)	(0.559)	(0.496)
1.program#2.cropsX	-1.046	-1.574***	-0.718***
	(0.901)	(0.316)	(0.202)
1.ethnic#1.sex	-1.118	-0.721**	-0.0620
	(0.779)	(0.320)	(0.333)
1.ethnic#1.location	15.01***	-0.410	0.520
	(1.075)	(0.359)	(0.320)
1.ethnic#2.location	13.67***	-0.369	0.643***
	(0.885)	(0.428)	(0.156)
2.q8#1.location	0.181	-0.769	-0.926**
	(0.763)	(0.904)	(0.387)
2.q8#2.location	0.237	0.130	-0.519
	(0.519)	(0.738)	(0.440)
3.q8#1.location	13.58***	-3.558***	-3.014***
	(1.234)	(1.122)	(0.626)
3.q8#2.location	14.71***	-1.087	-1.883**
	(0.874)	(0.893)	(0.743)
Constant	-0.960	-0.456	0.535
	(1.132)	(0.608)	(0.442)
Observations	1,130	1,130	1,130

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix 2.C.2. Regression output for the mechanisms – Uzbek and Kyrgyz program respondents

KNOWLEDGE

	Logit			
VARIABLES	q7	q10	q12	q15
1.location	-0.158	0.0337	-0.665***	-0.462***
	(0.308)	(0.231)	(0.250)	(0.171)
2.location	-0.588***	0.0778	-0.949***	-0.811***
	(0.0697)	(0.357)	(0.332)	(0.105)
1.sex	-0.311*	0.274	-1.354***	-1.112***
	(0.168)	(0.444)	(0.0773)	(0.0470)
1.ethnic	2.761***	1.098**	0.133	-0.145
	(0.278)	(0.450)	(0.159)	(0.358)
1.cropsX	1.575***	1.345***	1.462***	-0.865***
	(0.176)	(0.295)	(0.396)	(0.209)
2.cropsX	0.648**	-0.621***	0.109	-0.331
	(0.283)	(0.0887)	(0.0716)	(0.323)
agec	-0.0223***	-0.0145**	-0.00415	-0.0105
	(0.00656)	(0.00625)	(0.0245)	(0.0197)
logsizec	0.644***	0.757***	0.359	0.170
	(0.0887)	(0.0664)	(0.438)	(0.497)
2.member	-1.742***	-1.797***	-0.763	-1.509**
	(0.531)	(0.574)	(0.500)	(0.607)
3.member	-1.579***	-2.466***	0.113	0.0521
	(0.398)	(0.918)	(0.110)	(0.134)
1.ethnic#1.sex	-1.100***	-1.627***	0.657***	0.290***
	(0.177)	(0.437)	(0.0963)	(0.0539)
1.ethnic#1.cropsX	-1.073***	-1.416***	-1.626***	1.118***
	(0.180)	(0.280)	(0.491)	(0.302)
1.ethnic#2.cropsX	-0.778***	-0.0524	-0.701***	0.417
	(0.280)	(0.0892)	(0.149)	(0.417)
1.ethnic#1.location	-0.365	-0.0306	1.010***	-0.143
	(0.322)	(0.231)	(0.250)	(0.152)
1.ethnic#2.location	0.476***	-0.579*	0.834***	-0.483***

	(0.0837)	(0.342)	(0.261)	(0.0320)
2.member#1.ethnic	-2.352***	-1.073*	-1.256**	-1.721***
	(0.514)	(0.585)	(0.579)	(0.517)
3.member#1.ethnic	-0.885**	-0.797	-1.084***	0.388***
	(0.365)	(0.917)	(0.111)	(0.121)
Constant	1.807***	2.237***	1.970***	1.218***
	(0.306)	(0.498)	(0.418)	(0.187)

Logit

VARIABLES	q17a	q17b	q17c	q17d	q17e
1.location	-0.0715	-0.186	0.0397	-0.353**	-0.133
	(0.0892)	(0.175)	(0.182)	(0.159)	(0.299)
2.location	-0.175	-0.486	-0.552***	-0.784**	-0.441**
	(0.650)	(0.673)	(0.0972)	(0.339)	(0.221)
1.sex	-1.438**	-1.213*	-0.723	-1.285***	-0.673***
	(0.631)	(0.682)	(0.641)	(0.270)	(0.0201)
1.ethnic	1.963**	2.022***	1.742***	2.147**	2.300***
	(0.767)	(0.752)	(0.492)	(0.884)	(0.621)
1.cropsX	1.553**	1.286***	1.691***	1.577*	1.894**
	(0.649)	(0.232)	(0.462)	(0.853)	(0.875)
2.cropsX	-0.195	-0.424	-0.772**	1.112	0.466
	(0.589)	(0.577)	(0.313)	(0.860)	(0.476)
agec	-0.0132	-0.00752	-0.0145	0.00171	-0.0169
	(0.0249)	(0.0213)	(0.0263)	(0.0191)	(0.0220)
logsizec	0.701***	0.420***	0.957***	0.560**	0.684
	(0.196)	(0.110)	(0.297)	(0.281)	(0.480)
2.member	-1.324***	-1.642***	-0.268	-1.245*	-0.927
	(0.157)	(0.320)	(0.582)	(0.665)	(0.609)
3.member	-1.322**	-3.172***	-1.831***	-3.435***	-2.409***
	(0.619)	(0.196)	(0.159)	(0.173)	(0.306)
1.ethnic#1.sex	1.707***	1.149*	0.681	1.625***	0.738***
	(0.614)	(0.671)	(0.623)	(0.258)	(0.0535)
1.ethnic#1.cropsX	-1.207	-1.690***	-1.613***	0.758***	-0.0285
	(0.743)	(0.242)	(0.580)	(0.157)	(0.309)
1.ethnic#2.cropsX	-0.285	-0.314	0.412	0.245	-0.430
	(0.657)	(0.642)	(0.378)	(0.394)	(0.283)
1.ethnic#1.location	0.445***	0.609***	-0.153	-2.506***	-1.750
	(0.0922)	(0.186)	(0.181)	(0.864)	(1.076)
1.ethnic#2.location	0.214	0.311	-0.0615	-1.876**	-1.082**
	(0.777)	(0.793)	(0.174)	(0.857)	(0.524)
2.member#1.ethnic	-0.455***				

	(0.0427)				
3.member#1.ethnic	-2.029***				
	(0.542)				
Constant	-0.849	-0.984	-0.583	-1.327	-0.512
	(0.776)	(0.720)	(0.558)	(1.065)	(0.737)

PARTICIPATION

VARIABLES	OLS PARTIC_C	Logit Q13
1.location	0.203	-0.499
	(0.0925)	(0.433)
2.location	0.532***	-0.567***
	(0.0229)	(0.132)
1.sex	0.806	-1.552***
	(0.366)	(0.249)
1.ethnic	0.384*	-2.191***
	(0.0936)	(0.353)
1.cropsX	0.197**	0.251*
	(0.0290)	(0.144)
2.cropsX	0.308	-0.610
	(0.135)	(0.451)
agec	0.00375	-0.00359
	(0.00226)	(0.0114)
logsizec	-0.289*	0.724
	(0.0837)	(0.455)
2.member	1.561***	-2.040***
	(0.0782)	(0.331)
3.member	0.989	-1.358***
	(0.420)	(0.211)
1.ethnic#1.sex	-0.260	0.0316
	(0.367)	(0.198)
1.ethnic#1.cropsX	-0.203**	0.477**
	(0.0305)	(0.197)
1.ethnic#2.cropsX	-0.197	0.759
	(0.163)	(0.535)
1.ethnic#1.location	-0.290*	1.037**
	(0.0873)	(0.422)
1.ethnic#2.location	-0.254**	-0.853***
	(0.0571)	(0.197)
2.q8#1.ethnic	0.0913	
	(0.100)	
3.q8#1.ethnic	0.438	
	(0.412)	
Constant	-1.487***	1.206***
	(0.0235)	(0.102)
Observations	542	542

