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IRRIGATION AND TRANSBOUNDARY WATER MANAGEMENT IN THE LOWER COLORADO RIVER: THE CHANGING ROLE OF AGRICULTURISTS IN THE MEXICALI VALLEY, MÉXICO

By

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ABSTRACT

IRRIGATION AND TRANSBOUNDARY WATER MANAGEMENT IN THE LOWER COLORADO RIVER: THE CHANGING ROLE OF AGRICULTURISTS IN THE MEXICALI VALLEY, MÉXICO.

By

Alfonso Andrés Cortez-Lara

In this work I provide an empirically grounded analysis of the evolution of irrigation and transboundary water management and socio-productive processes in the Mexicali Valley, México. An institutional analysis approach is applied as a theoretical framework for examining changes and impacts of institutional arrangements followed by agriculturists as they relate to water issues. I interviewed people who have worked and lived in the agricultural area of Mexicali for more than 50 years in order to compare two cases: the salinity problem of the 1960s-70s and the All-American Canal lining conflict that became critical during the 2000s.

The results show that agriculturists have lost economic, political, and organizational power to influence transboundary water issues. This appears to be directly related to the socio-productive polarization and the high degree of elitism among agricultural water users within the irrigation district. Furthermore, the results indicate that for the salinity problem a large, unified, and strong leadership among agriculturists was observed. However, today there are many opposing views in regards to the All-American Canal lining conflict and a weak and dispersed leadership of agriculturists. The research revealed different levels of stress on agriculturists for both the salinity problem and the All-American Canal lining conflict depending on the area of the Mexicali Valley studied.

I examine convergences and divergences in agriculturists' and water managers' views of institutional impacts of participation of agriculturists in the salinity and the All-American Canal cases. I also explore institutional explanatory factors for social and irrigation impacts of the salinity problem case and the All-American Canal lining conflict on agriculturists in the regions of study area. Finally, I investigate differences in the perceptions between older and newer water managers as well as differences in the views of agriculturists and water managers concerning agricultural water users' institutions in the Mexicali Valley.

This research constitutes an institutional analysis of irrigation management with transboundary water conflicts. The work incorporates the input of key actors such as agriculturists and water managers. The research focuses on agriculturists and water managers in three major regions of the Mexicali Valley: the northern, central, and southern areas.

This research, by linking transboundary water management, irrigation, and land productivity, will help improve our understanding of institutions facing the challenge of working with both local irrigation and transboundary water management issues. This research also helps illuminate the complexities of water management in the U.S.-Mexican border regions and the role that agriculturists may play in increasing transboundary cooperation.

Anyone who solves the problem of water deserves not one Nobel Prize but two
-one for science and the other for peace.

President John F. Kennedy

One is just the sum of all the persons we know through one's lifetime,
the tribe changes one and one changes the tribe.

Anonymous

DEDICATION

To

my family, my daughters Rosandri and Andrea Rossana, and my son Sergio Andrés....to them my effort legacy

my friends, those that unconditionally were always very supportive during the hard times

Thank you.

And to all who always eager for cooperation through action,
and keep up the good sense of work.

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CHAPTER 1

INTRODUCTION

In this work I provide an empirically grounded analysis of the views of agriculturists and irrigation water managers concerning irrigation and transboundary water management in the Mexicali Valley, México. This chapter outlines the literature on institutions, irrigation, and transboundary water management, identifies gaps in the literature, and presents the research questions and methodology of this dissertation.

This study examines the characteristics and impacts of institutional arrangements of agriculturists in the Mexicali Valley to address two critical transboundary water conflicts in the lower Colorado River region: the salinity problem that took place from 1961 to 1973 and the All-American Canal lining conflict during the 2000s, since agricultural activities and irrigation in the Mexicali Valley are based mostly on flows from the Colorado River watercourse.

The institutions used by agriculturists to participate in and influence water management decision-making processes, at both the local and binational level, have changed in recent history. Agricultural water users, generally acknowledged as key stakeholders, have worked to reach solutions to critical cross-border water conflicts. The agricultural water users appear to exhibit a different behavior and influence during the conflict in the 2000s as compared with that of the conflict in the 1960s. These changes have influenced institutional responses as they relate to transboundary and local irrigation water management in the Mexicali Valley region.

INSTITUTIONS, IRRIGATION, AND TRANSBOUNDARY WATER MANAGEMENT

Institutions and irrigation

The terms 'institutions' and 'organizations' are often used interchangeably, but it is useful to distinguish between them. Institutions are understood to be 'the humanly devised constraints that shape human interaction' and consist of complexes of norms, values, and behaviors that persist over time and inform action (North 1990, 3). On the other hand, an organization is defined as a group of people with shared institutions and mutual recognition of opportunity sets. Organizations are systems of relationships for coordinating individual actions according to some decision rule --a mix of authority and custom (Schmid 2004, 75). The combination of institutions and organizations that pertain to a particular resource and its management may be defined as the institutional arrangements. Therefore, institutional arrangements for irrigation water management include: a) an established policy and legal environment (policies, laws, rules, rights, regulations, conventions, and customs, both formal and informal); b) water organizations also called water users' associations, with responsibilities for irrigation management, as such, a means for collective action that can be used to manage Common-Pool Resources (CPRs); and c) processes and procedures for decision-making, coordination, and planning (Svendsen, Wester, and Molle 2005, 4).

In regards to the legal environment for water resources management, it is important to emphasize that there are significant differences between the U.S. and Mexican water rights systems in terms of formal institutions. In México, water coming from both underground and surface sources is said to be a "*National Property Good*"; as such, the rule functions similarly for the entire country. The several water uses (including irrigation, domestic, commercial, and industrial) then hold "*Concessions to Use*" always regulated by the federal government, that is, the Mexican National Water Commission (CONAGUA 1999, 9).

On the other hand, the Water Law system in the United States is a complex subject composed of state laws with little federal guidance. The two major doctrines are the "*Riparian Rights*" and the "*Prior Appropriation*"; the former, extended over the eastern states, is based on the premise that only persons who own land that is in actual contact with inland waters such as streams, rivers, lakes, or bays are granted rights of this sort whereas the latter dominates in western states and establishes the "first in time, first in right" principle (Field 2000, 297; Dzurik 2003, 26).

Moreover, when considering the features of effective institutions, Lam (1998, 53) points out that rules that are made by local stakeholders such as the farmers are more likely to take information and knowledge of the local situation into consideration. Since farmers deal directly with problems and benefits of irrigation on a daily basis, they likely understand issues, concerns, and impacts of water management decisions.

However, as more diffuse and naturally occurring factors influence water systems, the effective management of irrigation systems becomes more complex. Ostrom, Burger, Field, Norgaard, and Policanski (1999, 278) have elaborated on the constraints that agriculturists face in participating in and influencing transboundary water management, a specific type of CPR. These authors assert that an effective role of such actors can be only reached under specific conditions of small watersheds and when no political boundaries are involved.

It is possible to list some of the factors that may affect both the involvement of agriculturists in irrigation and the effective management of irrigation systems.

Involvement of agriculturists depends on environment and social dimensions such as physical, socioeconomic, and policy (Gulati, Meinzen-Dick, and Raju 2005, 242); while irrigation management performance mostly depends on agro-ecological, technical, economic, historical, socio-cultural, and political-legal contextual characteristics (Uphoff 1991, 71).

Transboundary water issues may be better understood by considering all those contextual characteristics described by Uphoff (1991), which also can be used to identify, describe, compare, and design effective institutions for local irrigation. This in turn may signify how institutions increase the benefits from a fixed set of inputs; conversely, they also might reveal lower efficiency so individuals have to work harder to achieve the same kind and level of benefits. In the end, "institutions shape human behavior through their impact on incentives" (Ostrom 1992, 24).

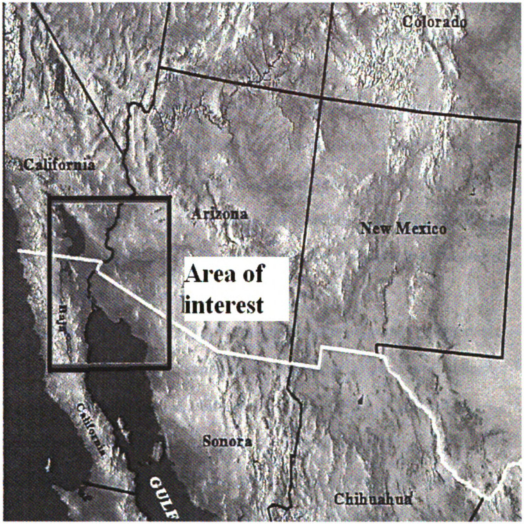
In summary, institutional arrangements in place might either facilitate or hinder the problem-solving capabilities of participants in irrigation systems. Therefore, it may be helpful to learn from empirical studies of the performance of various institutional arrangements. Ideally this examination would draw on and extend a theoretical framework that identifies the key attributes of successful collective action (Meinzen-Dick, Raju, and Gulati 2002) with institutional attributes treated as variables that take on different values according to their specific circumstances (Tang 1992, 13; Tang 1994).

Irrigation and transboundary waters: the United States–México border region

The rapid economic and population growth in the U.S.–Mexican border region is stressing the utilization of transboundary waters (Cech 2003, 405). Population immediately adjacent to the border reached 12 million people in the year 2009 and is expected to reach 19.4 million by the year 2020 (United States-México Border 2012 Program 2009). Such a stress has gradually increased since the post- North America Free Trade Agreement (NAFTA) era. Yet, even before NAFTA, Armstrong (1982, 37) anticipated critical water problems in the U.S.-Mexican border region because of rapid industrialization and urbanization processes taking place along the border areas (see Figure 1.1). Other studies show how global climate change is inducing social and physical vulnerability in the Colorado River basin (Gleick 1990; Kiparsky and Gleick 2004, 157).

Researchers point out that issues as complex as transboundary water conflicts require a permanent revision of legal and institutional frameworks (Brañes 1991, 62; Field 2000, 19). Field (2000) asserts that as nations pursue their economic growth and development goals, these conflicts are likely to become more frequent and severe. He also mentions that understanding the genesis of, and possible solutions to, international conflicts calls for an understanding of how international law and international political institutions function, or often don't function. In the same vein, this author emphasizes that economic efficiency is involved, because it is important to be able to establish how a resource might be used so as to maximize its net social value. "How the total gets divided is also important, because fairness becomes an even more critical factor." Brañes (1991, 65) establishes that overlapping legal instruments between countries threaten territorial sovereignty, thus, nation-states will lose capacity to manage water resources within their own nation. At the end, the implementation of the United States-México International Water Treaty is a difficult matter and provisions made in the past are now insufficient to solve ever-increasing water-related problems (Mumme 2004, 5).

Figure 1.1 Area of interest map.



Source: Southern Nevada Water Authority. Resources Department, 2000.

A need for strengthening local actors' participation in transboundary water issues has been noticed by other authors (Browning-Aiken, Richter, Goodrich, Strain, and Varady 2004, 354). These scholars see the potential for success in binational water resources planning and management in the U.S.-Mexican border with an increase in informal, regional "bottom-up" approaches rather than with more traditional "top-down" diplomatic or regulatory approaches based on formal treaties. The focal point of this argument is that the bottom-up, local people-centered approaches emphasize social processes, build relationships, and strive for consensus through shared value formation and the co-evolution of perceptions and preferences, which in turn tends to favor integrated watershed and water resources management.

Milch and Varady (1999, 260) further elaborate on the use of the traditional top-down paradigm to try to solve transboundary water conflicts in the United States-México border region. Their analysis offers both a theoretical explanatory framework as well as an avenue for further inquiry. The authors assert that "local agents lack the capacity and motivation to be effective, and local informal arrangements that might have become the basis of formal cooperation are largely ignored."

Kolavalli and Kerr (2002, 213) assert that participation is widely accepted as a prerequisite to successful watershed management. Regarding the top-down and bottom-up as well as the participation concepts these authors go on to say that,

> Recent years have seen a movement toward decentralized, participatory management of natural resources in developing countries. Inefficient and inequitable outcomes of top-down management approaches, along with increasing recognition of the site-specific complexities of management needs, have contributed to the interest in including resource users in management. Some of the most successful examples of participation, in which local people play a meaningful role in managing productive, sustainable and equitable natural resource management systems, come from non-governmental organizations (NGOs).

In relation to their research in several regions of India, Kolavalli and Kerr (2002, 227) mention that although participation is necessary to successful watershed development there is no shared understanding of its meaning, nor of how to make it operational. While participation that enhances local communities' ownership of development efforts and encourages creative solutions to site-specific problems in a complex environment is mostly fostered by NGOs, the authors' findings, in line with those from Milch and Varady (1999) and other scholars that studied water conflicts along the U.S-Mexican transboundary settings, show that government agencies lacked staff with skills in social organization and they lacked the flexibility to give local people a substantial voice in the approaches that projects undertook.

The findings in the context of India, while keeping the appropriate scale and site-specific conditions, fit well the situation of stakeholders' participation in the U.S-Mexican transboundary settings such as the Mexicali Valley in the lower Colorado River region. In order to face this disadvantageous situation, other authors recommend acting in congruence with "substantive stakeholder representation" instead of just "stakeholder participation." This is said to be a better way to achieve efficient and equitable water management (Wester, Merrey, and De Lange 2003, 797).

Transboundary water issues in the lower Colorado River region

Agriculturists in the Mexicali Valley have faced, among several others, two significant cases involving transboundary waters that impact local irrigation (see Figure 1.2): one is the salinity problem that took place during the 1960s-early 70s (SAL) and the other is the All-American Canal lining conflict (AAC) which gained momentum in the 2000s (Doughman 2002, 199; Nier and Campana 2007, 42).

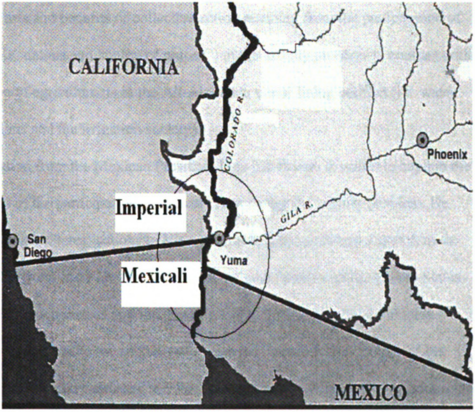
The salinity of the Colorado River results from an increase of natural salts concentration process over time and throughout the watercourse (Cervantes and Bernal 1991, 129). Yet, in addition to this "natural" increase in water salinity, anthropogenic activity exacerbated critical conflicts during the period from 1961 to 1973 when the Mexicali Valley received significant amounts of salt from agricultural drainage in Yuma, Arizona, which affected the productivity of agricultural lands downstream. Oyarzabal-Tamargo and Young (1976, 18) found that as consumptive uses and agricultural return flows increased in the United States, México's Colorado River water that supported agriculture in the Mexicali Valley became saltier.

In 1961, a crisis was reached when a new drainage system for the Wellton-Mohawk irrigation project on the Arizona-California border began emptying heavily saline water into the river, just below the last U.S. diversion but above the diversion for México. Total dissolved solids (TDS) increased from 785 mg/l (or ppm) in 1959 up to 1,490 mg/l by 1962, causing extensive damage to crops in the Mexicali Valley.

More recently during the 2000s, the decision of the United States to "improve" the lining of the All-American Canal has resulted in a new transboundary water conflict (Utton 1991, 480; Navarro 1998; Ingram 2000, 185; Sánchez 2006, 13). The All-American Canal lining project is part of a water conservation plan in California and consists of building a new parallel lined canal along 82 miles of the Mexicali-Imperial borderline.

The "new" conflict emerges because there is a direct hydrological interconnection between seepage from the unlined canal and the Mexicali Valley's aquifer since early 1940s, when the canal initiated operations. The lining of the canal is expected to reduce as much as 80 percent of the inflows of groundwater crossing the border from north to south and that feed the aquifer in the Mexican side (Imperial Irrigation District 1989; CONAGUA 1991; Herrera-Barrientos, Norzagaray-Campos, García-Saillé, Cortez-Lara, and Jorquera 2006, 65). The All-American Canal's seepage represents a source of fresh, high-quality water for more than 19,000 hectares in the northeast portion of the Mexicali Valley where water is pumped through more than 470 deep wells for irrigation (CONAGUA 1991). The All-American Canal lining project is practically finished (by 2010) and it is expected to have immediate impacts in Mexicali.

Figure 1.2 Lower Colorado River transboundary region.



Source: Southern Nevada Water Authority. Resources Department, 2000.

The transboundary region of Imperial-Mexicali illustrates the diversity and complexity of the problems of sharing international waters as well as potential opportunities for finding cooperative schemes. In any case, it is useful to elucidate not only the evolution of institutional arrangements, the participation, and influence of key local stakeholders, but also how agricultural water users might influence transboundary water issues that in turn affect their lands' productivity and irrigation performance.

The suggestions from Uphoff (1991) for analyzing the contextual characteristics (including political aspects) might help to better understand the features of the participation and impacts of institutional arrangements followed by agriculturists while managing water systems. In this regard, the political landscape observed in each case illustrates the costs and benefits of collective action resulting from the participation of agriculturists (i.e. unions and "union of unions") in the salinity problem in contrast with the participation of agriculturists in the All-American Canal lining conflict (i.e. water users' associations and the irrigation society).

A quotation from the Mexican President Luis Echeverría is useful to explain the political context of the participation of agriculturists during the salinity problem. He contrasted the United States' actions in Vietnam and in Mexico during a speech to the United States Congress in 1972: "It is impossible to understand why the United States does not use the same boldness and imagination that it applies to solving complex problems with its enemies to the solution of simple problems with its friends." Luis Echeverria (as presidential candidate and later as president of Mexico emerged from the Institutional Revolutionary Party, PRI) successfully transformed a regional issue into an international platform for promoting Mexican nationalism (Ward 1999, 131).

The agricultural unions have been always politically attached to the PRI. This party dominated the national politics in Mexico for more than 70 years, but since the year 2000 Vicente Fox became the first president from an opposition party, the National Action Party, PAN. In fact, it was in the state of Baja California where initiated the transformation of the political landscape when the first governor coming from an opposition party (PAN), Ernesto Ruffo, arrived to the power in 1989. This enables the PAN to continue dominating the regional political scenery to date (Espinoza 2002).

These facts elucidate that both the national and local political contexts are notoriously different between the times of the salinity problem and the All-American Canal lining conflict. The agriculturists' unions showed a political power in the first case since most of their leaders participated actively in politics at local, regional, and national levels. Besides, they were also influential in all aspects of agricultural development, including water management issues.

Today, unions are no longer directly "operating" developmental aspects in the agricultural sector. They were replaced by water users' associations (WUAs) and the Irrigation Society (SRL) in irrigation operation duties. The WUAs operate in a very different structure, of course, without formal links to political parties. Actually, they (WUAs' officials) are now diversified regarding the party they belong to, say, the PRI, PRD (Democratic Revolution Party), and PAN. However, there exists a clear dominance of the latter party influencing local and national water management policies.

Such an independent, political diversification within WUAs/SRL explains the characteristics of the processes for collective action and the supposed inherent costs and benefits these imply: on one hand, the unified political context dominated by the PRI that facilitated the participation and impact of unions with reduced costs and maximized benefits mostly due to the high extent of coordination, and on the other hand, a diversified political context dominated by the PAN that appeared to induce increased costs and reduced benefits due to the difficulties to keep an integrated vision of the problem and its potential solutions. This later assertion agrees with Espinoza's (1998, 109) findings regarding the main criticisms of the PAN administrations due to the lack of an effective interaction project between government and society.

GAPS IN THE LITERATURE

Previous research suffers from two analytical weaknesses. First, it focuses on issues from a unilateral perspective. Second, previous analyses mostly fail to include key local actors like agriculturists. Also, previous borderlands research shows that the guidelines for transboundary water management should include present and future water users and uses, as well as address cultural, social, legal, political, and institutional dimensions (North American Hydrology for the Environment, Life, and Policy 2006). So the study of hydrological basins should include observation and analysis of such dimensions and analyze how they interact with all physical aspects of the basin that result in water policy and management as well as existing or potential conflicts.

Browning-Aiken et al. (2004), Milch and Varady (1999), and Schmid (2004) argue that an institutionalized combination of perspectives that link the physical, legal, social, economic, and political aspects around water issues should consider the bottom-up approach as a necessary condition to face the complexity of managing cross-boundary waters. As a result, this study emphasizes aspects previously left aside in studies and the existing literature: the institutional aspects that determine success and the changing role of key social actors, such as agricultural water users, in increasing effectiveness to manage transboundary waters as well as to reduce critical conflicts impacting irrigation.

CONTRIBUTION OF THIS RESEARCH

The study of agricultural water users in the context of transboundary water management is important for several reasons. First, it facilitates a better understanding of the differentiated link between transboundary water issues, agriculturists' organization, institutional features, and irrigation performance. Secondly, this study also helps organizations and individuals evaluate strategies aimed at equitable, efficient, and sustainable use of contested water resources. Finally, researchers have often studied transboundary water management issues without proper consideration of key stakeholders such as agriculturists and the institutions they implement to face cross-border water issues.

This research uses the strengths of the institutional analysis approach to provide better insights on the complexities that transboundary water management implies. This study identifies different ways to analyze the problems by focusing on key stakeholders, critical issues over time, and conflictive regions, which in turn help to find effective processes for reaching cooperative behaviors as well as limitations to it (Yankelovich 1999, 39; Doughman 2002, 191).

The reported research also contributes to the institutional analysis literature on irrigation management and expands the perspective of transboundary water conflicts in the lower Colorado River while including the agriculturists' standpoint. The practical contributions of this research will help improve performance of agriculturists' institutions facing the challenge of working with both local irrigation matters and transboundary water management issues.

MAJOR RESEARCH QUESTIONS

This study overall examines socio-productive processes, that is, the mechanisms for enhancing social well-being and productivity in the rural area. Also it examines forms of organizing, agricultural water users' associations and institutions in the Mexicali Valley, and explores questions related to the impact of and changes in these institutions. The study also considers the extent of stress that agricultural activities, irrigation, and transboundary water management processes have on institutions. It also considers actor-oriented and participative processes as factors in transboundary water management that might favor equity.

This dissertation explores:

1. The characteristics of institutions used by agriculturists in two cases: the salinity problem and the All-American Canal lining conflict;
2. How institutional arrangements impact the behavior of agriculturists as it concerns productive activity, irrigation, and transboundary water management;
3. How institutional arrangements affected agricultural performance in three major sub-regions of the Mexicali Valley: northern, central, and southern; and
4. The influence of agriculturists to induce institutional change as it relates to water management at the local and binational levels.

It is hypothesized that transboundary water management in the Imperial-Mexicali region of the lower Colorado River had in the past during the salinity problem and will have in the All-American Canal lining conflict impacts on the productivity of lands and irrigation management of agriculturists in the Mexicali Valley. The impacts are in turn, related to the kind of institutions put into practice by agriculturists.

From the above general assumption, it is thought that in the context of agricultural water users' realm, informal institutions dominated the salinity problem era while formal ones the All-American Canal lining conflict. It is also supposed that informal institutions are more effective than formal ones in allowing voice and influence over transboundary water issues; thus, direct benefits on irrigation management and land productivity are achieved. Besides, the impacts of institutional arrangements are differentiated by region of the valley in each case under study. Finally, it is assumed that leadership and agriculturists' social mobilization in the past induced water agencies to move forward towards a solution to the salinity problem while current formal irrigation organizations lack of power to influence water agencies to find a solution to the All-American Canal lining conflict.

APPROACH

An institutional analysis approach is used in this study. The literature offers a variety of definitions of institutions and makes a differentiation between institutions (formal and informal) and organizations. North (1990, 3) states that institutions are the rules of the game in society. The author categorizes formal institutions as those that refer to constitutions, statute and common law, and regulations. Institutions are the humanly devised constraints that shape human interaction; consequently, they structure incentives in human exchange, whether political, social, or economic.

On the other hand, North (1990, 5) defines organizations as groups of individuals bound by some common purpose to achieve objectives. An insight from these definitions is how organizations come into existence and how institutions influence behaviors evolve; there is a feedback process in part because of the linkages between situation, institutional structure, and performance. Schmid (2004, 21) calls this circular and cumulative causation, learning, and evolution processes.

Schmid (2004, 69) asserts that institutions and organizations are mental constructs and that institutions are more than the rules of the game; they are enabled to do what the individual cannot do alone. Schmid specifies categories of institutions as formal rights and informal habits and customs; thus, institutions affect attitudes and preferences, and provide cues to uncalculated action (70).

The institutional analysis used in this research focuses on three levels: the constitutional, everyday, and within-firms; and two degrees of formality: the formal legislated institutions and the informal cultural institutions. The analysis also examines two particular types of effects of these institutions and populations: impacts and changes. Understanding the impact of a given institution may be distinguished from understanding institutional change (11).

OVERVIEW

Next, Chapter 2 explores the analytical framework and methods used in this research. The institutional analysis and its situation-structure-performance (SSP) methodology stressed by Schmid (2004, 12) is applied to understanding the changing role of agriculturists of the Mexicali Valley for operating local irrigation as well as for addressing transboundary water management issues over time.

The qualitative analysis of primary data in Chapters 3, 4, and 5 addresses the four research questions. Chapter 3 analyzes the views of agriculturists of the northern Mexicali Valley (NAH), Chapter 4 focuses on the agriculturists' perceptions of the central Mexicali Valley (CAH), and Chapter 5 analyzes agriculturists of the southern Mexicali Valley (SAH). A differentiation of the institutional explanatory functions emerged in the three regions of the valley. The features of institutional arrangements, impacts and changes present different behaviors and extent of stress in the three regions studied. For example, the salinity problem was critical in the central and southern Mexicali Valley while the All-American Canal conflict is perceived as to have major risks in the northern region of the valley. However, the institutional response of agriculturists to the salinity was homogeneous, unified, and influential across regions while the institutional response of agriculturists to the All-American Canal seems to be heterogeneous and disorganized across the regions of the valley.

Chapter 6 analyzes the perspectives of water managers that operate in the Mexicali Valley, both older water managers (OMGRs) and newer water managers (NMGRs). It is hypothesized that water managers who have lived and worked in the Mexicali Valley since the times of the salinity (more than 40 years of experience) differed significantly from the newer water managers in their relationship and views of impacts of institutions used by agricultural water users. The institutional features, impacts, and changes as understood by water managers are also examined in this Chapter (see Appendices B, C, and D).

Chapter 7 summarizes the findings of this study: agriculturists in the Mexicali valley have lost economic, political, and organizational power to influence transboundary water management issues. Furthermore, there seems to be polarization and differentiation within the irrigation district. There also appear to be different levels of stress associated with both the salinity problem and All-American Canal lining conflict transboundary water issues which depends on the region of the valley under study.

The research provides evidence of differences in the perceptions between older water managers and newer water managers as well as between agriculturists and water managers on the impacts of institutional arrangements followed by agricultural water users in the Mexicali Valley. The two types of actors studied here –agriculturists (from the northern, central, and southern), and the water managers (older and newer) – have been disregarded as key stakeholders with the capacity to influence positive change. The research findings suggest that taking key local stakeholders into account may help advance work towards achieving equity, efficiency, and sustainability in management of shared and contested transboundary water resources.

CHAPTER 2

ANALYTICAL FRAMEWORK AND RESEARH METHODS

INSTITUTIONAL ANALYSIS

Ostrom (1992, 24) asserts that "institutions shape human behavior through their impact on incentives." In their work on irrigation and river basin management, Svendsen et al. (2005, 4) point out that institutional arrangements typically include: a) the established policy and legal environment (policies, laws, rules, rights, regulations, conventions, and customs, both formal and informal); b) water users' organizations with responsibilities in irrigation water management; and c) processes, mechanisms, and procedures for decision making, coordination, negotiation, and planning.

In exploring the efficacy of institutions, Lam (1998, 53) observes that rules made by farmers are more likely to take into account local information and knowledge about the situation and context. Therefore, it seems that since agriculturists deal directly with problems concerning irrigation in their daily lives they likely understand water management problems best. Institutions may help increase the benefits that flow to individuals from a given set of inputs; conversely, they may increase inefficiencies and transaction costs so that individuals have to work harder to achieve the same benefits.

While examining power issues and definitions within the institutional analysis framework, Schmid (2004, 73) highlights that institutional analysis is not about calculating advantageous exchanges and resource combinations; instead, it is about the non-marginal questions of whose interests count via distributions of opportunity sets. He adds that "to have an opportunity in your opportunity set is to have power". Power is "the ability of one actor to alter the decisions made and/or welfare experienced by another actor relative to the choices that would have been made and/or welfare that would have been experienced had the first actor not existed or acted" (Bartlett 1989, 30). In summary, power is the ability to have one's interests count.

Water systems and institutional analysis

Waterstone (2003, 9) states that over the past decades natural resource issues – including water- have transcended the geopolitical divisions. The problems are exacerbated when water resources cross more than one jurisdiction. Such geopolitical divisions often are overlaid upon shared water resources systems and frequently dissect common aquifers and rivers. The placement of political lines often disadvantages one group of resource users while benefiting or privileging another. Nevertheless, such issues might be resolved by implementing technological or structural mechanisms. However, for such solutions to proceed, an appropriate institutional framework must be in place (10). Finally, Waterstone asserts that, "If transboundary water problems require changes in institutional arrangements for solution, clearly one essential step is the development of an appropriate framework for defining and analyzing institutions" (11).

Gregersen, Folliott, and Brooks (2007, 43) state that many of the most useful watershed and water management approaches also involve complex systems of activities and events from a technical perspective and the same holds for the institutional context within which such activities take place. The authors use the term institutions in the broadest sense of its meaning –namely to include all the ways by which people come together to cooperate, coordinate, and guide their activities. Therefore, this term includes organizations that people establish, laws that people pass and implement through regulations and policies, and the various forms of collective behavior associated with social, economic, and political mechanisms that people adopt. In other words, at any point in time, there is an institutional context within which watershed and water management takes place.

Also, institutional effectiveness depends on the complexity and complications introduced into the real world in an institutional context which mostly relates to the following aspects: a) watershed boundaries are defined by physical factors and seldom coincide with political boundaries. This becomes a complicating factor if a river flows through several countries and international treaties need to be negotiated; b) stakeholder groups normally include a highly diverse set of entities and the interactions among these groups can be complex; c) watershed and water management responsibilities are shared by a multitude of organizations; and d) there is an intricate set of intertwined and conflicting laws and policies to govern behavior in a watershed (44).

If institutional arrangements can facilitate or impede the problem-solving capabilities as well as the benefits of participants in water distribution systems, then the empirical study of the performance of various, changing institutions and institutional arrangements may be useful. Such a study may draw on and extend theoretical frameworks that identify key attributes of collective action institutional structures in irrigation systems. It is possible to treat such attributes as variables that may take different values depending upon the circumstances (Tang 1994, 225). In the end, the variables and the relationships among them may be systematically explored, including in ways that take into account varied settings and contexts.

Studying effective institutional arrangements for water management, especially in transboundary contexts, is conceptually challenging. For example, institutions that differ in principle and in practice, that may be contested, that are beset with ambiguities, and that are subject to outcomes of political practices may result in very different perceptions of efficacy. That is, what is defined as 'effective' by some will be deemed ineffective by others. Nonetheless, there are strong connections between certain institutions and how water is managed (Svendsen et al. 2005, 5). Heathcote (1998, 7) suggests that institutional arrangements for watershed management may be considered effective if they:

1. Allow for the provision of an adequate supply of water that is sustainable over many years with equitable access.
2. Maintain water quality at levels that meet government standards and other societal water quality objectives.
3. Allow sustained economic development over both the short and long term.

In addition, the authors mention that in order to be sustainable, water management must protect and restore natural systems, enhance the well-being of people, and improve economic efficiency. These three objectives may be mutually exclusive, as the partial attainment of one may negatively impact the attainment of the others. Because there are competing uses of water that may be incompatible, institutional arrangements for water management is of paramount importance while also being highly problematic (6).

If institutions are viewed in managerial or interventionist terms, effective water institutions may contribute to sustainable water management by reducing transaction costs, enhancing collective action, and increasing certainty (6). If a more process-oriented and dynamic view of institutions is adopted, analytical emphasis may be placed on how institutions are embedded in power relations with equitable as opposed to economic efficiency concerns of greater importance (6). This dissertation attempts to take into consideration a mix of the managerial and the process-oriented views of water management institutions in the context of a U.S.-Mexican transboundary setting. Individuals or organizations, also called “actors,” can play a number of roles vis-à-vis institutions. These may be simultaneously split among different actors, or separate (7).

Therefore, this dissertation considers the twofold role of actors: in the form of individuals (i.e. agricultural water users) and organizations (i.e. Agricultural Water Users' Associations, WUAs) in the particular institutional contexts. In institutional analysis, “roles” are sets of expectations and tasks associated with a particular function (Coward 1980, 15) while “stakeholders” are individuals or groups which have a legitimate interest in outcome but which may or may not play an active role in decision making. Hence, actors in the watershed are a subset of watershed stakeholders and do not comprise the complete set of stakeholders (Svendsen et al. 2005, 7). This dissertation describes and evaluates the changing role of agriculturists as key stakeholders in transboundary water management in two cases affecting irrigation in the Mexicali Valley--the salinity problem and All-American Canal lining conflict (see Figure 2.1).

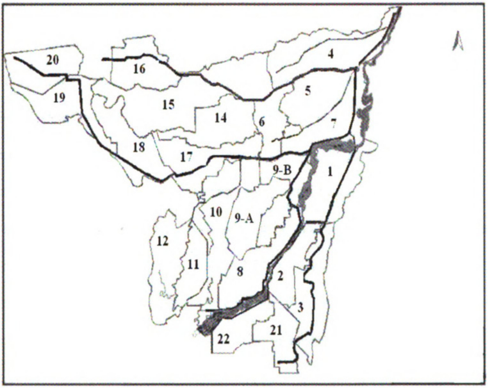
Institutional analysis framework

Mitchell (2007, 6) asserts that questions of performance are central to scholars and practitioners interested in environmental institutions. Mitchell goes on to say that,

> We want to know ‘how well did this institution do at achieving a particular objective?’ Performance questions move beyond causal questions of whether an institution influenced outputs, outcomes, or impacts to ask about how much an institution contributed to achieving - or at least contributed to progress toward - a specified goal.

Questions of performance force us to specify a performance dimension in which we will evaluate an institution, that is, a criterion or objective of judgment.

Figure 2.1 Irrigation system in the Mexicali Valley: modules divisions and major canals network of the Irrigation District, 014.



Source: Colorado River Irrigation District, Irrigation Society, S.R.L., 2009.