R-squared	0.330

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

ATTITUDES

	OLS			
VARIABLES	IRMAN	ISF	STAFF	PUNISH
1.location	0.0545	-0.145*	0.0173	0.209
	(0.131)	(0.0406)	(0.338)	(0.247)
2.location	0.597**	0.156	0.374	0.413
	(0.0872)	(0.177)	(0.336)	(0.175)
1.sex	0.444	-0.100	0.150	0.423
	(0.373)	(0.220)	(0.233)	(0.196)
1.ethnic	-0.792*	0.279	-0.450	-0.959
	(0.238)	(0.152)	(0.428)	(0.392)
1.cropsX	-0.358	0.174	-0.706	-0.831
	(0.151)	(0.352)	(0.384)	(0.318)
2.cropsX	-1.282*	0.143	-0.845*	-1.325*
	(0.337)	(0.0729)	(0.281)	(0.428)
Agec	-0.00192	-0.0105	-0.00819	0.00533
	(0.000708)	(0.00426)	(0.00710)	(0.00697)
Logsizec	0.237	0.0442	0.245	0.0697
	(0.176)	(0.137)	(0.201)	(0.181)
2.q8	0.699***	1.138	0.614	0.281**
	(0.0641)	(0.424)	(0.237)	(0.0554)
3.q8	-0.0160	0.360	0.361	0.0303
	(0.0259)	(0.131)	(0.154)	(0.405)
1.ethnic#1.sex	-0.518	0.215	-0.144	-0.269
	(0.387)	(0.219)	(0.244)	(0.197)
1.ethnic#1.cropsX	0.0962	-0.920	0.424	0.725
	(0.166)	(0.364)	(0.418)	(0.345)
1.ethnic#2.cropsX	0.863	-0.778***	0.267	0.830
	(0.361)	(0.0733)	(0.288)	(0.431)
1.ethnic#1.location	-0.221	0.111	-0.0754	-0.222
	(0.127)	(0.0426)	(0.343)	(0.254)
1.ethnic#2.location	0.116	0.607*	0.545	0.114
	(0.0760)	(0.204)	(0.356)	(0.188)
2.q8#1.ethnic	-0.0900	-0.532	1.055*	-0.721**
	(0.0562)	(0.410)	(0.246)	(0.0843)
3.q8#1.ethnic	0.167**	-0.126	-0.351*	0.415
	(0.0341)	(0.156)	(0.105)	(0.436)
Constant	-0.327	-0.407**	-0.308	-0.222
	(0.158)	(0.0784)	(0.441)	(0.355)
Observations	543	546	543	542

R-squared	0.431	0.238	0.274	0.256

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

	Logit	**Multinomial**		
VARIABLES	Q16	q22 (outcome 1)	q22 (outcome 3)	q22 (outcome 4)
1.location	0.427**	-1.471***	0.0187	-0.352
	(0.173)	(0.0794)	(0.170)	(0.274)
2.location	-0.144	-2.150	0.906***	1.499**
	(0.132)	(1.427)	(0.226)	(0.758)
1.sex	-0.638**	0.595	0.551	1.363**
	(0.299)	(0.523)	(0.359)	(0.554)
1.ethnic	0.446***	-0.334	-14.47***	-12.75***
	(0.0774)	(0.414)	(0.778)	(1.398)
1.cropsX	-0.568	1.340*	-0.0709	-1.081***
	(0.418)	(0.721)	(0.430)	(0.156)
2.cropsX	0.159**	0.968	-1.011***	-3.559***
	(0.0632)	(0.794)	(0.0825)	(0.130)
Agec	0.000548	0.0105	-0.00549	-0.0331**
	(0.0164)	(0.0328)	(0.0107)	(0.0153)
Logsizec	-0.0863	0.711***	0.568	0.425
	(0.450)	(0.164)	(0.358)	(0.263)
2.member	-1.027***	-0.136	0.527	1.536***
	(0.324)	(0.243)	(0.437)	(0.569)
3.member	-0.796***	0.276	0.470	0.578
	(0.0342)	(0.896)	(0.429)	(0.695)
1.ethnic#1.sex	-0.213	-0.131	-0.305	-1.924***
	(0.305)	(0.434)	(0.413)	(0.613)
1.ethnic#1.cropsX	1.019*			
	(0.522)			
1.ethnic#2.cropsX	0.644***			
	(0.0703)			
1.ethnic#1.location	-0.615***	1.134***	14.98***	0.235*
	(0.178)	(0.0808)	(1.315)	(0.125)
1.ethnic#2.location	-1.044***	1.065	15.23***	15.22***
	(0.194)	(1.407)	(1.057)	(1.244)
2.member#1.ethnic	1.131***	-15.95***	-16.32***	-0.561
	(0.282)	(1.120)	(1.617)	(0.612)
3.member#1.ethnic	1.339***	-16.93***	-1.983***	-1.425*
	(0.0484)	(2.166)	(0.568)	(0.771)
Constant	0.836***	-2.242**	-2.035***	-3.229***

	(0.250)	(1.136)	(0.331)	(0.759)
Observations	545	531	531	531
R-squared				

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

SOCIAL CAPITAL

	OLS				
VARIABLES	COOP	COMREL	ECSTAT	RELETH	FAIR
1.location	-0.0354	0.0289	-0.0993	-0.0618	-0.0187
	(0.0673)	(0.153)	(0.131)	(0.186)	(0.296)
2.location	-0.397	0.345	-0.263	0.0177	-0.269
	(0.185)	(0.253)	(0.0914)	(0.0929)	(0.346)
1.sex	-0.513*	0.340	-0.397	-0.169	0.0801
	(0.136)	(0.194)	(0.149)	(0.156)	(0.330)
1.ethnic	1.429**	-1.078*	-0.635	-0.951*	0.512
	(0.232)	(0.276)	(0.259)	(0.274)	(0.538)
1.cropsX	0.644*	-0.104	0.230	0.00461	0.486*
	(0.188)	(0.0650)	(0.129)	(0.178)	(0.150)
2.cropsX	1.298**	-1.077**	-0.0817	-0.375**	0.476
	(0.237)	(0.201)	(0.139)	(0.0756)	(0.321)
Agec	-0.00313	-0.0103***	0.00130	0.000412	-0.00158
	(0.00576)	(0.000957)	(0.00201)	(0.00266)	(0.00462)
Logsizec	-0.124	0.403*	0.0769	0.457**	0.247
	(0.163)	(0.131)	(0.115)	(0.0651)	(0.192)
2.member	-0.579***	0.391	-0.205	0.243	-0.00530
	(0.0535)	(0.209)	(0.215)	(0.394)	(0.200)
3.member	-0.00569	0.0181	-0.598***	-0.460	-0.929**
	(0.407)	(0.0342)	(0.0444)	(0.234)	(0.103)
1.ethnic#1.sex	0.665**	-0.227	0.532*	0.531*	-0.908
	(0.128)	(0.200)	(0.155)	(0.156)	(0.345)
1.ethnic#1.cropsX	-0.364	-0.0878	-0.390	0.0515	-0.704*
	(0.221)	(0.0826)	(0.138)	(0.178)	(0.182)
1.ethnic#2.cropsX	-1.156**	0.841*	0.297	0.253	-0.794
	(0.238)	(0.213)	(0.162)	(0.0945)	(0.340)
1.ethnic#1.location	-0.218*	-0.0447	0.366	0.189	0.290
	(0.0689)	(0.152)	(0.132)	(0.187)	(0.297)
1.ethnic#2.location	-0.208	0.202	0.778**	0.578**	-0.0556
	(0.206)	(0.257)	(0.107)	(0.116)	(0.370)
2.member#1.ethnic	0.773***	-0.734*	0.384	-0.394	0.166
	(0.0683)	(0.212)	(0.205)	(0.381)	(0.188)
3.member#1.ethnic	1.195*	0.385***	0.0844	-0.313	1.855***
	(0.368)	(0.0178)	(0.0592)	(0.238)	(0.0684)
Constant	-0.233	0.0510	0.104	-0.188	-0.548
	(0.175)	(0.210)	(0.198)	(0.230)	(0.480)

Observations	545	545	541	542	542
R-squared	0.352	0.410	0.094	0.229	0.101

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

	Logit	**Multinomial**			
VARIABLES	q39a	q19e (outcome 1)	q19e (outcome 3)	q33d (outcome 1)	q33d (outcome 3)
1.location	0.235	-0.151	0.0816	-0.871**	-0.294
	(0.539)	(0.709)	(0.299)	(0.396)	(0.216)
2.location	0.699***	-0.877*	0.446	0.186	-0.440
	(0.249)	(0.507)	(0.421)	(0.177)	(0.320)
1.sex	-0.740***	0.137	0.0799	1.236***	0.00990
	(0.172)	(0.360)	(0.577)	(0.311)	(0.699)
1.ethnic	-0.861	2.195**	1.195***	-14.43***	1.042**
	(0.637)	(0.933)	(0.0371)	(1.099)	(0.525)
1.cropsX	-1.163**	1.392***	0.726***	-2.332***	1.624***
	(0.572)	(0.200)	(0.0817)	(0.889)	(0.484)
2.cropsX	-0.613	2.144***	0.537***	-1.573***	0.986***
	(0.614)	(0.783)	(0.180)	(0.393)	(0.332)
Agec	0.0219*	0.000496	-0.0174*	0.0295***	-0.0187*
	(0.0129)	(0.0101)	(0.00976)	(0.00428)	(0.00966)
Logsizec	-0.895***	0.0520	0.0861	-0.566	0.157
	(0.111)	(0.394)	(0.178)	(0.371)	(0.311)
2.member	-0.712**	-0.854**	0.998***	1.263**	0.0697
	(0.340)	(0.348)	(0.326)	(0.558)	(0.457)
3.member	0.836	0.394	1.194***	0.876***	1.561*
	(0.702)	(1.011)	(0.401)	(0.0866)	(0.898)
1.ethnic#1.sex	0.858***	-0.0811	0.337	-1.834***	0.164
	(0.170)	(0.371)	(0.589)	(0.328)	(0.715)
1.ethnic#1.cropsX	1.258**	-1.973***	-1.170***	-12.45***	-0.557
	(0.594)	(0.219)	(0.0554)	(1.216)	(0.556)
1.ethnic#2.cropsX	1.405**	-2.252***	-1.537***	1.333***	-0.610*
	(0.609)	(0.800)	(0.120)	(0.378)	(0.328)
1.ethnic#1.location	0.621	0.0226	-0.128	14.30***	-0.388*
	(0.539)	(0.716)	(0.311)	(1.544)	(0.216)
1.ethnic#2.location	-0.897***	0.0133	0.590	12.20***	0.237
	(0.251)	(0.538)	(0.519)	(1.268)	(0.343)
2.member#1.ethnic	0.712*	-0.460	-2.138***	-14.04***	0.807*
	(0.364)	(0.340)	(0.387)	(1.337)	(0.437)
3.member#1.ethnic	-0.291	-1.844*	-1.448***	2.838***	0.295

	(0.709)	(1.085)	(0.380)	(0.192)	(0.898)
Constant	1.758***	-1.712**	-1.853***	-1.374***	-0.921
	(0.668)	(0.864)	(0.137)	(0.138)	(0.635)
Observations	540	546	546	547	547
R-squared					

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix 2.C.3. Regression output for the mechanisms – Uzbek and Kyrgyz respondents in Ykbol WUA

KNOWLEDGE

1.location	-0.861***	0.608	-0.518	-0.355
	(0.189)	(0.417)	(0.315)	(0.310)
2.location	-0.410***	0.842***	-0.861**	-0.638***
	(0.100)	(0.149)	(0.411)	(0.124)
1.sex	-0.447***	0.580*	-1.426***	-1.186***
	(0.0776)	(0.304)	(0.166)	(0.0499)
1.KYRGYZ	0.310	-1.342***	-0.232	0.552**
	(0.264)	(0.208)	(0.187)	(0.224)
1.cropsX	1.308***	1.837***	2.498***	-0.755***
	(0.329)	(0.345)	(0.638)	(0.188)
2.cropsX	0.225**	0.631***	0.693***	-0.278***
	(0.0999)	(0.0973)	(0.130)	(0.0566)
Agec	-0.0214***	-0.0214***	-0.0180	-0.0154
	(0.00586)	(0.00450)	(0.0143)	(0.0226)
Logsizec	0.847***	0.501***	0.0953	-0.0579
	(0.0535)	(0.0759)	(0.556)	(0.349)
2.member	-1.637***	-1.156**	-0.830	-1.620***
	(0.109)	(0.553)	(0.542)	(0.543)
3.member	-2.473***	-2.514***	0.176***	0.0191
	(0.518)	(0.700)	(0.0371)	(0.259)
2.q8#1.location	1.442***	-0.747		
	(0.338)	(0.624)		
2.q8#2.location	-0.409*	-1.388***		
	(0.227)	(0.261)		
3.q8#1.location	1.391	-0.0591		
	(1.314)	(0.593)		
3.q8#2.location	0.794***	0.422**		
	(0.150)	(0.200)		

1.KYRGYZ#2.q8	-4.776***			
	(0.437)			
1.KYRGYZ#1.location				
	2.237***	-.239	-.721	-.830
	(0.158)	(0.440)	(0.321)	(0.396)
1.KYRGYZ#2.location	0.119	-0.477**	-0.774**	-1.188***
	(0.115)	(0.221)	(0.392)	(0.257)
Constant	1.791***	1.986***	2.065***	1.195***
	(0.248)	(0.441)	(0.508)	(0.152)
Observations	388	387	386	383

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

	Logit				
VARIABLES	q17a	q17b	q17c	q17d	q17e
1.location	-0.0796	-0.0964	0.183	-0.487***	-0.248
	(0.208)	(0.139)	(0.301)	(0.126)	(0.313)
2.location	0.381	-0.0660	-0.243	-0.361**	-0.571***
	(0.358)	(0.335)	(0.255)	(0.153)	(0.133)
1.sex	-2.046***	-1.081	-0.460	-1.109***	-0.457***
	(0.474)	(0.718)	(0.589)	(0.329)	(0.114)
1.KYRGYZ	-0.392	0.102	-0.636***	-0.159	0.186
	(0.378)	(0.673)	(0.0912)	(0.921)	(0.378)
1.cropsX	1.731***	1.373***	1.489***	1.371***	1.527**
	(0.523)	(0.138)	(0.508)	(0.488)	(0.644)
2.cropsX	0.401**	-0.505***	0.0774	1.147***	0.0919
	(0.185)	(0.0740)	(0.182)	(0.213)	(0.117)
Agec	-0.0238	-0.0310	-0.0301	-0.0313***	-0.0450
	(0.0315)	(0.0249)	(0.0397)	(0.00583)	(0.0348)
Logsizec	0.816***	0.494**	1.096***	0.909***	0.986
	(0.220)	(0.243)	(0.356)	(0.0928)	(0.643)
2.member	-1.334***	-1.372***	0.618	-0.922	-0.256***
	(0.203)	(0.246)	(0.495)	(0.828)	(0.0827)
2.member#1.location	0.737***	-0.230	0.166	-0.143	0.0374
	(0.0870)	(0.244)	(0.421)	(0.0910)	(0.291)
2.member#2.location	-1.663***	-2.413	-0.716	-1.252***	-0.144
	(0.429)	(1.515)	(0.687)	(0.121)	(0.316)
1.KYRGYZ#2.member	0.273**	1.386**	-1.227***	0.00744	-1.842***
	(0.113)	(0.664)	(0.0833)	(0.780)	(0.150)
1.KYRGYZ#1.location				0.900***	0.797**
				(0.200)	(0.386)
1.KYRGYZ#2.location				-0.549***	0.883***
				(0.145)	(0.165)
2.member#1.sex			-1.635***		-0.682**
			(0.584)		(0.278)
Constant	-1.106*	-1.221**	-0.896*	-1.643	-0.740
	(0.614)	(0.565)	(0.507)	(1.109)	(0.486)
Observations	363	367	367	365	365

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

PARTICIPATION

VARIABLES	OLS PARTIC_C	Logit Q13
1.location	0.557**	-0.347
	(0.110)	(0.494)
2.location	0.755**	-0.571***
	(0.105)	(0.196)
1.sex	0.921	-1.500***
	(0.352)	(0.200)
1.KYRGYZ	0.265	-1.302***
	(0.373)	(0.113)
1.cropsX	0.166*	0.493**
	(0.0562)	(0.224)
2.cropsX	0.0293	0.576***
	(0.0478)	(0.0909)
Agec	0.00327	-0.00881
	(0.00155)	(0.00771)
Logsizec	-0.222	0.413
	(0.0969)	(0.252)
2.member	2.059***	-2.032***
	(0.0381)	(0.326)
3.member	1.660***	-1.036***
	(0.0952)	(0.394)
2.member#1.location	-0.984***	
	(0.0839)	
2.member#2.location	-0.534**	
	(0.123)	
3.member#1.location	-1.736	
	(0.686)	
3.member#2.location	-0.732**	
	(0.0828)	
1.KYRGYZ#2.member	0.797**	
	(0.110)	
1.KYRGYZ#3.member	1.174	
	(0.419)	
1.KYRGYZ#1.location	-0.0231	-0.388
	(0.227)	(0.509)
1.KYRGYZ#2.location	-0.347	0.349**
	(0.201)	(0.177)
Constant	-1.731***	1.291***
	(0.137)	(0.166)