In addition to defining and using performance dimensions, Schmid (2004, 11) explains that institutional analysis should consider three levels of analysis: constitutional, everyday, and within-firm relationships and activities. Furthermore, these analyses should, according to Schmid, address institutions of two types: formal, legislated institutions and informal, cultural institutions. Schmid also instructs that institutional analyses need to examine questions of impact and change. That is, understanding the impact of a given institution may be distinguished from understanding changes to or as a result of institutions. In this chapter I elaborate on the features and scope of institutional questions as they relate to transboundary and irrigation water management (Biswas 2008, 17; Rap 2004, 16).

Impact analysis

The typical initial application of impact analysis examines how alternative formal and informal institutions affect commodity transactions as well as wealth distribution. For this dissertation, formal institutions are treated as alternatives to informal institutions. That is, informal habits, organizations, and preferences are treated as given with human interaction responsible for shaping formal institutions (Schmid 2004, 11).

A subsequent phase of impact analysis attempts to explain how internal structures of organizations (e.g., agriculturists' unions and WUAs) and contractual arrangements affect performance such as the management of transboundary and irrigation water. Therefore, the institutional framework defines and limits the set of economic organizations potentially open to a range of economic actors. One such boundary may be a function of transaction costs associated with the types of commodities exchanged and the nature of exchange (Eggertsson 1990, 10). Another aspect of institutional impact analysis looks at the role of creativity and knowledge in organizations as members envision their future and try to adapt accordingly (Hodgson 1999). In some cases, the impacts of an "everyday" institution cannot be identified absent an understanding of the internal structure and working of institutions (Campos and Nugent 1997). When an institution is being analyzed by way of impact analysis, its performance is measured relative to that of others.

Change analysis

Schmid (2004, 14) argues that impact and change analyses are embedded in each other. However, readers are reminded that understanding institutional change requires an evolutionary model that addresses what Ostrom (1992) sees as the influence of institutions in shaping human behavior. Schmid observes that individuals (e.g. agricultural water users) are born into an institutional context that shapes their thinking (e.g. about irrigation and transboundary water management), and, in turn, these individuals' thinking shapes the institutional context (e.g. the National Water Law, WUAs' ordinances for guiding operation, and even the International Water Treaty). Hodgson (1998, 184) asserts that, "Neither individual nor institutional factors have complete explanatory primacy". Change analysis essentially focuses on the processes of existing rules and conventions for making decisions as well as for making rules. Change analysis must explain changes over time in informal institutions and culture as well as changes in formal institutions created by legislatures, executives, and courts.

In this research, the short run implies the analysis of just one case in study, either the salinity problem or All-American Canal lining conflict since no comparisons over time can be made. This research considers the long run as the time frame that encompasses both events, that is, from the 1960s until the 2000s. Therefore, undertaking analysis of institutional change may benefit from the use of a model of institutional change that incorporates feedback loops and change over time. Such an approach to institutional change analysis may consider dimensions such as technology, population, resources, and imagination. Technology affects institutions and their outcomes while institutions, in turn, impact the path of technology. To better understand changes in systems and communities' informal rules, it is necessary to understand the learning process of community members, including their beliefs, ideologies, and habit formation.

To understand change in formal institutions, it is necessary to understand the cognitive processes that feed demand for change into the formal legislative and judicial channels of governance. This may be followed by developing an understanding of how alternative constitutional and political rules impact demands for change which involve a power issue. Thus impact analysis of alternative constitutional and political rules is not a prediction of the future but rather an effort to create information that parties can use as they participate in shaping the future (Schmid 2004, 12).

Situation, structure, and performance framework (SSP)

As Schmid (2004, 16) points out, institutional economics theory suggests using an analytical framework that focuses on the a) situation, b) structure, and c) performance (SSP) together with behavioral, signal, technology, and time variables.

Situation refers to the inherent characteristics of goods that affect human interdependence. The inherent characteristics of the "good" in this study, specifically waters in a transboundary watershed, may be categorized as a Common Pool Resource (CPR) which may be seen as a source of several kinds of interdependences. Kerr (2007, 89) explains that "a watershed is a special kind of CPR: an area defined by hydrological linkages where optimal management requires coordinated use of natural resources by all users." The author mentions that management is difficult because watershed systems have multiple, conflicting uses, so any given approach will spread benefits and costs unevenly among users. As a final point, watershed development seeks to manage hydrological relationships (in the case of an irrigation district which is a other kind of CPR, the central aim is to manage both hydraulic and hydrological relationships to operate irrigation water) to optimize the use of natural resources for conservation, productivity, and poverty alleviation (90).

According to Ostrom (1990), it is critical to distinguish the resource system (pool) from the resource units. The resource system or pool is a typical high exclusion cost good. For CPR goods, there are three typical sources of interdependence included in the situation:

a) Incompatible use of good (IUG) due to scarcity, which might create an externality and a lost opportunity for future generations;

b) High and low exclusion costs (HEC, LEC) to owner/user of the good to exclude others. The interdependence associated with an HEC good is similar to that in the Prisoner's Dilemma (PD) (Poundstone 1992). Here its distinguishing feature is a payoff function that produces a dominant choice to a calculating and selfish individual; and

c) Economies of scale (EOS) which refer to the declining cost of adding another unit of the good which raises the issue of who pays fixed costs and who pays marginal costs which are always falling (Schmid 2004, 16).

Structure refers to the institutional alternatives that people can choose to order the interdependences created by the situation. The actual structural choices may be informal and unconscious as well as formal. Structure also describes the relationships between people that define their relative opportunity sets. Structure is subject to human choice, but when informal structures change only slowly, they are often given in the short-run impact analysis of formal institutional alternatives. Institutional structures may be seen as formal laws or existing only in habits of the mind. Administrative, bargained, customary, and threat transactions, both formal and informal, and for both everyday economic and political functions, are interlinked in an evolutionary, ever-changing, non-equilibrating meta-process. Finally, Schmid (2004, 17) states that "Opportunities in one context can be used to alter opportunities in another". General institutional structures or major ways people interrelate are the following:

a) Administrative transactions that consider people arranged hierarchically;

b) Bargained transactions that consider people arranged as legal equals;

c) Customary transactions such as social norms that are learned or habitual, internalized, and informal; and

d) Threat transactions which refer to people's exchange of threats of bads, not exchange of goods. In these cases there is neither understanding nor tolerance among individuals.

Performance refers to who gets what. Since people have different interests that may conflict, aggregate measures of total welfare may not be possible or useful. Performance consequences of alternative institutions must be disaggregated, in substantive terms, to who gets what goods. The performance measures should be focused on answering the question of whose interests count (who has power) with institution A compared with institution B. All performance measures in the analysis undertaken in the study have a stakeholder or interest group subscript reflecting the parties to a transaction (Schmid 2004, 19).

It seems clear that impact and change theories as they relate to institutional analysis are embedded in each other. The independent variable in an equation describing impact theory of institutions may become the dependent variable in another equation describing institutional change. For example, the impact of political rules for making working rules is the adoption of a working rule whose impact on the economy can be studied (Schmid 2004, 302).

In Table 2.1, a general theoretical framework is formulated in order to link situation, structure, and performance for water resources such as the transboundary CPR in the lower Colorado River. Such a framework together with the following specific frameworks for each case studied (Table 2.2 and 2.3) are used in this dissertation to support the analytical tasks.

Table 2.1 Typical sources of human interdependence and links between situation, structure, and performance for water resources.

Situation (S)	Structure (S)	Performance (P)
Good: Common Pool Resource. (Access to water resources).		
Sources of human interdependence:		
A) Incompatible use good (IUG) **a)** Between agriculturists and urban users (domestic level).	**a_1)** Agriculturists are factor owners (have power), may trade. **a_2)** Urban users as factor owners, (beneficiary of regulation).	**a_1)** Agriculturists transfer water to the city whose bid is higher than agriculturists' reservation price **a_2)** Urban users keep and agriculturists lose water access opportunity.
b) Between water users of country A (upstream) and country B (downstream).	**b)** Imprecise definition of factor ownership at binational level. (i.e. groundwater resources)	**b)** Country B affected:wetlands, agriculturists, and cities Increased costs for B's
B_1) High exclusion cost (HEC) **a)** Between agriculturists and urban users (domestic level).	Agriculturists are factor owners. **a)** Market. Bargaining. Urban users must bid.	**a)** Free-riders problem. Bid fails. City fees system strengthened and individual city consumers must pay for increased costs.
b) Between country A (upstream) and country B (downstream) users.	Imprecise ownership (transboundary aquifers). **b_1)** Bargaining. Country B must bid country A. **b_2)** Administrative transaction. Standards and regulation, no trade allowed. **b_3)** Customary transaction. Country B boycotts to A's.	**b_1)** Non-cooperative behavior Country A keeps unilateral control over water resources. **b_2)** Regulation favors country A. It keeps water control. **b_3)** Few free-riders. Bid is successful. Sharing water system improves bilaterally.
B_2) Low exclusion cost (LEC) **a)** Among individual agriculturists (users in the same sector).	**a)** Market. Bargaining (water transfers). Agriculturist A bids to agriculturist B.	**a)** Rights traded; individual agriculturists economize. Irrigation modules and govmt. coordinate water transfers.
B_3) Prisoner's Dilemma (PD) **a)** Interdependent binary choices. (binationally). Similar to HEC.	**a_1)** Market. Only if ownership is clearly defined. **a_2)** Administrative transaction. Litigation. **a_3)** Bargained transaction. Collective action. **a_4)** Customary transaction. Downstream users claim water rights.	**a_1)** Dominant non-cooperative behavior for sharing water. **a_2)** Prevalence of dominant choice and zero-sum game. **a_3)** Dialogue and cooperation. Win-win situation. **a_4)** Potential attainment of shared water rights. Total transaction costs increase.
C) Economies of scale (EOS) **a)** Building and sharing water infrastructure (domestic/binational).	**a_1)** Monopoly vs. many firms. **a_2)** Cost-sharing rules for building and operating. **a_3)** Rules determine market.	**a_1)** Unit cost vs. variety tradeoff. **a_2)** Difficulties to find payers of fixed and variable costs. **a_3)** Potential economies of scale.

Institutional analysis methodology and SSP analytical framework adapted from Schmid (2004).

Based on the general theoretical framework established, the situation, structure, and performance links for the case of the salinity problem is described in Table 2.2. This aims to show specific features of the alternative institutional structures and resulting outcomes.

Table 2.2 Major sources of human interdependence and links between situation, structure, and performance for water resources issues during the salinity problem.

Situation (S)	Structure (S)	Performance (P)
Good: CPR. Transboundary and irrigation water.		
Sources of human interdependence:		
A) Incompatible use good (IUG) **a)** Between water users of country A (upstream) and country B (downstream).	**a)** Lack of factor ownership regarding water quality standards.	**a)** Country B affected: agriculturists reduce acreage and productivity. Increased costs for B's.
B_1) High exclusion cost (HEC) **a)** Between country A and country B users.	Lack of factor ownership for water quality standards. **a_1)** Bargaining. Country B must bid country A. **a_2)** Administrative transaction. Standards and regulation, no trade allowed. **a_3)** Customary transaction. Country B boycotts country A.	**a_1)** Non-cooperative behavior. Country A keeps unilateral control over water quality entering country B. **a_2)** Regulation favors country A. It keeps water quality control. **a_3)** Bid is successful and sharing water (quality) system improves binationally.
B_2) Prisoner's Dilemma (PD) **a)** Interdependent binary choices (binationally).	**a_1)** Ownership regarding water quality is clearly defined according to Country A's interests. **a_2)** Bargained transaction. Explicit collective action within and between countries.	**a_1)** Dominant non-cooperative behavior for sharing water quality. **a_2)** Dialogue among water users and cooperation achieved. Win-win situation achieved. Modification of the binational water framework.
C) Economies of scale (EOS) **a)** Building and sharing water infrastructure (local and binational). (i.e. Wellton-Mohawk canal).	**a_1)** Monopoly vs. many firms. **a_2)** Cost-sharing rules for building and operating water infrastructure. **a_3)** Change in the binational water framework (1944 Water Treaty).	**a_1)** Unit cost vs. variety tradeoff. **a_2)** Upstream users are payers of fixed and variable costs. (compensation given by the producer of the externality). **a_3)** Economies of scale achieved (upstream salty water drains; downstream quality and wetlands improve).

Institutional analysis methodology and SSP analytical framework adapted from Schmid (2004).

In addition, the situation, structure, and performance links for the case of the All-American Canal lining conflict are presented in Table 2.3. This shows features of the alternative institutional structures and resulting outcomes.

Table 2.3 Major sources of human interdependence and links between situation, structure, and performance for water resources issues during the All-American Canal lining.

Situation (S)	Structure (S)	Performance (P)
Good: CPR. Transboundary and irrigation water.		
Sources of human interdependence:		
A) Incompatible use good (IUG) **a)** Between water users of country A (upstream) and country B (downstream).	**a)** Nonexistent definition of factor ownership regarding transboundary groundwater resources.	**a)** Country B affected: agriculturists reduce acreage, wetlands reduced, and aquifer reduces water availability and quality. Increased costs for B's.
B_1) High exclusion cost (HEC) **a)** Between country A and country B users.	Non existent ownership for transboundary aquifers: **a_1)** Bargaining. Country B must bid country A. **a_2)** Administrative transaction. Standards and regulation, no trade allowed. **a_3)** Customary transaction. Country B boycotts country A.	**a_1)** Non-cooperative behavior. Country A keeps unilateral control over water source. **a_2)** Regulation favors country A. It keeps water control. **a_3)** Few free-riders. Bid is successful and sharing water system improves. Binational equity reached.
B_2) Prisoner's Dilemma (PD) **a)** Interdependent binary choices (at the binational level).	**a_1)** Market. Only if ownership is clearly defined. **a_2)** Administrative transaction. (Litigation). **a_3)** Bargained transaction. Collective action within and between countries. **a_4)** Customary transaction. Downstream users claim water rights in international courts.	**a_1)** Dominant non-cooperative behavior. No sharing of seepage water. **a_2)** Prevalence of dominant choice. Zero-sum game considering the high extent of interdependence. **a_3)** Dialogue and cooperation. Win-win situation. **a_4)** Potential attainment of shared water rights (mandatory compensation to the affected party). Slow progress and transaction costs increase for both countries.

Institutional analysis methodology and SSP analytical framework adapted from Schmid (2004).

ANALYTICAL FRAMEWORK FOR THIS STUDY

Institutional analysis is applied to explore the features and impacts of institutional arrangements used for agriculturists in response to the salinity problem and All-American Canal lining conflict. Therefore, this dissertation specifies dependent variables of interest as well as the broad categories of independent variables.

For impact analysis, institutional alternatives are independent variables. The dependent variable is a measure of substantive performance (i.e. benefits to agricultural water users as a result of their participation in the salinity and the All-American Canal processes). The set of independent variables with which institutional variables interact contains aspects of the characteristics of good and the environment that create human interdependence which, in turn, may help contextualize and describe the situation. Ultimately, the structure of institutional variables influences the outcome or performance. Thus, the term "function" should here be read as "facilitates" since institutional model processes are never fully deterministic (Schmid 2004, 13).

In impact analysis, the situation is given and we ask how different institutions affect the outcome of the interdependence that the situation creates in the context of different interests of different people. The institutions may be formal or informal or often a fusion of both.

Performance = f (institution X, or institution Y, holding a situation constant).

In diagrammatic form, we have:

Situation → Structure → Performance

Situation here refers to the context of each case studied, that is, the SAL and AAC. The linkage between situation, structure, and performance is a function of cognition and behavioral regularities of people experiencing the situation and their structured opportunity set. In this regard, Schmid (2004, 19) goes in depth by establishing that:

> As for behavioral regularities, there is no simple mechanical connection between institutional structure, situation, and performance. Instead, the linkage is a mental one of cognition and formation of images and meanings. Institutions structure opportunities, but these have to be perceived and acted upon [.....] institutional analysis is firmly rooted in the behavioral sciences and its theory is built on our best understanding of how the human brain works. It is built on understanding of behavioral regularities of a population, not a particular individual. By "regularities" it is suggested that these characteristics are generally true of a population in most instances. It does not imply that everyone exhibits them all the time.

In change analysis, institutions become the dependent variable. In this case, it is important to ask how changes of situational or independent variables (i.e. technology, demographics, power distribution, etc.) alter the performance of existing institutions and how these changes are perceived and possibilities imagined by conflicting groups.

If everyday institution 'X' is chosen in time 1, and then the situation may change in time 2, the performance changes. This in turn may led to formal and informal institutional change in time 3 depending on perception and power. Formal institutions change in part when everyday performance changes interrupt routines or depart from the performance desired by some group with the power to change the institutions, given the constitution in place at the time. Change may result from either (or both) a change in the rules for making rules or the environmental situation.

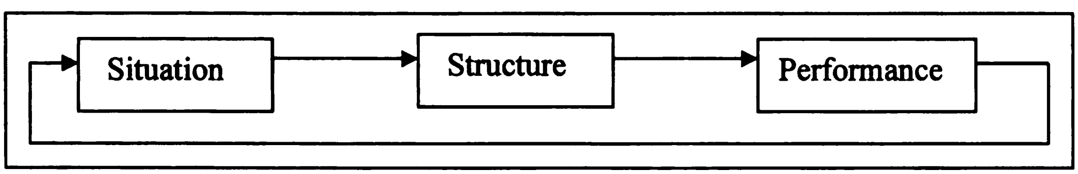
Stated in functional form,

Change in everyday formal institutions = f (rules for making rules, change in the situation).

On the other hand, informal institutions form out of largely unconscious learning. Stated in functional form,

Change in everyday informal institutions =f (changes in widely shared learning, functionality, power, and situation).

In diagrammatic form for both formal and informal institutions,



The new institution's performance may feed back and change the situation including the thought processes of the actors as well as a given situation such as level of technology causing continuous evolution.

If the physical situation does not change, then the only source of institutional change is ideology (i.e. preferences) and cognition. However, technology and ideology may also interact as technology gives a different world-view. Technology can act as a metaphor and affect institutions apparently unrelated - for example the change may be in biology and have effects on thinking in economics as applied to markets, etc. (Mirowski 2002).

Socialized, transacting individuals are subconsciously doing what the analyst is trying to do –make sense out of institutional impacts, plus creating themselves. They cannot be conscious of all the situation variables that the analyst may find explicitly useful, but these same interdependence creating characteristics of goods are out there. People will necessarily find some simplifying conception that will be the basis for their sharing informal institutions and working toward altering formal institutions.

Change in rules for making everyday rules may be referred to as change at the constitutional level (or international level such as bilateral water treaties) although it includes more broadly all political rules. While the constitution (or bilateral water treaty) is itself a function of rules for making constitutions, all of this ultimately rests on fundamental ideology carried largely in people's heads that evolves as a result of functionality, power, and learning processes.

In functional form,

Change in rules for making rules = *f (changes in widely shared learning, functionality, power, and situation).*

I use this analytical framework to explore the characteristics of the institutions followed by agriculturists in both the salinity problem and the All-American Canal lining conflict. I also use this framework to describe and explain how institutional arrangements guide the agriculturists' behavior and impact the local productive activity, irrigation and transboundary water management. In the following section I portray the qualitative analysis implemented and the methods used in this study.

QUALITATIVE ANALYSIS

The study of agricultural water users in the context of transboundary and irrigation water management allows for a better understanding of the links between transboundary water processes, irrigation, and the institutional features of agriculturists operating in a boundary setting. This also helps to reveal the impact of institutional arrangements in place and, therefore, guides organizations and individuals to evaluate strategies aiming to achieve an equitable, efficient, and sustainable use of highly contested shared water resources (Cech 2003, 407; Rap 2004).

Furthermore, researchers have often studied transboundary water management issues without proper consideration of key stakeholders such as agriculturists and the institutions they follow to face the always critical cross-border water issues. Ultimately, this study identifies different ways to analyze the problems by focusing on key stakeholders, critical transboundary water issues, and conflictive regions.

Qualitative approaches and methods

Chung (2002, 37) asserts that "There is no clear consensus on the definition of 'qualitative data'." The author states that different researchers assume different definitions, and most are not explicit about what they mean when they use the term. Chung highlights that during a qualitative research process, qualitative methods can help to confirm hypotheses. The author also states that during a quantitative research process the researcher may be unable to explain counterintuitive or inconclusive findings of the quantitative analysis, and in this case the qualitative research can be useful in improving the quality of the interpretation of survey results (44).

Qualitative methods and their instruments, specifically those of cultural and topical interviews, are useful for contextualizing and better understanding the interviewees' worldviews as well as eliciting the matters of fact during empirical processes (Rubin and Rubin 1995, 195). This research uses a kind of process based on topical interview. As such, it aims to explore issues of what, when, how, and why something happened. In this kind of interview factual content matters; accordingly, the researcher checks out details, tries to solve contradictions, and ascertains how interviewees know what they claim to know. For this to occur, these authors mention that prior to the interview, the researcher prepares a set of specific questions based on background research and structures the interviews by including main questions, probes, and follow-up questions (202). At the end, Rubin and Rubin state that qualitative interviews emphasize context and, as such, context suggests clues to the integrity of answers (225).

Patton (2002, 4) adds more in the features and relative advantages of using qualitative methods. The author states that data for qualitative analysis come from fieldwork and that during fieldwork, the researchers would take advantage of spending time in the setting under study like an organization, a community or wherever situations of importance to a study can be observed, people interviewed, and documents analyzed. He mentions that:

> Qualitative research allows for talking with people about their experiences, perceptions, opinions, feelings, and knowledge. As a result, the voluminous raw data in the field notes are organized into narrative descriptions with major themes, categories, and illustrative case examples extracted through content analysis. The

themes, patterns, understandings, and insights that emerge from field work and analysis are the fruit of qualitative inquiry (5).

Kaplowitz, Lupi, and Hoehn (2004, 506) offer an illustrative example of differentiation between two qualitative research techniques. While studying an iterative multiple-method approach to survey design and evaluation, these researchers point out the weaknesses and strengths of using qualitative research techniques such as focus groups and cognitive interviews to design an environmental valuation questionnaire. The authors show that qualitative cognitive interviews appear to be the preferable evaluation methods for getting embarrassing and potentially sensitive information (523). These findings fit the results from other studies which recognize that qualitative interviews and focus groups may provide different but complementary information for environmental valuation (Kaplowitz and Hoehn 2001). Additionally, it is observed that cognitive interviews may place respondents in a setting that facilitates their sharing of (sensitive) resource information they otherwise might not share in a group (Kaplowitz 2000).

This research, similarly to the study from Kaplowitz, Lupi, and Hoehn, considers obtaining information that refers to sensitive resources and issues such as transboundary and irrigation water in local and binational conflictive contexts. In this way, qualitative research methods based on face-to-face, in-depth interviews used in this study seem to be a proper and effective instrument to get good responses from agriculturists and water managers since they are likely to feel comfortable sharing in their own living or working settings what they would consider "sensitive" information.

Qualitative research was carried out in this research in order to identify and characterize evolving aspects of the institutional features and productive and organizational practices involving irrigation and transboundary water management. van Hofwegen and Jaspers (1999, 3) propose the following methodological steps, among others, as a practical process for institutional framework assessment: a) to review reports about water management situations combined with registered problems; b) to identify and select relevant stakeholders at different operational and organizational levels; and c) to elaborate and implement interviewing procedures considering face-to-face interviews with key informants such as agricultural water users and water managers.

Research process

Activities carried out during 2005 and 2006 included an initial review of documentary sources, exploratory visits to potential areas of study in several Mexican northern border irrigated areas (Nuevo Laredo in Tamaulipas, the Delicias Valley in Chihuahua, and the Mexicali Valley in Baja California), preparatory meetings, and informal interviews with agricultural water users' representatives and binational water agencies' officials. Such activities helped to operationalize the theoretical-analytical framework, define the research areas, as well as to determine the research methods to be used. Pre-research activities were supported in part by funding from a binational project: "Water in the México-United States region: Convergences, Divergences, and Challenges" [The Center for U.S.-Mexican Studies (UCMEXUS) of the University of California, San Diego, and El Colegio de San Luis (COLSAN), 2004-2005. (http://usmex.ucsd.edu/environment/index.html)].

The research was designed to examine situational conditions, institutional arrangements, and performance consequences in irrigation and agriculture for water users in the Mexicali Valley, México which are directly linked to transboundary water management in the lower Colorado River region. Field research activities were supported by the Institute of International Education (IIE), Social Sciences Doctoral Dissertation Program, 2007.

Two cases allowed for comparisons over time, that is, SAL *vis-à-vis* AAC. Such a case study method takes advantage of naturally occurring events where some decision makers are (or were) applying some institution to a set of existing situational variables. Case study methods have been used to study CPRs such as irrigation systems operation and management (Ostrom 1990; Poteete and Ostrom 2003) and also while assessing integrated water resources management programs (van Hofwegen 2001, 39). Given that one case of study by itself cannot warrant the connection between alternative institutions and performance, a meta-analysis of at least two points over time can look for distinctive patterns informing on meaningful differences (Schmid 2004, 150).

Research location

Ward (2001, 106) draws on how the Mexicali Valley has historically played a critical role in the struggle between Mexican and the United States interests for control of land and water in the Colorado River Delta through the twentieth century. He states that during the first four decades of the past century, the Colorado River Land Company, owned by private interests in the United States, exerted a firm hold over the whole agricultural area of Mexicali as well as over the water supply that sustained the agricultural transformation of the valley.

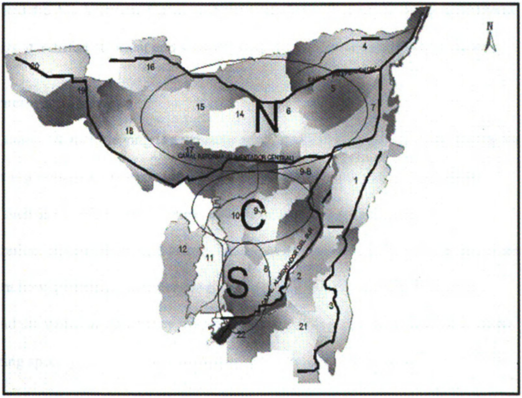
Ward (2001) describes the ending of the international companies' dominion (mostly from the United States) over the Mexicali Valley agricultural area. He mentions that the Mexican President Lázaro Cárdenas initiated a land expropriation process that finished in 1937 to form and benefit groups of *ejidatarios* in Mexicali. This refers to a specific type of social/communal land property structure where each member of the *ejido* is endowed with a piece of land for production (about 20 hectares). The 1992 Mexican Land Reform modified this original property structure by giving individual rights to each *ejidatario*. With this institutional change, agriculturists operate as private owners that are allowed to work, sell or rent their lands.

The above mentioned together with the signing of the 1944 International Water Treaty between the United States and México modified the water management processes among agricultural water users. These facts together inform the current developmental characteristics taking place in the region in which transboundary water management remains as a central and conflictive issue impacting agriculture and irrigation performance in the Mexicali Valley (107).

The Mexicali Valley is located in the farthest northwest corner of México. It is crossed by the 32° 30' North latitude and the 115° 00' West longitude geographical coordinates and encompasses an irrigated area of 207, 234 hectares (equivalent to 512,087 acres) in an arid region (CONAGUA 2002). Regarding production, the official registers indicate that among a list of 49 different types of crops, three of them predominate: wheat (80,200 hectares), alfalfa (29,000 hectares), and cotton (21,000 hectares) which represented 79.8 percent of the total agricultural area under production. Also, these three types of crops reached together a production value of U.S. $ 175, 342, 785.00 dollars which represented 66.2 percent of the total gross production value during the agricultural year 2007-2008 (Cortez, Quesada, and Whiteford 1999, 104; SAGARPA 2009).

Water availability and quality as well as transboundary water management conflicts in the Mexicali-Imperial area are among the paramount problems faced by agriculturists operating in this agricultural region from the early 1900s (Garcia-Acevedo 2001, 57; Garcia-Saillé, López, and Navarro 2006, 77). The Mexicali Valley is located in the borderline between southeastern California and northeastern Baja California (see Figure 2.2). It encompasses a portion of the Mexican Irrigation District 014, Colorado River. In this region, surface and groundwater run over geopolitical divisions taking a general direction from north to south. Such a feature makes this hydrological resource take characteristics of transboundary waters (CONAGUA 1991).

Figure 2.2 Mexicali Valley's regions of study based on the major canals network in the Irrigation District 014, Colorado River.



Source: Colorado River Irrigation District, Irrigation Society, S.R.L., 2009.

Irrigation water is mostly drawn from the Colorado River, which is also tapped for water by major urban and rural areas in Mexican cities of Mexicali and Tijuana in Baja California and for the city of San Luis Rio Colorado in Sonora (Cortez, Quesada, and Whiteford 1999, 104). A second source comes from the groundwater or the Colorado aquifer naturally shared by the United States and México (known as the Mexicali Valley aquifer in the Mexican side). Water supply from this aquifer has been largely contested between both countries; likewise, this water is not regulated in the 1944 International Water Treaty and this fact has brought about critical controversies in regards to the use of and rights over groundwater (105). Given the features of this region and the water management issues implied, this research aims to examine two referential transboundary water conflicts that take place at different moments in the Mexicali Valley, the salinity problem and the All-American Canal lining conflict, both of them involving agricultural water users at a different extent and showing their own institutional behavior features.

Semi-structured interviews

Qualitative interviewing is a versatile approach to doing research. The qualitative interview is a principle research tool for a broad variety of study areas of the social sciences such as sociology, social work, education, political sciences, public administration, anthropology, and history among many others. It is through the use of this instrument how qualitative interviewers listen to people as they describe how they understand the world in which they live and work. Qualitative interviews are also useful in exploring specific topics, events, or happenings since they allow for exploring social, political, and economic changes (Rubin and Rubin 1995, 3).

Rubin and Rubin emphasize that to elicit in-depth answers about culture, meanings, processes, and problems it is necessary to choose from a family of closely related types of qualitative interviews. They suggest that when the research aims to get more specific information, the researcher should use a semi-structured (focused) format through which the interviewer introduces the topic, and then guides the discussion by asking specific questions (5). Ultimately, the idea of using this research tool is not to impose a set of answer categories such as “yes” or “no” or “agree” or disagree” (6). In this research, a semi-structured format is used to control the interview to better elicit sensitive and specific information from interviewees about both the salinity problem and All-American Canal lining conflict. (See appendix A).

Bernard (1995, 209) helps to resolve the decision of choosing among several qualitative interview tools. He mentions that “in situations where you won’t get more than one chance to interview someone, semi-structured interviewing is best.”

For the case of this doctoral research process, both the agricultural water users and the water managers (older and newer) were difficult to reach during field research work. In the case of the former group of interviewees, subjects are mostly very elderly people who, although in good condition to respond in a first round of interviews, they moved away and in some cases passed away before a second interview could be conducted during the research process. The same is true for water managers (older). So, it was very critical to choose the type of interview to implement as well as the people who could talk about two comparative moments over time.

In-depth, open-ended interviewing, as used in this research process, allows for exploring a topic in detail to deepen the interviewer’s knowledge of the topic and, at the same time the interviewer is open to any and all relevant responses. There are no correct answers, and the interviewee is not asked to select from a series of alternative choices. This in turn, allows for a maximum flexibility in exploring any topic in depth and in covering new topics as they arise. In short, two of the main strengths of the in-depth, open-ended interviewing in this study are to break down domains into factors and sub-factors and obtain orienting information about the context and history of the study and the study site (Schensul, Schensul, and LeCompte 1999, 121).

For the above mentioned to occur, the authors assert that the appropriate interviewee has to be chosen. Considering the format of the formative theoretical framework followed by the in-depth semi-structured interviews, people identified as knowledgeable about the topics targeted are selected as key informants or cultural experts to be interviewed. It is not necessary to interview many key informants to obtain a large amount of information about a subject; however, it is necessary to find key informants who are well informed (123). Ultimately, semi-structured interviews combine the needed flexibility of the unstructured, open-ended interview with the directionality and agenda of the survey instrument to produce focused, qualitative, textual data at the factor level, as such, it can be used to operationalize factors into variables (150).

A series of face-to-face semi-structured, in-depth, open-ended interviews addressing key informants was used in this research as the main qualitative research tool. These key informants' individuals are encompassed in two major groups: a) agriculturists re-grouped in three categories according to the irrigation area to which they belong, namely, northern, central, and southern Mexicali Valley; and b) water managers/officials working (or retired) for water agencies at the local (i.e. Water Users' Associations), national (i.e. the Mexican National Water Commission), and binational level (i.e. the Mexican Section of the International Boundary and Water Commission). Water managers were in turn re-grouped in two categories according to the level of experience or their time in service.

Sampling frame

The research design for this study used an *a priori* definition of the sample structure in which the sampling decision was taken with a view to selecting groups of cases. This means that the structure of the groups taken into account is defined in advance of data collection. This procedure is suitable for further analyzing, differentiating and testing assumptions about common features and differences between specific groups (Flick 2002, 63). Given the characteristics of this study in which the major domains and research questions to be explored were previously and widely defined, the overall aim was to get richness in relevant information, thus going as deep as possible in the analysis. So, richness in relevant information is obtained through the perceptions of people who lived and worked in the study area during both the salinity problem and All-American Canal lining conflict. As such, the appropriate subjects for this research are complementary units or sampling groups of cases, namely, agriculturists and water managers in the Mexicali Valley.

Rubin and Rubin (1995, 65) assert that who is chosen to be interviewed should match how the subject of the research is defined. The authors add that all interviewees should satisfy three basic requirements: a) they should be knowledgeable about the cultural arena or situation or experience being studied; b) they should be willing to talk;

and c) when people in the cultural arena have different perspectives, the interviewees should represent the range of points of view (6).

Accordingly, this study uses two types of units of analysis, individual agriculturists (sub-grouped according to their location in areas of the Mexicali Valley) and water managers (sub-grouped by their level of experience or the time working in the valley) as they relate to the issues explored and both groups of units often have different perspectives. The entire interviewing process included thirty-six interviewees in total: twenty-seven agriculturists and nine water managers divided according to the following sample (see Table 2.4).

Table 2.4 Interviews implemented in the Mexicali Valley.*

Irrigation area in the valley	Kind of subjects studied		
	Agriculturists	Older water managers	Newer water managers
I. Northern	9	6	3
II. Central	10		
III. Southern	8		

*All data collected was recorded in Spanish and then translated to English by the author.

Agriculturists are users of transboundary water for irrigation; as such, their productive performance is and has been directly linked to the salinity problem and All-American Canal lining conflict. Water managers are people (technicians) who serve or served as operative intermediates between the water source and agricultural water users through the several levels of water infrastructure operation such as the international boundary points of delivery (IBWC/CILA at the Morelos Dam and Sánchez Mejorada Canal); the irrigation district headwater delivery points (CONAGUA at the Matamoros Wash Dam and All-Mexican Canal); and, finally, the canals' major network and wells as well as secondary, tertiary, and inter-parcel irrigation canals for irrigation (SRL and Irrigation Modules).

In the case of water managers, both older and newer, their high degree of rotation among areas in the valley did not allowed dividing groups by region of study like in the case of agriculturists, so their responses were mostly focused on the Mexicali Valley as a whole.

Data analysis procedures

Rubin and Rubin (1995, 226) mention that data analysis begins while the interviewing is still under way. The authors explain that,

> After completing each interview and then again after finishing a larger group of interviews, you examine the data you have heard, pull out the concepts and themes that describe the world of the interviewees, and decide which areas should be examined in more detail [....] After the interviewing is complete, you begin a more detailed and fine-grained analysis of what your conversational partners told you. In this formal analysis, you discover additional themes and concepts and build toward an overall explanation.

Rubin and Rubin further assert that during final data analysis it is necessary to categorize all the material from all the interviews that speaks to specific themes or concepts. This procedure enables the researcher to compare material within the categories to look for variations and nuances in meanings. Finally, compare from across the categories allows the researcher to identify connections between themes and concepts in order to integrate them into a theory that offers interpretation of the research issues (227).

Miles and Huberman (1994, 50) offer additional insights on qualitative data analysis. The authors strongly recommend early analysis as a way to improve the analysis as a whole since it helps the researcher cycle back and forth between thinking about the existing data and generating strategies for collecting new, better data.

This research implemented the data analysis stages and procedures suggested by Rubin and Rubin and Miles and Huberman. Specific procedures used in this study consisted of:

1. Collecting information in the form of both handwritten notes and tape recording of interviews. These tasks were carried out in a parallel fashion in order to capture as much information and detail as possible during individuals' interviews.
2. Then, the basic, raw data was processed and converted into write-ups. The tape recording and hand written materials were put together and then transcribed (and translated from Spanish to English) to get formal documents in which major themes, ideas, and concepts that emerged could be identified in the texts.
3. Next, such formal documents were coded in order to have them available for analysis of each interview. The codes used considered an initial list prior to performing field research which in turn emerged from reflections of the conceptual framework, core research questions, and problem areas (Miles and Huberman 1994, 58). So this coding technique allowed for improving the coding system as themes and concepts emerged in the text analysis.
4. After the coding system was developed, a series of displays were elaborated to re-pack, summarize, and organize data according to the kind of subjects studied

[agriculturists from the northern Mexicali Valley (NAH), central Mexicali Valley (CAH), and southern Mexicali Valley (SAH) and for water managers both older (OMGRs) and newer (NMGRs)]. In these displays, specific answers such as definitions of themes, concepts, and ideas were linked to interview questions and these in turn to the central research questions of the study. Finally,

5. These display tables gave place to the creation of facilitating institutional functions showing explanatory factors and variables as they relate to themes, sub-themes, and, ultimately, to the theory of institutional analysis (Appendices B, C, and D present data tables and institutional functions).

In summary, the data analysis process identifies and codifies qualitative information gathered from interviewees and includes three major steps: a) elaborating categories of themes, sub-themes, and concepts; b) comparing material within the categories to look for variations and nuances in the meanings; and c) comparing across the categories to discover connections between themes (Rubin and Rubin 1995, 195; Schensul, Schensul, and LeCompte 1999).

Development of institutional functions and explanatory factors

Table 2.5 summarizes the institutional analysis facilitating functions used for each of the two kinds of actors studied in the Mexicali Valley: agriculturists and water managers. For each kind of actor/stakeholder analyzed, twelve functions (a-l) were built as a result of the major themes (1- 4) and sub-themes (A-I) that emerged from the qualitative analysis. Some examples of institutional explanatory factors (independent variables) are shown for each institutional function in column four, although all of them are described and analyzed in subsequent chapters. Also, definitions of dependent variables are annotated in column five as the outcomes for each of the twelve functions. Column six shows the type of analysis carried out (descriptive, impact, and change).

Descriptive functions for each case explain impacts of the salinity of the Colorado River in the Mexicali Valley (SAD) and expected damages in the Mexicali Valley due to the implementation of the All-American Canal lining project (JEO).

Impact analysis is done for the following functions: a) referential functions such as the progress view concerning agriculture in the Mexicali Valley (PRO), regression view concerning agriculture in the Mexicali Valley (REG), successful irrigation water management view (SIM), and failing irrigation management view (FIM); b) core functions such as the high level of agriculturists' participation during the salinity problem (HIP), influence of agriculturists' participation and institutions in the salinity problem (ITS), the low participation and weak defense against the All-American Canal lining project on the part of agriculturists in the Mexicali Valley (DAS), the water users' associations low participation and weak defense against the All-American Canal lining project (ELU), and the influence of agriculturists in the All-American Canal lining conflict (DIT).

Table 2.5 Institutional functions differentiated by theme and sub-theme and for each of the actors studied: agriculturists and water managers in the Mexicali Valley.

Actor/ Stakeholder (1)	Theme (2)	Sub-theme (3)	Institutional function (4)	Dependent variable (5)	Type (6)
Agriculturists and water managers	1. Major developmental issues in the Mexicali Valley.	A. Changes in the agricultural sector.	a. PRO = *f* (change in productive practices, technology, financing, etc.)	Progress view	I
			b. REG = *f* (Δ prod. costs, reduced GDP, reduced relative prices, Δ land rented)	Regression view	I
		B. Changes in the irrigation sector.	c. SIM = *f* (Δ bargaining capacity, water use efficiency, Δ technology).	Successful water management view	I
			d. FIM = *f* (Higher bureaucracy, operation problems, inequality among users, etc.).	Failing water management view	I
	2. The salinity problem (SAL). (t_1)	C. Salinity damages in Mexicali.	e. SAD = *f* (Yields decrease, Δ prod. costs, abandon activity).	Salinity of agricultural lands	D
		D. Participation of agriculturists in the salinity.	f. HIP = *f* (unification, financial capacity, local and national leadership).	High level of participation of agriculturists	I
		E. Influence of agriculturists in the salinity.	g. ITS = *f* (binational waters, national support, capital, etc.).	Strong influence in solutions	I
	3. The All-American Canal lining conflict (AAC). (t_2)	F. Expected damages in Mexicali due to the All-American Canal lining project.	h. JEO = *f* (economic, environmental, damages, water adjustments, lands reduction, etc.).	Lining project threat and expected damages for agriculturists	D
		G. Participation of agriculturists in the All-American Canal lining conflict.	i. DAS = *f* (apathy, external leadership, lack of farmers leadership, etc.).	Agriculturist weak defense of the seepage water	I
			j. ELU = *f* (bureaucracy, coordination with IBWC/CILA, lack of systemic view).	WUAs weak defense of the seepage water	I
		H. Influence of agriculturists in the canal lining issue.	k. DIT = *f* (no power in the sector, external leadership, etc.).	No influence in the canal lining issue	I
	4. SAL vs. AAC (t_1) vs. (t_2)	I. Agriculturists' institutional differences.	l. DIF = *f* (organization, leadership, economic and political power).	Major institutional differences.	C

Type column indicates the analysis carried out: I = impact, C = change and D = descriptive.

Impact and change analysis functions are reviewed as they are embedded in each other along the study. However, change analysis considers the review of the institutional differences shown by agriculturists to address the salinity and All-American Canal lining issues (DIF). This core function regarding comparisons between time one (t_1) and time two (t_2) explains the changing role of agriculturists of the Mexicali Valley in irrigation and transboundary water management.

This theoretical-methodological framework allows for additional and varied institutional factors to be included in the analysis, thus, broadly explain performance. Some factors surface in more than one function according to the nature of the issues in study. A discussion of the functions obtained for each of the three groups of agriculturists (NAH, CAH, and SAH) and the two groups of water managers (OMGRs and NMGRs) is developed in following Chapters 3, 4, 5, and 6, respectively.

Documentary analysis

As a complement for the qualitative information gathering process, this dissertation considered data gathered from written materials and other documents from organizational or programs records; official publications and reports, and memorabilia, which are mostly available in archives of governmental agencies. This task helped to elucidate the institutional arrangements that either took or are taking place in transboundary water management and to gain insights that allow for comparing socio-productive and irrigation operation procedures as well as socio-organizational aspects linked to the salinity problem and All-American Canal lining conflict.

Most documentary analysis included the review of newspapers' archives and official documents related to the issues in study. Such archives are available at the

International Boundary and Water Commission (IBWC/CILA)-Mexican section and the Mexican National Water Commission (CONAGUA), this latter water agency formerly named Secretaría de Recursos Hidráulicos at the time of the salinity problem. Some official documents refer to specific internal reports which expose technical opinions about the potential impacts in the Mexicali Valley of the salinity problem and the All-American Canal lining project.

Data analysis includes the categorization of information and identification of themes and sub-themes emerged (Patton 2002, 28). This process is useful in unraveling the arguments used in the policy literature addressing water conflicts between the United States and México and to complement the qualitative information gathering processes based on interviews (Parkin 1990; Doughman 1999, 6; Fischer 2000, 29).

CHAPTER 3

INSTITUTIONS AND AGRICULTURAL WATER USERS IN NORTHERN MEXICALI VALLEY (NAH)

The Mexicali Valley agriculturists' perspectives on local agriculture and irrigation have evolved over time. The following analysis explores how agriculturists in the northern Mexicali Valley (NAH) participated in, influenced, and have been impacted by two significant water resource conflicts – the salinity problem (SAL) and the All-American Canal lining conflict (AAC). The research reveals local processes and institutions as well as their impacts on agricultural productive activities. The results show different views of these stakeholders concerning the extent of stress, features and impacts of the participation of agriculturists, and outputs across the two water conflict cases studied as well as across the regions of the Mexicali Valley.

An institutional analysis framework is used to examine research questions regarding the institutional characteristics, the impacts on the productive activity, irrigation and transboundary water management, the different levels of stress of the transboundary conflicts for each sub-region, and the influence of agriculturists to induce institutional change at the local and binational levels.

This chapter focuses on the perceptions of nine agriculturists interviewed in the northern Mexicali Valley, according to the sample described in Chapter 2 (Table 2.4). First, I review the views of respondents concerning general aspects of the evolution of agriculture and irrigation in the Mexicali Valley both as a whole and in particular in the northern region of the valley. Next, I explore the perceptions concerning the institutional response to the salinity crisis and the respondents' views of their participation and influence in addressing the salinity problem. Third, I describe the views of agriculturists in the northern region concerning the impending impact of the All-American Canal lining project and explore the institutional devices used by agriculturists in response to the All-American Canal issue. Finally, I explore the similarities and differences regarding the institutional responses to these two transboundary water crises in the northern region.

Data analysis in this and the chapters ahead includes the categorization of information, the identification of themes and sub-themes emerged during the qualitative interview process. Such a process was useful in unraveling the concepts and arguments expressed by interviewees regarding transboundary water conflicts between the United States and México as well as irrigation issues in this region. Although the variables used in every case are introduced and presented in a table, further definitions for each variable as well as the complete list of them are presented in Appendix B.

VIEWS OF THE NORTHERN AGRICULTURISTS ON THE EVOLUTION OF AGRICULTURE IN MEXICALI

As discussed in Chapter 2, the functioning and development of agriculture and irrigation in the Mexicali Valley is linked to issues of transboundary water management in the lower Colorado River. Since it is hypothesized that the Mexicali Valley is impacted differentially by transboundary water issues, I first focus on the perceptions of agriculturists of the northern Mexicali Valley regarding the evolution of and impacts on agriculture and irrigation. First, here it seems that two opposing views were revealed concerning major changes that took place during the last five decades (from the early 60s to 2008) in the Mexicali Valley. Some respondents' views of "progress" (PRO) over the last five decades were contrasted with other respondents' views of "regression" (REG) which were also seen during that same period. First of all, these findings inform about the existence of opposite views among agriculturists in the Mexicali Valley who perceived the existence of social polarization: some agriculturists mentioned that there has been agricultural socio-economic growth while others stated that there has been agricultural socio-economic decay.

Further exploring the institutional facilitating function of the view that agricultural activity has shown consistent progress over the years, it was observed that the PRO view was a function of the diversification of cropping patterns in the Mexicali Valley, the larger size of individual agriculturists' operations, the higher productivity of agricultural lands, technology improvement for crops and lands management, and agri-industry development in the area. This relationship may be expressed as follows (also see Table 3.1 for variable definitions):

PRO = f (DIV, LAR, HIL, TIM, IND)

The interconnected factors facilitate the view held by some that there has been progress in their region in the last 40 or 50 years. That progress is seen by those who noticed more diversified cropping patterns in the Mexicali Valley (DIV) that now include grains crops and a broad variety of valuable vegetables in addition to the formerly dominant crop, cotton; the larger scale of individual agriculturists' operations spread in the Mexicali Valley (LAR) which for this particular area of the valley changed from the last official 1937 allotment of 20 hectares per household to 200 hectares on average. This fact is meant as a re-concentration of agricultural lands as a result of the permanent growing land leasing and selling processes that have been taking place among agriculturists mostly since the last Mexican Land Reform of 1992 which included significant changes and addendums to the Constitutional Article 27; the higher productivity of lands (HIL) as a result of land management improvements, intensive use of fertilizers, and improved seeds; the implementation of either new or improved technology (TIM) focused on crops, land, and irrigation management; and finally, the improvement of productive chains giving place to the agri-industrialization (IND) of major crops such as wheat and cotton.

Table 3.1 Perceptions of agriculturists of the northern Mexicali Valley concerning the evolution of regional agriculture.

GENERAL PERCEPTION	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
PRO = Progress		44	Polarization of views among agriculturists about socio-productive aspects — 56 percent of the respondents were classified as REG and the remaining 44 percent as PRO. There were no respondents that were not easily grouped as REG or PRO.
	DIV = Diversification of crops.	44	
	LAR = Larger scale of agricultural operations (from 20 to 200 hectares on average).	33	
	HIL = Higher productivity of lands.	44	
	TIM = Technology improvement for land management.	33	
	IND = Industrialization of agricultural sector and growing productive chains.	33	
REG = Regression		56	
	HIC = Higher production costs.	56	
	LOP = Lower relative prices.	44	
	CRE = Drastic reduction of credit and increasing of credit security requirements for small farmers.	56	
	COM =Generalized commercialization problems mostly noticed in grains' small farmers.	33	
	EQU = Growing inequality among agriculturists.	44	
	REN = Growing area of agricultural land rented (80 percent on average)	56	

For example, as an older agriculturist who has lived and worked in the northern Mexicali Valley since 1949 said (expressing the idea of PRO):

> ..... lots of positive changes can be observed since those years [1960s] to date in regards to irrigation technology and genetically improved seeds, which have given place to obtain better products and increase crop yields. Besides, agriculture in the Mexicali Valley of those years was traditionally for growing just a few crops like cotton, and then, wheat and alfalfa together with vegetables became important crops [.....] This fact brings out more valuable products that reach high prices in international markets." (Int_7).

In contrast, the institutional facilitating function for REG may be expressed as follows (see also Table 3.1):

REG = *f* (HIC, LOP, CRE, COM, EQU, REN)

For agriculturists living and working in the northern Mexicali Valley that see things as worse off (regression), they attribute this to the interconnection of factors like higher costs in most inputs for production (HIC), mainly pesticides, fertilizers, and water; lower relative prices for products like grains (LOP); drastic reduction of credit and financial support to small farmers for production together with the increase of credit security requirements (CRE); commercialization problems for the dominant basic crops such as grains (COM); the elitism among growers that is noticed through the inequalities in the support received from governmental agencies that promote the agricultural activity (EQU). Finally, all these factors together represent downward-spiral interrelated to a key factor referred to the increase of agricultural lands rented (REN) which today reaches levels of 80 percent in the northern Mexicali Valley (which means that 8 out of 10 owner farmers give their lands in rent to others).

As one respondent explained:

> What I can see is a clear declining process instead of progress in the Mexicali Valley. It is easy to observe how land renting is dramatically increasing since the liberalization of the Mexican agricultural sector in 1992 which brought about

> difficulties to small farmers who are facing high production costs together with lower prices and lack of credit have been forced to leave the activity.....Today just a few hands work the Mexicali Valley's lands. I'm not sure if this can be called progress." (Int_1).

The perceptions of agriculturists in the northern region on the evolution of agriculture in the Mexicali Valley are summarized above in Table 3.1. Of the 9 respondents in the northern region of the valley, 4 were classified as PRO (44 percent) and 5 were classified as REG (56 percent) as they explicitly mentioned about it and argued on one or several factors above mentioned explaining either the PRO or REG views, respectively.

From this, one of the initial general findings is the existence of opposing views on the evolution of agriculture in the Mexicali Valley and this in turn led the researcher to conclude that there is polarization of agriculturists' views regarding the productive and developmental aspects in the Mexicali Valley.

The irrigation sector of the Mexicali Valley

Major changes in irrigation in the Mexicali Valley represent another focal point of the research regarding the impacts and response of agriculturists to the salinity problem and the All-American Canal lining conflict. As the agricultural sector has changed so too have irrigation practices changed in the northern Mexicali Valley over the last 40 or 50 years. Interviews with respondents from this region revealed that perceptions about successful irrigation management (SIM) and failing irrigation management (FIM) both are present among northern agriculturists. In fact, this difference of opinion among irrigation users has made some agriculturalists argue that operation of canals and wells, administration of resources, as well as conservation and development of infrastructure is gradually improving while others argue equally strongly to the contrary. Among those respondents in this reported research 78 percent are classified as keeping a SIM viewpoint while just 22 percent keep a FIM point of view.

To better understand those factors associated with such differing views on the success or failure of irrigation efforts in northern Mexicali, an institutional facilitating function was specified for SIM as follows (see also Table 3.2):

$$SIM = f\,(SIW, LIT, IWE, GIT, COS, PRU, RIG, OFF, ALT, ENV, BAR)$$

To illustrate this, it was mentioned that, in general, better irrigation water management techniques have gradually been implemented to make better irrigation water use in the field (SIW); increased costs associated with irrigation service changes to improve several other operation activities and management tasks within the irrigation district (COS); and finally, an improved irrigation technology such as land leveling, efficient irrigation methods at the parcel level, improved deep wells and more lined canals for water distribution which were lacking in the past are today widespread in the Mexicali Valley (LIT). Regarding this later aspect, it is important to emphasize that because the irrigation system is interconnected (wells and canals users receive the same individual water allotment on the order of 117 liters per second per day of irrigation operation), those agricultural water users impacted with surface water savings and the consequent reduction of infiltrations (e.g. those irrigators using wells) are systematically and formally compensated through a reduced energy fee (special tariff) and, if necessary, by using both sources of water in a complementary manner (CONAGUA 1989).

Additional factors that the interviews revealed concerned explanations of SIM. For example, the learning experiences of members of the former Water Users' Societies that operated during the 1940s which are being used by current Water Users' Associations (PRU); the official establishment of the Irrigation District 014 and the standardization of water rights per household or user that changed from 100 or 50 to 20 hectares of irrigated land in 1955 (RIG); the experience gained by agriculturists as a result of official intervention and subsequent formation of the current Water Users' Associations (WUAs) in the early 1990s (OFF); current development and implementation of irrigation and drainage (ALT); the articulation of possibilities to protect water resources and improving local environmental conditions (ENV); and the increased bargaining capacity of water users at different levels (BAR) were revealed as explanatory factors of successful irrigation management in the region.

For example, as one respondent put it:

> .....in this sense, here have had many advances.....in previous times [40 years ago], we had to cross rough lands and the irrigation canals were built unlined over the natural terrain. Most times the irrigation network was not scientifically checked [....] to water my land in the past represented a real adventure, now, in the corner of my parcel there is located a deep well and I just have to turn on the water valve to opportunely access water for irrigation." (Int_4).

In contrast, others' experiences suggest that irrigation changes have not been positive at all. A function that represents such a view may be represented as follows (see also Table 3.2):

FIM = f(IMU, BUR, ALA, LAN, GIA, DEM, TWI, IQU, TEC, COS, LOV, ICO)

Table 3.2 Perceptions of agriculturists of the northern Mexicali Valley concerning the evolution and impacts of irrigation water management.

GENERAL PERCEPTION	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
SIM = Successful irrigation management		78	SIM viewpoint dominates over FIM- Elitism among irrigation water users-
	SIW = Better irrigation water use than in the past.	78	
	LIT = More irrigation technology than in the past	67	
	IWE = More efficient irrigation water use than in the past	78	
	GIT = Growing irrigation tech.	78	
	COS = Higher but suitable cost of irrigation service improving operation as a whole	44	Increased irrigation service costs is a twofold issue since some see this fact as beneficial for the whole district operation while others (the less) see this as affecting individual incomes-
	PRU = Learning gained from old Water Users Societies.	56	
	RIG = Irrigation district and water rights entitled people to act	78	
	OFF = Learning got from governmental agencies for irrigation water management	67	
	ALT = Alternatives offered for saving irrigation water	67	
	ENV = Environmental benefits from best water management practices.	44	
	BAR = Increased bargain capacity of irrigation water users	78	
FIM = Failing irrigation management		22	
	IMU= Imposed WUAs (top-down)	22	
	BUR= Bureaucracy WUAs-CONAGUA	22	
	ALA= Lack of accountability to users of WUAs	11	
	LAN= Big landholders dominate WUAs administration	22	
	GIA= Groups of interests in WUAs	11	
	DEM= Increasing water demand	22	
	TWI= Transboundary waters use Implications	22	
	IQU= Inequality among water users	22	
	TEC= Lack of irrigation technology	11	
	COS= Increasing irrigation service costs affect incomes	22	
	LOV= Short-term vision of WUAs	11	
	ICO= Internal conflicts in the sector	11	

FIM represents the notion of failing irrigation management that is attributable to a broad range of factors. These factors include: the way current WUAs were imposed using a top-down approach (IMU); the high level of bureaucracy in the new "co-management" between WUAs and CONAGUA (BUR); lack of accountability to water users, mainly smallholders, by WUAs' officials erroneously following directives from superiors like CONAGUA (ALA); the increase of "harmful" dominance by new, large landholders that command and control irrigation water in their roles both as WUAs officials and/or as preferential water users (LAN); and the increased presence of interest groups within WUAs that resulted in apathetic, ineffective, and splintered participation (GIA).

At the same time, external factors like increasing water demands from urban sectors seem to have resulted in the view of failing water management in those areas with dependence on transboundary waters for irrigation because management was more difficult (DEM). Those voicing a view of failed water management also commented on the inequality among water users since WUAs' officials supported specific groups of powerful agriculturists and ignored smallholders evidencing a sort of elitism in water management (IQU). An absence of irrigation technology and advancement programs (TEC), the permanent increase in irrigation water services costs (COS); and the lack of a long-term vision of WUAs (LOV) are seen as reasons for the failure of the water management regime. Furthermore, all those factors have been seen as contributory to increased internal conflicts among users (i.e., surface vs. groundwater users; wheat vs. alfalfa growers) especially in seasons of high demand for water in the agricultural sector of the Mexicali Valley which is typically during March and April each year (ICO).

As one agriculturist put it:

> Now, having developed irrigation infrastructure, still there are critical problems in water distribution, many times water is not enough for irrigating my land and this is impacting my production costs……..what is happening? [Maybe] there are powerful groups influencing imbalance? Or maybe we don't know how to manage our irrigation module." (Int_9).

The differing views on the evolution and impact of irrigation management in the Mexicali Valley allows us to differentiate irrigation water users into two principal groups, 'winners' and 'losers.' The evolution of irrigation in the Mexicali Valley may be understood in terms of institutional explanatory factors summarized in Table 3.2. The empirical findings of this study clearly show a social polarization and differentiation among irrigation users in the Mexicali Valley supporting the premise that the irrigation regime resulted in "structural inequity" (Galtung 1980, 64) and this, in turn, must be taken into account for understanding the changing role of agriculturists of the Mexicali Valley in irrigation and transboundary water management.

The perceptions of agriculturists in the northern region on the evolution of irrigation in the Mexicali Valley are summarized in Table 3.2. Of the 9 respondents in the northern region of the valley, 7 were classified as to advocate the successful irrigation management view (78 percent) and 2 were classified as to express failing irrigation management view (22 percent) as they explicitly argued on the several factors explaining either the successful or failing views, respectively. Accordingly, the successful irrigation management viewpoint dominates over the failing irrigation management.

From this, the major findings on the evolution of irrigation in the Mexicali Valley according to the northern agriculturists are that the successful irrigation management viewpoint dominates over the failing irrigation management view. Also, it is clear that there exists a differentiation among irrigation water users which in turn may elicit the presence of elitism among them. Finally, regarding the theme of increased irrigation service costs, it can be established that it is a twofold issue since some see this fact as beneficial for reaching an efficient irrigation district operation while others (the less) see this fact as affecting individual irrigators' incomes.

A general understanding of agriculture and irrigation changes from the perspective of agriculturists provides a background that allows for better understanding of the characteristics and impact of institutions used by agriculturists during the salinity and All-American Canal episodes, respectively. These features help explain the high level of participation of agriculturists during the salinity problem (time one, t_1) and the low level of participation during the All-American Canal lining conflict (time two, t_2) which will be analyzed next.

THE SALINITY PROBLEM PERIOD (SAL)

Having discussed the general view that participants in this region shared about the evolution of agriculture and irrigation in the region, this section focuses on the perceptions of northern agriculturists concerning the impact of increased salinity of water and land in the northern Mexicali Valley between 1961 and 1973 (SAL). It is safe to say that agriculturists in this region have been impacted by salt pollution in their production and the productivity of their lands. The institutional response to SAL appears to have been to work towards finding a "definitive solution" to the problem. The salinity crisis that took place during the 1960s and early 1970s represents a critical transboundary water management problem that resulted in social, economic, environmental, and political impacts in the Mexicali Valley. The salinity problem was also a milestone in the bilateral relationships between the United States and México.

The rising salinity of the Colorado River water as it passed through the Mexicali Valley impacted agriculture through high concentration of salts permanently and increasingly deposited on individual parcels during such a period. A descriptive representation that facilitates the understanding and explanation of the damage to the agricultural sector in Mexicali (SAD) may be expressed as follows (see also Table 3.3):

SAD = *f* (MIX, ROU, SAH, YED, ICS, CRI, SAR)

Water delivered to México as part of the 1944 Water Treaty included such point source pollution as salty waters from drainage of agricultural lands in the Yuma Valley, Arizona. Such a phenomenon was well known as the "salinity of the Colorado River water" (MIX).

Although salinity is due to natural mineralization processes that concentrate salts considering temporal and spatial scales along the Colorado River, water salinity into the watercourse is also induced by anthropogenic activity which exacerbated conflicts when the Mexicali Valley received significant amounts of salts coming from agricultural drainage operations in Yuma which affected productivity of agricultural lands in the Mexicali Valley (Cervantes and Bernal 1991, 129). This salty water gave rise to what became known as the "salty route" ("ruta de la sal") which represents a long strip of layered salty soils crossing the Mexicali Valley from north to south all through its central area (ROU). Here, salts were rapidly accumulated and as a result salinity damaged crops occurring with different levels of stress according to physical conditions of water and soils in the entire valley (see Figure 3.1).

Table 3.3 Damages to the agriculture of northern Mexicali Valley as a result of the salinity of the Colorado River.

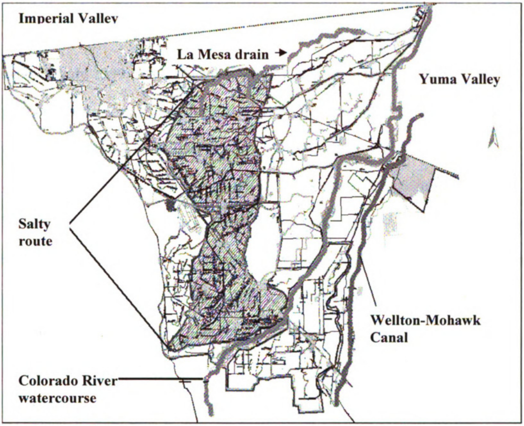
THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
SAD = Damage in agriculture of the Mexicali Valley.	MIX = Disposed of salty waters upstream (salinity of the Colorado River).	67	-Social, productive, economic, and environmental impacts. -The salinity problem remains as a critical issue halting productivity of some areas in the Mexicali Valley currently.
	ROU = Existence of salty soils strip along the valley (ruta de sal).	44	
	SAH = High extent of salts pollution in individual parcels.	56	
	YED = High extent of crop yields reductions.	56	
	ICS = Increasing production costs for individual agriculturists	33	
	CRI = High extent of contraction of agricultural credit to unproductive lands	33	
	SAR = Salinity problems remain since the salinity problem period.	67	

In the northern Mexicali Valley, productive, economic, and environmental impacts were felt at the level of individual parcels with reductions in crop yields (SAH). Wheat was the major crop in this region and drops in productivity, which at that time reached 4.5 tons per hectare on average, was reduced in 65 percent (YED). At the same time, there were increasing production costs associated with salt accumulation in soils including modifying productive practices for planting and fertilizing and more intensive water use to leach salts below the plant root area (ICS). Furthermore, agriculturists had to face a transitory but critical period of credit insufficiency (CRI) which used to come from both governmental and private sources.

Agriculturists in this region explained the negative impacts of salinity as follows:

> Unfortunately the salty water coming from agricultural drainage in Yuma was mixed with surface water before entering into the Mexicali Valley." (Int_2)

Figure 3.1 Location of the salinity problem area known as "the salty route" in the Mexicali Valley.



Source: The Mexican National Water Commission, 2009.

Other agriculturists went further by mentioning that:

I can remember easily how difficult those times were for all of us....over my parcel I could observe salts in the form of large white spots over the land and also over the irrigation furrows." (Int_1)

......the water coming from the Colorado River was not even suitable for drinking....the lands became so hard for growing cotton and wheat, before the salinity problem occurred I used to 'pick up' 170 packs per hectare of cotton and such yield was gradually getting down until levels of 60 or 70 packs per hectare, then, I couldn't pay my credits and the banking system stopped financing my productive activity until the solution was found some years later." (Int_6).

The salinity problem process reached its "crisis period" between 1961 and 1973 when a "permanent and definitive solution" was negotiated and added to the 1944

International Water Treaty. This event brought about social mobilization on the part of agriculturists in the Mexicali Valley and the later formulation of Minute 242 in 1973 which was named: *"Permanent and definitive solution to the Salinity of the Colorado River Water."* (Ward 1999, 127). However, salinity issues remain a critical problem affecting production in a vast portion of the Mexicali Valley (SAR). Today's salinity problems originated during the salinity crisis of the 1960s. They include: high concentration of salts in the Sánchez Mejorada Canal (Southern International Boundary point of delivery to México); the ineffective monitoring system used by IBWC/CILA for measuring salts concentration of the Colorado River water at the Morelos Dam (Northern International Boundary point of delivery to México); and the (permanent) accumulation of salts mostly in the "salty route" in central and southern Mexicali Valley.

As local water users explain,

> .....at this moment I can say that the problem is not solved at all. Still there are many salty parcels, even in this area [northern Mexicali Valley]." (Int_5).

> I can see that the problem still exists, delivery of salty waters continues running from the north [the United States]. They [Americans] continue mixing waters to alter salinity of water delivered to México into the Morelos Dam. The Americans [officials] argue to comply with the standards, and perhaps it is true, so, the real problem is the salts' monitoring system implemented. The official "annual average" approach currently used isn't suitable for both parts, it is unequal and, in the end, it is affecting us." (Int_7).

The perceptions of agriculturists in the northern Mexicali Valley about the damages to the agricultural sector of the Mexicali Valley (SAD) are summarized above in Table 3.3. The several explanatory factors (descriptive) that govern such perceptions are based on direct experiences of the 9 respondents in the northern region of the valley. Overall they highlight the fact of a mixture of "good" and "bad" waters upstream in the

Colorado River (MIX) where 67 percent of respondents comment on this aspect, and this in turn brought damages at the level of individual parcels (SAH) and affected the yields of crops (YED), in this sense 56 percent argued this point as well the association of the SAL process with the current salinity problem (SAR) which was highlighted by 67 percent of interviewees in this area. Not less important were the resultant increased production costs (ICS) that led agriculturists mostly located in the "salty route" area to struggle with reduction of financial support from credit institutions due to the unproductive lands.

The major findings on the perceptions of damages felt in the agricultural sector according to the northern agriculturists are that they see critical social, productive, economic, and environmental impacts and that the well known "former" salinity problem still remains critical and is halting productivity of some areas in the Mexicali Valley.

Participation of agriculturists during the salinity period

Institutional responses by some agriculturists in the Mexicali Valley to the salinity problem may be understood by examining agriculturalists' participation and influence in the so-called "permanent and definitive solution" to the salinity problem. A high level of participation (HIP) of agriculturists in local, regional, national, and bilateral efforts was observed during the salinity crisis. It seems that, at the time, there was effective vertical coordination between the social base at the local level and the State and Federal governments, including the Presidential authority in the region. This is strongly related to the political ties between all levels of government and the agricultural sector, specifically the agriculturists' unions which were (and still are) mostly linked to the political party in power during the salinity problem, the PRI.

A description of the institutional relationship may be articulated as follows (see also Table 3.4):

HIP = f (UNI, FIC, SOL, CEJ, LOL, PAL, LAU, SAU, PAU, LEA) + POS

Table 3.4 High level of participation of northern agriculturists as an institutional response to the salinity problem.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
HIP = High level of participation in the salinity problem.	UNI = Unity base at the household level	78	Effective vertical and horizontal coordination among agriculturists and several levels of government in México.
	FIC = Financial capacity of agriculturists	78	
	SOL = High degree of solidarity among agriculturists	89	
	CEJ = Fundamental local/ neighborhood leadership	89	
	LOL = Outstanding local leaders	78	
	PAL = Principal leader	89	
	LAU = Local agricultural unions' leadership	89	
	SAU = Strong agricultural unions	100	
	PAU = Principal agricultural union	67	
	LEA = Significant presidential leadership	100	
	POS = Politics behind the salinity	44	

There appears to have been strong horizontal unification of society within the agricultural sector. The behavior of agriculturists in response to the salinity crisis emerged as highly uniform with high levels of participation and a view that such participation had positive impacts on the salinity experience. Such horizontal unification across various members of social class has deep roots in households in the Mexicali Valley during the salinity problem where relative favorable economic conditions in the agricultural sector helped to keep rural families rooted to related activities within the countryside (UNI).