Observations	387	387
R-squared	0.322	

Robust standard errors in parentheses
***p<.001,**p<.05,*p<.01

ATTITUDES

	OLS			
VARIABLES	STAFF	PUNISH	IRMAN_NEW_C	ISF_NEW_C
1.location	0.103	0.418	0.174	0.0965
	(0.385)	(0.292)	(0.0718)	(0.148)
2.location	0.357	0.428	0.654***	0.228
	(0.380)	(0.225)	(0.0321)	(0.309)
1.sex	0.200	0.393*	0.488	-0.0900
	(0.223)	(0.119)	(0.337)	(0.184)
1.KYRGYZ	-1.170	-1.207*	-1.473**	0.148
	(0.420)	(0.294)	(0.218)	(0.357)
1.cropsX	-0.504	-0.646	-0.153*	0.0349
	(0.259)	(0.238)	(0.0446)	(0.457)
2.cropsX	0.0767	-0.217*	-0.0503	-0.00394
	(0.0631)	(0.0640)	(0.0215)	(0.135)
agec	-0.00640	0.00917	6.65e-05	-0.0132**
	(0.00796)	(0.00754)	(0.00244)	(0.00276)
logsizec	0.0852	-0.132	0.0196	0.140
	(0.172)	(0.0622)	(0.0662)	(0.223)
2.member	0.396	0.298	0.627***	1.490
	(0.229)	(0.130)	(0.0523)	(0.612)
3.member	0.735	-0.145	0.185	1.407**
	(0.572)	(0.155)	(0.110)	(0.143)
2.member#1.location	0.0209	-0.134	-0.0627	-0.644*
	(0.0914)	(0.276)	(0.0220)	(0.212)
2.member#2.location	0.165	-0.224	-0.00394	-0.197
	(0.197)	(0.0891)	(0.0552)	(0.170)
3.member#1.location	-0.483	0.167	-0.102	-1.783***
	(0.168)	(0.414)	(0.0537)	(0.151)
3.member#2.location	-0.0392		-0.0663	-1.147*
	(0.711)		(0.0463)	(0.360)
1.KYRGYZ#2.member	0.958**	-0.428**	0.189	-0.695
	(0.183)	(0.0598)	(0.0747)	(0.438)
1.KYRGYZ#3.member	-0.148	1.052***	0.145	0.340
	(0.391)	(0.0860)	(0.0892)	(0.156)
1.KYRGYZ#1.location	-0.0720	-0.520	-0.0686	0.0808
	(0.444)	(0.277)	(0.161)	(0.104)
1.KYRGYZ#2.location	-0.0635	0.316	-0.0933	-0.0442
	(0.358)	(0.263)	(0.113)	(0.242)
Constant	-0.196	-0.127	-0.217**	-0.557
	(0.384)	(0.341)	(0.0345)	(0.228)

Observations	390	384	390	386
R-squared	0.238	0.231	0.381	0.246

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

	Logit	**Multinomial**	
VARIABLES	Q16	q22 (outcome 1)	q22 (outcome 3)
1.location	0.373*	-1.488***	0.0464
	(0.223)	(0.0525)	(0.171)
2.location	-0.144*	-2.083	0.925***
	(0.0869)	(1.449)	(0.258)
1.sex	-0.685*	0.799	0.573
	(0.376)	(0.720)	(0.366)
1.KYRGYZ	1.369***	-14.43***	-15.54***
	(0.372)	(1.885)	(1.249)
1.cropsX	-0.741	1.397**	0.530***
	(0.543)	(0.550)	(0.0516)
2.cropsX	-0.680***	15.25***	13.98***
	(0.132)	(1.743)	(1.242)
agec	0.00378	-0.0141	0.000964
	(0.0215)	(0.0110)	(0.0123)
logsizec	0.0590	0.550***	0.111
	(0.564)	(0.209)	(0.171)
2.member	-1.057***	-0.123	0.366
	(0.310)	(0.297)	(0.402)
3.member	-0.718***	0.504	0.742*
	(0.176)	(1.221)	(0.410)
1.KYRGYZ#2.member	0.255		
	(0.231)		
1.KYRGYZ#3.member	-0.0935		
	(0.218)		
1.KYRGYZ#1.location	-0.335		
	(0.272)		
1.KYRGYZ#2.location	-1.055***		
	(0.189)		
Constant	0.785***	-2.129*	-1.845***
	(0.261)	(1.126)	(0.197)
Observations	387	378	378

R-squared		

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

SOCIAL CAPITAL

			OLS		
VARIABLES	COOP_NEW_C	COMREL_C	ECSTAT_C	RELETH_NEW_C	FAIR_NEW_C
1.location	-0.216**	0.0832	-0.293	0.0177	-0.154
	(0.0361)	(0.214)	(0.328)	(0.242)	(0.338)
2.location	-0.250*	0.144	-0.311	-0.000806	-0.311
	(0.0587)	(0.251)	(0.138)	(0.138)	(0.425)
1.sex	-0.537*	0.347	-0.425*	-0.113	0.118
	(0.142)	(0.233)	(0.138)	(0.142)	(0.446)
1.KYRGYZ	1.516**	-1.469**	0.310	-0.277	0.188
	(0.162)	(0.304)	(0.407)	(0.375)	(0.680)
1.cropsX	0.402*	-0.0461	0.0809	-0.0128	0.295*
	(0.134)	(0.192)	(0.170)	(0.207)	(0.0968)
2.cropsX	0.0216	-0.0914	-0.302**	0.171	0.0868
	(0.0445)	(0.0615)	(0.0665)	(0.0686)	(0.0987)
Agec	-0.00672**	-0.00780	0.000630	0.00326	-0.00714
	(0.00128)	(0.00306)	(0.00325)	(0.00370)	(0.00688)
Logsizec	0.113	0.303	0.183	0.427*	0.446
	(0.0771)	(0.113)	(0.143)	(0.135)	(0.157)
2.member	-0.459***	0.317	-0.344	0.315	0.0435
	(0.0369)	(0.316)	(0.366)	(0.468)	(0.407)
3.member	-0.0364	0.148	-1.141**	-0.694	-1.650*
	(0.0386)	(0.131)	(0.258)	(0.516)	(0.522)
2.member#1.location	0.283	-0.00259	0.486	0.0398	0.163
	(0.275)	(0.120)	(0.229)	(0.155)	(0.266)
2.member#2.location	-0.555***	0.378*	0.135	0.131*	-0.110
	(0.0550)	(0.105)	(0.166)	(0.0378)	(0.262)
3.member#1.location	0.777*	-0.232	1.103*	0.388	0.845
	(0.198)	(0.163)	(0.360)	(0.809)	(1.205)
3.member#2.location	-1.122**	0.0706	0.562	0.206	0.477
	(0.129)	(0.232)	(0.257)	(0.524)	(0.406)
1.KYRGYZ#2.member	0.456	-1.202**	-0.406	-1.548*	-0.294
	(0.228)	(0.260)	(0.240)	(0.368)	(0.355)
1.KYRGYZ#3.member	0.388***	-0.300	-0.342*	0.439**	0.386
	(0.0208)	(0.112)	(0.0883)	(0.0679)	(0.162)
1.KYRGYZ#1.location	-0.191	0.368	0.0516	-0.181	0.453
	(0.0689)	(0.231)	(0.300)	(0.193)	(0.336)
1.KYRGYZ#2.location	0.402**	0.957*	0.0929	-0.0142	0.544

	(0.0873)	(0.268)	(0.122)	(0.118)	(0.429)
Constant	-0.363***	0.188	0.153	-0.211	-0.574
	(0.0360)	(0.177)	(0.309)	(0.333)	(0.506)
Observations	390	387	385	389	388
R-squared	0.282	0.337	0.078	0.145	0.122