These economic conditions facilitated the financial ability of both individual agriculturists and agricultural unions to make monetary contributions to support political activities of their respective unions (FIC). Being able to fund such political activity as unions and other representatives further aided social mobilization. Since the times of the salinity problem and until recently (1992), a voluntary contribution of about five Mexican cents per unit of volume of water served was included in the irrigation fees in order to support the unions' action. On average, each agriculturist was served with 120 liters per second per service and up to five irrigation services per season, as such; each individual agriculturist (of a total of 14,000 users) contributed 300 Mexican pesos per year.

The fees collection process considered the joint participation of the *Comisariado Ejidal* and *Colonias'* representatives and officials from the former Secretaría de Recursos Hidráulicos (The Mexican Water Resources Ministry). This fact also facilitated a high level of social participation during the salinity period. As one senior agriculturist in the northern Mexicali Valley pointed out, the financial success of farmers in the region coupled with unions' desire to be effective resulted in increased social participation. He reported that:

> .....I can establish that the 'money' was a basic incentive to participate because the leaders always need money to mobilize them and in turn to mobilize masses. This type of contribution was familiar and a social agreement to keep political power and strength of our productive sector and our leaders [...] the money, about five cents per liter of water served, was collected by the *Comisariado Ejidal* and deposited in a formal banking account of the Secretaría de Recursos Hidráulicos which was jointly handled by unions and the federal government. This was an effective collaborative mechanism that gave us power and presence." (Int_7).

As a result of such factors, there was a strong solidarity among individuals and unions which may be identified as one of the principle characteristics of the agriculturalists and their social mobilization during the salinity period (SOL). As a complement to the solidarity seen at the household level during the salinity problem period, the interviews revealed the perception of outstanding leadership at different stages of the salinity period based on the political links of local officials at several levels of government. First, there was leadership at the local level with the official leader of the "*ejido*" (communal land structure), named the *comisariado ejidal.*

The *ejidos* members used to be organized around the President of the *Comisariado Ejidal* (CEJ) who usually was able to call for massive assemblies and who had significant political power based on his effective representativeness, credibility within the *ejido* or *colonia* (private property land structure), respectively. Such leaders also were seen as capable of coordination with leaders and officials of higher levels of government, including the then dominant political party, the Institutional Revolutionary Party (Partido Revolucionario Institucional, PRI) as well as with agriculturists' unions such as the Mexican Independent Peasants' Union (Central Campesina Independiente, CCI), the Mexican National Peasants' Confederation (Confederación Nacional Campesina, CNC), the Regional Farmers' Union (Unión Agrícola Regional, UAR), and the Mexican National Small Private Rural Owners' Confederation (Confederación Nacional de Pequeños Propietarios Rurales, CNPPR). It is observed that 89 percent of interviewees in this region underscored these later factors.

It appears that the social mobilization of agriculturists in the region during the salinity period was headed by those national unions based on the local level. These groups jointly gave voice to large numbers of agriculturalists concerned with the salinity problem and were interested in fighting to defend their interests (LOL). One organization, the CCI, was clearly identified (67 percent of agriculturists interviewed) as particularly outstanding in its effort and involvement (PAU) and its leader, Mr. Alfonso Garzón, was noted for his ability to work with all the unions helping to bring about a horizontally, unified force (PAL). Although Mr. Alfonso Garzón is acknowledged as the main promoter and defender of the social movement regarding the salinity problem in the Mexicali Valley, it is also mentioned that he worked together with other leaders such as Rodolfo Fierro, Salvador Solorio, Miguel Monge, and Luis Granados.

The economic, financial, and political strength of the various unions gave them a central role as institutional participants during the salinity problem period. The total number agriculturists interviewed in this region asserted that such agricultural unions, both formally and informally, gave voice to claims, complaints, demands, as well as mobilized potential boycotts so that governments of both countries worked towards finding a fair and suitable solution to the salinity. Also, they were seen as instrumental in advancing agricultural productivity and social welfare in the Mexicali Valley (SAU).

Similarly, all respondents commented on the leadership of the President of México Luis Echeverría being imperative in advancing the process and achieving compensation from the United States for salinity damage to agricultural lands in México. The administration of President Luis Echeverría is seen by agriculturists of the northern Mexicali Valley as a crucial indicator of the integration of horizontal and vertical forces needed for addressing the critical salinity issue (LEA).

The federal government was highly supportive of the agriculturists in various ways and different stages of the salinity problem process. It established formal commitments that included delivering credit and technical assistance to growers affected by salt pollution; offering guidance and representation in the bilateral negotiation for agriculturists; and achieving a formal "permanent and definitive solution" that included compensation to the salinity problem (Minute 242 of the International Water Treaty). This concurring with financial support provided for agriculturists to improve their production conditions in the Mexicali Valley through the Rehabilitation Program.

As some agriculturists put it:

> I can remember just as a dream I had last night that President Luis Echeverría came here (to the *ejido*) and told us: 'we are going to solve the problem, I promise a real and fair solution to you all, and it will happen soon.'" (Int_1).

Another added that:

> Just a few months after the President [Luis Echeverría] visited the Mexicali Valley to see the problems occurring in our lands, agricultural credit started flowing and we were able to continue working in our crops with the money that the President sent to us." (Int_6).

Types and characteristics of institutions during the salinity problem

Major findings of this dissertation regarding views of northern Mexicali Valley's agriculturists about their participation during the salinity period show that characteristics of institutions and social behaviors of agriculturists were based upon a rich variety of human relationships. Institutions were mostly characterized as informal processes based on strong agriculturists' customs and ideologies that led to the creation of formal institutions, such as the *addendums* to the 1944 International Water Treaty, highlighting the establishment of Minute 242.

A high degree of unification within the agricultural sector was an informal institutional behavior that was guided by local and national leaderships which, at the time, enjoyed of a high level of credibility and trust. This resulted within individual agriculturists and the many different unions a more cohesive social force that was able to call for massive public meetings and the capacity to boycott commerce between the United States and México at the international port of entry in Mexicali.

At the same time, there was remarkable vertical integration with federal officials (including the President) directly engaged with the problem, the various groups, and public, formal commitments "*in situ*" for solving the problem. Additionally, the social forces were somewhat financially independent since they used their own informal mechanisms to collect funds. It is clear that the amalgamation of institutions and organizations, informal processes and groups, and formal entities were able to work towards suitable solutions to the salinity problem.

Influence of agriculturists in the salinity problem

The kind and extent of participation and involvement of agriculturists in the salinity problem gave them a significant weight as key social actors which in turn enabled them to press both Mexican and the United States governmental agencies to move towards reaching a binational agreement on the issue. According to the perceptions of participants in this study area, the influence of agriculturists to push for technical solutions to the salinity problem (ITS) may be depicted as follows (see also Table 3.5):

$$ITS = f\,(IBI, REQ, REL/REI, CAP/COR) + POS$$

The influence of agriculturists for finding a solution to the salinity problem was a function of the significant participation embodied in formal institutions (i.e. collective action in the form of unions) and informal institutions (i.e. "union of unions," individual actions, individuals' voluntary financial contributions, and massive boycotts) which induced good communication and coordination with governmental agents at different levels. The proposed solutions to the salinity of the Colorado River water and the resulting damages to agriculture in the Mexicali Valley were analyzed jointly by Mexican officials, scientists, unions' leaders, as well as individual agriculturists.

Table 3.5 Influence of the institutional response (high participation) of agriculturists for finding technical solutions to the salinity problem.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
ITS = Influence of participation of agriculturists for reaching technical solutions to the salinity.	IBI = Influential participation of agriculturists in inducing institutional change for binational water management	44	Agriculturists as a key social actor pressing for a solution to the salinity plus the politics behind the salinity problem process.
	REQ = Influential participation of agriculturists in defining the implementation process of infrastructure for recovering water quality in the Colorado River	56	
	REL = Influential role of agriculturists in defining and implementing the rehabilitation program in the Mexicali Valley	78	
	REI = The role of agriculturists in the unfinished rehabilitation program.	33	
	CAP = Influential participation of agriculturists for obtaining financial support to continue production	33	
	COR = High extent of corruption and mismanagement of the U.S. compensation and Mexican financial support funds by Mexican actors	33	
	POS = Politics behind the salinity problem issue	22	

A proportion of 44 percent of the northern agriculturists participating in this study accentuate that during the salinity problem period agriculturists in the Mexicali Valley had a strong influence in the modification of the binational framework for transboundary water management, particularly the establishment and later implementation of the Minute

242 of the 1944 Water Treaty (IBI). This fact in turn represented the paramount technical and institutional solution to the salinity problem. Such a formal institutional change considered the design of new water quality standards intending to reduce the concentration of salts disposed into the Colorado River water entering México at the Morelos Dam point of delivery.

Interviewees of the northern Mexicali Valley mentioned that during the salinity crisis the agriculturists used their basic experience and expertise for land management, salinity detection, and irrigation water management coupled with their practical skills gained through the salinity crisis they had to deal with. Such an acquired experience allowed agriculturists to provide valuable inputs for scientists and other officials that were establishing/negotiating the "new" parameters for salinity concentration limits into the Colorado River water entering México. The final outcome of the bilateral U.S.-Mexican negotiations, after the long way of diplomatic tasks that originated the previous Minutes 218 and 241, was the signing of the Minute 242 in 1973 [...]. In addition, this latter agreement set a quality standard for water that México would receive from the United States (Garcia-Acevedo 2001, 72). The standard stipulates a range of 121±30 ppm of salts (115± 30 ppm of salts as U.S. norms) at the Morelos dam and having as measure reference the salts concentration at the Imperial dam, 25 miles upstream the Morelos Dam (Román 1991, 120).

As some agriculturists mentioned:

> .....we the farmers had the capacity to immediately detect the problem (salinity) in our parcels, at the local level, and also to transmit it to the several authorities related to the issue, communicate to experts and even to contact and bring President Luis Echeverría here to Mexicali. The idea was to make all these people aware of the magnitude of the problem and to expose the practical tasks we might have to do to defeat the problem." (Int_1).

In complement, the other interviewee mentioned that:

> Certainly, as a result of the multiple field trips and technical meetings where we participated as affected agriculturists along with officials and researchers, [after we] analyzed [the problem, we came to the conclusion] about the maximum limits we should allow in salts concentration in waters received from the United States in order for us to continue working our lands… Thus, [creating] the foundations for setting an agreement about water quality within the context of the International Water Treaty. We did it! We induced a modification to the binational framework for transboundary water management." (Int_8).

Another area at the binational level in which agriculturists influenced the salinity problem process was to call for significant infrastructure programs for improving irrigation water quality. About 56 percent of the northern Mexicali Valley participants mention how agriculturalists advanced this agenda through their socio-political activities aimed at building the Wellton-Mohawk Canal for drainage water canalization (REQ). The "permanent and definitive solution to the salinity of the Colorado River water" (Minute 242) also stipulates the construction of a desalination plant financed by the United States to treat water coming from the Wellton-Mohawk District and conduct it throughout the Wellton-Mohawk Canal to the Gulf of California all over Mexican territory (García-Acevedo 2001, 72).

One of the major aspects (factors) that northern participants mentioned as having influence in establishing the technical solutions to the salinity problem was the high participation of the Mexicali Valley agriculturists that resulted in the accomplishment of local infrastructure programs implemented by the Mexican government together with agriculturists' unions to help recover productivity of agricultural lands (REL). As much as 78 percent of the interviewees stressed this issue. The "Rehabilitation Program for the Irrigation District 014, Colorado River" included funding and specific activities at the macro (irrigation district) and micro (individual parcels) levels for processes to leach salts, build large networks of open drainage systems, level lands, and line major and secondary irrigation canals (northern, central, and southern irrigation water distributors). The hydraulic operation in the Mexicali Valley is sub-divided into three major irrigation sub-regions: Independencia Canal (northern); Reforma Canal (central); and del Sur Canal (southern).

Nevertheless, the water quality rehabilitation program showed implementation problems that in turn hindered the achievement of its basic goals. During the salinity problem period it was noticed that program implementation was incomplete and that there was still salinity problems and inefficient water use in the agricultural sector (REI). This negative aspect blocking the technical solutions to the salinity problem can be better understood in the words of one of the rehabilitation program beneficiaries:

> We asked our authorities to ask the U.S. government to divert salty waters to the sea [Gulf of California] and also avoid mixing drainage waters from Yuma with those of the Colorado River." (Int_1)
>
> .....however, after almost 40 years, we can see that the (promised) rehabilitation program was not finished at all. Perhaps just 70 percent of the program was achieved, even, key technical aspects were disregarded, for example, the necessary land leveling slope!, how incredible is this!, how "experts" failed in determining the slope for appropriated irrigation, no slope instead of the normal one or two percent needed! Besides, although it was agreed by our leaders and the government officials, there were many areas where the rehabilitation program was not implemented." (Int_5).

In addition to the benefits that were to be received by the irrigation district as a whole through the rehabilitation program, there were also various benefits that agriculturists were to receive at the parcel level directly impacting their production, productivity, and individual financial circumstances. According to the agriculturists interviewed, this is another key factor explaining the achievement of technical solutions to the salinity problem.

For instance, agricultural credit and technical assistance to implement and maintain crops together with capital for machinery and equipment was "given to" individual agriculturists but managed through the unions to which they belonged (CAP).

As an interviewee explained:

> .....they [Mexican governmental agencies] had promised to give us support, that is, they were going to give us money to buy tractors and in fact they did it. They gave us money and we bought tractors to 'begin' working our lands again [...] in fact they helped us to continue working and living in the Mexicali Valley." (Int_6).

Nevertheless, the financial support administrated by agriculturists' unions diminished and limited the potential positive impact for individual agriculturists. Corruption was a characteristic of the salinity compensatory fund management (COR). Corruption among local agriculturists' leaders was noticed that impacted both the individual (parcel) and the general programs' (irrigation district) operation. It is believed that corruption is the principle reason why the Rehabilitation Program of the Mexicali Valley was not finished.

As some respondents assert:

> As it always occurs some of our "bad leaders" engage in social actions that they keep in mind as with double purpose: one, the social, and the other, personal benefit from their actions. This explains how some people become rich from night to daylight!! [...] these bad leaders knew about the social needs and the way how to manage money to get personal benefits. For example, they knew the money available and the needs for acquiring new major equipment to clear lands and to build huge drains and canals to deliver water but they just bought old equipment or sublease to others to partially make up the problems. The real problem was that our government trusted in these people to perform their tasks and this fact facilitated dishonest behaviors." (Int_4).

> Even though the money given to us [agriculturists] to make up for the salinity problem was good enough, the rehabilitation program was incomplete as a result of the bad fund management by some leaders. The federal government had to directly supervise the application of these funds." (Int_5).

Finally, according to the perception of northern Mexicali Valley participants, it appears that politics played an important role in agriculturists' participation as well as in their ability to influence positive outcomes towards reaching technical solutions to the salinity problem. Although a thorough political analysis is beyond the scope of this study, the data suggests the importance of politics in enabling or constraining the participation of agriculturists during the salinity process.

Politics behind the salinity problem process (POS) refers to a premeditated or, at least, partially calculated, negotiation between high-level spheres of both governments towards finding a technical solution to the salinity problem. It seems that there were political interests in the United States as well as in México to work towards a resolution that had social, economic, environmental, and political implications for key stakeholders in the Mexicali Valley.

This issue might be illustrated by the following assertions:

> .....and yes, they [government officials and high-level leaders of agriculturists' unions] did take what was convenient for them and make 'nebulous' [unofficial] arrangements so that they could keep good relations with Americans." (Int_4).

> During the salinity crisis, rumors circulated among agriculturists of the whole Mexicali Valley in regards to the reason why Americans did mix and send salty waters to México. One of the widespread comments among us and under an strong control of unions' leaders and officials both belonging to the PRI, was that everything was part of a 'big show' and that the so called 'deliberated' pollution had already been negotiated in high spheres of both governments. And, as a result of the México's acceptance [of the damage], the Mexicali Valley might later receive significant compensation to modernize the Irrigation District. This is the reason why leaders and officials were so hermetic in communicating details of the technical information about the negotiation process." (Int_3).

The lack of transparency in sharing information while the salinity process took place, especially with respect to the negotiation details, is why many of the agriculturists claim that such negotiations were "premeditated negotiations" with the behind the scenes politics. That is, many agriculturists believe that since the final negotiations were already fixed, the federal and state officials of the Mexican government were able to promote and facilitate a high level of participation of agriculturists in the process and, particularly, in the establishment of technical solutions to the salinity problem.

Views of northern Mexicali Valley agriculturists of the impact of institutional structures followed by agriculturists in the Mexicali Valley during the salinity

Schmid (2004, 69) asserts that: "Institutions and organizations are mental constructs. They influence what things humans put together to produce physical things." The northern Mexicali Valley's agriculturists saw their informal institutions during the salinity crisis as favoring a high level of participation which they viewed as more effective in reaching their objectives of recovering the productive status seen prior the salinity problem period and improving water management conditions and agriculture in the Mexicali Valley.

Agriculturists created a dominant informal institutional response to the salinity problem which according to participants in northern Mexicali Valley allowed agriculturists to be acknowledged as influential social and political actors that pushed for obtaining direct benefits. They were also seen as influential in the process of negotiation and securing benefits at the binational level through the modification of the transboundary water management legal framework (Minute 242 of the 1944 International Water Treaty). In fact, informal institutional structures were seen as effective tools with the threat of massive boycotts seen as a concern to high level authorities. Therefore, the informal institutions of individual agriculturists and their unions in NAH were able to produce formal institutional change in the local and binational frameworks for water management.

THE ALL-AMERICAN CANAL LINING CONFLICT (AAC)

Next, this section focuses on the results of the qualitative analysis concerning the perceptions of agriculturalists in the northern Mexicali Valley regarding the All-American Canal lining conflict. I first discuss the views of agriculturists on the potential negative impacts of the All-American Canal lining project as well as the impacts of institutional devices for addressing the All-American Canal lining issue.

Agriculturists expect damage to the Mexicali Valley as a result of the implementation of the All-American Canal lining project (JEO). Potential adverse productive, economic, social, and environmental impacts in the northern Mexicali Valley are seen along with the feeling that such harms might be gradually shared over the entire Mexicali Valley (see Figure 3.2).

Nevertheless, also the AAC issue does present an opportunity for agriculturists to properly address the conflict by involving key stakeholders and providing an opportunity to improve water management conditions on both sides of the border. This is so because the current All-American Canal seepage provides a positive externality to agricultural lands and environment on both sides of the border since the canal seeping water has good quality of about 800 ppm on average (and usually 300 ppm less salty than that of the Mexicali Valley's aquifer) (Herrera et al. 2006, 75). A descriptive function that facilitates the discussion of the AAC issue from the perspective of northern Mexicali Valley agriculturists may be as follows (see also Table 3.6):

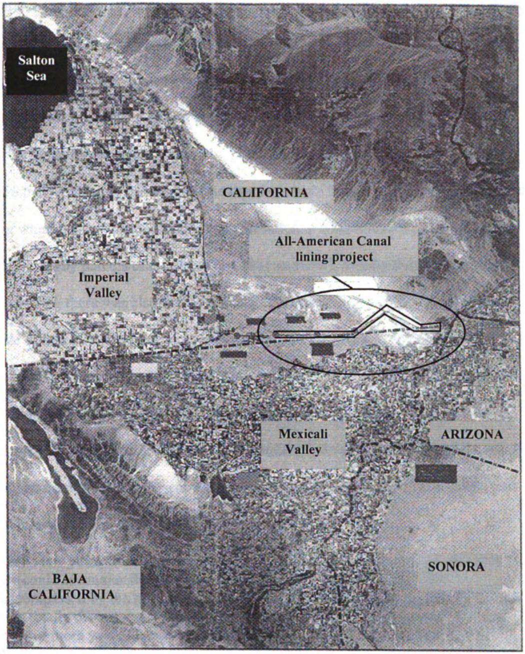
$$JEO = f\,(UCY, CYC, MES, DRE, RAF, WEL, ADJ, RED, WET, NOR, RUT, MIG) + IOP$$

Table 3.6 Impacts of the All-American Canal lining project over agricultural lands.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
JEO = All-American Canal lining as a threat to the Mexicali Valley sustained agricultural development.	UCY = Uncertainty about the impacts.	44	Productive, economic, environmental, and societal risks perceived parallel to the opportunity to improve conditions at the local and binational level.
	CYC = Cyclic damages induced by the All-American Canal	56	
	MES = The La Mesa Drain as a technical solution in the past	56	
	DRE = The La Mesa Drain as today's affected water source	44	
	RAF = Regional upper aquifer impacts	67	
	WEL = Deeper wells digging	33	
	ADJ = Water adjustments for agriculturists	33	
	RED = Reduction of growing areas	56	
	WET = Impacts on wetlands.	44	
	NOR = No rights irrigators affected.	22	
	RUT = Small rural towns affected.	22	
	MIG = Induced migration from México to the United States.	33	
	IOP = Opportunity for mutually improving water management.	44	

The perception of impending degradation of natural resources as a result of the implementation of the AAC project is a function of a variety of factors described by respondents. They emphasize the idea of a generalized uncertainty about the extent of damage that each individual agriculturist might experience at the parcel or household level when the seepage stops (UCY).

Figure 3.2 All-American Canal lining project location.



Source: Southern Nevada Water Authority. Landsat Satellite Image, June 2000.

Despite the uncertainty about the damages, interviewees state their point of view by informing through several explanatory factors about the potential impacts of this project in their area. For instance, 44 percent of respondents express uncertainty despite the potential benefits of a "big picture" improved irrigation system that will benefit users at the American side of the border.

The following four aspects (factors) described below show a higher response frequency. For example, the AAC issue has been seen by respondents as a persistent problem for agriculturists since the canal was built and started its operations in 1942. Around 56 percent of respondents indicate that there have been adverse impacts since the beginning when All-American Canal seepage resulted in *ejidos'* and *colonias'* flooding problems on nearby parcels of land between 1944 and 1955. During the following ten years, after 1955, there was also flooding attributed to the All-American Canal seepage meanwhile efforts were made to recover these lands (CYC). Today, after Mexican agriculturalists have already adapted to the canal seepage, the problem associated with the All-American Canal lining is the threat of expected damages which might create a potential water scarcity for agriculturists of the Mexicali Valley that have come to rely upon seepage from the All-American Canal for more than sixty years. In this respect, an insightful interviewee reported that:

> Just a few years [four or five] after the All-American Canal initiated operations, we could see major flooding problems over several productive *ejidos* encompassed by the great area above the train tracks [northern Mexicali Valley] was totally damaged and became rapidly unproductive.....ten years of flooding and ten more years to recover these lands, the best lands of the Mexicali Valley......today, we can foresee the opposite situation, there will be a critical scarcity maybe in the same period of time when the seepage stops running to the Mexican side.....the bottom line is "damage then and damage now." In the end [we have], cyclic damages to all of us the agriculturists." (Int_9).

The same proportion of participants in this study area (56 percent) mentioned that as a result of the initial flooding problems of the All-American Canal, the La Mesa and

Culiacán major drains were built in 1954 along the Mexican side of the border to intercept the excess of water seeping from the All-American Canal (MES). This "technical solution" to a transboundary water problem has given rise to the concept of "seepage water rights" for Mexican water users that come to rely upon and use such waters to irrigate agricultural land mostly located at the northern region of the valley since 1942.

The initial flooding problems became, for the local farmers, a new high-quality freshwater source for irrigating significant portions of the Mexicali Valley. On this topic, 44 percent of interviewees considered that the cession of canal seepage might, at a first stage, dry up waters feeding the La Mesa and Culiacán drains eliminating such irrigation water sources for more than 2,000 hectares (about 200 rural households) in Irrigation Modules 4, 5, and 16 as well as other areas under irrigation out of the district limits (i.e., *Ejido* Netzahualcóyotl) all of them located in the northern and northeastern portions of the Mexicali Valley (DRE). The La Mesa and Culiacán drains (still) have the function of intercepting the All-American Canal seepage in order to keep the water table in this northern area under control (Cortez 1999, 46); Regarding the seepage intercepted, the CONAGUA determined that such a flow is composed of 2,000 lps coming from the All-American Canal seeping (1,200 intercepted by the La Mesa and 800 lps by the Culiacán drains, respectively) which have a salts concentration of 900 ppm, only 100 ppm below the salts concentration in the All-American Canal water flow in the American side of the border (CONAGUA 1991).

Another potential adverse impact of the All-American Canal lining project concerns the regional upper aquifer (RAF). Most agriculturists (67 percent) mentioned that without water seepage from the All-American Canal, the Mexicali Valley's aquifer will only be able to provide diminishing quantities and [high] water quality for more than 19,000 hectares (about 1,000 households) of agricultural lands in Irrigation Modules 4, 5, 6, 7, and 16 located in the northern and northeastern portion of the valley. In fact, the Mexicali Valley's aquifer receives approximately 64,900 acres-feet per year (AF/y) from the All-American Canal seepage, which represents a quantity of water equivalent to the total annual consumption of the urban Mexicali area with a population of more than one million people (U.S. Department of Interior 1994; CONAGUA 2002). In addition, this area currently has highly productive soils that are classified as first (72 percent) and second class (23 percent) (García, López, and Navarro 2006, 83).

Studies estimate that an increase of soluble salts concentrations in water used for agriculture in the area might reach levels of 23.5 mg/l/y which would reduce yields of sensitive crops like green onions (45 percent), fruitages (34 percent), alfalfa and asparagus (15 percent) (García, López, and Navarro 2006, 94). The likely degradation in both surface and groundwater sources will force such alternative actions as digging deeper wells (WEL). While the deeper aquifer may have better water quality and availability, accessing it will raise initial investment costs to irrigators. An interviewee points out that:

> .....we might have to build new deeper irrigation wells or just deepen the ones already in operation. In the former case, it is possible to dig 20 new wells from the Mexicali International Airport area [northwest] to Los Algodones Township area [northeast]. However, it might imply increasing costs to us. Besides, these wells cannot be built in other areas different than those on the northern region because of the risk of intrusive saline water coming in from the sea [south bond]. So, we are very constrained both economically, technically, and environmentally." (Int_9).

In addition, two other core measures are envisioned by local water users, which are the necessary water adjustments, and the potential reduction of individuals' growing area. One concerns implementation of water adjustment mechanisms among irrigators in order to limit irrigation water allotments at individual, sub-regional, and irrigation district levels (ADJ). These actions might take place given the operational linkages of the hydraulic network in the whole irrigation district that includes surface and groundwater sources (canals and wells). It is important to recall that during the salinity problem episode, actions suggested to México included "adjusting the frequency and amount of irrigation to the available water supply by adding groundwater to supplement the winter water, changing the delivery schedule, and 'adjusting' its cropping pattern to fit the quality and quantity of water available in various seasons." (Ward 2001, 110).

Approximately 56 percent of respondents state that the other measure could likely be the reduction of the size of growing areas at the individual parcel level (RED). This type of response previously occurred in the region during the 1970s when cotton growers were forced to reduce their irrigation rights (permits) from 20 to 18 hectares and alfalfa growers who were asked to reduce their individual irrigation rights from 20 to 16 hectares.

As some agriculturists pointed out:

> Since we all belong to a whole unit or Irrigation District [system], we have to be attached to a norm based on the "real" water availability. We the individual agriculturists have a water allotment right [concession] to irrigate 20 hectares that we 'own' just if water availability allows it. The problem is that this would bring about social conflicts among agriculturists because many of us do not understand the difference between 'ownership' and 'concession'." (Int_9).

> .....the forced alternative we might have to follow is the reduction of growing area, this already occurred, we already lived such a situation. I had to reduce my program to grow 18 instead of 20 hectares of cotton because of a reduction in

> water allotment. Now, having our current individual allotment of 117 lps, I would need to re-adjust my program under the threat of a temporary water reduction, I don't know, maybe up to 115 or 112 lps and this again might impact my growing area and my household economy." (Int_8).

Also, adverse environmental impacts in the form of wetlands reduction are associated with the All-American Canal lining project (WET). A series of small wetlands formed since the initial operation of the All-American Canal in 1942, extends over 3,374.2 hectares mostly surrounding the *ejidos* Irapuato and Netzahualcóyotl in the northern Mexicali Valley (Zamora, Culp, and Hinojosa 2006, 29).

> .....the vegetation, the wetlands that currently we see along the northern side of the valley was originated by the current [AAC] seeping. Here, we can see trees born 50 years ago. They function as air filters, as coolers of this hot region [...] there are many Alamo (cottonwood) and Mesquite trees, Salty Pine, etcetera, which embrace the many animal species of the place such as quails, coyotes, rabbits, black doves [*chanates*], these later help us to control our crop's pests....." (Int_7).

In this particular area of the northern Mexicali Valley, there are a specific kind of landowners who are irrigators that are not part of the Irrigation District; they do not hold water concessions (NOR). This group of 100 households belongs to *Ejido* Netzahualcóyotl and is known as "the precaristas" (squatters). This *ejido* was founded after the All-American Canal seeping had begun to cross the border towards the Mexicali Valley aquifer. *Ejido* Netzahualcóyotl main water source is the current All-American Canal seepage which they use to grow mostly alfalfa and wheat. Without doubt, if the canal seepage is stopped, this community would feel direct and significant environmental, economic, and social impacts. A leader of this community put it as follows:

> .....we are so vulnerable and unprotected now, we also felt alone in this fight [against the All-American Canal lining project]. Now that we are getting production benefits to live and that we could survive to those flooding times, they [American officials] want to withdraw our only water source [.....] Definitively, here impacts are going to be felt strongly and this situation got us really uncertain about our future since we depend on the All-American Canal seepage..." (Int_5).

In addition to environmental degradation and potential economic impacts associated with the All-American Canal lining project for agriculturists in the Mexicali Valley, societal impacts of this project also seem to be critical threats. Several small but well-functioning rural towns are spread all over the agricultural area, particularly in the northern area, and these towns' domestic water supply comes from the local aquifer which receives All-American Canal seepage (RUT). There are thirty small towns in the region, each with a population of at least one thousand people. Major rural towns in the region potentially adversely affected by the All-American Canal lining project include Morelos City (7, 913); Benito Juárez Township (4,609); Los Algodones Township (4,374); and Paredones Township (3,870) (CONEPO 2007).

According to those interviewed, one effect of the implementation of the All-American Canal lining project would be massive migration both legally or illegally from small rural towns and the agricultural sector to the United States (MIG). This customary practice of out migration has already been seen in the region in response to previous crises such as the salinity problem of the 1960s and 70s. When socio-economic conditions are threatened, the vulnerable groups of agriculturalists tend to cross the border in order to find better opportunities to live and work. As one interviewee put it:

> .....the significant factor for us to be rooted here in our lands is the water availability. If our people go to the United States it is because they need to reach a [better] way of living, I know because I have gone and I have returned to my land. [.....] Now, if the All-American Canal project is implemented then my family

and I might have to cross the U.S. border, we are going to jump the fence even if this is so high….we need to work, to eat, and to live." (Int_4).

It is noteworthy that some interviewees (44 percent) mentioned that while the lining of the AAC presents challenges, the project may also represent an opportunity for mutual improvement of productive and living conditions for water users on both sides of the border (IOP). This since there exists a significant extent of interdependence in terms of economic exchange through export crops grown in the area as well as American agricultural enterprises established in the Mexican side of the border which attract local handwork. As a result, key local actors such as agriculturists may be able to play an effective role in shaping outcomes.

Agriculturists have been directly linked to transboundary water management since the beginning of agricultural productive history of the Mexicali Valley (e.g., the salinity process). Unfortunately, it is reported that Mexican agricultural water users have not been heard in the ongoing discussion/debate over the lining project (Cortez-Lara and García-Acevedo 2000, 273; Cortez-Lara, Donovan, and Whiteford 2009, 143). This will be explored in the next section of this chapter. One interviewee summarized the issue of mutual equal-opportunities as follows:

> The All-American Canal issue represents both a threat to our welfare and also an opportunity to improve our situation, to motivate and apply the 'good neighbor principle' [...] it will depend on how we develop dialogue among ourselves as agriculturists and between us and other users in this and the other side of the border […] it also depends on the leadership our governments." (Int_1).

Such an assertion is in line with the ideas from Doughman (2002, 191) and Neir and Campana (2007, 45) about potential binational cooperation on transboundary water issues and the peaceful resolution of water disputes regarding the All-American Canal lining conflict. Nevertheless, it is also clear that according to the results of the All-American Canal lining dispute process neither cooperation nor peaceful resolution was reached between the parts involved. As such, agriculturists in the Mexicali Valley were disregarded as key actors to find a suitable solution, thus, potential damages are expected to occur in the agricultural area (García-Acevedo 2006, 143; Cortez, Donovan, and Whiteford 2009, 144).

From this, it is established that agriculturists of the northern Mexicali Valley perceive significant productive, economic, environmental, and societal risks parallel to the opportunity to improve conditions at local and binational levels.

Participation of agriculturists in the All-American Canal lining conflict

In contrast to what occurred during the salinity problem episode, the participation of agriculturists in the All-American Canal lining conflict evidences features of social disarticulation among irrigation water users as well as a lack of vertical and horizontal coordination among themselves, productive sectors, and different levels of government. This is related to the political landscape described in Chapter 1. During the All-American Canal lining conflict, agriculturists' participation was mostly guided by operative entities such as the WUAs and SRL, which replaced the unions for addressing transboundary water issues. Agricultural water users and their WUAs and SRL remain with no direct links to political parties of any sort. However, the water policy at the local and national levels is today guided by governments emerged from the PAN.

The following institutional function illustrates the factors that explain the low level of participation (DAS) of agriculturists in the All-American Canal lining process (see also Table 3.7):

DAS = f (APA, APS, LIN, MIN, TRA, PLA, GLA, ALE, LED, ELE, LES, NOF, REN, DOW) + POC

There seems to be a wide-spread, generalized apathy among water users interviewed concerning the All-American Canal project and possible alternatives. Local agricultural water users expressed a lack of interest and motivation among those who seem to focus their priorities on solving problems linked to their daily productive activity (APA).

Other factors discussed by participants such as the lack of information, lack of leadership and support, and the current critical political, social, and economic situation in the countryside are seen as reasons for agriculturists to avoid participating in a sustained and organized fashion as concerns the All-American Canal lining project. This apathy and withdrawal from problem solving processes is particularly noticed in other areas belonging to the Irrigation District 014 such as the San Luís Río Colorado Valley and the southern Mexicali Valley area (APS).

Lack of information, misleading information, and a lack of transparency are identified by respondents as fundamental factors linked to the apathy and inaction among agriculturists which, in turn, has resulted in weak participation and involvement in the All-American Canal process. The official information agriculturalists have received about the issue according to respondent agriculturalists is insufficient and not timely (LIN).

Furthermore, it is reported that such information is not systematically shared widely among irrigation water users by agencies charged with addressing transboundary water problems such as the Mexican Section of the International Boundary and Water Commission (IBWC/CILA) and the Mexican National Water Commission (CONAGUA).

Table 3.7 Institutional responses of agriculturists to the All-American lining process (individual agriculturists).

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DAS = Weak defense of agriculturists against the All-American Canal lining project.	APA = Generalized apathy on the part of agriculturists of the Mexicali Valley.	89	-No vertical coordination of agriculturists and federal government. -Horizontal social disarticulation of the agricultural sector.
	APS = Sub-regional localized apathy of agriculturists.	44	
	LIN = Lack of information	89	
	MIN = Misleading information	78	
	TRA = Lack of transparency on the part of Federal agencies.	89	
	PLA = Presidential lack of accountability to locals.	89	
	GLA = Lack of accountability to locals on the part of federal governmental agencies	78	
	ALE = Aging leadership in the Mexicali Valley countryside.	89	
	LED = Disarticulated leadership in the Mexicali Valley.	100	
	ELE = External, urban-based leadership facing the AAC.	67	
	LES = Lack of external support for agriculturists.	56	
	NOF = Lack of agriculturists' financial capacity	89	
	REN = High degree of lands rented	78	
	DOW =Downward spiral in the agricultural sector	67	
	POC = Politics behind the AAC issue	33	

It seems that critical information about the All-American Canal lining project (i.e. transboundary impacts and legal processes) is often missing or misleading in communications from governmental agencies and that these agencies tend to minimize the problem (MIN). Frequently, governmental and science perspectives tend to differ and show different data on impacts and basic information (Román and Ramírez 2003, 116). Many agriculturists see this as an example of the lack of transparency on the part of governmental agencies that, in turn, hinders individual or collective public involvement of irrigation water users (TRA). In the words of one interviewee:

> .....considering that our governments have the economic capacity to widespread information about irrelevant things, my question is: why doesn't our government handle [information] correctly and spreads out relevant information like the impacts that the All-American Canal lining will have in the Mexicali Valley? This action will make us aware about it and will also induce a stronger and more unified, collective action towards finding suitable solutions. But as always, the All-American topic is treated as a 'top secret' issue. (Int_5).

The lack of presidential leadership and federal governmental agencies' apparent lack of accountability to agriculturists in the Mexicali Valley combined to make information lacking or confusing to the potential affected parties. Respondents note frequently that among the several federal administrations involved with the All-American Canal issue, there is a lack of leadership, interest on local impacts, and accountability to locals. Not only that, respondents reported a complete absence of leadership and presence in the region on the part of the former President Vicente Fox in times when the issue became critical. Also, the current President, Felipe Calderón, despite campaign rhetoric has not addressed the All-American Canal lining conflict either (PLA).

The All-American Canal issue is always used as a fundamental matter during politicians' campaigns. Just as other predecessors did, Vicente Fox (2000-2006) and the current president Felipe Calderón (2006 to date), as presidential candidates embraced the issue and made explicit public commitments to find a solution. No previous President is reported to have shown such a lack of accountability and misunderstanding of irrigation problems affecting and threatening the future of agriculturists of the Mexicali Valley (GLA). President Vicente Fox was poor showing, in the eyes of respondents, stands in sharp contrast with the effective political and diplomatic actions of President Luis Echeverría (1970-1976) and his agencies during the salinity problem period.

Likewise, it is reported that local leadership is weak, in some cases nonexistent. In the countryside, an aging population is one constraint on public participation of agriculturists in issues like the All-American Canal (ALE). Individual and collective leaders are practically nonexistent and such leaders' former political power to mobilize and articulate social and governmental forces is completely missing. As a result, dispersed and uncoordinated leadership among agriculturists or irrigation water users has limited their ability to undertake unified action against the All-American Canal lining project (LED).

In this respect, one agriculturist shared the following:

> Ernesto Derbez, former Ministry of Foreign Affairs during President Vicente Fox administration, came here to Mexicali [City] but he did not visit the affected area in the valley. He just said that Mr. President ordered to him to attend the issue [AAC] in depth. He told us that 'if you agriculturists disagree or are affected in some way…we are going to find the best solutions for you'….but he never returned to Mexicali during the remainder of that federal administration period….Now, Felipe Calderón during his political campaign for the presidency came here as well and said: 'I'm going to address with all my resources, the All-American Canal issue. I will work harder than in the past'….however, the All-American Canal lining project has already started." (Int_5).

Another agriculturist pointed out:

> ….they by themselves [current federal and state governments from the PAN, a historically opposition political party that have recently won local and national elections] did it; they disassembled the agricultural sector in the Mexicali Valley; they made us weak with no unification…. For the current government, it is not convenient for us to be unified as in the past when we dealt with the salinity problem […] we have neither real leadership nor support at the presidential level." (Int_9).

It is common to see various 'factions' of agriculturists within the same Irrigation District when they come together for planning meetings of the "Irrigation District Hydraulic Committee." called by officials of the CONAGUA. The *Irrigation District Hydraulic Committee* is a planning mechanism for irrigation water use and management for the Irrigation District 014, Colorado River. It is constituted by representatives of agricultural users of the 23 irrigation modules and the Irrigation District Society of the Mexicali Valley as well as officials of the Mexican National Water Commission (CONAGUA. Instructive for the Decentralized Operation, Conservation, and Administration of the Water Users' Associations and the Irrigation District Society, Appendix 5. 1991).

These factions or allied interests include large and small agriculturists, exporters and domestic producers, the Mexicali Valley (Baja California) and the San Luís Río Colorado Valley (Sonora) producers, the wells-based and the canal-based irrigators, the northern and the southern agricultural water users, the *ejidatarios* and the private owner producers, and agriculturists belonging to the PRI (Institutional Revolutionary Party), the PAN (National Action Party), or the PRD (Democratic Revolution Party). Excluding the later political party, the fact of the matter is that these same 'interest groups' managed to get together, participate, act as unified and influential forces during the salinity period. Today, agriculturalists are dispersed, no unified, weak, and without local leadership. This may be explained by an agriculturist as follows:

> .....what is happening is that if we all agriculturists would have the same political ideology then we would work together like in the past [...] the current minimal leaderships in the countryside of the Mexicali Valley have been deteriorating our past strong level of unification [...] agriculturists' leaders manipulated by the current government are getting down our strength as agricultural sector." (Int_9).

Another interviewee mentioned that:

> Maybe, we could synchronize our strength as water users' associations but who is going to organize us? Who is going to finance us? Who is going to prepare an effective strategy to defend our water? Who is going to give us guidance? Is the government the leader (CONAGUA, CILA)? Are the experts our allies? I don't think so!! We are a so disarticulated and weak rural society." (Int_8).

Moreover, such a lack of leadership and unified socio-political organization within the agricultural sector of the Mexicali Valley has enabled social actors like entrepreneurs belonging to urban areas of the Mexicali City to advance their own interests. External leadership of the industrial and urban sectors has taken on the issue of the AAC for the region, including the agriculturists (ELE).

This factor shows a significant shift in the kind of people and organizations voicing and concerned with transboundary water conflicts (even those that mostly affect the agricultural sector). The Economic Development Commission of Mexicali (CDEM), an entrepreneurs' organization headed by the President of Mexicali Capital City has brought a civil action against the United States Department of Interior in order to stop the All-American Canal lining project. In July 2005, the CDEM jointly with another environmental group of southern California sued the Department of Interior of the United States to stop the project presenting an argument to implement a Precautionary Principle for potential damages to economy and environment on the Mexican side (CDEM 2005). That lawsuit, according to interviewees, disregarded the agricultural sector and incorporated agricultural sector participation in the form of 'moral support.' As an interviewee points out, the rise of the urban-based leadership makes clear the absence of rural agriculturists' leadership around water issues like the All-American Canal issue:

> .....when our heads [the President and local leaders in the countryside] do not act, then there is no guidance, in fact, I think nowadays there are no leaders with moral values, there are neither committed leaders nor governors nor Presidents.....Here [to the *ejido*] came people from CDEM, they had gotten some money from state governmental agencies [....] they invited us to participate in the process but we have no money to do that and we had to trust them [CDEM] to solve 'our' problems....but nothing occurred, nothing was resolved." (Int_5).

One topic that arose from explaining the perception of agriculturists that they are unorganized and weak is that absence of external financial and technical support from experts and governmental agencies (in contrast to what occurred in the past during the salinity problem process) (LES). The task of organizing, participating in and leading an effort to address the All-American Canal conflict feels almost impossible to agriculturists without effective support from governmental agencies and the urban sectors.

Another factor that is attributed to the lack of participation of agriculturists of the Mexicali Valley in the current transboundary water conflict surrounding the All-American Canal lining issue is the absence of financial capacity of agricultural water users to unify and organize (NOF). The voluntary contribution of funds for organizing during the salinity problem process was accomplished using irrigation water fees. This institutional device was eliminated as a mechanism for funding agriculturists' unions. Just after the irrigation water transfer process in the Mexicali Valley in the early 90s, the voluntarily contribution fee disappeared from the agricultural water users' accounts thereby diminishing union operations and leadership expenditures. One interviewed agriculturist shared his concerns as follows:

> .....for us, individual agriculturists, to bring a claim against the project and to participate as meaningful stakeholders in the AAC conflict is practically impossible, we have no money to do so, we have no economic support to mobilize [ourselves] and to ask for suitable solutions..." (Int_4).

Another northern agricultural water user put it this way:

> We are not the same people working in the Mexicali Valley [...] the fact is that we left our financial responsibility aside; we 'new' organized irrigators considered that the donation [voluntarily contribution] of three or five cents per liter of water served was no longer necessary to support our 'social actions', we simply stopped giving money and this decision was a big mistake. As a result, our unions became more disarticulated, the CCI cut links with the CNC and the UAR, people started abandoning memberships [....] we divided ourselves and when we were asked to voluntarily contribute, we just responded: 'well, no money anymore' ." (Int_2).

Other factors also explain the unfavorable conditions within the agricultural sector, the loss of financial capacity and organization, and their absence as a unified force to address the All-American Canal lining conflict. Many, if not all, people interviewed echoed the sentiments that, "we are not the same people working and living in the Mexicali Valley countryside" and they go on to point to the high level of agricultural land rented (REN), permanent price erosion of agricultural products, and increased costs for most inputs for production in the trend of a downward spiral (DOW).

From this, major findings about institutional responses of individual agriculturists to the AAC issue show an overall lack of vertical coordination of agriculturists and federal government as well as a horizontal social disarticulation of the agricultural sector, as a result, a weak participation and defense of the current All-American Canal seepage water. Among the main explanatory factors underscored by northern agriculturists are the following: generalized apathy, lack of information released to agriculturists as well as transparency of water agencies when dealing with this issue, and the observed lack of presidential (Presidents Vicente Fox and Felipe Calderón) accountability to water users of the Mexicali Valley (89 percent of respondents mentioned this aspect).

Also, disperse and disarticulated leadership among agriculturists in the Mexicali Valley (all respondents stated this aspect) and the absence of financial capacity of agricultural water users to unify and organize themselves (89 percent) were perceived as two core interrelated factors that diminished the effective agriculturists' participation.

Such previously described conditions among others seem to hinder social organization and participation in what respondents called "secondary issues" like the transboundary water conflicts related to the All-American Canal. This lack of participation regarding fundamental aspects of the agricultural area, that is, the defense of a basic water source, is resulting in further weakening of the agricultural sector that is still using a high proportion of the region's available water, as much as 86 percent from both water sources.

Participation of Water Users' Associations in the All-American Canal lining conflict

As discussed in Chapter 2, an organization may be thought of as a means for collective action like that applied to Common-Pool Resources (CPRs) management for individual members (e.g. agricultural water users) within a boundary (e.g. irrigation system or district). An organization is a given set of people with shared institutions and mutual recognition of opportunity sets. At the same time, organizations are systems of relationships for coordinating individual actions according to some decision rule of persuasion (Schmid 2004, 75). Institutional arrangements for water management thus include the following: a) the established policy and legal environment; b) water management organizations with responsibilities in water management; and c) processes, mechanisms, and procedures for decision making, coordination, and planning (Svendsen et al. 2005,4).

Two questions explored in this research are the following: (1) Can the current institutional arrangements (WUAs and SRL) followed by agriculturists in the Mexicali Valley effectively encourage the governance of transboundary waters used for local irrigation? and (2) What circumstances and contexts can help local WUAs and SRL ensure viability of this strategic resource? Tang (1992, 8) contrasts the depressing scene of many bureaucratic irrigation systems with those positive experiences of other successful community organizations. He points out that: "in these [successful] organizations, farmers are able to construct, maintain, and operate their own irrigation facilities effectively." In exploring the features of effective institutions, Lam (1998, 53) points out that rules that are made by farmers are more likely to take information and knowledge about the local situation into consideration. Since farmers are the ones who deal with problems concerning irrigation in their daily needs, they are likely the ones who understand their problems best.

Various factors appear to affect both involvement of agriculturists in local organizations and effective management of irrigation systems. They depend on environment dimensions: a) physical; b) socioeconomic; and c) policy (Gulati, Meinzen-Dick, and Raju 2005, 242) as well as contextual characteristics including: a) agro-ecological; b) technical; c) economic; d) historical; e) socio-cultural; and f) political-legal (Uphoff 1991, 71). The effective management of irrigation systems especially when confronted with changing environmental conditions is complex which is in line with Ostrom et al. (1999, 278) who elaborate on the limitations and opportunities of agriculturists for participating in and influencing transboundary water management.

If institutional arrangements can facilitate or impede the problem-solving capabilities of participants in irrigation systems, then it may be possible to learn from a previous study about changing institutional arrangements. The established WUAs in the Mexicali Valley, in accordance with Tang (1992), Lam (1998), and Ostrom et al. (1999) appear to have lacked capacity to keep them involved and therefore are ineffective representatives for participating in transboundary water issues such as the All-American Canal lining conflict. This differs significantly with the level of participation and influence of agricultural water users during the salinity problem period when their organizations were "agriculturists unions" not "WUAs." The institutional function illustrating the explanatory factors for low levels of participation of WUAs (ELU) may be depicted as (see also Table 3.8):

$$ELU = f\,(IMU, LER, BUR, ALA, GIA, LAN, LIM, LAC, LIC) + POC$$

The WUAs of the Irrigation District 014, established over the Mexicali, Baja California and San Luís Río Colorado, Sonora valleys were formed as part of the Irrigation Transfer Policy implemented in México. The CONAGUA on behalf of the Mexican Federal Government "gives the legal Water Concession under the form of an Irrigation Service and Hydraulic Infrastructure use" to the 23 WUAs belonging to the "Distrito de Riego 014, Río Colorado, Baja California and Sonora" (CONAGUA, Water Concession Titles 1991).

These organizations were intended to substitute for other organizations of agricultural water users previously used and were framed as more "managerial" (Fisher 1990) in nature as opposed to being more "communitarian" (Barber 1998). Such a managerial perspective for 'stakeholder' organizations is keeping in line with the directives of such agencies as the International Bank for Reconstruction and Development (IBRD), the World Bank (WB) and the Inter-American Development Bank (IDB) (Doughman 1999, 68). As such, WUAs were imposed by using a top-down approach. As a result, WUAs in Mexicali have still limited ability for managing water, resolving conflict resolutions, and addressing transboundary water issues directly impacting irrigation operation in the Mexicali Valley (IMU).

Table 3.8 Institutional responses of agriculturists' WUAs to the AAC.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
ELU = Low level of participation of agricultural WUAs in the AAC	IMU = Top-down imposed WUAs	44	WUAs not effectively involved with any representation in the AAC process.
	LER = WUAs entitled to participate in the AAC process	56	
	BUR = Bureaucracy of co-management	56	
	ALA = WUAs' lack of accountability to individual users	44	
	GIA = Groups of interest and apathy within WUAs	78	
	LAN = Large landholders command WUAs	78	
	LIM = Lack of information about formal mechanisms to participate.	89	
	LAC = Lack of formal coordination mechanisms.	89	
	LIC = Lack of coordination with IBWC/CILA.	100	
	POC = Politics behind the AAC	33	

Thus, individual water users argue that this shift in the philosophical principles together with the way WUAs were imposed in the Mexicali Valley (and in the rest of the country) doomed them from the start as means for effective participation of agriculturists.

One interviewee expressed it as follows:

President Carlos Salinas (1989-1994) made a meaningful decision of transferring the official irrigation districts to water users, this in congruence with the guidelines imposed by the Inter-American Development Bank in order for this agency to continue financing the irrigation sector in México [...] the 23 WUAs and the umbrella organization, the Irrigation Society, were formed in 1991 and 1998, respectively. Nevertheless, we are still 'controlled' or at least depending upon upper water agencies such as CONAGUA. Thus, it is difficult to participate in issues like the All-American Canal although this issue impacts directly our irrigation performance. [...] I can remember that in the past, during the salinity crisis, we had the strength and also the mechanisms to effectively deal with." (Int_3).

Even though agricultural water users and their representatives have not formally participated in the AAC process, WUAs do have the authority to defend their "legal interests." Because the water seeping from the All-American Canal has represented a fundamental source for more than 60 years, the All-American Canal lining project is a direct threat to the productive and irrigation performance in the Mexicali Valley (LER). This right over the seepage water (according to the years of using it) may entitle agriculturists to formally participate in the AAC process; however, the limitations of WUAs impede them from doing so. Heavy bureaucratic and inefficient co-management between WUAs and CONAGUA also gets in the way (BUR). Two central themes relating to the bureaucratic barriers are the increasing costs for social mobilization as well as the lack of agricultural leadership. As an interviewee points out:

.....for example, before the modules were formed, if somebody needed to transfer his irrigation rights to other place within the valley, both the paperwork and administrative processes with the Irrigation District, state and federal agencies, and the bank were single, easier, and cheaper than current processes handled together by WUAs and CONAGUA. A response or solution used to be given to individuals in just a few days. [...] Now, in order to get a single document such as an irrigation right letter or permit, one doesn't have the possibility to receive a personalized service, but one has to buy and to fill out several official formats for the Ministry of Budget just to ask to any other governmental agency for a single service, after that one need to go to the bank to pay for such a service and finally one has to return to the original agency [CONAGUA]. Then, this federal agency asks me for another 'free of debt" letter issued by my Irrigation Module, plus presenting proof of other several registered official documents like the Tax Federal Register [RFC], Population Federal Register [CURP], among others. This is becoming a real 'built cancer' that is obstructing management processes and ability to respond to critical issues. Can you imagine this heavily constructed red tape when transboundary water issues come into play?" (Int_9).

In addition to this co-management feature halting effective participation of agriculturists, there is a perceived lack of accountability to individual agriculturists (most of whom are small scale producers) of WUAs. The WUAs have direct operative links with several agencies: first, the upper-level Irrigation Society or SRL (water users' organization operating the three main canals in the Irrigation District); secondly, CONAGUA (through the Irrigation District 014, Colorado River) focusing on the regulatory aspects; and finally, the City of Mexicali water authority named Comisión Estatal de Servicios Públicos de Mexicali (CESPM) which receives water from modules' irrigation canals to serve both rural and urban townships. The WUAs lack of accountability to small landholders is frequently reported in the several irrigation modules. Instead, representatives of WUAs tend to be accountable to upper agencies such as CONAGUA or to some group of powerful users (ALA).

The following five explanatory factors that northern agriculturists argue as they relate to the low level of participation of WUAs are the most significant ones among those listed in Table 3.8. For instance, 7 out of 9 participants in this study area mentioned that interest groups within WUAs are observed and they have been identified as another factor inducing apathy and lack of water users' participation (GIA). The same proportion of participants emphasized that, typically, those seen as participating in WUAs are large-scale agriculturists, the "new big landholders" (LAN). One particular agriculturist described the failure of WUAs' leadership to organize and represent the individual and small agriculturalists as follows:

> I have seen too much apathy on the part of the modules as well as the irrigation society's representatives. Considering the magnitude of the imminent problem over our lands, they have lacked interest. There are no real leaders who could defend our interests, they have the control of the modules but they are 'big landholders.' There are many words but no action on their part. ....The modules must be strong and organized promoters of our participation in social sector, they must call on us to defend and participate in the All-American Canal issue, together as one. It is true that neither CONAGUA nor CILA have promoted our participation, but...it is not a valid justification for our [local WUAs] representatives to behave similarly." (Int_5).

Furthermore, 89 percent of interviewees perceived an absence of coordination between WUAs and key governmental water agencies, also seen as an aspect of ineffective participation in the AAC process (LAC). They also perceive that this lack of coordination may be explained, in part, by the lack of information about and development of formal mechanisms to strength institutional links between WUAs and agencies such as IBWC/CILA, which traditionally focuses on transboundary water issues although these water issues directly affect local agriculture and irrigation (LIM).

It appears that a core explanatory factor (as all respondents mentioned) is the fact that WUAs' representatives do not appear to properly inform their constituencies on critical issues and, for this reason, both IBWC/CILA and WUAs are frequently criticized by the individual agriculturists participating in this study. Furthermore, there seems to be no formal coordination mechanisms between IBWC/CILA and WUAs for jointly analyzing and establishing courses of action (LIC). Such formal links or institutional mechanisms for working together simply do not exist. That is, despite the importance of having good communication and coordination between water agencies responsible for distributing water coming in from the United States, agriculturists situated at both water delivery points in the Mexicali Valley (Northern International Boundary) and San Luís Río Colorado Valley (Southern International Boundary) have no such formal mechanisms for communication with the international agency responsible for controlling international water distribution in México such as IBWC/CILA.

Respondents did articulate a need for WUAs as a kind of formal institution that can represent agriculturists' interests and formally engage in the All-American Canal lining issue. That is, local agriculturalists' representatives would be able to raise effectively their concerns with the All-American Canal lining project with authorities at state, federal, and international-level water agencies. It appears that there is significant sentiment among local agriculturalists to build bridges between current top-down approaches and the "new" bottom-up approaches. In doing so, it is believed, this action may defeat the current *status quo* of low levels of participation of agriculturists in the AAC issue. As one agriculturist put it:

> .....The CILA [IBWC-Mexico] thinks that we the agriculturists are not good participants, CILA thinks we are not reasoning people, that we are mostly uneducated. They [CILA] always negotiate with IBWC but our viewpoint is not valid for them to use it as argument in the processes of conflict resolution about transboundary water issues like the AAC [...] I really would appreciate that some day the CILA and CONAGUA's officials in Mexicali could formally invite us to participate, to present technical documents, to expose our standpoints, to consider our concerns, to collaborate with them towards building an unified force. But this has never happened before and might not happen in the near future. [...]. This lack of coordination is the main reason why our representatives make a lot of mistakes while negotiating critical issues." (Int_7).

Finally, local, national, and international politics are seen by local agriculturalists as a factor blocking their participation in the All-American Canal dispute. Respondents describe their perception about "politics" as of having already arrived at a predetermined outcome for the high level negotiations between governments concerning the All-

American Canal issue (POC). From this, the project will be implemented subject to later review based on "*Principles and Mechanisms for Compensation*" instead of standards that protect and benefit agriculturalists in the Mexicali Valley. Such standards being promoted by CDEM are based on the *Precautionary Principle.*

Several schools of thought on Environmental Economics state that "the Precautionary Principle implies that under conditions of uncertainty of environmental damage, it must consider a hybrid criterion where efficiency, sustainability, ethical and ecological principles come together to inform decision-making." (Perman, Ma, McGilvray, and Common 2003, 249).

As one respondent says:

> Just as in the salinity problem process occurred, the politics behind or beneath critical transboundary water issues are alike. Here in the rural realm of the valley it is said that more than 15 or 20 years ago a negotiation at the very high level of governments was initiated in order to implement the AAC project today." My point here is that when a government deals with a critical issue in such a secrecy and confusing way it seems to me that just some elite representatives of the government know about it while most of us affected users, suffer from a lack of information, thus, hinder [us] to participate effectively as key social and productive actors." (Int_3).

Views of northern Mexicali Valley agriculturists of the institutions used by agriculturists during the All-American Canal lining conflict

Respondents described very different characteristics of the institutions in the Mexicali Valley during the All-American Canal lining process from those of the salinity problem period. In the case of the All-American Canal, agriculturists of the northern Mexicali Valley described institutions that set about to constrain them both as individuals and as members of organizations. This, in turn, resulted in the participants' point of view that the outcome of the All-American Canal issue will have, at best, weak support and poor outcomes as far as agriculturalists in the Mexicali Valley are concerned (DAS and

ELU). The formal and informal institutions in the region, according to those interviewed, may as well be characterized by processes anchored in the viewpoint dominated and guided by formal institutions that represent WUAs in turn dominated by a few powerful individuals and who have avoided raising the All-American Canal lining issue. It appears as though there is a horizontal disconnection among households in the agricultural sector, an absence of agriculturists' participation in the water management process, and only nominal vertical integration of agriculturalists in state and federal agency information gathering, negotiation, and decision making.

During the All-American Canal lining episode, there appears to have been a generalized apathy among agriculturalists, lack of leadership, and no financial wherewithal to facilitate individual agriculturists' ability to voice their concerns. Furthermore, the bureaucratic "co-management process" between WUAs and CONAGUA, while superficially appearing to promote representativeness, eroded individual agriculturalists' interests because the WUAs were dominated by powerful, large extension land owners.

What respondents shared was a picture in which institutional arrangements that served agriculturists during the salinity problem episode failed to do so during the All-American Canal conflict period. As a result, only a weak attempt seems to have been made to defend, protect, and argue about the continuation of All-American Canal seepage or other freshwater source for agriculture into the Mexicali Valley. Such concerns were taken to the U.S. federal court of the Ninth Circuit by a coalition of groups representing community and environmental interests on both sides of the border.

The effort was spearheaded by CDEM, an urban-based economic development corporation. Important co-plaintiffs in the suit included Citizens United for Resources and the Environment (CURE), a California based non-profit organization focused on sustainable development and resource management, as well as Desert Citizens Against Pollution (Desert Citizens), a community-based non-profit organization concerned with environmental justice. Even the U.S. town of Calexico, California intervened in the suit. Seeking to enjoin the project as a violation of property rights and environmental interests, the case thus represented an international effort to access the U.S. court system on behalf of cross-border economic and environmental interest groups (Cortez, Donovan, and Whiteford 2009, 144).

The coalition of plaintiffs brought about a total of eight claims against the Department of the Interior, the Bureau of Reclamation, and relevant regional and local entities. Initially dismissed by the federal district court for a variety of technical deficiencies, new hope for their claims emerged when the Ninth Circuit enjoined the project from proceeding pending an appeal in 2006. Ultimately, however, in April 2007 the Court of Appeals found broader substantive grounds upon which to dismiss all eight claims, foreclosing further legal challenges and insulating the All-American Canal lining project from judicial review (148).

Influence of agriculturists in the All-American Canal lining conflict

As discussed above, there have only been low levels of participation by agriculturists in the All-American Canal process. This in turn has resulted in little or no influence on identifying potential solutions to the All-American Canal elimination of seepage. This decreased participation has taken place at the same time the Mexicali

Valley has seen a diminishing agricultural economy and the loss of political power of agriculturists. This may be represented as follows (see also Table 3.9):

DIT = f (ING, DOW, ORG, CIL, ELE)

Table 3.9 Influence of the institutional response (low participation) of agriculturists of northern Mexicali Valley for finding solutions to the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DIT = Influence of participation of agriculturists in finding solutions to the All-American lining conflict.	ING = Indifference of domestic governments to support the agricultural sector	89	Agricultural sector as a whole and WUAs with neither economic nor political power to influence suitable solutions.
	DOW =Downward spirals in the Mexicali Valley	67	
	ORG = Deteriorated organizations	89	
	CIL = Loss of capacity for influencing positive change	89	
	ELE = External, urban-based leadership facing the AAC	56	

A proportion of 89 percent of interviewees in the northern area of the valley revealed that a major factor behind the marginal influence of the agriculturists in the All-American Canal lining process may be the institutional behavior of contemporary governmental agencies at both the state and federal levels. Interviews revealed that more than twenty years of governmental indifference has been felt in Mexicali's agricultural sector (ING). It was learned that small landholders have suffered systematic reductions in credit and subsidies while production costs have risen and agricultural product prices have fallen.

According to the 67 percent of respondents, these factors have resulted in a downward spiral (DOW) leading to detrimental economic conditions that further weaken organizational structures (ORG) which in turn reduced social participation and agricultural leadership as influential forces to addressing transboundary water conflicts such as the All-American Canal issue (CIL and ELE). A proportion of 89 percent of participants asserted these aspects and all this together can be illustrated as follows with one interviewee's opinion:

> Nowadays, the government [federal and state officials] sees as 'inconvenient' that we the agriculturists organize ourselves to call for crowded public meetings in order to raise our concerns and disagreements with the current agricultural and water public policies. They dislike that we use massive media such as the local, national and even international press, the radio, and the TV; they [governments] just want us out of the ways to participate. To them [governments] it is very 'prickly' that we express our reality, the awful reality, the true about what is happening in the Mexicali's countryside [...]. Why we have no power and room to participate? Well, the answer is because there is a remarkable lack of support on the part of the government of any sort [municipal, state, and federal] in terms of creating good conditions for economic growth, thus, power to induce positive change as an upward spiral." (Int_8).

Views of northern Mexicali Valley agriculturists of the impact of the institutional structures used by agriculturists during the All-American Canal lining conflict

The impacts of the institutions used by agriculturists during the All-American Canal lining process to address transboundary water management issues, irrigation, and agricultural development in the northern Mexicali Valley seem to have been minimal. In fact, it appears that the formal institutions followed during the All-American Canal lining conflict actually blocked local stakeholders' participation and made them ineffective social actors. Their viewpoint and interests vis-à-vis the All-American Canal lining project were effectively ignored. That is, little or no commitments for compensation or improved water management were made for agriculture in the Mexicali Valley despite likely damages envisaged to the regional agriculture.

Instead of the formal institutional addressing of agriculturalists' concerns about the All-American Canal process, agriculturalists were impeded from becoming significant and influential actors in this process. This was also true at the binational level, for example, in the modification of the transboundary water management legal framework. The formal institutional structures such as WUAs and SRL seemed to be dominated by urban-based leadership such as the Mexicali Economic Development Commission (CDEM) as well as several federal agencies. Agriculturists lost economic and political power to influence local and transboundary water management in the Mexicali Valley. As such, this key stakeholder is no longer seen as a social actor with capacity to produce institutional change.

CONCLUSION

The reported research on the institutions of agriculturists of the northern Mexicali Valley shows that institutions have changed from effective mechanisms to other ones less so between the period of the salinity problem and the All-American Canal lining conflict. Agricultural water users have lost their economic and political power which has diminished their capacity to participate and influence transboundary water issues affecting their productive activity and irrigation operation and management.

In general, a combination of formal and informal institutions has influenced the agriculturists' social behavior. In the case of the salinity process, informal institutions dominated the context (i.e. individual mobilization, congregation of unions, and boycott) allowing agriculturalists to participate and influence change at the local and binational level. In contrast, during the All-American Canal process, agriculturists ended up relying upon formal institutions (i.e. WUAs). There was virtually no unified, social behavior, nor effective leadership, nor economic and political power. Major differences (DIF) between the SAL and AAC processes can be illustrated as follows (see also Table 3.10):

$$DIF = f\ (DIP, DOR, DAL, DIG, CIL, SOS, BEC) + SIP$$

Table 3.10 Perceptions of agriculturists of the northern Mexicali Valley concerning major institutional differences between the salinity problem and the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DIF = Major institutional differences between the SAL and AAC.	DIP = Extent of presidential leadership.	56	-Different/reduced presidential and local leadership.
	DOR =Extent of agriculturists' organization.	67	
	DAL =Degree of agriculturists' leadership.	78	-However, similar politics behind the salinity and All-American canal issues are in fact perceived: high-level politicians in both countries make no transparent agreements.
	DIG =Kind of groups making pressure in SAL and AAC.	67	
	CIL =Capacity for influencing changes.	78	
	SOS =Socio-productive structure (due to level of lands rented).	22	
	BEC =Economic constraints in agriculture.	56	
	SIP =Politics behind the salinity and All-American Canal.	33	

First of all, northern agriculturists perceive a significant difference between Presidents Luis Echeverría and Vicente Fox in terms of accountability to local people and their interests such as defending the Mexicali Valley's precious water resources (DIP). While the salinity problem period was characterized by institutions with strong leadership, skillful diplomacy, energy and a sense of patriotism, the All-American Canal lining period was described as one in which President Vicente Fox was strongly criticized by agriculturists for his absence of leadership and disregard of local interests in the sustainability of the region. The different approach used by the two presidents seems to have had repercussions on the organization and strength of agriculturists as a unified force (DOR).

During the salinity problem, agriculturists showed unity through the informal institutional structure of "union of unions" whose operation was based on self-financing mechanisms and headed by outstanding local leaders (DAL). On the contrary, during the All-American Canal lining conflict there was organizational, economic, and financial disaggregation within the irrigation sector and there was a decrease in the representativeness and effectiveness of WUAs.

For instance, the agriculturists' unions such as Central Campesina Independiente (The Mexican Independent Peasants' Union or CCI), Confederación Nacional Campesina (The Mexican National Peasants' Confederation or CNC), Unión Agrícola Regional (The Regional Farmers' Union or UAR), and Confederación Nacional de Pequeños Propietarios Rurales (The Mexican National Private Small Rural Owners' Confederation or CNPPR) were outstanding organizations that dominated during the SAL period but they have been replaced by urban-based groups such as Comisión de Desarrollo Económico de Mexicali (The Mexicali Economic Development Commission or CDEM) in the All-American Canal process (DIG). As a result, the capacity of agriculturists to influence transboundary water management has been significantly diminished (CIL) together with the economic constraints faced by most agriculturists in the Mexicali Valley (BEC).

Although mentioned by just a small proportion of interviewees (33 percent), a significant aspect explaining the possibilities for either facilitating or blocking the institutional response of agriculturists in both cases under study is perceived in terms of the politics behind such an event in which a "premeditated" negotiation between high-level governmental actors takes place to face and solve a technical problem transformed in conflict and where damage is "allowed" to occur and then the affected party is compensated (SIP).

Finally, it is clear that there exist negative externalities in both the salinity and All-American Canal lining processes. As shown for the former case, it is expected that implementing a compensatory approach might surmount the later one but for this to occur a more intensive and structured participation of agriculturists should take place. As noticed, in the former case t_1, participation of agriculturists was promoted and supported to accelerate compensatory measures while in the later case t_2, participation of agriculturists as key stakeholders has been hindered by a diversity of factors that in turn might block the implementation of compensatory measures in the near future for the All-American Canal lining project impacts.