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

	Logit	**Multinomial**				
VARIABLES	Q39a	q19e (outcome 1)	q19e (outcome 3)	q19e (outcome 4)	q33d (outcome 1)	q33d (outcome 3)
1.location	0.634***	-0.301	0.0604	-1.321**	-0.741***	-0.337
	(0.185)	(0.647)	(0.307)	(0.556)	(0.281)	(0.258)
2.location	0.768***	-1.011**	0.439	-2.101***	0.179	-0.473
	(0.276)	(0.458)	(0.418)	(0.697)	(0.156)	(0.289)
1.sex	-0.897***	0.0359	0.0671	0.586*	1.335***	-0.0833
	(0.215)	(0.282)	(0.592)	(0.308)	(0.202)	(0.710)
1.KYRGYZ	1.321**	2.014***	0.0428	3.691***	-14.97***	1.137***
	(0.524)	(0.432)	(0.183)	(1.012)	(1.323)	(0.196)
1.cropsX	-1.135**	0.952***	0.731***	1.248	-2.026***	1.452***
	(0.466)	(0.129)	(0.0977)	(0.866)	(0.756)	(0.423)
2.cropsX	-0.234	0.719***	0.500***	-0.372***	12.98***	0.153
	(0.149)	(0.0658)	(0.0847)	(0.0653)	(1.235)	(0.160)
Agec	0.0236	-0.0142**	-0.0206**	-0.00761	0.0300***	-0.0200
	(0.0152)	(0.00596)	(0.00966)	(0.0125)	(0.00397)	(0.0131)
logsizec	-1.030***	0.548*	0.0636	-0.123	-0.970*	0.422
	(0.0842)	(0.314)	(0.233)	(0.305)	(0.562)	(0.341)
2.member	-0.747**	-0.760**	1.003***	-0.567***	1.244**	0.102
	(0.328)	(0.359)	(0.337)	(0.205)	(0.538)	(0.478)
3.member	0.873	0.290	1.195***	-0.928***	1.291**	1.474*
	(0.681)	(1.079)	(0.386)	(0.0199)	(0.525)	(0.873)
1.KYRGYZ#1.location	-2.601***					
	(0.198)					
1.KYRGYZ#2.location	-0.760***					
	(0.204)					
Constant	1.729***	-1.978***	-1.840***	-2.309***	-1.259***	-1.084**
	(0.635)	(0.741)	(0.142)	(0.890)	(0.110)	(0.526)
	383	389	389	390	390	390

Appendix 2.C.4. Regression output for the mechanisms – Kyrgy respondents in Ykbol WUA and other program sites

KNOWLEDGE

VARIABLES	q7	q10	q12	q15
1.location	1.491	-0.0805	-0.0601	-0.638
	(1.255)	(0.524)	(0.459)	(0.406)
2.location	-0.487	-0.313	-0.700	-1.347***
	(1.261)	(0.585)	(0.532)	(0.474)
1.sex	-0.925	-0.185	-1.322***	-1.015***
	(0.595)	(0.786)	(0.401)	(0.377)
1.ethnic	3.261**	0.887*	1.489**	0.0873
	(1.526)	(0.504)	(0.742)	(0.342)
1.cropsX	0.928	0.112	2.083	0.650
	(0.889)	(0.616)	(1.420)	(0.461)
2.cropsX	0.0463	-0.224	0.542	0.0378
	(0.650)	(0.515)	(0.632)	(0.420)
agec	-0.0721***	-0.00129	0.0680***	-0.00853
	(0.0278)	(0.0189)	(0.0205)	(0.0157)
logsizec	1.310**	0.247	-0.0436	1.130***
	(0.657)	(0.479)	(0.444)	(0.405)
2.member	-5.207***	-3.311***	-2.880***	-2.721***
	(0.816)	(0.538)	(0.547)	(0.671)
3.member	-2.950***	-3.232***	-0.525	0.361
	(0.768)	(0.568)	(0.492)	(0.467)
1.ethnic#1.sex		-1.294		
		(0.941)		
1.ethnic#1.location	-3.156*			
	(1.726)			
1.ethnic#2.location	-0.601			
	(1.679)			
1.ethnic#1.cropsX			-2.645	
			(1.615)	

1.ethnic#2.cropsX				
			-1.535*	
			(0.895)	
Constant	2.784**	2.035***	1.358*	1.459**
	(1.246)	(0.754)	(0.695)	(0.587)
Observations	226	230	227	230

VARIABLES	q17a	q17b	Logit q17c	q17d	q17e
1.location	0.473	0.528	0.144	0.526	-0.0740
	(0.422)	(0.427)	(0.416)	(0.414)	(0.414)
2.location	0.575	0.0309	-0.347	-0.594	-0.637
	(0.494)	(0.489)	(0.489)	(0.522)	(0.484)
1.sex	-0.277	-0.395	-0.368	0.136	-0.164
	(0.390)	(0.402)	(0.388)	(0.399)	(0.369)
1.ethnic	2.767***	2.134***	2.307***	3.606***	1.482***
	(0.875)	(0.428)	(0.436)	(1.166)	(0.364)
1.cropsX	2.614**	-0.181	-0.0684	2.260	0.0235
	(1.185)	(0.497)	(0.496)	(1.437)	(0.492)
2.cropsX	0.468	-0.602	-0.161	1.626	-0.368
	(0.870)	(0.456)	(0.468)	(1.110)	(0.432)
Agec	-0.000253	0.0138	0.0113	0.0227	0.00767
	(0.0167)	(0.0168)	(0.0165)	(0.0176)	(0.0161)
Logsizec	0.134	0.252	0.210	0.264	0.00814
	(0.412)	(0.407)	(0.411)	(0.421)	(0.388)
2.member	-1.603***	-1.388***	-1.972***	-1.720***	-2.524***
	(0.503)	(0.518)	(0.591)	(0.595)	(0.587)
3.member	-2.610***	-2.955***	-1.588***	-3.290***	-2.099***
	(0.633)	(0.804)	(0.552)	(1.079)	(0.536)
1.ethnic#1.sex					
1.ethnic#1.location					
1.ethnic#2.location					
1.ethnic#1.cropsX	-2.222*			-3.381**	
	(1.308)			(1.542)	
1.ethnic#2.cropsX	-0.578			-2.462**	
	(0.999)			(1.237)	
Constant	-2.331***	-1.422**	-1.505**	-2.799**	-0.00369
	(0.872)	(0.638)	(0.653)	(1.136)	(0.588)
Observations	229	229	228	228	227

PARTICIPATION

VARIABLES	PARTIC_C	Q13-
1.location	0.00141	0.667
	(0.167)	(0.810)
2.location	0.211	-0.210
	(0.196)	(0.943)
1.sex	0.513***	-1.808***
	(0.150)	(0.602)
1.ethnic	-0.174	-1.418*
	(0.275)	(0.860)
1.cropsX	-0.121	1.159*
	(0.438)	(0.627)
2.cropsX	-0.0879	0.665
	(0.252)	(0.565)
Agec	0.000550	0.0300
	(0.00643)	(0.0184)
Logsizec	-0.247	0.754
	(0.158)	(0.466)
2.member	1.774***	
	(0.193)	
3.member	1.373***	
	(0.197)	
1.ethnic#1.cropsX	0.0766	
	(0.497)	
1.ethnic#2.cropsX	0.0879	
	(0.328)	
1.ethnic#1.location		1.147
		(0.981)
1.ethnic#2.location		-1.211
		(1.201)
2.q8#1.ethnic		
3.q8#1.ethnic		
Constant	-0.867***	-0.281
	(0.270)	(0.910)
Observations	229	227
R-squared	0.418	

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

ATTITUDES

	OLS			
VARIABLES	STAFF_NEW_C	PUNISH3_C	IRMAN_NEW_C	ISF_NEW_C
1.location	-0.178	-0.0644	-0.0825	0.0221
	(0.373)	(0.204)	(0.137)	(0.188)
2.location	0.0596	0.765***	0.551***	0.608***
	(0.428)	(0.234)	(0.159)	(0.220)
1.sex	-0.0199	0.237	-0.120	0.0603
	(0.178)	(0.183)	(0.124)	(0.170)
1.ethnic	-0.158	-0.209	0.422*	0.497
	(0.382)	(0.175)	(0.226)	(0.311)
1.cropsX	-0.277	-0.119	0.215	0.163
	(0.225)	(0.237)	(0.362)	(0.533)
2.cropsX	-0.243	-0.364*	0.0642	0.0956
	(0.201)	(0.213)	(0.208)	(0.288)
agec	-0.0216***	-0.00193	0.00272	-0.00588
	(0.00744)	(0.00790)	(0.00530)	(0.00748)
logsizec	0.130	-0.0850	-0.136	-0.124
	(0.179)	(0.188)	(0.130)	(0.177)
2.q8	1.284***	-0.0552	0.604***	0.691***
	(0.219)	(0.229)	(0.157)	(0.213)
3.q8	0.147	0.552**	0.241	0.184
	(0.228)	(0.242)	(0.164)	(0.231)
1.ethnic#1.cropsX			-0.721*	-1.082*
			(0.412)	(0.592)
1.ethnic#2.cropsX			-0.514*	-0.839**
			(0.270)	(0.368)
1.ethnic#1.location	0.215			
	(0.438)			
1.ethnic#2.location	1.083**			
	(0.488)			
Constant	-0.908**	-1.201***	-1.590***	-0.583*
	(0.387)	(0.293)	(0.221)	(0.310)
Observations	230	229	229	227
R-squared	0.321	0.177	0.261	0.222