CHAPTER 4

INSTITUTIONS AND AGRICULTURAL WATER ISSUES FOR USERS IN CENTRAL MEXICALI VALLEY (CAH)

This chapter describes research into the perceptions of agriculturists living and working in the central Mexicali Valley (CAH) as they relate to the two main transboundary water management issues under investigation, the salinity problem and the All-American Canal lining conflict. Following the approach used to study water management issues in the northern Mexicali Valley in the previous chapter, this chapter uses institutional functions to facilitate understanding of explanatory factors and impacts of water management-related stress and institutional responses in the central Mexicali Valley. While there are many similarities between water users in the northern, central, and southern areas of the valley, this chapter focuses on highlighting the differences revealed from the analysis.

To explore viewpoints of the ten central Mexicali Valley agriculturalists interviewed, I will use the institutional functions to identify those similar and different factors that emerged from interview data. It appears that the level of societal stress in the case of the salinity problem was higher in the central and southern Mexicali Valley as compared to that of the northern area while the All-American Canal lining issue seems to be of major concern in the northern Mexicali Valley. Not surprisingly, the institutional responses of agriculturists to the salinity issue were broader and stronger in the central (and southern areas) than in the northern Mexicali Valley. In the case of the All-American Canal process, the institutional response although generally described as "weak" was still a predominant response of agriculturists in the northern Mexicali Valley and even in the urban area located at the northern region as well (Appendices C and D).

AGRICULTURE AND IRRIGATION IN CENTRAL MEXICALI VALLEY

In line with experiences and perceptions shared by agriculturalists in the northern Mexicali Valley region (NAH), participants in this area of the valley (CAH) pointed out significant structural changes such as social polarization among the agriculturists resulting from water management issues. Building on the previously discussed progress (PRO) and regression (REG) viewpoints, 30 percent of respondents in the CAH region did report having made progress such as technology improvements for land management, diversification of cropping patterns, and significant land reforms that allow expanding their land ownership.

Those water users in central Mexicali Valley with a progress viewpoint evidenced this perspective in the same way as those agricultural water users from the northern area of the valley as presented in Chapter 3. However, in comparing the explanatory factors raised by 20 percent of respondents, one factor--the change in the scale of land operations (LAR)--varies significantly in magnitude from that observed and expressed by respondents in other areas of the valley (i.e. expanded from normally 20 ha to 200 ha in the northern and up to 150 ha in the southern Mexicali Valley). In the central Mexicali Valley, respondents emphasized that typically the "new scale" or size of agricultural land operations (including irrigation water allocations) tended to be larger than in the near past, such that it resulted in areas of land operated per household of 20 ha to around 500 ha for sustainable agricultural production.

For those 70 percent of respondents with the view that agricultural functioning resulted in a gradually reduced quality of life or regression, additional arguments or factors were expressed by agriculturists in the central Mexicali Valley. Near 40 percent of participants mention that these factors refer to heavily bureaucratic processes including increases of paperwork to access agricultural credit (BUC) together with a loss of organizational capacity to grow crops on the part of agriculturists (LOZ). These farmers in the past used to form and organize large productive cooperatives both for processing agricultural products and managing livestock operations. Fifty percent of interviewees assert that the resulting "new scale" operations resulted in increased leasing of agricultural land in the CAH so that currently about 95 percent of the original owners is now renting their lands (REN). The function depicting the regression perspective is shown as follows (see also Table 4.1):

REG = *f* (HIC, LOP, CRE, BUC, COM, LOZ, REN)

One respondent highlighted these interlinked aspects when he pointed out that:

> In times of the salinity [crisis], there were crowded agriculturists' meetings and public manifestations, very well organized and headed agricultural sector used to be unified and strong. Now for the case of the All-American Canal, we are so disarticulated. Why? Because in those times almost everyone used to work his own land, there was not a lands renting phenomenon [...] now, it is a different situation, now normally in this sub-region [central] there are just a few agriculturists working the lands which hold up to 1,000 hectares for each individual to grow. For example, here in the *ejido* [Ejido Nuevo León] just about ten out of 265 original registered *ejidatarios* [owners] are working their lands, that is, 96 percent of the lands are given in rent to other 'new large landholders!! This is so because of the lack of agricultural credit and the cumbersome [bureaucratic] processes to get money from both private and official banking corporations. It seems to me that the Mexicali Valley is having deterioration and that it is going back to the 'ancient' times of the large landholders who concentrate vast land extensions." (Int_1).

Table 4.1 Perceptions of agriculturists of central Mexicali Valley concerning the evolution of regional agriculture.

GENERAL PERCEPTION	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
PRO = Progress		30	Socio-productive polarization among agriculturists in the Mexicali Valley.
	DIV = Diversification of crops	10	
	LAR =Larger scale of average agricultural operations (20 to 500 hectares)	20	
	HIL = Higher lands' productivity	10	
	TIM =Technology improvements for land management	30	
	IND = Industrialization of agricultural sector and productive chains	10	
REG = Regression		70	
	HIC = Higher production costs	70	
	LOP = Lower relative prices	70	
	CRE = Drastic reduction of credit and increasing of collateral requirements for small farmers.	70	
	BUC = Bureaucracy in credit Processing	40	
	COM =Generalized commercialization problems mostly noticed in grains' small farmers.	30	
	LOZ = Losing organizational capacity to produce.	40	
	REN = Growing area of agricultural lands rented (95 percent on average).	50	

The regression view expressed by participants in central Mexicali Valley can be linked to the worsened condition observed in terms of a drastic reduction of regional gross domestic product (GDP) in the agricultural sector in recent years. For instance, the trend shows a declining GDP that changed from average levels of five percent during the 1990s to three percent in the year 2000 and to two point six percent in the year 2007 (INEGI 2008).

In regards to the GDP concept, Field (2000, 18) mentions that conventional GDP measures are deficient in many respects. The author underscores that one important problem is that they measure only the value of goods and services that move through markets. Another problem is that GDP measures do not allow for natural resource depletion; however, depreciation may also occur in a society's natural resource capital (Field 2000). The production of conventional goods and services requires inputs from the natural environment such as water and agricultural land which might require a formal natural resource accounting exercise in the Mexicali Valley.

Agriculturists in the Mexicali Valley that perceived some extent of regression in the area also show a practical and, at the same time, valuable knowledge based on their lifelong experience as farmers. They see a gradual depletion in their resource base, soils and water. Agriculturists have noticed how their land has been gradually losing its natural productivity; as a result, they have been using fertilizers, pesticides and water intensively which in turn has direct repercussions in increased production costs. In the same vein, agriculturists have seen a diminished quality of both, groundwater and surface water sources for irrigation in Mexicali. This latter aspect will be discussed next.

The irrigation sector of the central Mexicali Valley

Another major issue raised by agriculturists of the central Mexicali Valley concerns changes in the management and development of the irrigation sector. First, just like in the northern Mexicali Valley, most respondents gave emphasis to an increased factionalism among agricultural water users with a rise in elitism among irrigation water users. As such, these factors inform the views on "failing" irrigation water management. In the central Mexicali Valley previously raised explanatory factors for both institutional functions (SIM and FIM) were observed. In any case, concerns regarding the failing irrigation management perception dominate the discussions accordingly to the opinion of 60 percent of respondents.

Conversely, additional factors that 30 percent of participants in this study in the central region attribute to a successful irrigation water management viewpoint include the opportunity for undertaking irrigation water transfers (TNS) at different scales of operation. These potential transfers include levels of operation and modes such as the intra-parcel changes in water use by an individual agriculturist (i.e. using individual surpluses of a normal water allotment to be used in a second crop within the same agricultural cycle); intra-module transfers among individual agriculturists (i.e. a wheat grower with a water surplus transferring water allotment rights to an alfalfa grower with a water deficit within the same module or sub-region of the irrigation district); inter-module transfers between water users within the same irrigation district (i.e. irrigation water transfers between water users in the central Mexicali Valley and water users in the southern Mexicali Valley); and the possibility of negotiating water transfers from agricultural uses to urban uses.

Water transfers within the central region's irrigation district (i.e. irrigation modules 9A, 9B, 10, and 17) have been taking place. However, the other theoretically possible trading mechanisms (e.g., agricultural sector-urban area) are having trouble with practice. Agriculturists appear to see water transfers out of agriculture to urban and industrial uses as a threat to the viability of agriculture. In any event, 30 percent of interviewees noted that agriculturists organized as WUAs and the Irrigation Society or SRL are now better positioned for negotiating and bargaining as they relate to water trading (BAR). An institutional function illustrating these factors is shown as follows (see also Table 4.2):

$$SIM = f\ (SIW, LIT, IWE, GIT, BAR, TNS)$$

As one respondent in the central Mexicali Valley explained:

> Here in this irrigation module [number 10], we have excellent personnel both representatives and water managers working together and in coordination. They have done a very good job of getting shared financial resources from our own water service fees [30 percent] as well as from governmental contributions to acquiring special large equipment and machinery for keeping our open drains and major irrigation network in suitable condition, for leveling our individual parcels, for buying secondary canals' water control devices, for lining or piping inter-parcel irrigation networks, etc." (Int_2).

In contrast, disappointment with the region's irrigation water management system appears to be even more profoundly felt by agriculturists in the central area than by those of the northern Mexicali Valley as described in Chapter 3. This is evidenced by the comments of 60 percent of the respondents who emphasize high level of bureaucracy, hydraulic operation system failures, and increasing irrigation water service costs, among several other negative factors.

In addition to the increased frequency and intensity of the factors raised by northern agriculturalists disappointed with water management, central region agriculturalists point out operational problems in the Irrigation District (014) as a whole. Respondents point out how their region's WUA representatives lack a system-wide perspective and that there is inequality among agricultural water users, insufficient irrigation technology, lack of governmental investment, and lack of inter-agency coordination. The respondents also point out that naturally occurring seismic activity can affect irrigation infrastructure and hydraulic operation in this particular central region of the Mexicali Valley. The institutional model illustrating participants' perspective of a failing irrigation management system is as follows (see also Table 4.2):

$$FIM = f\,(IMU, BUR, OPE, SYS, LAN, GIA, TWI, EQU, IQU, TEC, INV, CIC, ERQ, COS, LOV, ICO)$$

A proportion of 30 percent of respondents emphasize local irrigation system operational problems (OPE) while mentioning the theme of frequent bad planning and operation procedures by the water users' representatives and officials of their WUAs. Discussion also revealed clear differences in how irrigation management was undertaken in the several modules of the central Mexicali Valley as compared with that of modules in the northern and southern regions. In the central region, irrigation modules rely on one major central canal and irrigation water flows through it to irrigate their crops (modules 9A, 9B, 10, 11, 12, 17, 18, 19, and 20) (Figures 2.1 and 2.2).

The same proportion of participants mentions that this fact coupled with an apparent absence of a system view by WUAs and the SRL officials (SYS) that resulted in the fragmentation of the hydraulic irrigation system. This in turn led to disregard key technical and managerial links among irrigation modules which affected the operational efficiency of the irrigation district. It was observed that one of the main tasks of the SRL of the Mexicali Valley was supposed to be the promotion of a system-wide vision as well as the coordination among their twenty three WUAs members. However, respondents pointed out that after more than 10 years of operation of the SRL (from 1998 to 2008 and continued), there are still divergent interests among irrigators that have resulted in irrigation water operation problems at the irrigation district level.

Table 4.2 Perceptions of agriculturists of central Mexicali Valley concerning the evolution and impacts of irrigation water management.

GENERAL PERCEPTION	EXPLANATORY FACTORS	FERQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
SIM = Successful irrigation mgmt.		40	
	SIW = Better irrigation water use than in the past	40	-Differentiation among irrigation water users. -Elitism. -Physical conditions of the central area make irrigation problems more critical than in the northern area.
	LIT = More irrigation technology than in the past	40	
	IWE =More efficient irrigation water use than in the past	30	
	GIT = Growing irrigation tech.	40	
	BAR = Increased bargain capacity of irrigation water users	30	
	TNS = Irrigation water transfers	30	
FIM = Failing irrigation mgmt.		60	
	IMU= Imposed WUAs (top-down)	50	-Additional factors facilitating explanation of FIM.
	BUR= Bureaucracy of co-management	60	
	OPE = Irrigation operation problems	30	
	SYS = WUAs representatives' lack of a system view.	30	
	LAN= Large landholders dominate WUAs administration	20	
	GIA= Groups of interests in WUAs	30	
	TWI= Significance of transboundary Waters	10	
	EQU = Inequality among Agriculturists	40	
	IQU= Inequality among water users	20	
	TEC= Lack of irrigation technology	30	
	INV = Lack of govmt. Investment	20	
	CIC = Lack of agencies coordination	60	
	ERQ = Intensive earthquake area	50	
	COS= Increasing irrigation service costs affect incomes	40	
	LOV= Short-term vision of WUAs	20	
	ICO= Internal conflicts in the sector	20	

For example, 40 percent of interviewees in the central Mexicali Valley mention that equality between irrigation water users is lacking (EQU). That is, support given to agricultural water users from both WUAs' officials and governmental water agencies like CONAGUA appears to show high extent of elitism since it tends to favor productive activities for vegetables and alfalfa producers over wheat or grain producers. Also, central region participants commented on privileged treatment given to WUAs of the northern Mexicali Valley (e.g., at the head water source and wells area) as opposed to WUAs located in the central and southern Mexicali Valley.

The few current investment programs that involve the state and federal governments and water users (INV) focus mostly on particular groups of producers such as those using wells in the northern sub-region. Those with the viewpoint that irrigation management is failing (60 percent of central region's respondents) also point to the lack of coordination (CIC) between the two main governmental water agencies, CILA (which receives water from the United States) and CONAGUA (which delivers water to Mexican users). Some water users expressed their disappointment in the following manner:

> .....no, I think that they [irrigation modules] are increasing the cost of the water service [...] I can see it daily, they have a lot of people working in the office and also in the field. There are many *canaleros* [water operators at field level], besides, their wages are so high including those of the officials and 'our honorary' representatives [...] supposedly, modules were created to support us so we could have more efficient water operation at an affordable cost, isn't it?" (Int_4).

Another added that:

> As a result, there is a lack of investment, there is not enough irrigation technology at the parcel level, besides the way how water is distributed among users is so bad, that frequently, water flows are stopped while watering, that is, the module is having troubles in keeping a suitable water level in canals for efficient operation and this fact [per se] shows the lack of coordination between upstream-downstream modules as well as between CILA, CONAGUA, and the irrigation modules." (Int_10).

A permanent natural process in the central Mexicali Valley region pointed out by 50 percent of respondents as a critical problem for water management and other societal risks is the intensive earthquakes activity in this area (ERQ). For example, during

February 2008 about 450 earthquakes of magnitude ranging from 3.0 to 5.5 on the Richter scale were registered by the United States Geological Survey (USGS) and the Center for Scientific Research and Higher Education of Ensenada (Centro de Investigación Científica y de Educación Superior de Ensenada, CICESE). Another was felt on December 30, 2009 registering magnitude 6.0, and on April 4, 2010 the strongest and most devastating earthquake in 122 years registering magnitude 7.2 on the Richter scale affected 59,000 hectares and 25,000 people living in the area. The epicenters were located in central Mexicali Valley and they are linked to three different geological failures: the Imperial, Laguna Salada, and Cerro Prieto failures (USGS 2010).

As a result, earthquakes have impacted the operation of major lined canals such as the Reforma Canal and Nuevo Delta Canal both serving most central and southern irrigators. Furthermore, the seismic activity is reported to keep permanently broken the irrigation network in central Mexicali Valley and to induce seeping and flooding problems into agricultural lands as well as nearby rural towns (La Crónica de Baja California Press, April 5, 2010). A respondent put it this way:

> .....here [central Mexicali Valley], we have an enormous specific problem which also weakens and affects the irrigation operation. The constant underground movements affect investments made in costly hydraulic infrastructure that we have to repair each year or two or it simply stops functioning and then it has to be built up again in order to keep our water operation levels [...] Frequently, the Reforma and Nuevo Delta canals base drops and the water delivery devices keep high, so, we have to re-invest in rising canal bottom and lining additional canals [...] this is critical in nearby areas of the *ejidos* Tlaxcala, Nuevo León, Veracruz, Saltillo, Oaxaca, and other nearby *ejidos*." (Int_3).

It appears that social polarization and differentiation among irrigation water users in the central Mexicali Valley also support Galtung's concept of "structural inequity" (Galtung 1980, 64). Like in the other regions of the Mexicali Valley, there seem to exist changing roles of agriculturists vis-à-vis irrigation and transboundary water management in the central Mexicali Valley as well as a failure to consider actor-oriented and more participative processes towards improving irrigation water management.

Developing an appreciation of agricultural and irrigation changes by agriculturists in the region provides a background for better understanding of the type and extent of impacts of institutions in the central Mexicali Valley in response to the salinity and the All-American Canal processes. It appears that, despite some disagreements from other regions, agriculturalists engaged in high levels of participation (institutional behavior) during the salinity problem period (t_1) and low levels of participation (institutional behavior) during the All-American Canal lining conflict (t_2). Major institutional differences were observed in the central Mexicali Valley communities between t_1 and t_2. Subsequent sections identify and describe the institutions followed by agriculturists at the central Mexicali Valley during both times under analysis.

THE SALINITY PROBLEM PERIOD (SAL)

This section focuses on the perceptions of agriculturists of central Mexicali Valley regarding the damage to the agricultural sector as a result of the salinity of the Colorado River water (SAD). It is generally understood that the central area of the valley suffered more than other areas in the Mexicali Valley because of this sub-region's soil features which can be associated with significant productive, economic, and social impacts (Clemings 1996, 135). Therefore, one would expect that the central region agriculturists' institutional responses to the salinity crisis would evidence some differences relative to other regions. As a result, I primarily focus on those elements that stand out for central region agriculturalists and the institutional response to the salinity problem. The descriptive and facilitation function is as follows (see also Table 4.3):

$$SAD = f\,(MIX, ROU, SAH, YED, ICS, CRI, RED, ABA, SAR)$$

While some factors appear in both the function for the northern region and the central region's institutional response to the salinity issue, those factors that are different are highlighted here. Based on the interviews implemented in the central Mexicali Valley area, that there are significant differences in how the agriculturists felt and assessed "physical" impacts or damages to the agricultural sector due to the salinity in this agricultural area as well as in the entire Mexicali Valley.

Table 4.3 Damages to the agriculture of central Mexicali Valley as a result of the salinity.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONENTS)	MAJOR FINDINGS
SAD = Damages in agriculture of the Mexicali Valley.	MIX = Disposed of salty waters upstream (salinity of the Colorado River).	30	-Significant social, productive, economic, and environmental impacts. -Salinity problem more critical for CAH than for NAH.
	ROU = Existence of salty soils strip along the valley (ruta de sal).	60	
	SAH = High extent of salts pollution in individual parcels.	60	
	YED = High extent of crop yields reductions.	90	
	ICS = Increasing production costs for individual agriculturists	40	
	CRI = High extent of contraction of agricultural credit to unproductive lands	40	
	RED = High extent of individual parcels size reduction	50	
	ABA = High proportion of farmers abandoning the agriculture	50	
	SAR = Salinity problems remain	70	

For instance, a large number of respondents (60 percent) mentioned a widespread adverse impact to water users in the central area of the valley. Portions or whole parcels were described as becoming saltier (SAH) with the corresponding use of the term “salty route” for those parcels placed along a region or strip with significant salt accumulation (ROU). This physical feature is understood by respondents as a key indicator of the damage of salinity to the regional agriculture. A significant proportion of respondents (90 percent) also discussed significant yield reductions (YED) that were as much as 80 and 70 percent in principle crops like cotton and wheat, respectively. At the same time, 40 percent of respondents mentioned increasing production costs (ICS) associated with farming in the salty route. Also, respondents report that official agencies saw the productivity challenges as barriers to their being able to offer financial support (CRI), mainly during initial stages of the SAL process and the Presidency of Gustavo Diaz. One interviewee recalled his disappointment this way:

> .....by those times we used to grow mostly cotton [...] a parcel whose normal yield was 5 packs [equal to one metric ton each] per hectare before the problem, was reduced to 1 pack per hectare!!! The salts in water and soils affected us dramatically.” (Int_1).

Another agriculturist added on this topic the following:

> I think production costs raised more than 60 percent, everything, water use and fertilizers which had to be used in excess because its effect was blocked by salts [...] My lands became unproductive and, as such, I was taken off from official and private credit programs. Mr. Gustavo Diaz (former President of México before Mr. Luis Echeverría administration) was an insensitive person, he didn’t do anything to solve the salinity problem, and he stopped [providing] financial support to us.” (Int_10).

Half of the participants in this study area mention that as a result, agricultural water users showed wide variations in their social and productive behaviors. First, individual efforts to “compensate” for the negative impacts included “emergency actions” to modify the scale of operation. For example, the most common “emergency action,” according to the interviewees, was for 'salt-stressed' agriculturists to reduce the normal size of agricultural operations (RED) from 20 to 18 hectares, on average. Second, depending on the extent to which agriculturalists were impacted by salts pollution, many of them abandoned either temporarily or permanently their agricultural activity on their land (ABA). Some chose to leave their parcels to migrate to Mexican urban areas while others went to work "in the field" within the United States.

This type of response was shared by one respondent who lived through the salinity problem as follows:

> During several years land operations were reduced. We received water to irrigate 14 or 16 hectares instead of 20 hectares of our normal water rights. For this reason, we asked for water sources mixture [wells and canals] so that the impact was reduced to just 18 hectares [...] anyways, a lot of people here had to leave either permanently [lands sold] or temporarily [inactive lands]. Many of them emigrated to Los Angeles [California] and many others to their place of birth in central México. It was a really critical moment when we had no money to survive." (Int_9).

According to 70 percent of respondents, continual salinity problems were stressed by agriculturists in most areas of the Mexicali Valley (SAR). It appears that even today the salinity problem remains a critical issue affecting agricultural productivity in the Mexicali Valley. This assertion is in line with the work of Clemings (1996, 135) who studied *ejidatarios* of the central area of the Mexicali Valley.

Participation of central Mexicali Valley agriculturists during the salinity problem

The institutional response of agriculturists of the central Mexicali Valley (HIP) during the salinity problem period shows additional explanatory factors in contrast to those by agriculturalists in the northern Mexicali Valley. Once again, an institutional function illustrates the factors as follows (see also Table 4.4):

HIP = *f* (UNI, ADA, FIC, SOL, CEJ, LOL/FAL, PAL, LAU, SAU, PAU, LEA, EXS, SSS)

Table 4.4 High level of participation of central Mexicali Valley agriculturists as an institutional response to the salinity problem.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
HIP = High level of participation in the salinity problem.	UNI = Unity base at the household level	40	-Effective vertical and horizontal coordination among agriculturists and several levels of government in México. -Adaptation capacity shown by agriculturists. -Failing leadership.
	ADA = Adaptation to adverse situation	40	
	FIC = Financial capacity of agriculturists	80	
	SOL = High degree of solidarity among agriculturists	70	
	CEJ = Fundamental local/neighborhood leadership	30	
	LOL = Outstanding local leaders	70	
	FAL = Failing local leaders	40	
	PAL = Principal leader	70	
	LAU = Local agricultural unions' leadership	50	
	SAU = Strong agricultural unions	90	
	PAU = Principal agricultural union	30	
	LEA = Significant Presidential leadership	90	
	EXS = External support from local industry and commerce sectors.	50	
	SSS = Strong governmental support.	50	

In the central Mexicali Valley, interviewees revealed that there was an intensive participation at the individual level even in instances where most people persisted in implementing productive, economic, and social actions that enhanced their capacity to adapt to damages (ADA). There appears to be tremendous persistence among central Mexicali Valley farmers as they have confronted previous periods of water scarcity, the salinity crisis, and today the All-American Canal lining conflict.

Such a high degree of adaptability to adverse conditions was emphasized by 40 percent of respondents who mentioned how agriculturists created a variety of "technical" processes on their parcels as a response to avoid reduction in crop yields. Such informal institutional behavior (adaptability) responded with changes in crops' growing techniques, even with the absence of technical support from official agencies. For example, individual agriculturists tried "non-conventional" furrow irrigation methods and planting system modifications (e.g., place seeds at the bottom of an undulation so that contact with salt was minimized.

Eventually, development and substitution of crop varieties more tolerant to salts were undertaken. As one senior agriculturist pointed out, his ability to face and overcome the problem was not easy:

> Although it was a critical and costly crisis for us, one always found the way to defeat the salts [...] I tried furrow irrigation, I also tried seeding at the bottom of the channel. It was tricky but not impossible to face it. We had to do these modifications 'in field' [in situ] before any action to defend and participate collectively against the United States [was undertaken]." (Int_1).

Another agriculturist shared that:

> I personally suggested to the engineer that along the "ruta de la sal," [salty route] we might implement cropping pattern changes by including crops like barley as well as developing grazing in order to leach salts out of the plants' root area. And this occurred with support of official agencies; we empirically, gradually, and successfully recovered our lands' productivity." (Int_8).

About 70 percent of respondents reported outstanding local leadership (LOL). In addition to the often mentioned Alfonso Garzón, other outstanding leaders mentioned included Hipólito Rentería, Celestino Salcedo, and Francisco Aguilar regarding their ability to mobilize masses of people (PAL). Nevertheless, agriculturists from central Mexicali Valley strongly criticize other widely acknowledged leaders in other parts of the valley such as Rodolfo Fierro. Around 40 percent of respondents tagged this "leader" as failing in protecting and defending interests of central Mexicali Valley agriculturists (FAL). One respondent mentioned the following:

> .....the great financial support coming from President Luis Echeverría for recovering our lands during the salinity problem was badly managed by some leaders like Rodolfo Fierro. This is the reason why many agri-industries, livestock and grazing operations in this central sub-region got down in bankruptcy [...] just a few corrupt people belonging to the "political group" of Rodolfo Fierro became millionaires, bought extensive lands and this hindered our agricultural recovery and development [...] We initiated the fight against Rodolfo and his "cacicazgo" (political bossism), he wanted to control everything and everyone and we always tried to save "our" agri-industries before they went to bankruptcy [...] it was impossible at those times, but nowadays he [Rodolfo Fierro] no longer controlled our productive will, we finally defeated him, he is not such a 'big leader' anymore." (Int_6).

Two other factors reported by half of respondents to have impacted agriculturists' participation in the salinity process are the extent and type of support coming from external political, governmental, and economic sectors. This support was provided in addition to the internal financial capacity of agricultural water users (e.g., voluntary contributions included into the irrigation service fees).

At the local level, this external moral and economic support came from the commercial and industry sectors in Mexicali. For instance jointly commercial and industrial leaders organized fund-rising actions that during the SAL period they provided water users with meals, water, and shelter (EXS). As one respondent recalled:

> .....yes, there was a lot of support coming in from commerce of Mexicali [city], they used to give us [agriculturists] help of any sort like meals and cloths while we were attending prolonged crowded meetings." (Int_1).

In line with the strong national presidential hold and leadership of the President Luis Echeverría (LEA), respondents reported strong state and federal agency support

(SSS) which resulted in technical assistance, financial programs, and organizational guidance being apportioned among agriculturists affected by the salinity. As one interviewee pointed out:

> ……all together as a unified force, agriculturists, unions, the Mexican President, the State Governor, and the City Mayor […] all in constant and strong movement. Particularly, we received a magnificent financial support from state and federal agencies, a lot of money during the social movement and then through agricultural credit and the well known 'rehabilitation program' to recover our lands' productivity." (Int_3).

Types and characteristics of institutions during the salinity problem

The features perceived by central Mexicali Valley's agriculturists in regards to the institutions followed by agriculturists during the SAL process show a type of human relationship that enabled opportunities for a high level of participation in such a process (HIP). Such institutions were characterized by informal processes based on strong agriculturists' customary transactions (ideologies) that resulted in the later implementation of formal institutions such as the modification of the Water Treaty and the parallel compensation mechanism.

For instance, the high degree of unity among agriculturists embodies an informal institutional social behavior guided by local and national leaderships which enjoyed a high level of credibility in society. This fact made individual agriculturists and their respective unions a cohesive social force that had the capacity to call for public massive assemblies to boycott commerce between the United States and México. Also, they had a remarkable vertical and horizontal coordination capacity to ask federal officials and even the President Luis Echeverria to directly solve the problem and to establish public formal commitments for solving the problem. It is noticed that the President Luis Echeverría visited the problem area several times during the salinity crisis and even after the solution was reached.

Furthermore, such a social force was financially independent since they also employed autonomous informal mechanisms to collect funds (voluntarily given). Also, a hallmark noticed in this central sub-region during the SAL process was the intensive participation and emergence of local leaders that helped to elaborate the federal programs to ameliorate the crisis while the problem was mostly noticed and felt all over the "salty route" which is mostly located in the central Mexicali Valley.

Another specific institutional feature was the informal customary transactions and standard operation procedures that were predominant among the people working in this region. While having just a few alternatives to continue producing, they showed a significant capacity to adapt to the adverse situation created by salts over their lands. Agriculturists from central Mexicali Valley had to face the problem "in field and underway" in order to keep their lands productive through the modification of water and land management procedures, this even without having formal official technical support at the beginning of the salinity problem.

The aforementioned issue was done by individual agriculturists even before the design and implementation of the Mexicali Valley "Rehabilitation Program." In this respect, it is important to highlight the mismanagement of administrative procedures for financial programs administration created to support individual and organized agriculturists. Corruption was mentioned by respondents as a particular feature that halted progress of the rehabilitation program leaving it incomplete.

A proper information reference about this issue can be found in the interview of Khalid Ahmed (2003, 86) with Dr. Nazir Ahmad, a retired and highly respected irrigation scientist from the Irrigation Research Institute whose work focused on the Indus Basin Irrigation System in Pakistan. Dr. Ahmad found that in 1948 foreign expertise and assistance was sought as the main mechanism that local governments from Pakistan used to control water logging and salinity through the implementation of Salinity Control and Rehabilitation Projects. Americans and Canadians, besides UNESCO, studied specific problems and advised pumping and opening drains systems to lower the water table.

In this regard, in his interview, Dr. Nazir Ahmad went on to say that:

> "The difference between how the Indians used foreign expertise and consultancy services and how we did [Pakistanis], is that they controlled the whole process from day one. If they needed expertise not available locally, they would request services. But they would not let control, direction, and decision-making slip into foreign hands. We could not do the same, and as a result, were swept away in the flood of foreign expertise which always worked for the interests of the country it originated from and not for our benefit."

The comparison made by Dr. Ahmad for the case between India and Pakistan shows some similarities to what happened in the Mexicali Valley during the salinity problem period. In fact, the experience in Mexicali is tilted towards the Indian case. In the Mexicali Valley, agriculturists (from all over the valley) mentioned that control, direction, and decision-making were performed jointly between federal governments and local water users. However, too many problems aroused such as corruption and incomplete program implementation. This fact can be seen as a customary transaction or informal institution that dominated the entire salinity process in its compensatory stage. However, a combination of [different] institutions and organizations were in place. Informal processes and groups dominated the scenery and also put pressure upon formal entities mobilizing towards finding suitable solutions to the salinity with the overall aim of getting benefits to recover their lands' productivity and compensation for damages to the agricultural sector.

Influence of agriculturists in the salinity problem

The findings discussed above show the distinctive factors explaining the high level of participation of agriculturists of the Mexicali Valley during the salinity problem process. Such institutional features of the agriculturists participation, in turn, inform about their significant and effective influence to induce solutions to salinity in terms of legal, economic, and technical changes, and finally, towards obtaining benefits for the Mexicali Valley countryside.

Except for the issue of "politics behind the salinity process" mentioned by northern Mexicali Valley participants, the institutional depiction below is similar to the one described in Chapter 3. The following explanatory function expresses the perception of central agriculturists of the influence of agriculturists for reaching technical solutions to the salinity problem (ITS) (See also Table 4.5):

ITS = *f* (IBI, REQ, REL/REI, CAP/COR)

Here, I point out those issues underscored by interviewees in the central Mexicali Valley. About 60 percent of respondents talked about the influential participation of agriculturists in the salinity process so that transboundary water issues were modified

(IBI). In line with this influential participation, agriculturists of the Mexicali Valley were also benefited in different ways, for example, in the implementation of the rehabilitation program (REL) (all respondents mentioned this issue), in getting better water quality and large hydraulic infrastructure such as the Wellton-Mohawk Canal in order to eliminate risks of salts contamination (REQ) (30 percent of respondents), and finally the benefits realized at the parcel level when government delivered financial support for continuing production (CAP) (70 percent of respondents remarked on this point). Such factors together are understood by agriculturists interviewed in this study area as a key influence in reaching technical solutions to the salinity problem.

Table 4.5 Influence of the institutional response (high participation) of agriculturists for finding technical solutions to the salinity problem.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
ITS = Influence of participation of agriculturists for reaching technical solutions to the salinity.	IBI = Influential participation of agriculturists in inducing institutional change for binational water management	60	Agriculturists as a key social actor pressing for a solution to the salinity.
	REQ = Influential participation of agriculturists in implementing water quality infrastructure in the Mexicali Valley and Colorado River.	30	
	REL = Influential role of agriculturists in defining and implementing the rehabilitation program	100	
	REI = The role of agriculturists in the unfinished rehabilitation program.	20	
	CAP = Influential participation of agriculturists for obtaining financial support to continue production	70	
	COR = High extent of corruption and mismanagement of the U.S. compensation and the Mexican financial support funds by Mexican actors	40	

Also, just like in the case of northern agriculturists' responses, corruption was mentioned by 40 percent of central Mexicali Valley respondents as a present issue in the salinity process (COR). In general, central Mexicali Valley respondents feel they were both most affected by the salinity problem and benefited by technical solution programs as compared with other areas of the Mexicali Valley.

Views of central Mexicali Valley agriculturists of the impact of institutional structures followed by agriculturists of the Mexicali Valley during the salinity

The impact of the institutions followed by agriculturists of the Mexicali Valley on transboundary water management issues, irrigation performance, and agricultural development (ITS) is highlighted in this section. From the perspective of central Mexicali Valley agriculturists, informal institutions created by agriculturists during the salinity crisis resulted in a high level of participation which was more effective for recovering the productivity that existed prior to the salinity crisis and improving water management conditions and agriculture in the Mexicali Valley.

The impacts of putting into practice an overall dominant informal institutional response to the salinity crisis allowed to agriculturists to be acknowledged as influential social and political actors that pressed towards getting direct local benefits such as the definition and implementation of financial programs at the parcel level as well as the rehabilitation program at the irrigation district level.

In fact, such a rehabilitation program was initially visualized among central Mexicali Valley agriculturists ([those who were] most negatively affected by salinity) for establishing a new cropping pattern based on grazing areas and livestock to substitute for the traditional cotton and wheat production in this area. The most positive impact resulting from dominant informal institutions created and put into practice by agriculturists was the so called rehabilitation program, despite the fact that internal problems among agriculturists existed during its operation. It is also acknowledged as one of the major benefits obtained as a result of the high social participation in the salinity process.