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

	Logit	Multinomial	
VARIABLES	Q16	Q22(outcome 1)	Q22 (outcome 3)
1.location	-0.0201	-0.0330	0.473
	(0.483)	(0.388)	(0.848)
2.location	-1.205**	-1.100**	1.288
	(0.513)	(0.473)	(0.844)
1.sex	-1.082***	0.0453	0.178
	(0.384)	(0.369)	(0.534)
1.ethnic	-0.360	0.946***	0.260
	(0.650)	(0.356)	(0.519)
1.cropsX	0.299	0.505	-0.0729
	(1.249)	(0.491)	(0.623)
2.cropsX	-0.307	0.0847	-0.385
	(0.626)	(0.440)	(0.568)
agec	-0.00855	-0.00914	-0.00449
	(0.0166)	(0.0158)	(0.0223)
logsizec	0.830**	0.261	-0.242
	(0.419)	(0.383)	(0.527)
2.q8	-0.499	0.856*	0.0822
	(0.499)	(0.468)	(0.743)
3.q8	0.123	-1.466***	-0.379
	(0.518)	(0.538)	(0.665)
1.ethnic#1.cropsX	0.393		
	(1.381)		
1.ethnic#2.cropsX	1.237		
	(0.814)		
1.ethnic#1.location			
1.ethnic#2.location			
Constant	2.118***	-0.410	-2.271**
	(0.714)	(0.586)	(0.985)
Observations	229	230	230

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

SOCIAL CAPITAL

	OLS				
VARIABLES	COOP	ECSTAT	RELETH	FAIR	COMREL
1.location	-0.448*	0.186	0.0530	0.229	0.0673
	(0.233)	(0.149)	(0.213)	(0.262)	(0.186)
2.location	-0.722***	0.349**	0.461*	-0.100	0.681***
	(0.268)	(0.171)	(0.245)	(0.300)	(0.212)
1.sex	-0.899**	0.110	0.330*	1.185***	0.0755
	(0.377)	(0.134)	(0.194)	(0.446)	(0.169)
1.ethnic	0.123	0.0332	-0.382**	0.221	-0.308*
	(0.220)	(0.128)	(0.185)	(0.247)	(0.161)
1.cropsX	0.408	-0.269	-0.156	0.0144	-0.161
	(0.265)	(0.173)	(0.249)	(0.299)	(0.216)
2.cropsX	0.0476	-0.00415	-0.0841	-0.0765	-0.117
	(0.240)	(0.156)	(0.224)	(0.269)	(0.194)
agec	0.00373	0.000514	0.00499	0.00731	-0.00206
	(0.00876)	(0.00578)	(0.00842)	(0.0100)	(0.00717)
logsizec	0.237	0.0234	0.207	0.0248	0.00910
	(0.213)	(0.137)	(0.203)	(0.239)	(0.173)
2.q8	0.255	0.0865	-0.466*	0.0955	-0.364*
	(0.263)	(0.168)	(0.249)	(0.292)	(0.212)
3.q8	0.917***	-0.466***	-0.515**	0.373	0.416*
	(0.272)	(0.177)	(0.256)	(0.310)	(0.220)
1.ethnic#1.sex	1.073**			-1.793***	
	(0.452)			(0.529)	
Constant	1.437***	-0.336	-0.764**	-0.560	-1.035***
	(0.350)	(0.215)	(0.308)	(0.390)	(0.265)
Observations	226	228	227	228	230
R-squared	0.167	0.093	0.105	0.068	0.126

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

	Logit	Multinomial				
VARIABLES	q39a	q19e (outcome 2)	q19e (outcome 2)	q19e (outcome 2)	q33d (outcome 1)	q33d (outcome 3)
1.location	-0.160	0.348	-0.254	0.0382	0.234	0.797
	(0.537)	(0.403)	(0.773)	(1,637)	(0.390)	(0.835)
2.location	-0.0830	1.842***	2.506***	17.09	-0.528	1.412*
	(0.603)	(0.516)	(0.824)	(1,386)	(0.463)	(0.851)
1.sex	-0.196	-0.200	-0.765	-0.0909	-0.204	-0.00195
	(0.462)	(0.381)	(0.712)	(1.142)	(0.369)	(0.548)
1.ethnic	0.351	-0.573	0.433	0.914	1.059***	0.346
	(0.425)	(0.359)	(0.607)	(1.301)	(0.357)	(0.521)
1.cropsX	0.311	0.539	-1.023	0.367	0.139	-0.168
	(0.568)	(0.520)	(0.854)	(0.872)	(0.480)	(0.653)
2.cropsX	0.706	0.631	0.298	-14.68	0.245	-0.0799
	(0.501)	(0.467)	(0.658)	(787.1)	(0.432)	(0.580)
agec	-0.000636	0.00595	-0.00662	-0.0158	0.00500	-0.00686
	(0.0201)	(0.0162)	(0.0272)	(0.0385)	(0.0157)	(0.0235)
logsizec	-0.934*	-0.174	-0.275	0.258	0.0601	0.0203
	(0.527)	(0.406)	(0.620)	(0.905)	(0.375)	(0.553)
2.q8	0.695	0.473	3.687***	2.478**	0.657	0.0488
	(0.664)	(0.679)	(0.700)	(1.237)	(0.454)	(0.730)
3.q8	1.246	0.812*	1.335	-14.51	-1.576***	-0.624
	(0.797)	(0.481)	(0.850)	(1,359)	(0.570)	(0.720)
1.ethnic#1.sex						
Constant	0.683	-1.126*	-3.246***	-17.90	-0.880	-2.502**
	(0.704)	(0.606)	(1.027)	(1,386)	(0.586)	(0.996)
Observations		230	230	230	230	230

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

BIBLIOGRAPHY

Abdullaev, I., M. Ul Hassan, H. Manthrithilake and M. Yakubov. 2005. "Making Water Distribution More Transparent: Application of the Time-based Water Distribution Method to Tertiary Canals in Central Asia." *Journal of Applied Irrigation Science* 40:2-3.

Abdullaev, I., K. Jumaboe, J. Kazbekov, and H. Manthritilake. 2008. "Water User Groups in Central Asia: Emerging Form of Collective Action in Irrigation Water Management." *Water Resource Management* 24:1029-1043.

Agrawal, Arun, 1994. "Rules, Rule Making, and Rule Breaking: Examining the Fit between Rule Systems and Resource Use." In Rules, Games, and Common-Pool Resources, ed. Elinor Ostrom, Roy Gardner, and James Walker, 267-82. Ann Arbor: University of Michigan Press.

_____. 2001. "Common property, forest management, and the Indian Himalaya." *Contributions to Indian Sociology* 35:181-212.

_____. 2002. "Common Resources and Institutional Sustainability." In *The Drama of the Commons,* National Research Council, Committee on the Human Dimensions of Global Change, ed. Elinor Ostrom, Thomas Dietz, Nives Dolšak, Paul Stern, Susan Stonich, and Elke Weber, 41-85. Washington, DC: National Academy Press.

_____. 2008. "Sustainable governance of common-pool resources: context, method, and politics." In *The Contested Commons: Conversations between Economists and Anthropologists,* ed. B. Pranab and Isha Ray. Maidan MA: Wiley Blackwell.

Allison, Paul D. 2008. *Fixed Effects Regression Models*. Sage Publications, Inc.

Asankanov, A. 1996. "Ethnic conflict in the Osh Region in Summer 1990: Reasons and Lessons." In *Ethnicity and Power in the Contemporary World,* ed. K. Rupesinghe and V.A. Tishkov. Tokyo: United Nations University.

Baland, Jean-Marie.1999. "The Ambiguous Impact of Inequality on Local Resource Management." *World Development* 27(5):773-788.

Baland, Jean-Marie, and Jean-Philippe Platteau. 1996. *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* Oxford: Clarendon Press.

Baland, Jean-Marie, Pranab Bardhan, and S. Bowleds, eds. 2006. *Inequality, cooperation, and environmental sustainability.* Princeton,NJ: Princeton University Press.

Bardhan, Pranab. 2000. "Irrigation and Cooperation: An Empirical Analysis of 48 Irrigation Communities in South India." *Economic Development and Cultural Change*. 48 (4): 847-865.