Also, agriculturists were influential in the process of getting benefits at the binational level through the modification of the transboundary water management legal framework, specifically the establishment of the Minute 242 of the 1944 Water Treaty. In fact, informal institutional structures such as the massive boycotts instigated by the cooperation of the irrigators were a concern to high level authorities. This procedure used by individual agriculturists and their unions in turn produced formal institutional change in the local and binational frameworks for water management.

THE ALL-AMERICAN CANAL LINING CONFLICT (AAC)

In this section, I analyze the central Mexicali Valley agriculturists' perceptions regarding the All-American Canal lining process. I first discuss the views of agriculturists on the potential damages that the All-American Canal lining project might bring in Mexican territory. Next, I discuss the impacts of institutional devices for addressing the issue.

In general, agriculturists expect productive and economic as well as environmental damages to the Mexicali Valley as a result of the implementation of the American hydraulic project. Particularly, agriculturists in the central Mexicali Valley, in contrast with those of the northern region of the valley, neither identified social factors such as deterioration of rural small towns nor migration as explanatory factors that could induce damages to the Mexicali Valley's agricultural sector (JEO). A descriptive function that facilitates the discussion of the All-American Canal lining issue from the perspective of central Mexicali Valley agriculturists is as follows (see also Table 4.6):

$$JEO = f\ (UCY, CYC, DRE, RAF, WEL, ADJ, RED, WET)$$

Table 4.6 Impacts of the All-American Canal lining project over agricultural lands.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
JEO = All-American Canal lining as a threat to the Mexicali Valley's sustained agricultural development.	UCY = Uncertainty about the impacts.	60	Productive, economic, environmental, and societal risks perceived parallel to the opportunity to improve conditions at local and binational level.
	CYC = Cyclic damages induced by the AAC.	10	
	DRE = The La Mesa Drain as affected water source.	40	
	RAF = Regional upper aquifer impacts.	70	
	WEL = Deeper wells digging.	20	
	ADJ = Water adjustments for agriculturists.	60	
	RED = Reduction of growing areas.	60	
	WET = Impacts on wetlands.	20	

The eight factors represent technical aspects of the potential negative impacts. Similar to the perception of northern agriculturists analyzed in Chapter 3, these factors were also mentioned by most agriculturists (6 out of ten respondents) as explanations of the kind and extent of risks envisaged as a result of the implementation of the All-American Canal lining project. In addition, central Mexicali Valley interviewees communicate a concept that represents a macro-level vision of the problem. For example, they categorize the impacts of the project as more generalized and extended to the whole Mexicali Valley instead of a specific region of Mexicali, for example, the northern or northeastern side of the valley, near the All-American Canal lining project.

With respect to the potential negative impact to the regional aquifer (RAF), 70 percent of respondents in the central Mexicali Valley mentioned that the damage will not just occur in irrigation modules located nearby the project area (i.e. irrigation modules 4, 5, 6, 7, and 16 located at the northern and northeast Mexicali Valley). Instead, the damage might be gradually felt in the whole Mexicali's Irrigation District 014 since it encompasses an interconnected hydraulic compound of wells and canals that serve the same irrigation system as well as the agricultural water users ruled by the same local institutional framework such as the WUAs Titles of Concession and the Irrigation District 014 Ordinance which emphasize issues of equity in access to water.

The same proportion of respondents asserts that, as a result, one of the impending productivity impacts to the Mexicali Valley's agriculturists is the reduction of land to grow crops (RED). For instance, wheat growers expect to reduce their individual parcels of land from 20 to 14 hectares cotton and alfalfa growers may be affected similarly. An interviewee summarizes his standpoint by mentioning the following:

> ....I think that the damage to the aquifer will expand at least 30 kilometers to the south of the border, anyways, sooner or later, it (the canal lining project) might affect everybody because we all are part of one same irrigation system!!" (Int_1).

Another agriculturist states that:

> The All American Canal lining project will affect us tremendously! The number of hectares to grow might be reduced again! We already suffered this situation in the past when water shortage took place and we had to grow just 14 instead of our normal 20 hectares of wheat." (Int_2).

Participation of agriculturists in the All-American Canal lining conflict

Just as it was discussed in Chapter 3 for the case of northern Mexicali Valley, the institutional response of agriculturists to the All-American Canal lining process (DAS) is seen by irrigators of the central Mexicali Valley as ineffective and with a notorious lack of cohesion since there was no coordination with official water agencies and even within the agricultural water users' sector itself. The function showing explanatory factors for inducing such a social behavior is as follows and it is also described in Table 4.7:

DAS = *f* (APA, GBC, LIN, MIN, TRA, PLA, GLA, ALE, SOI, ASY, LED, ELE, LES, NOF, REN, DOW) + POC

Aspects related to generalized apathy (80 percent of respondents), either lack or manipulation of critical information on the part of water agencies (30 percent of participants mentioned it), lack of presidential and local leadership (30 percent), a high degree of land leasing (60 percent of interviewees mentioned this aspect) as well as deficient mechanisms to finance participation of agriculturists in the AAC process (as 70 percent of respondents mention) led to a remarkably weak defense of the water seepage on the part of agriculturists (DAS).

An interviewee's assertion better describes the issue of weak participation and the ineffective defense by agriculturists of the All-American Canal seepage:

> Even though this project might affect the whole valley, there are no more crowded agriculturists' meetings to fight against this project [AAC]. By now, there is a high level of disorganization among agriculturists. Besides, there are only a few 'original' farmers since most of us are renting our lands." (Int_6).

20 percent of respondents highlighted that as a result of the lack of timely information for agriculturists coming from officials, they mostly use indirect sources of information such as isolated television programs, radio, and local printed press in order to learn about the All-American Canal process (SOI). This suggests that most information for agriculturists is very informal and mostly circulated among themselves as "rumors".

Table 4.7 Institutional responses of agriculturists to the All-American lining process (individual agriculturists).

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DAS = Weak defense of agriculturists against the All-American Canal lining project.	APA = Generalized apathy on the part of agriculturists of the whole Mexicali Valley.	80	-No vertical coordination of agriculturists and federal government. -Horizontal social disarticulation of the agricultural sector.
	GBC = State Government intervention	40	
	LIN = Lack of information	30	
	MIN = Misleading information	30	
	TRA = Lack of transparency on the part of federal governmental agencies	30	
	PLA = Presidential lack of accountability to locals	30	
	GLA = Lack of accountability to locals on the part of federal governmental agencies	40	
	ALE = Aging leadership in the Mexicali Valley countryside.	40	
	SOI = Indirect sources of information	20	
	ASY = Formal users' assembly mechanism to inform	40	
	LED = Dispersed and disarticulated leadership in the Mexicali Valley	60	
	ELE = External, urban-based leadership facing the AAC	40	
	LES = Lack of external economic and technical support for agriculturists	30	
	NOF = Lack of agriculturists financial capacity.	70	
	REN = High degree of lands rented	60	
	DOW = Downward spiral in the agricultural sector	50	
	POC = Politics behind the AAC Issue	30	

As a matter of fact, 40 percent of respondents assert that individual agricultural water users asked WUAs' representatives for more accurate and opportune information about the issue as well as for technical support from governmental agencies. This resulted in some scattered and not crowded meetings in WUAs assemblies (ASY), and brought about the intervention of state government representatives at some final stage during the AAC process (GBC). Someone went further in this aspect by stating the following:

> Actually, I don't really know about the issue at all. I realize that this project [AAC] could cause us serious problems also here in the central area, not only to those agriculturists living in the north side. However, the little I know about it, I read it in some articles in *La Voz* [local newspaper] and also I have heard it in the radio [...] well, for this particular issue, one module meeting was held here in the ejido in order to offer 'moral' support from the state governor, Eugenio Elorduy, which was the only one that seemed interested in the AAC conflict." (Int_1).

The role of organized agricultural water users in WUAs also explains the kind and extent of participation of the irrigators sector in the AAC process. Around 60 percent of respondents from the central Mexicali Valley indicated that WUAs were neither formally nor effectively involved in the issue, similar to the opinion of northern agriculturists. In fact, WUAs representatives tended to avoid the All-American Canal issue (ELU). The institutional function can be read as follows (see also Table 4.8):

$$\begin{aligned} ELU = f\,(&IMU, LER, BUR, ALA, GIA, LAN, LIM, LAC, LIC,\\ &ROL, SYS, OPE) + POC \end{aligned}$$

Even though WUAs had the fundamental role of pressing the state government to intervene in the All-American Canal lining conflict to press federal government to strongly defend the issue on behalf of agriculturists potentially affected (ROL), 30 percent of participants in this study area mentioned that the WUAs' performance as a social and productive element was not effective. This was mainly due to their lack of a system view (SYS) that led to the sector's social disintegration as well as the overwhelming internal irrigation planning and operation problems among irrigation modules (OPE). Both causes impeded an effective representation of the Mexicali Valley agricultural water users' interests in the All-American Canal lining issue.

An interviewee suggested the following assertion:

The irrigation modules' [representatives] participation has focused on pressing the state government to "encourage" the federal government agencies to really face the problem [AAC], however, we felt that everything was already "done" at upper levels, we were out! [...] WUAs still have huge water operation constraints that keep them very busy and with no chance to address binational issues, but this fact just let us see the lack of an integral point of view on the part of the WUAs' representatives. They should know that our several modules, our irrigation district, our wells, our canals, all this stuff depends on availability of water and the All-American Canal seepage represents one important water source to us." (Int_3).

Table 4.8 Institutional responses of agriculturists' WUAs to the All-American Canal lining.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
ELU = Low level of participation of agricultural WUAs in the AAC process.	IMU = Top-down imposed WUAs	60	WUAs not effectively involved with any representation in the AAC process.
	LER = WUAs entitled to participate in the AAC process.	20	
	BUR = Bureaucracy of co-management	50	
	ALA = WUAs' lack of accountability to individual users	50	
	GIA = Groups of interest and apathy within WUAs	40	
	LAN = Large landholders command and control WUAs	40	
	LIM = Lack of information about formal mechanisms to participate.	30	
	LAC = Lack of formal coordination mechanisms.	30	
	LIC = Lack of coordination with IBWC/CILA.	30	
	ROL = Pressing role of WUAs.	30	
	SYS = WUAs' lack of system view	30	
	OPE = Irrigation operation problems.	30	
	POC = Politics behind the All-American Canal lining issue.	30	

Views of central Mexicali Valley agriculturists of the institutions used by agriculturists during the All-American Canal lining conflict.

In agreement with northern agriculturists' views, central Mexicali Valley agriculturists perceive that the characteristics of institutions followed by agriculturists of the Mexicali Valley during the All-American Canal lining conflict contrast with those followed during the salinity problem process. Agriculturists, both as individuals and as formal organizations, show institutional structures that tended to constrain to create opportunities for proper participation in the All-American Canal process. This in turn explains the apparent weak support and minimal outcomes as far as agriculturists in the Mexicali Valley are concerned with the All-American Canal issue (DAS and ELU).

While there was a combination of formal and informal institutions influencing agriculturists' behaviors, formal institutions like the WUAs, which systematically avoided addressing the All-American Canal issue, dominated. The noticeable social disarticulation within the agricultural sector and the lack of political and economic power hindered their involvement in the process and blocked effective representation. Hence, they were also limited in their coordination with those Mexican state and federal agencies related to the All-American Canal lining issue.

Generalized apathy and the lack of leadership together with the limited financial capacity in the irrigation sector presented unfavorable conditions for individual agriculturists to voice concerns on the transboundary issue. Instead, they rested upon the representation of WUAs as formal institutional structures. However, the heavy bureaucracy in the co-management between WUAs and CONAGUA resulted in a loss of representativeness in the All-American Canal lining process. From this, it was noticed that WUAs showed a remarkable degree of accountability to federal water agencies as much as a lack of coordination with key transboundary water agencies such as the IBWC/CILA-Mexican section.

These facts show the kind of formal institutional arrangements followed by agriculturists during the All-American Canal lining conflict. As such, the formal institutions keep the agriculturists under the umbrella of urban-based leadership which led to the low level of participation and weak defense against the All-American Canal lining project on the part of agricultural water users.

Influence of agriculturists in the All-American Canal lining conflict

Similar to the situation expressed by agriculturists of the northern area of the valley, the central Mexicali Valley agriculturists perceive that the weak defense against the All-American Canal lining project and low level of participation shown by formal agricultural water users' entities such as WUAs and SRL limited the influence of agriculturists to find suitable solutions to the impending impairment that the project will produce in the agricultural area of the Mexicali Valley. The foremost factor leading to such institutional behavior and, consequently, the no influence of agriculturists in the issue (DIT) is the diminished economic situation within the rural realm. The descriptive function that explains this assertion is as follows (see Table 4.9):

DIT = *f* (ING, DOW, ORG, CIL, ELE)

An interviewee elaborates on this issue by stating the following:

> The WUAs' representatives, which were mostly 'appointed' by governmental agencies, are just as 'little kids', they seem to be playing to be water managers, they do not solve any critical problem for most of us, they are not interested in this critical issue [AAC]. They are 'devoted' to deliver and collect water fees […] We users are so poor, with no money to participate in the AAC problem nor influencing a substantial change, with no leaders, with no political power, without support coming from either federal or state governments; they [WUAs

representatives and governmental water agencies] are not our social partners anymore." (Int_7).

Table 4.9 Influence of the institutional response (low participation) of agriculturists of central Mexicali Valley for finding solutions to the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DIT = Influence of participation of agriculturists in finding solutions to the All-American lining conflict.	ING = Indifference of domestic governments to support the agricultural sector	80	Agricultural sector as a whole and WUAs with neither economic nor political power to influence suitable solutions.
	DOW =Downward spirals in the Mexicali Valley	40	
	ORG = Deteriorated organizations	30	
	CIL = Loss of capacity for influencing positive change	50	
	ELE = External, urban-based leadership facing the AAC	30	

Views of central Mexicali Valley agriculturists of the impacts of the institutional structures used by agriculturists during the All-American Canal lining conflict

The impacts of the institutions used by agriculturists during the All-American Canal lining process on transboundary water management, irrigation, and agricultural development is elaborated next. From the perspective of the central Mexicali Valley agriculturists, the formal institutional structures followed by agriculturists during the All-American Canal lining conflict obstructed their participation in the process and also made them ineffective in promoting the agriculturists' viewpoint and obtaining compensation commitments.

They were also irrelevant actors thus prevents them from influencing positive change at the binational level, for instance, through the modification of the transboundary water management legal framework in regards to transboundary groundwater management. Formal institutional structures followed by agriculturists such as the administrative transactions represented by the participation of WUAs in the context of urban-based leadership is seen as a realistic behavior showing the agriculturists' loss of economic and political power to influence local and transboundary water management affecting agriculture in the Mexicali Valley. As such, this some time key stakeholder is no longer seen as a social actor with capacity to produce formal institutional change at the binational level in the case of the All-American Canal conflict contrasting significantly with the institutional behavior of agriculturists during the salinity problem process.

CONCLUSION

In this chapter I find that, according to the central Mexicali Valley agriculturists interviewed, institutional arrangements of agriculturists in the Mexicali Valley and their impacts in each case, the salinity problem and All-American Canal lining conflict have changed significantly. As a result, agricultural water users have lost economic and political power which in turn weakened their capacity to participate and influence transboundary water issues affecting their agricultural productive activity and irrigation performance.

Combinations of formal and informal institutions have guided the agriculturists' social behavior. However, it is noted that for the case of the salinity problem process, informal institutions dominated the context (i.e. massive mobilization and boycott). This feature allowed them to participate in the salinity process and influenced institutional change locally and binationally.

In contrast, during the All-American Canal lining conflict agriculturists mostly relied on formal water users' associations and institutions in place. As such, the impact of their social behavior on the process was all but unnoticed. The social articulation, leadership and economic and political power that could help them change the context of potential adverse conditions for transboundary and irrigation water management was lacking. Major institutional differences between the salinity and All-American Canal processes are described through the following representation (see also Table 4.10):

$$DIF = f\ (DIP, DOR, DAL, DIG, CIL, SOS, BEC)$$

A difference between presidential leadership (DIP) and their level of accountability to agriculturists (Luis Echeverría *vis-à-vis* Vicente Fox) was perceived. While the salinity problem was in process, Luis Echeverría showed personal and institutional behavior characterized by strong leadership, skillful diplomacy, and sense of patriotism whereas President Vicente Fox was highly criticized by agriculturists because of his disregard for this region's agricultural sustainability.

Table 4.10 Perceptions of agriculturists of the central Mexicali Valley concerning major institutional differences between the salinity problem and the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DIF = Major institutional differences between the SAL and AAC.	DIP = Extent of presidential leadership.	20	- Different or diminished agriculturists' organization and leadership from t_1 to t_2.
	DOR =Extent of agriculturists' organization.	50	
	DAL = Agriculturists' leadership.	70	
	DIG = Kind of groups making pressure on SAL and AAC.	20	
	CIL = Loss of capacity for influencing changes.	70	-Reduced capacity of agriculturists to influence change from t_1 to t_2.
	SOS = Socio-productive structure (due to level of lands rented).	30	
	BEC =Economic constraints in agriculture.	20	

Also, such a different presidential institutional behavior had repercussions in the level of organization (DOR) and strength of agriculturists, particularly those in the central Mexicali Valley, as a unified force. For instance, during the salinity process, which had a higher negative impact than in any other region of the valley, agriculturists showed capacity to adapt both crops grown and irrigation techniques rapidly in order to face the adversities brought by the salinity of the Colorado River. Afterward, they fostered unity and strength through their "unions" whose operation was based on self-financing mechanisms and headed by outstanding local leaders (DAL).

Conversely, during the All-American Canal lining process, organizational, economic, and financial disarticulation within the irrigation sector were observed. Also, lack of effectiveness of WUAs' representatives resulted in criticism due to their incapability to formally intervene in the issue as well as a lack of a system view. This fact, in turn, brought about a change in the kind of organizations or groups of pressure when critical transboundary water issues take place. For instance, while the agriculturists' unions were dominant in the past, they have now been replaced by urban-based groups (DIG). As a result, the capacity shown by agriculturists during their participation in the salinity problem to influence transboundary water issues and to induce institutional change at different levels is now diminished (CIL) together with the economic constraints faced by most small agriculturists in the Mexicali Valley (BEC).

CHAPTER 5

INSTITUTIONS AND AGRICULTURAL WATER ISSUES FOR USERS IN SOUTHERN MEXICALI VALLEY (SAH)

This chapter describes the perceptions of the southern Mexicali Valley's agriculturists (SAH) regarding transboundary water management issues under investigation. The institutional functions framed by the approach used in this study and detailed in Chapter 2 facilitate the understanding of the level of stress related to transboundary water management as well as the institutional responses of agriculturists to face such issues. I chose to illustrate differences in the kind of outcomes for each function in relation to perspectives of agriculturists described previously in Chapters 3 and 4.

I interviewed eight southern Mexicali Valley agriculturists on three primary themes: the major changes in agriculture and irrigation, the salinity problem, and the All-American Canal lining conflict. Similar to the northern Mexicali Valley and central Mexicali Valley cases, I suggest that there are similarities and differences in the extent of stress perceived and the institutional responses of agriculturists when comparing the cases of the salinity crisis and the All-American Canal lining conflict (see Appendices C and D).

I use institutional functions to identify those explanatory factors (similarities and differences) for each transboundary water management case, and I also explore additional explanatory factors that emerged as well as their distinctive characteristics while contrasting the three regions of the Mexicali Valley. I conclude that the level of stress for the case of the salinity process was higher in both central and southern regions than in the northern Mexicali Valley area. However, the case of the All-American Canal, although acknowledged by agriculturists as a threat that will affect irrigation gradually in the entire Mexicali Valley due to the physical interconnections in the hydraulics of the irrigation district operation, was perceived to have a more immediate and critical impact in the northern side of the valley than in the other regions.

AGRICULTURE AND IRRIGATION IN THE SOUTHERN MEXICALI VALLEY

In accordance with experiences and perceptions shared by agriculturists in the northern and central Mexicali Valley, the southern participants indicated that there are significant structural changes such as social polarization among agriculturists in the Mexicali Valley resulting from water management and agricultural development issues. Accordingly, southern participants mentioned that progress (PRO) and regression (REG) were simultaneous processes. In the same way expressed by northern and central participants, a minority of 38 percent of southern respondents offer arguments on the PRO point of view.

One of the explanatory factors mentioned by just 13 percent of southern respondents was the change in the scale of operations (LAR), which varies in magnitude. As such, agriculturists in the southern Mexicali Valley have adapted a production scale that tends to be larger than in the past; it has changed from 20 hectares to 150 hectares on average, almost the same size mentioned in the northern area of the valley (200 hectares) but much smaller than in central Mexicali Valley (on the order of 500 hectares). In addition, two meaningful factors emerged as contributing to the progress standpoint. The first is human resources improvement, including the various rural community services and qualifications of agricultural technicians giving technical assistance to agriculturists

(HUM). Such a factor was highlighted by 25 percent of respondents. The other factor refers to the urban sprawl process which tended to expand rural population into relatively small towns spread over the Mexicali Valley (POP). This issue was mentioned by 38 percent of the participants in this study area. Excerpts below exemplify this fact. Also the following institutional depiction illustrates such features (see also Table 5.1):

PRO = *f* (DIV, LAR, TIM, IND, HUM, POP)

An interviewee explained this idea as follows:

> Well, the Mexicali Valley has changed much in a positive manner. By those times [1960s], this area was barely populated but as the 'white gold' [cotton growing] became important many people came from many places of the country. Besides now I can see more experienced growers, higher level of professional personnel, especially, agronomy engineers [...] we were gaining experience and practical knowledge as producers; the accumulated learning is noteworthy and noticed among people living and working in the Mexicali Valley." (Int_1).

Another agriculturist added:

> Now, 99 percent of rural towns have public services like electricity and drinking water and some *ejidos* that some years ago had 100 or 200 inhabitants now have 3,000, 4,000, 5,000 people. Indeed, there are several 'small rural towns' with more than 10,000 people." (Int_2).

Regarding the regression stance (REG), participants' views of the central and southern Mexicali Valley seem to be alike. Five out of eight southern participants commented on the REG view. One of the core explanatory factors, the high extent of agricultural lands under rental contract (REN), was mentioned by half of respondents in the southern side of the valley. It is noticed by respondents that although the proportion of rented area in the southern Mexicali Valley is high, it is still lower than in the rest of the valley due to the diminished quality of agricultural lands as well as the lack of rural services. It can be observed that about 70 percent of land is rented in the southern Mexicali Valley compared to 80 percent in the northern and 95 percent in the central Mexicali Valley. The function for the REG view is depicted as follows (see Table 5.1):

REG = f (HIC, LOP, CRE, BUC, COM, LOZ, REN)

One of the explanations offered by agriculturists on the lower percentage of land under rent in the southern Mexicali Valley as compared to other areas of the valley is the lower land quality, which leds agricultural entrepreneurs to choose the best quality lands located in the northern Mexicali Valley and some areas of the central Mexicali Valley. Quality of lands is classified by salinity (Electric Conductivity [EC] and Percentage of Interchangeable Sodium [PIS]). In the northern and central Mexicali Valley more than 95 percent of agricultural lands are classified as first and second class while in the southern area of the valley these types of land represent just 50 percent of the total available agricultural land (García, López, and Navarro 2006, 81).

This fact in turn explains why the high productivity of land (HIL), as emphasized by the northern and central region interviewees, was not considered as an important factor by agriculturists belonging to the southern Mexicali Valley.

An interviewee argues about these linked aspects as follows:

> It is noticed that the Mexicali Valley is going back to the times of huge landholders. The Constitutional amendment to the Article 27 means to us an opportunity to rich people to get more and more lands. The agricultural lands are being acquired both by leasing and buying them in just a few hands [...]. Now, it is common to see how one person can take in rent the whole ejido. In many *ejidos* of this area there are some five or six people working, operating or growing the whole acreage of the lands, it is astonishing how the new concentration of lands [is in] just a few people's hands!"(Int_2).

Table 5.1 Perceptions of agriculturists of southern Mexicali Valley concerning the evolution of regional agriculture.

GENERAL PERCEPTION	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
PRO = Progress		38	
	DIV = Diversification of crops	25	Socio-productive polarization among agriculturists of the Mexicali Valley.
	LAR = Larger scale of agricultural operations 20-150 ha on average	13	
	TIM = Technology improvements	38	
	IND = Industrialization of agricultural sector and productive chains	25	
	HUM =Human resources improvement	25	
	POP = Rural population increase (sprawl)	38	
REG = Regression		62	
	HIC = Higher production costs	50	
	LOP = Lower relative prices	38	
	CRE = Drastic reduction of credit and increasing of collateral requirements for small farmers	25	
	BUC = Bureaucracy in credit processing	13	
	COM =Generalized commercialization problems mostly noticed in grains' small farmers	25	
	LOZ = Losing organizational capacity to produce	25	
	REN = Growing area of agricultural lands rented (70 percent on average)	50	

The irrigation sector of southern Mexicali Valley

Another major issue raised by agriculturists of southern Mexicali Valley concerns changes made in the irrigation sector. First, similar to the northern and central regions, the majority of respondents in the southern Mexicali Valley noticed segregation among individual agricultural water users, with some users favored over others by WUAs and

CONAGUA. As a result, some agricultural water users expressed successful irrigation management views and some expressed failing irrigation management views. However, in this case, additional explanatory factors for the successful irrigation management and failing irrigation management institutional functions were observed. The institutional function explaining successful irrigation management (SIM) can be read as follows (see also Table 5.2):

SIM = *f* (SIW, LIT, IWE, GIT, COS, TNS)

One of the few respondents that expressed views on SIM mentions that:

> Now, with the irrigation modules operation in which we users are able to directly participate, we are working better than the former official water agencies did in the recent past. There is more water availability, there are less costs to operate water services, we are close to the water administration offices within the Mexicali Valley and these facts allow us to better perform our irrigation and agricultural activities. Overall, we can directly make surveillance to avoid mismanagement and excessive paperwork expenditures." (Int_4).

On the contrary, the failing irrigation management (FIM) point of view is also argued by agriculturists of the southern Mexicali Valley. Factors supporting this perspective refer to internal operation problems within the Irrigation District 014, WUAs representatives' lack of a system view, inequality among agricultural water users, insufficient irrigation technology, lack of investment on the part of governments, and lack of inter-agencies coordination. The institutional function illustrates this as follows (see also Table 5.2):

FIM = *f* (IMU, BUR, OPE, ALA, SYS, GIA, EQU, IQU, INV, CIC, LOV, ICO)

Table 5.2 Perceptions of agriculturists of southern Mexicali Valley concerning the evolution and impacts of irrigation water management.

GENERAL PERCEPTION	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
SIM = Successful irrigation mgmt.		38	
	SIW = Better irrigation water use than in the past.	25	-Differentiation among irrigation water users. -Elitism.
	LIT = More irrigation technology than in the past.	25	
	IWE = More efficient irrigation than in the past.	25	
	GIT = Growing irrigation tech.	38	
	COS = Higher but suitable cost of irrigation water service leading improved operation.	25	
	TNS = Irrigation water transfers	25	
FIM = Failing irrigation mgmt.		62	
	IMU= Imposed Water Users Associations (top-down)	25	-Additional factors facilitating explanation of FIM
	BUR= Bureaucracy management WUAs-CONAGUA.	38	
	OPE = Irrigation operation problem	62	
	ALA= Lack of accountability to users of WUAs	50	
	SYS = WUAs representatives' lack of a system view.	50	
	GIA= Groups of interests within WUAs	50	
	EQU =Inequality among agriculturists	50	
	IQU= Inequality among water users	50	
	INV = Lack of governmental investment	38	
	CIC = No agencies coordination	25	
	LOV= Lack of long-term vision of WUAs	25	
	ICO= Internal conflicts in the irrigation sector	50	

62 percent of respondents in this area mentioned that local or internal irrigation operation problems (OPE) resulting in frequent failures in the planning process and operation procedures on the part of WUAs' officials. This factor, just as in the central region, is in turn linked to the lack of a system view on the part of WUAs (SYS) and their tendency to segregate the hydraulic operation without proper consideration of key and

necessary operational and organizational links that have to be permanently strengthened in order to keep an efficient operation of the irrigation district as a whole. This idea is in line with assertions from producers as well as the President of the Agriculture and Livestock Council of Baja California (Consejo Agropecuario de Baja California, A.C., CABC) who recently declared that "there are several critical problems in irrigation due to the inopportune water delivery at the parcel level in this region of the valley." (Villalobos López 2009, *Semanario El Pionero* 5-11 December, p. 1).

For example, it is frequently mentioned by respondents (50 percent of them) that equality among individual agricultural water users was lacking (GIA, EQU, and IQU). Respondents added that, as a result, technical support coming from both WUAs' officials and governmental water agencies such as CONAGUA shows significant preference to some while promoting productive activities that favor large producers over small producers. Also, privileged treatment is given to WUAs of the northern region when compared with those in central and southern Mexicali Valley. For this reason, sometimes agriculturists of the Mexicali Valley get involved in internal conflicts among them (ICO). An agriculturist pointed out the following:

> The truth is that they [WUAs and water agencies' officials] just help those who have money, those large producers. We small and median producers are left aside. Most official support for investment is given to some groups of rich agriculturists. Why do officials allow this discrimination?" (Int_2).

Additionally, agriculturists and the President of the CABC stated that "in the irrigation module number eight, for example, there is a notorious concentration of irrigation water services on the part of WUAs' representatives and managers favoring a 'selected group of producers,' mostly vegetables growers and their 'protégées' which are typically the same WUAs' representatives." (Villalobos López 2009, *Semanario El Pionero* 5-11 December, p. 1).

As discussed in Chapters 3 and 4, the social polarization and differentiation among irrigation water users in the Mexicali Valley support the Galtung's concept of "structural inequity" (1980, 64). The Galtung's concept might also be linked to the Blaikie's political-economic approach applied while analyzing soil erosion issues into rural realms of developing countries (Blaikie 1985; Blaikie and Brookfield 1987). The authors' approach and method is in turn useful to better understand the evolution of agriculture and irrigation, the way key water resources are used, and the changing role of agriculturists in irrigation and transboundary water management in the Mexicali Valley.

Blaikie (1985) applies a bottom-up approach, beginning with the smallest unit of decision (i.e. household) and moving up through local political organizations to the government and the international system. The important thing to him is to take into consideration all key actors who, in a given area, affect land use and thus potentially have an impact upon soil erosion. Ultimately, as a result of the households' dissimilar control over resources and their access to income opportunities, they will pursue very different resource management strategies. Similarly, at a higher level of aggregation, different social classes have varying interests in relation to land management. The same might apply to other types of resources (Belshaw, Blaikie, and Stocking 1991).

THE SALINITY PROBLEM PERIOD (SAL)

In this section, I describe the perceptions of agriculturists of southern Mexicali Valley regarding the damages to the agricultural sector of the Mexicali Valley as a result of the salinity of the Colorado River. It is noticed that in the southern area of the valley, similar to the central region, the situation became more critical than in the northern portion of the valley due to the characteristics of soils which induced negative productivity, economic, and social impacts (Clemings 1996, 135). Hence, the institutional response to the salinity crisis by agriculturists in southern Mexicali Valley would show differences relative to other regions of the valley. I emphasize those aspects that characterize the southern region in order to broaden the understanding of the case. The institutional function used here to explain the effects of the salinity of the Colorado River water in the southern Mexicali Valley (SAD) is as follows (see Table 5.3):

$$SAD = f\,(MIX, SAH, YED, ICS, RED, SAR)$$

In line with aspects discussed in Chapter 4 in the central Mexicali Valley, factors that evidence the level of stress about the salinity problem induced in this southern region of the valley are also emphasized. For instance, the negative impacts affecting agricultural water users in the southern Mexicali Valley related to other regions is shown when 38 percent of respondents in this area mentioned that either portions of or entire individual parcels became severely salty (SAH). Consequently, yield reductions (YED) reached levels of 70 and 80 percent over major crops like wheat and cotton, respectively. As a result, increasing production costs (ICS) became an additional problem for agriculturists because of the reduction in lands' productivity, thus, the need to invest more in production inputs (i.e. fertilizers, water, etc.).

In this area, an interviewee brought to mind that:

> While I was young, our lands used to yield much more [...] the Colorado River salinity affected our lands making them hard and compacted, consequently, the lands gradually but rapidly were losing nutrients and we had to use larger amounts of costly fertilizers." (Int_1).

Table 5.3 Impacts of the salinity over the southern Mexicali Valley.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
SAD = Damages in agriculture of the Mexicali Valley.	MIX = Disposed of salty waters upstream (salinity of the Colorado River).	38	-Significant social, productive, and economic impacts.
	SAH = High extent of salts pollution in individual parcels.	38	
	YED = High extent of crops yields reductions.	38	-Salinity problem similar to CAH but more intensive than in NAH.
	ICS = Increasing production costs for individual agriculturists	38	
	RED = High extent of individual parcels size reduction	25	
	SAR = Salinity problems remain since the salinity period	25	

Agricultural water users from the southern Mexicali Valley tried to "balance" the negative impacts of the salinity of the Colorado River in the agricultural area by implementing actions that tended to modify the scale of agricultural operations. For example, just as the central region's agricultural water users did, 25 percent of respondents mentioned that the most common "emergency action" taken by stressed agriculturists was a reduction in the normal size of agricultural operations from 20 to 16 hectares, on average (RED).

Also, the same proportion of participants (25 percent) underscored that the salinity problem is seen by southern agriculturists as a critical one that still represents a constraint for increasing land productivity (SAR) given the level of permanent accumulation of salts over large land extensions as well as throughout soils' layers. It is important to recall that the southern Mexicali Valley is located at the end "outlet" of the Irrigation District 014; thus, problems with salts in water and soil are common among agriculturists working in this particular area. One participant commented:

Even though such a huge social mobilization against the salinity and the supposedly solution was reached, I think that we are still having significant salinity problems over our lands. I don't know why but despite the Minute 242 on the 'definitive solution', despite the construction of the Wellton Mohawk bypass, and despite the implementation of the magnificent rehabilitation program of the Mexicali Valley, we still have critical problems on our parcels, say, salts accumulation. Is the Colorado River salts' monitoring system placed at the Morelos Dam working? Well, I don't think so!!" (Int_3).