Bardhan Pranab and Isha Ray. 2008. "Economists, anthropologists, and the contested commons." In *The Contested Commons: Conversations between Economists and Anthropologists,* ed. B. Pranab and I. Ray. Maidan MA: Wiley Blackwell.

Basurto, Xavier and Elinor Ostrom. 2009. "The Core Challenges of Moving Beyond Garett Hardin." *Journal of Natural Resources Policy Research* 1(3):255-259.

Baxter, John. 2005. "Problems Facing Water User Associations in Uzbekistan." USAID Natural Resources Management Project.

Berkes, Fikret, ed. 1989. *Common Property Resources: Ecology and Community-Based Sustainable Development*. London: Belhaven Press.

Beyer, J. 2006. 'Revitalization, Invention and Continued Existence of the Kyrgyz *Aksakal* Courts: Listening to Pluralistic Accounts of History', *Journal of Legal Pluralism and Unofficial Law*, special issues 53/54: 141-176.

Bichsel, Christine. 2006. *Conflict Transformation in Central Asia: Irrigation Disputes in the Ferghana Valley*. London: Taylor and Francis.

Campbell, Ian W. 2011. "Knowledge and Power on the Kazakh Steppe, 1845-1917." Ph.D. diss,. University of Michigan, Ann Arbor.

Church, Larry and Michael Roth. 1996. "Legal Underpinnings of Land Reform and Farm Restructuring in the Kyrgyz Republic: Assessment and Recommendations." In Irrigation and Land reform in the Kyrgyz Republic, ed. Bloch, P., Delehanty, J. and Roth, M., Land Tenure Center Research Paper 128. Madison: University of Wisconsin-Madison

Coleman, James. 1988. "Social capital in the creation of human capital." *American Journal of Sociology* 94(supplement): S95-S120.

Degnbol, P., H. Gislason, S. Hanna, S. Jentoft, J. Nielsen Raakjaer, D. Sverdrup-Jensen, and D.C. Wilson. 2006. "Painting the floor with a hammer: technical fixes in fisheries management." *Marine Policy* 30(5):534-543.

Deitz, Thomas, Elinor Ostrom, and Paul Stern. 2003. "The Struggle to Govern the Commons." *Science* 302(5652):1907-12.

Dolšak, Nives, and Elinor Ostrom, eds. 2003. *The Commons in the New Millennium: Challenges and Adaptations.* Cambridge, MA: MIT Press.

Edwards, Victoria M. and Nathalie A. Steins. 1999. Collective Action in Common-Pool Resource Management: The Contribution of a Social Constructivist Perspective to Existing Theory. *Society & Natural Resources* 12: 539-557.

Ensminger, Jean. 1990. "Co-opting the Elders: The Political Economy of State Incorporation in Africa." *American Anthropologist* 92:662-75.

ENVSEC. 2005. "Environment and Security: Transforming risks into cooperation." http://www.envsec.org/

Everett-Heath, Tom ed. 2003.*Central Asia: Aspects of Transition*. London: Routledge Curzon.

Fernandez-Gimenez, Maria E. and Cheryl L. Wagner. 2008. "Does Community-Based Collaborative Resource Management Increase Social Capital?" *Society & Natural Resources* 21(4):324-344.

Fumagalli, Matteo. 2007. "Informal Ethnopolitics and Local Authority Figures in Osh, Kyrgyzstan." *Ethnopolitics* 6(2): 211-233.

Garces-Restrepo, C., D. Vermillion, and G. Muñoz. 2007. "Irrigation Management Transfer: Worldwide efforts and results." *Water Reports* 32: 1-62.

Gardner, Roy, Elinor Ostrom and James Walker. 1994. *Rules, Games and Common-Pool Resources*. Ann Arbor: The University of Michigan Press.

Gebremedhin, Berhanu, John Pender and Girmay Tesfay. 2004. "Collective action for grazing land management in crop-livestock mixed systems in the highlands of northern Ethiopia." *Agricultural Systems* 82 (3) 273-290.

Geiss, P.G. 2003. *Pre-Tsarist and Tsarist Central Asia: Communal Commitment and Political Order in Change*. London: Routledge.

Gibson, Clark, Krister Andersson, Elinor Ostrom, and Sujai Shivakumar. 2005. *The Samaritan's Dilemma: The Political Economy of Development Aid*. New York: Oxford University Press.

Goldberg, Joseph. 2004. "Assisting Irrigation in Central Asia." Presentation at World Bank Water Week.

Habyarimana, James, Macartan Humphreys, Daniel N. Posner, and Jeremy M. Weinstein. 2009. *Coethnicity: Diversity and the Dilemmas of Collective Action*. New York: Russell Sage Foundation.

Hardin, Garett. 1968. "The Tragedy of the Commons." *Science* 162:1243-1248.

Hardin, Russell. 1995. *One for All: The Logic of Group Conflict.* Princeton: Princeton University Press.

Hierman, Brent. 2010. "What use was the election to us? Clientalism and political trust amongst ethnic Uzbeks in Kyrgyzstan and Tajikistan." *Nationalities Papers* 38(2) 245- 263.

Hirsch, Francine. 2005. *Empire of Nations: Ethnographic Knowledge and the Making of the Soviet Union*. Ithaca: Cornell University Press.

ICG (International Crisis Group). 2001. *Kyrgyzstan at ten: Trouble in the "Island of Democracy.* ICG Asia Report 22, Osh/Brussels: International Crisis Group.

IWRMI (Integrated Water Resources Management Institute). 2003. "How to establish a Water User's Association: Practical Steps for Social Mobilizers."

Kandiyoti, D. 2000."Modernisation with the Market? The Case of the "Soviet East." In *Anthropology, Development and Modernities: Exploring Discourses, Counter-tendencies, and Violence,* ed. A. Arce and N. Long London: Routledge.

Katz, Elizabeth G. 2000. "Social Capital and Natural Capital: A Comparative Analysis of Land Tenure and Natural Resource Management in Guatemala." *Land Economics* 76(1):114-132.

Koichiev, Arslan. 2003. "Ethno-Territorial Claims in the Ferghana Valley During the Process of National Delimitation, 1924-7." In *Central Asia: Aspects of Transition,* ed. Tom Everett-Heath. London: Routledge Curzon.

Krishna, Anirudh. 2004. "Understanding, measuring and utilizing social capital: clarifying concepts and presenting a field application from India." *Agricultural Systems* 82 (3) 291-305.

Kupatdze, Alexander. 2008. "Organized Crime before and after the Tulip revolution: the changing dynamics of upperworld-underworld networks." *Central Asian Survey* 27(3): 279-299.

Lansing, John Stephen. 2006. *Perfect Order: Recognizing Complexity in Bali*. Princeton: Princeton University Press.

Li, Tania Murray.1999. "Compromising Power: Development, Culture, and Rule in Indonesia." *Cultural Anthropology* 14(3): 295-322.

Lowe, Robert. 2003. "Nation Building and Identity in the Kyrgyz Republic." In *Central Asia: Aspects of Transition,* ed. Tom Evertt-Heath. London: Routledge Curzon.

Matveeva, A. 2006. *Central Asia: A Strategic Framework for Peacebuilding.* London: International Alert.

McGinnis, Michael D. ed. 2000. *Polycentric Games & Institutions: Readings from the Workshop in Political Theory & Policy Analysis*. Ann Arbor: The University of Michigan Press.

McKean, Margaret A. 1992. "Success on the Commons: A Comparative Examination of Institutions for Common Property Resource Management." Journal *of Theoretical Politics* 4(3): 247-82.

Megoran, Nick. 2010. "The Uzbekistan-Kyrgyzstan Boundary: Stalin's Cartography, Post-Soviet Geography." In *Borderlines and Borderlands: Political Oddities at the Edge of the Nation-State,* ed. A. Diener. A and J. Hagen. New York: Rowman & Littlefield Publishers, Inc.

Meinzen-Dick, Ruth. 2007. "Beyond Panaceas in Water Institutions." *PNAS* 104(39):15200-05.

Meinzen-Dick, Ruth, Monica DiGregorio and Nancy McCarthy. 2004. "Methods for Studying Collective Action in Rural Development." *Agricultural Systems* 82 (3): 197-214.

Michaels, Paula A., 1998. "Medical Traditions, Kazakh women, and Soviet medical politics to 1941. *Nationalities Papers* 26(3): 493-509.

Mosse, David. 2003. *The rule of water: statecraft, ecology and collective action in south India.* New Delhi: Oxford University Press.

_____. 2005. *Cultivating Development: An Ethnography of Aid Policy and Practice*. Ann Arbor: Pluto Press.

_____. 2008. "Collective action, common property, and social capital in South India : an anthropological commentary." In *The Contested Commons: Conversations between Economists and Anthropologists,* ed. B. Pranab and I. Ray. Maidan MA: Wiley Blackwell.

Mott Macdonald. 2003. "Final Report: Privatization and Transfer of Irrigation Management in Central Asia." Mott Macdonald: Department for International Development Knowledge and Research Services.

Nagendra, Harini. 2007. "Drivers of reforestation in human-dominated forests." *PNAS* 104(39): 15218-23.

North, Douglas. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.

O'Hara, G. and Sarah L. 2000. "Lessons from the past: Water management in Central Asia." *Water Policy 2*(4-5): 365-384.

Olson, Mancur. 1974. *The Logic of Collective Action: Public Goods and the Theory of Groups,* Revised edition. Cambridge: Harvard University Press.

O'Neill, Gerard. 2003. "Land and Water 'Reform' in the 1920s: Agrarian Revolution or Social Engineering?" In *Central Asia: Aspects of Transition,* ed. Tom Everett-Heath. London: Routledge Curzon.

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.

_____ .1998. "A Behavioral Approach to the Rational Choice Theory for Collective Action." *American Political Science Review* 92: 1-22.

_____. 2001. "Reformulating the Commons." In *Protecting the Commons: A Framework for Resource Management in the Americas*, ed. Joanna Burger, Elinor Ostrom, Richard B. Norgaard, David Policansky, and Bernard D. Goldstin, 17-41. Washington, DC: Island Press.

_____. 2007a. "Collective Action Theory." In *The Oxford Handbook of Comparative Politics*, ed. Carles Boix and Susan C. Stokes, 186-208. Oxford: Oxford University Press.

_____. 2007b. "A Diagnostic Approach for Going Beyond Panaceas." PNAS 104(39): 15181-87.

Ostrom, Elinor, Roy Gardner, and James Walker. 1994. *Rules, Games, and Common-Pool Resources*. Ann Arbor: University of Michigan Press.

Ostrom, Elinor, and Harini Nagendra. 2006. "Insights on Linking Forests, Trees, and People from the Air, on the Ground, and in the Laboratory." *PNAS* 103(51): 19224-31.

Ostrom, Elinor, (2008) "Design Principles of Robust Property-Rights Institutions: What Have We Learned?" Workshop in Political Theory and Policy Analysis, Indiana University; Center for the Study of Institutional Diversity Arizona State University, forthcoming May 2009 in Property Rights and Land Policies, ed. K. Gregory Ingram and Yu-Hong Hong (Cambridge, MA: Lincoln Institute of Land Policy).

Ostrom, Elisnor. 2009. "Engaging Impossibilities & Possibilities." In *Arguments for a Better World: Essays in Honor of Amartya Sen*, ed. Kaushik Basu and Ravi Kanbur. New York: Oxford University Press: 522–41.

Passon, D. and A. Temirkulov, A. 2004. "Analysis of Peace and Conflict Potential in Batken Oblast." Kyrgyzstan, Batken: German Technical Cooperation and Analysis Research Consulting.

Platteau, Jean-Philippe and Frederic Gasparat. 2003. "The Risk of Resource Misappropriation in Community-Driven Development." *World Development* 31(10):1687-1703.

Platteau, Jean-Philippe. 2008. "Managing the commons: the role of social norms and beliefs." In *The Contested Commons: Conversations between Economists and Anthropologists*, ed. B. Pranab and I. Ray. Maidan MA: Wiley Blackwell.

Platteau, Jean-Philippe. 2004. "Monitoring Elite Capture in Community-Driven Development." *Development and Change* 35(2):223-46.

Pomeranz, Kenneth. 2009. "The Great Himalayan Watershed: Water Shortages, Mega-Projects and Environmental Politics in China, India and Southeast Asia." *The Asia-Pacific Journal* 30(2).

Poteete, Amy R. and Elinor Ostrom. 2004. In pursuit of comparable concepts and data about collective action. *Agricultural Systems* 82 (3): 215-232.

Rao, Vijayendra. 2008. "Symbolic public goods and the coordination of collective action: a comparison of local development in India and Indonesia." In *The Contested Commons: Conversations between Economists and Anthropologists*, ed. B. Pranab and I. Ray. Maidan MA: Wiley Blackwell.

Rasanayagam, J. 2002. "Spheres of Communal Participation: Placing the State within Local Modes of Interaction in Rural Uzbekistan." *Central Asian Survey*, 21: 55-70.

Ray, Isha. 2008. “Cooperative conversations: outcomes and processes in economics and anthropology.” In *The Contested Commons: Conversations between Economists and Anthropologists*, ed. B. Pranab and I. Ray. Maidan MA: Wiley Blackwell.

Reeves, Madeline. 2010. “A Weekend in Osh.” *London Review of Books* 32(13): 17-18.

Ruddle, K., and F.R. Hickey. 2008. “Accounting for the mismanagement of tropical nearshore fisheries.” *Environment, Development, and Sustainability* 10(5):565-589.

Ruttan, Lore. 2008. “Economic Heterogeneity and the Commons: Effects on Collective Action and Collective Goods Provisioning.” *World Development* 36 (5): 969-985.

Sarker, A., and T.Itoh. 2001. “Design Principles in Long-Enduring Institutions of Japanese Irrigation Common-Pool Resources.” *Agricultural Water Management* 48(2): 89-102.

Schoeberlein-Engel, John. 1994. “Identity in Central Asia: Construction and Contention in the Conceptions of “Ozbek,” “Tajik,” “Muslim,” “Samarguandi” and other groups.” PhD diss., Harvard University, Cambridge.

_____. 2000. “Between Two Worlds.” *Harvard International Review* 22(1):56-61.

Sehring, Jenniver. 2005. “Water User Associations (WUAs) in Kyrgyzstan. A Case Study on Institutional Reform in Local Irrigation Management.” *ZEU* Discussion Paper No. 24.

_____. 2007. “Irrigation Reform in Kyrgyzstan and Tajikistan.” *Irrigation Drainage Systems* 21: 277-290.

_____. 2009. *The Politics of Water Institutional Reform in Neopatrimonial States: A Comparative Analysis of Kyrgyzstan and Tajikistan*. Germany: VS Verlag.

Sievers, E.W. 2002.”Water, Conflict, and Regional Security in Central Asia.” *New York University Environmental Law Journal* 10: 356-402.

Steins, Nathalie A. and Victoria M. Edwards. 1999. “Collective Action on Common Pool Resource Management: The Contribution of a Social Constructivist Perspective to Existing Theory.” *Society and Natural Resources* 12:539-57.

Stock, James and Mark Watson. 2007. *Introduction to Econometrics.* Pearson Higher Education.

Sundberg, J. 1998. “NGO Landscapes in the Maya Biosphere Reserve, Guatemala.” *Geographical Review* 88(3):388-412.

Tang, Shui Yan. 1994. “Rules, Rule Making, and Rule Breaking: Examining the Fit between Rule Systems and Resource Use.” *In Rules, Games, and Common-Pool Resources*, ed. Elinor Ostrom, Roy Gardner, and James Walker, 225-45. Ann Arbor: University of Michigan Press.

Temirkulouv, Azamat. 2006. “Tribalism, Social Conflict, and State-Building in the Kyrgyz Republic.” Forum Berliner Osteuropa Info: 94-100

Thurman, J.M. 1999. “Modes of Organization in Central Asian Irrigation: The Ferghana Valley, 1876 to Present.” unpublished PhD thesis, Department of Central Eurasian Studies, Indiana University.

Ul Hassan, Mehmood., R. Starkloff and N. Nizamedinkhodjaeva. 2004. “Inadequacies in the Water Reforms in the Kyrgyz Republic: An Institutional Analysis.” *International Water Management Institute*. Research report 81.

Ul Hassan, Mehmood and Murat Yakubov. 2007. “Mainstreaming Rural Poor in Water Resources Management: Preliminary Lessons of a Bottom-Up WUA Development Approach in Central Asia.” *Irrigation and Drainage* 56: 261-276.

UNESCO (United Nations Educational, Scientific, and Cultural Organization). 2009. *Water in a Changing World.* The United National World Water Development Report 3. Paris, France: UNESCO.

Wade, Robert. 1988. *Village Republics: Economic Conditions for Collective Action in South India*. New York: Cambridge University Press.