Participation of southern Mexicali Valley agriculturists during the salinity problem

Southern Mexicali Valley agriculturists participated in high numbers during the salinity crisis in an effort to overcome the problem. This institutional response shows similar explanatory factors to those discussed in Chapter 4. The institutional function for their high participation (HIP) is as follows (see also Table 5.4):

$$HIP = f\ (UNI, ADA, FIC, SOL, LOL, PAL, LAU, SAU, PAU, LEA\ EXS, SSS)$$

Table 5.4 High level of participation of southern Mexicali Valley agriculturists as an institutional response to the salinity problem.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
HIP = High level of participation in the salinity problem.	UNI = Unity base at the household level	38	-Effective vertical and horizontal coordination among agriculturists and several levels of government in México. -Adaptation capacity shown by agriculturists.
	ADA =Adaptation to adverse situation	38	
	FIC = Financial capacity of agriculturists	63	
	SOL = High degree of solidarity among agriculturists	63	
	LOL = Outstanding local leaders	63	
	PAL = Principal leader	75	
	LAU = Local agricultural unions' leadership	63	
	SAU = Strong agricultural unions	50	
	PAU = Principal agricultural union	38	
	LEA = Significant presidential leadership	75	
	EXS = External support form local industry and commerce sectors	50	
	SSS = Strong governmental support.	38	

Southern Mexicali Valley agriculturists assert that the high level of social participation of agricultural water users during the salinity crisis (HIP) is mostly explained by factors such as the presidential and local leadership (75 percent of participants mentioned), high extent of cohesion among agriculturists' unions (63 percent), and financial capacity of agriculturists to face the issue (63 percent).

In addition, 38 percent of interviewees emphasized that, just as in the central Mexicali Valley, an intensive participation at the individual level was also observed. This was noticed while most people resisted such an adverse salinity problem by implementing productive, economic, and social actions that enhanced their capacity to adapt to damages (ADA). This social and productive behavior has been a major feature shown by agriculturists of the Mexicali Valley when other critical conditions have emerged and affected their productive activity.

To illustrate such an institutional behavior to address adverse productive conditions induced by the salinity, respondents in this study area mentioned that most agriculturists of central and southern Mexicali Valley implemented immediate technical procedures to avoid crop yield reductions. They changed crop production techniques, even without technical support coming from official agencies. For example, individual agriculturists tried new irrigation and planting methods as well as new varieties of crops which were tolerant to high levels of salts in the soil.

Types and characteristics of institutions during the salinity problem

The features given and perceived by southern Mexicali Valley agriculturists in regards to the institutions followed by agriculturists during the salinity problem process show a kind of human relationship that created opportunities for broad and significant participation in such a process (HIP). These institutions were mostly characterized by informal processes based on strong customary transactions among agriculturists that resulted in the later implementation of formal institutions, for example, the implementation of the Minute 242 of the Water Treaty and the Irrigation District 014 rehabilitation program.

For instance, the high degree of amalgamation among agriculturists' unions and the unity at the household level induced social mobilizations. This corresponds to a kind of informal institutional behavior guided by local and national leaders that had high credibility and trust among agriculturists. This in turn makes individual agriculturists and the several unions a much more cohesive social force that could call for massive public meetings to boycott commerce between the United States and México. Also, agriculturists had a remarkable vertical and horizontal coordination capacity to ask federal officials for directly attending and facing the problem and to establish public formal commitments to solve it.

Furthermore, such a social force was financially independent since they also employed autonomous informal mechanisms to collect funds (voluntarily given through water fees). Another informal institutional feature during the salinity process recognized by agriculturists of southern Mexicali Valley, similar to central Mexicali Valley agriculturists, was the widespread customary transactions among people working within the southern region of the valley. This region of the valley is broadly acknowledged by agricultural officials and technicians as the one with lower levels of productivity due to the predominance of hard layers of stratified soils and the typical *capillarity* phenomenon they produce. Capillarity refers to a physical condition in soils which induces salts to rise from the low water table towards the surface and then accumulate on it (CONAGUA 1989).

Even though there were just a few alternatives for continuing production, southern Mexicali Valley's agriculturists showed noteworthy capacity to adapt to these adverse conditions induced by salts (ADA). Agriculturists had to face the problem by implementing their "own imagination and experience" to modify water and land management standard procedures so that their lands could keep producing.

In this regard, it is clear that, although a combination of institutions and organizations were in place, informal institutions, processes and groups dominated the Mexicali countryside and also pressured formal entities to find suitable solutions to the salinity problem.

Influence of agriculturists in the salinity problem

Based on the southern Mexicali Valley respondents' perspective, this section elucidates how the major institutional response shown by agriculturists, that is, the high level of participation in the salinity problem previously reviewed, explains their effective influence on technical solution of the salinity problem (ITS). The institutional function here is mostly similar to the one discussed in Chapter 4 (see also Table 5.5):

$$\text{ITS} = f\ (\text{IBI, REQ, REL/REI, CAP})$$

The perceptions of southern Mexicali Valley respondents regarding the impacts of the high participation of agriculturists in the salinity problem are in line with those of the northern and central region of the valley. In this case, 63 percent of southern participants emphasize the explanatory factor that the major impact of institutional devices used by agriculturists (high participation, mostly informal) was benefits obtained from the rehabilitation program to recover productivity of agricultural lands in Mexicali (REL).

Table 5.5 Influence of the institutional response (high participation) of agriculturists for finding technical solutions to the salinity problem.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
ITS = Influence of participation of agriculturists for reaching technical solutions to the salinity.	IBI = Influential participation of agriculturists in inducing institutional change for binational water management	50	Agriculturists as a key social actor pressing for a solution to the salinity.
	REQ = Influential participation of agriculturists in defining the implementation process of infrastructure for recovering water quality in the Colorado River and the Mexicali Valley.	25	
	REL = Influential role of agriculturists in defining and implementing the rehabilitation program in the Mexicali Valley.	63	
	REI = The role of agriculturists in the unfinished rehabilitation program.	25	
	CAP = Influential participation of agriculturists for obtaining financial support to continue production.	25	

In addition, half of southern Mexicali Valley interviewees reveal that agriculturists had an influential role in inducing institutional change for water management at the binational level through modification of the 1944 Water Treaty between the United States and México (IBI). In general, these two major factors together with the influential participation of agriculturists for obtaining financial support coming from Mexican governmental agencies to continue producing explain the influence of institutional devices (high level of participation) used by agriculturists of the three studied regions of the Mexicali Valley, the northern, central, and southern areas, to reach technical solutions to the salinity problem.

Views of southern Mexicali Valley agriculturists of the impact of the institutional structures followed by agriculturists in the Mexicali Valley during the salinity

Schmid (2004) states that institutions and organizations influence what things humans put together to produce physical things. Under this consideration, it can be affirmed that the role of agriculturists during the salinity crisis is explained by the type and characteristics of institutions created by them. This in turn may have a variety of impacts on transboundary water management, irrigation, and agricultural development in the Mexicali Valley.

From the perspectives of southern Mexicali Valley agriculturists, informal institutions created during the salinity problem encouraged a high level of participation which was an effective mechanism for reaching the core objectives of recovering the agricultural productivity and improving conditions for irrigation water management and agricultural development in the Mexicali Valley.

Evidence of the impacts of informal institutions during the salinity problem process allowed agriculturists to be acknowledged as influential actors who pushed to move forward in order to get technical solutions to the salinity, thus, direct local benefits such as the definition and implementation of productive programs at the micro level for individual agriculturists (i.e. agricultural credit to household) and at the macro level (like the previously mentioned rehabilitation program of the Mexicali Valley).

They were also highly influential in the process of getting benefits at the binational level through the modification of the transboundary water management framework. In fact, informal institutional structures such as the customary transactions represented by a strongly articulated collective action to induce commercial boycott were seen as a concern of high level authorities. This socio-productive behavior followed by individual agriculturists and their informal "union of unions" resulted in formal institutional change in the local and binational frameworks for transboundary water management in the lower Colorado River.

THE ALL-AMERICAN CANAL LINING CONFLICT (AAC)

This section focuses on the results of the analysis concerning the perceptions of agriculturists in the southern Mexicali Valley regarding the All-American Canal lining issue. I first discuss the views of agriculturists on the potential damages of the All-American Canal lining project in Mexican territory as well as the impacts of institutional devices used by agriculturists for addressing the conflict. I also discuss their level of participation and the influence of such participation towards finding proper and sustainable solutions.

More than 50 percent of the respondents mentioned that agriculturists envisage a high likelihood of productive, economic, social, and environmental damages in the Mexicali Valley (JEO). On the other hand, 38 percent of agriculturists interviewed see opportunities to find mutually advantageous solutions (IOP) if a fair compensation mechanism could be agreed (CTE). Also, a quarter of respondents assert that agriculturists of the southern side of the valley identify social risks from rural small towns' deterioration (RUT).

Additional explanatory factors of the expected damages of the All-American Canal lining project over the Mexicali Valley countryside (JEO) can be read in the facilitating function shown below (see also Table 5.6):

$$JEO = f\ (UCY, RAF, DRE, WET, WEL, ADJ, RED, RUT, CTE) + IOP$$

Most factors correspond to technical aspects of the potential impacts and, similar to the other regions, were mentioned by participants as explanatory of the kind and extent of envisaged risks resulting from implementation of such a project. Agriculturists express concern about the potential problem that might be expanded over the irrigation district from the regional aquifer deterioration in quantity and quality.

Table 5.6 Impacts of the All-American Canal lining project over agricultural lands.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
JEO = The All-American Canal lining as a threat to the Mexicali Valley sustained agricultural development.	UCY = Uncertainty about the impacts.	38	Productive, economic, environmental, and societal risks perceived parallel to the opportunity to improve conditions at local and binational level.
	RAF = Regional upper aquifer impacts.	75	
	DRE = La Mesa Drain as today's affected water source.	50	
	WET = Impacts on wetlands.	38	
	WEL = Deeper wells digging.	50	
	ADJ = Water adjustments for agriculturists.	88	
	RED = Reduction of growing areas.	50	
	RUT = Small rural towns affected.	25	
	CTE = The United States must compensate México.	50	
	IOP = Opportunity for mutually improving conditions.	38	

Half of the respondents highlighted that as a result of impending damages in the agricultural area, some of the adaptive operative measures of agriculturists will result in the reduction of the growing area (RED). Consequently, irrigation water adjustment procedures might come out with direct negative impacts in increasing investments to keep a steady land's productive level (ADJ). This latter aspect is acknowledged by most respondents (88 percent) as the major challenge to be faced by agriculturists of the Mexicali Valley.

Three quarters of participants in this study area also mentioned that agriculturists of the southern Mexicali Valley categorize the impacts of the All-American lining as comprehensive and extended to the whole Mexicali Valley instead of a specific area, say, the northern Mexicali Valley near the project location. Specifically damage resulting from effects on the regional aquifer (RAF), is expected to occur not just in the irrigation modules located near the project (see Figure 3.2), but gradually in the whole irrigation district since it is an interconnected irrigation system (hydraulic infrastructure network) ruled locally by the same legal framework.

As a result, one of the productive impacts to the Mexicali Valley's agriculture might be the reduction of land to grow major crops such as wheat, alfalfa, cotton, and a wide variety of produce. For instance, as with cotton and alfalfa growers, wheat growers are expected to reduce their individual parcels from 20 to 16 hectares.

It is important to notice that for the agricultural period of 2007-2008, wheat extended over 97,000 hectares, alfalfa over 33,000, cotton over 26,000 and produce over 14,000 hectares. All four kinds of crops together represented 82 percent of the total agricultural area in the Mexicali Valley which covers up to 207, 265 hectares annually (SAGARPA 2008).

An interviewee went further by asserting that:

The AAC will affect México by reducing our water availability and we will have less opportunity for agricultural development in the Mexicali Valley. Not the cities but we the agriculturists will be directly affected. If the project is going to be built then the water seepage that currently feeds our aquifer since more than 60 years ago will stop and water adjustments programs might [have to] be implemented within the whole irrigation district not just in the northern side, thus, everybody in the Mexicali Valley might suffer [its] negative consequences!" (Int_5).

Participation of agriculturists in the All-American Canal lining conflict

In line with the perceptions of agriculturists of other regions of the valley of the institutional response of agriculturists to the All-American Canal issue, southern Mexicali Valley agricultural water users see the participation of agriculturists as ineffective, disarticulated, and uncoordinated. The institutional function that shows factors explaining such social behavior is as follows (see also Table 5.7):

$$\text{DAS} = f\,(\text{APA, DAR, LIN, MIN, TRA, PLA, GLA, ALE, LED, ELE, LES, NOF, REN, DOW}) + \text{POC}$$

Although less involved (and less informed on the All-American Canal lining issue) than northern and central agriculturists (as indicated by the relative low proportions of participants talking about this issue), respondents of the southern region of the valley mentioned aspects such as the widespread apathy (APA), lack of and manipulation of critical information on the part of water agencies (LIN and MIN). Half of the participants in this region mentioned the lack of effective defense on the part of federal water agencies (GLA).

38 percent of respondents mentioned the lack of presidential and local leadership (PLA and ALE), high degree of land leasing (REN), deteriorated economic conditions within the Mexicali's countryside (DOW) as well as deficient mechanisms to finance

participation of agriculturists (NOF) as those key factors resulting in weak participation in and defense of the All-American Canal seepage (DAS).

Table 5.7 Institutional responses of agriculturists to the All-American Canal lining process (individual agriculturists).

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DAS = Weak defense of agriculturists against the All-American Canal lining project.	APA = Generalized apathy on the part of agriculturists.	38	-No coordination between agriculturists and government. -Horizontal social disarticulation of the agricultural sector.
	DAR = Mexican water agencies weak defense of the AAC.	50	
	LIN = Lack of information.	25	
	MIN = Misleading information.	13	
	TRA = Lack of transparency on the part of federal agencies.	25	
	PLA = Presidential lack of accountability to locals.	38	
	GLA = Lack of accountability to locals on the part of federal government agencies.	50	
	ALE = Aging leadership in the Mexicali Valley.	38	
	LED = Disarticulated leadership in the Mexicali Valley.	38	
	ELE = External, urban-based leadership facing the AAC.	25	
	LES = Lack of external economic and technical support for agriculturists.	25	
	NOF = Lack of agriculturists' financial capacity.	38	
	REN = High degree of lands rented.	25	
	DOW =Downward spiral in the agricultural sector.	13	
	POC = Politics behind the AAC.	25	

An interviewee's assertion summarizes the opinion and institutional behavior of agriculturists in the Mexicali Valley regarding the All-American Canal lining conflict:

> A successful defense of the All-American Canal water seepage will depend on governmental effectiveness and cleverness. The government must 'run the extra mile' in order to obtain something significant from the process, either water exchange [AAC] per water coming from other source or water [AAC] per hydraulic infrastructure for us to recover by means of irrigation. However, the

problem is that our government officials are not doing well, our leaders, if any, are not doing well [...] we aren't as participative as we used to be, so, with this lack of will and energy, surely we would not get anything from this process." (Int_2).

In this topic, the role of WUAs also reflects the kind and extent of participation of the agricultural sector in the AAC conflict. The southern Mexicali Valley respondents assert that WUAs were neither formally nor effectively involved in the AAC issue. The WUAs' representatives tended to elude the AAC issue (ELU). The institutional function depiction explaining this institutional behavior can be read as follows (see Table 5.8):

$$\text{ELU} = f\,(\text{IMU, BUR, WAL, ALA, GIA, LAN, LIM, LAC, LIC, ROL, OPE}) + \text{POC}$$

Half of the respondents of the southern Mexicali Valley mention that even though WUAs have had a fundamental role in pressing the state government to intervene (ROL) and pressure federal governmental agents to strongly defend against the All-American Canal project on behalf of agriculturists, the WUAs' performance was not effective (WAL). Respondents affirm that this was due to their internal irrigation planning and operation duties and problems among irrigation modules (OPE). These aspects obstructed participation and influence of the Mexicali Valley agricultural water users in the All-American Canal process.

An agriculturist elaborates on this aspect:

In order to gain equity in water sharing, both the Irrigation Society [SRL] and our irrigation modules [WUAs] must strongly participate and keep themselves on the right track to defend our hydrological interests. As long as our water organizations get involved in the AAC issue, we would have improved conditions in the irrigation district; otherwise we are lost in the middle of nothing! [...] We might suffer severe water shortages in the near future." (Int_2).

Table 5.8 Institutional responses of agriculturists' WUAs to the All-American Canal lining process.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
ELU = Low level of participation of agricultural WUAs in the AAC.	IMU = Top-down imposed WUAs	63	WUAs not effectively involved with any representation in the AAC process.
	BUR = Bureaucracy of co-management	75	
	WAL = Lack of water agencies links	63	
	ALA = WUAs' lack of accountability to individual users	50	
	GIA = Groups of interest and apathy within WUAs	63	
	LAN = Large landholders command WUAs	50	
	LIM = Lack of information about formal mechanisms to participate.	63	
	LAC = Lack of formal coordination mechanisms.	63	
	LIC = Lack of coordination with IBWC/CILA.	50	
	ROL = Pressing role of WUAs	50	
	OPE = Irrigation operation problems	50	
	POC = Politics behind the AAC	63	

Views of southern Mexicali Valley agriculturists of the institutions used by agriculturists during the All-American Canal lining conflict

In line with northern and central respondents, the southern Mexicali Valley participants affirmed that characteristics of institutions followed by agriculturists during the All-American Canal lining process contrast with those of the salinity crisis episode. In the AAC case, agriculturists (individuals and formal organizations) show a set of human relationship that constrain opportunities for appropriate participation in such a process. This in turn guided them towards a weak defense of the AAC issue (DAS and ELU).

Such a combination of formal and informal institutions is characterized by processes anchored in agriculturists' behaviors which in turn are tilted to and guided by formal institutions represented by WUAs and the SRL. Under the context of a horizontal social disarticulation in the agricultural sector of the Mexicali Valley, WUAs and SRL tended to avoid the All-American Canal lining issue and this fact limited their effectiveness in the process. They were also limited in their ability to reach coordination with both state and federal agencies.

During the All-American Canal lining conflict, findings in the southern region of the valley show a generalized apathy and lack of leadership together with limited financial capability in the irrigation sector to participate in this issue. This leads individual agriculturists' concerns about the formal WUAs' organization and institutional structure. However, the extraordinary bureaucracy in the co-management between WUAs and the Mexican National Water Commission (CONAGUA) made agriculturists lose representativeness in the process. Although entitled to participate and defend any aspect regarding water management affecting the performance of the irrigation sector and agriculture, the WUAs and SRL show a notable accountability to federal water agencies and a lack of coordination with key transboundary water agencies like the International Boundary and Water Commission-Mexican Section (IBWC/CILA).

In summary, the kind of institutional arrangements followed by agriculturists during the All-American Canal lining process were dominated by formal structures that bring them to remain under the umbrella of external forces and leadership and the control of state and federal agencies. Hence, agriculturists show a very low level of participation and a weak defense regarding the All-American Canal lining conflict.

Influence of agriculturists in the All-American Canal lining conflict

Similar to the perceptions of northern and central Mexicali Valley agriculturists, the southern Mexicali Valley respondents mentioned that their limited self-financing capacity and reduced political influence constrained participation, resulting in a weak defense against the All-American Canal lining project. This in turn blocked agriculturists, both as individuals and as organized agricultural water users' associations (WUAs) or the Irrigation Society (SRL), from finding suitable solutions to the All-American Canal lining conflict (DIT). The institutional function that explains such an institutional behavior is as follows (see also Table 5.9):

DIT = *f* (ING, DOW, ORG, LIC, CIL, ELE)

Table 5.9 Influence of the institutional response (low participation) of agriculturists of southern Mexicali Valley for finding solutions to the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DIT = Influence of participation of agriculturists in finding solutions to the All-American lining conflict.	ING = Indifference of domestic governments to support the agricultural sector	75	Agricultural sector as a whole and WUAs with neither economic nor political power to influence suitable solutions.
	DOW =Downward spirals in the Mexicali Valley	75	
	ORG = Deteriorated organizations	50	
	LIC = Lack of coordination with IBWC/CILA	50	
	CIL = Loss of capacity for influencing positive change	75	
	ELE = External, urban-based leadership facing the AAC	50	

Most respondents in the southern Mexicali Valley (75 percent) underscored that the primary factors leading to such institutional behavior and, consequently, the lack of influence of the agricultural sector in the All-American Canal issue (CIL) are the following: indifference from governments to support the agricultural sector (ING), the overall diminished economic situation in the Mexicali Valley (DOW), and the lack of effective coordination with key water agencies like the International Boundary and Water Commission-Mexican Section (LIC).

In addition, half of the respondents mentioned that organized agricultural water users (i.e. WUAs and SRL) have lost leadership and capacity for social mobilization and for this reason other local social actors have been involved in the process (ELE).

In this respect, an interviewee asserts that:

> I guess that if we could express [ourselves] as in the 'ancient' times, we could induce positive changes, we could get some benefit [from it], but [...]. We are not as strong and energetic fighters as we used to be in the past during the salinity problem. Our current organizations [WUAs] don't attend transboundary water issues anymore; it seems to me that these aspects do not matter! I think that if we the agriculturists might unify through our WUAs, then we will get something important, something fair." (Int_4).

Views of southern Mexicali Valley agriculturists of impacts of the institutional structures used by agriculturists during the All-American Canal lining conflict

From the perspective of southern Mexicali Valley agriculturists, dominating formal institutions during the All-American Canal lining process obstructed their participation in reaching the main objectives of improving transboundary water management as well as the irrigation performance and agricultural development of the Mexicali Valley.

In line with agriculturists belonging to other areas of the valley, southern agriculturists evidenced that the impacts of implementing prevailing formal institutional structures to respond to the All-American Canal lining conflict blocked agriculturists from participating effectively. Instead, they were disregarded as key actors with potential to push towards getting benefits in the local irrigation sector.

They also appear to be irrelevant actors in the process of influencing positive change at the binational level. Formal institutional structures followed by agriculturists such as the administrative transactions represented by the fragile position of WUAs in the All-American Canal issue allows for urban-based actors' leadership to dominate and guide the process of defense, showing the agriculturists' lack of economic and political power to influence local and transboundary water management. As such, agricultural water users are no longer seen as social actors with competence to induce formal institutional change at the binational level as they did in the past during the salinity problem process.

CONCLUSION

In this chapter I find that institutional arrangements followed by agriculturists of the southern Mexicali Valley and their impacts for each analyzed case, the salinity problem and the All-American Canal lining conflict have evolved such that agricultural water users of the Mexicali Valley have lost economic and political power in detriment of their capacity to participate and influence transboundary water management issues affecting their productive activity and irrigation functioning. This is mostly due to the major changes in the socio-productive structure of the agricultural sector represented by the high level of land under rental contract. Thus, social cohesiveness among agriculturists has declined, with consequent loss of power as a group of pressure.

I also find that a combination of formal and informal institutions have guided the agriculturists' social behavior between t_1 and t_2. However, it is noticed that for the case of the salinity problem process (t_1) informal institutions dominated the context (i.e. individual mobilization and informal amalgamation of unions as well as massive boycott). This feature allowed them to participate deeply in the salinity problem and influence institutional change at the local and binational level. In contrast, during the All-American Canal lining process (t_2) participation of agriculturists mostly followed already established formal institutions in place (i.e. WUAs and the SRL) as mechanisms and institutional devices to participate. As such, these institutions were unsuccessful in influencing the process. Major differences between the salinity and the All-American Canal processes can be described through the following depiction (see also Table 5.10):

$$DIF = f\ (DIP, DOR, DAL, DIG, CIL, SOS, BEC) + SIP$$

Table 5.10 Perceptions of agriculturists of the southern Mexicali Valley concerning major institutional differences between the salinity problem and the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DIF = Major institutional differences between the SAL and AAC.	DIP = Extent of presidential leadership.	25	- Different extent of agriculturists' organization and local leadership.
	DOR = Extent of agriculturists' organization.	50	
	DAL = Agriculturists' leadership.	63	
	DIG = Kind of groups making pressure on SAL and AAC.	13	
	CIL = Loss of capacity for influencing changes.	50	-Reduced capacity of agriculturists to influence change.
	SOS = Socio-productive structure (level of land rented).	13	
	BEC = Economic constraints in agriculture.	25	
	SIP = Politics behind the SAL and AAC.	13	

This function highlights the perception about differences between the presidential leaderships and their level of accountability to agriculturists (DIP). In the salinity problem process, President Luís Echeverría showed an institutional behavior characterized by strong leadership and skillful diplomacy, whereas the administrations of the Presidents Vicente Fox and the Felipe Calderón were highly criticized by agriculturists because of its fragile response and institutional behavior that disregarded the sustainability of the agricultural sector of the Mexicali Valley.

Such different presidential behavior regarding transboundary water conflicts affecting agriculturists had repercussions in the strength and level of organization and leadership of agriculturists as a unified group (DOR and DAL). For instance, during the salinity process, which in the southern region (similarly to the central region) had higher productive, economic, social, and environmental impacts than in the northern area of the valley, agriculturists showed a strong capacity to immediately adapt growing and irrigation techniques in order to face the adversities brought by salts in waters. Afterward, they fostered unity and strength through their several "unions" whose operation was based on self-financing mechanisms and headed by outstanding local leaders.

Conversely, during the All-American Canal lining process, an organizational, economic, and financial disarticulation was observed within the irrigation sector, as well as a lack of effectiveness of WUAs' and the SRL's representatives who received criticism due to the inability to be formally and effectively involved in the issue. This fact, in turn, brought about a significant change in the kind of organizations or groups coming from urban areas to make pressure during the All-American Canal lining process.

As a result, agricultural water users have lost the capacity they showed in the past during their participation in the salinity process to influence transboundary water issues and to induce institutional change at different levels such as local ordinances, nation states rules, and even the 1944 International Water Treaty.

A key factor explaining and either facilitating or blocking the agriculturists' institutional behavior in the All-American Canal case is the politics behind such an event where a "premeditated" negotiation between high-level governmental spheres takes place in order to solve a U.S. technical problem and where damage is "allowed" to occur and then the affected party in México is compensated (13 percent of participants mentioned this aspect). The expected negative externality to Mexico induced by the All-American Canal lining project will be resolved by implementing a compensatory approach. All through the All-American Canal process, participation of agriculturists as a key stakeholder was 'blocked' giving place to the possibility of going to the next step and looking for implementing compensatory measures (SIP).

CHAPTER 6

WATER MANAGERS IN THE MEXICALI VALLEY (OMGRs AND NMGRs)

In this chapter I discuss themes, ideas, and concepts resulting from the qualitative analysis regarding the perspectives of water managers in the Mexicali Valley on the evolution of the agricultural and irrigation sectors as well as on the agriculturists' participation and influence in the salinity problem and All-American Canal lining processes. The qualitative analysis shows different views that emerged about the extent of stress induced by these two transboundary water management conflicts, the features and impacts of the participation of agriculturists in the salinity and All-American Canal, and finally, the outcomes depending on the cases studied (see Appendices C and D). In order to do this, I analyze the views of two categories of water managers: the older (OMGRs) and newer (NMGRs) irrigation water managers.

The category of "older" water managers encompasses water officials who are working or used to work with governmental water agencies (i.e. SRH, former Mexican Hydraulic Resources Secretary currently titled CONAGUA) and were in office during both the salinity problem and All-American Canal lining conflict episodes. These six respondents studied may in current times continue serving either CONAGUA or the water users' associations (i.e. WUAs or SRL). Also, in a few cases in this study, the OMGRs retired recently. A major feature of this kind of subject is that they have had a high degree of mobility between areas of the irrigation district; as such, they express their opinion to refer to the entire Mexicali Valley instead of just a specific region of the valley.

On the other hand, the "newer" water managers include water officials who recently began working in the irrigation water sector; as such, they have directly experienced only later processes such as the All-American Canal lining conflict but were not working during the salinity problem period. This group of three participants (according to the sampling frame described in Chapter 2) encompasses water managers belonging to the Mexican National Water Commission (CONAGUA), and the International Boundary and Water Commission-Mexican section (IBWC/CILA), and water users' associations.

I first explore the institutional and descriptive functions generated to respond to the central research questions of the study, that is, the institutional characteristics of agriculturists for each case (salinity and All-American Canal), the impacts of the institutions followed in their productive activity, irrigation and transboundary water management functioning, the different level of stress in transboundary water conflicts, and finally, the influence of agriculturists of the Mexicali Valley to induce institutional change at the local and binational level.

In a subsequent section, I analyze both the older water managers and newer water managers' perspectives. I begin by describing general aspects regarding the evolution of agriculture and irrigation in the Mexicali Valley. Next, I discuss the irrigation water managers' perceptions of the agriculturists' institutional responses to the salinity problem process and the conditions for participating and influencing the "permanent and definitive solution." Then, I discuss the views of irrigation water managers concerning the pressures of the All-American Canal lining project and the institutional devices used by agriculturists to address it. Finally, I identify the major differences between each case being studied.

OLDER WATER MANAGERS' PERCEPTIONS

As discussed in preceding chapters, agriculture and irrigation development in the Mexicali Valley are directly linked to transboundary water management issues in the lower Colorado River. Accordingly, I elaborate on the perceptions of older water managers (OMGRs) in regards to the evolution of these interrelated sectors in order to understand central aspects of this study. First, I discuss the views articulated by OMGRs in regards to the major changes that have taken place during the last four decades (from early 60s to 2008) in the Mexicali Valley.

All the OMGRs respondents emphasize the progress standpoint (PRO) as a process explaining the positive change noticed in socio-economic growth, technical advances, and human development in both the agricultural and the irrigation sectors.

The institutional function that facilitates the explanation of this "progress" view is shown as follows (see also Table 6.1):

$$PRO = f\,(DIV, LAR, HIL, TIM, HUM, POP, URB, IWT, MOD)$$

The institutional explanatory factors for PRO appear to be similar to those revealed by agriculturists. For instance, one third of participants have observed significant changes in cropping patterns, with a transformation from a production plan largely dominated by cotton and wheat until the mid 60s to what nowadays incorporates more than fifty different types of cultivations (DIV). They also noticed larger scales of operation that have changed from the original allotment of 20 hectares per household (in the year 1955) to about 150 hectares on average today. This is meant as a new hoard phenomenon process resulting from the high proportion of land under rental contract and where just few agriculturists operate large growing areas (LAR).

Table 6.1 Perceptions of older water managers in the Mexicali Valley concerning the evolution of regional agriculture.

GENERAL PERCEPTION	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
PRO = Progress		100	
	DIV = Diversification of crops.	33	Consistency of the progress standpoint based on irrigation improvements and crop diversification.
	LAR = Larger scale of agricultural operations (from 20 to 150 hectares on avg.).	33	
	HIL = High productivity of lands.	50	
	TIM = Technology improvements for land management.	83	
	HUM =Human resources improvement	50	
	POP = Growing population of rural areas	50	
	URB = Urbanization of rural small towns	50	
	IWT = International Water Treaty	67	
	MOD =The Mexicali Valley as a development model.	33	

In addition, half of respondents emphasized higher productivity of lands as a result of technological improvements and intensive use of fertilizers (HIL). In this line, most participants (83 percent) mentioned that such technological improvements included the implementation of new production techniques and methods that focused on crop production as well as on land and irrigation water management skills (TIM).

Another 67 percent of interviewees considered that the advantageous condition given by the institutional arrangement for transboundary water management such as the 1944 Water Treaty is a key factor that has brought about direct benefits for developing agriculture and irrigation in the Mexicali Valley (IWT).

Besides, 50 percent of participants in this study asserted that the continuing human resources development regarding the availability of more experienced practitioners and skilled agriculturists as well as higher education level technicians have supported the growing agricultural and irrigation sectors of this region (HUM). In addition, social aspects are highlighted since steady population growth in rural areas is taking place parallel to the improvement of public services (water, energy, communication and transportation systems, and education) which facilitate the function of a diversified economy of small rural towns widespread in the Mexicali Valley (POP and URB).

All these aspects together have enabled the Mexicali Valley rural area to gain a national and international recognition as a social and productive system that has faced critical adverse situations and where both institutional and socio-productive adaptation procedures have been its major strength. Examples are the establishment of an international water treaty that mostly benefits the regional agricultural sector and the achievement of changing cropping patterns with significant participation and influence of local agriculturists (MOD).

To illustrate this viewpoint, an older water manager who has served several regions of the Mexicali Valley since 1965, formerly as an official belonging to a governmental water agency and now as a water manager in a WUA in the northern side of the valley, expressed the idea of "progress" as follows:

> The evolution of the Mexicali Valley means "progress" to me. Some years ago, unworkable rough lands were dominant, wood-made water control devices were in use, there were no lined secondary irrigation canals, thus, low water use efficiency, say, 40 percent or less. Also, the dominance of practically a single crop in the entire valley, say cotton. By now, and after the rehabilitation program was implemented, crops were diversified, irrigation canals were lined, efficient

> irrigation systems at the parcel level are spread out over the valley, therefore, water availability increased. There is no comparison between past and present times in regards to the socio-economic situation, available technology, and capacity of technicians for land and water management." (Int_2).

Another irrigation water manager currently working for a governmental water agency and living in the central Mexicali Valley for more than sixty years added the following:

> .....one of the most significant aspects is that now there are more prepared technicians. Besides, there are also more experienced and capable agriculturists who have developed individual and group initiatives to grow and sell their production. They also have an integral view to develop the Mexicali Valley's agricultural sector. Another point is that the Mexicali Valley is becoming an attractive place to live and work given the extent of urban development of rural towns and the availability and low cost of basic public services as well as education, including higher education. It is true, crises come and go recurrently but they are also learning experiences that help to attain progress." (Int_3).

As previously mentioned, the older water managers show a consistent view on the "positive change" of agriculture in the Mexicali Valley. They mention the high extent of agricultural lands rented in the valley (about 50 to 60 percent) as a negative factor for just agricultural development of small owners. The dominant progress view on the part of older water managers contrasts with the standpoint of agriculturists who underscore the existence of twofold and intertwined perspectives of progress and regression with the consequent social polarization among agriculturists which was discussed in previous chapters.

Views of older water managers on the irrigation sector in the Mexicali Valley

Changes in irrigation in the Mexicali Valley are another key topic reviewed in this research since it supports aspects later analyzed regarding the salinity problem and the All-American Canal lining conflict, both informing about the changing role of the

Mexicali Valley's agriculturists in irrigation and transboundary water management issues.

In line with what was asserted by agriculturists of the three regions of the Mexicali Valley, older water managers see that major changes in irrigation take two opposite directions: one relates perspectives on successful irrigation management (SIM) and the other relates perspectives on failing irrigation management (FIM), both present among water managers. As such, there are some (50 percent of participants) mentioning just a few factors concerning operation of canals and wells, administration of resources, and conservation and improvement of infrastructure as a result of better valuation of available water resources. In contrast, there are other respondents (the second half) that assess the irrigation sector evolution of the Mexicali Valley as a failing process, based on the observed lack of effective users' organization, water quality constraints, high level of bureaucracy in WUAs-CONAGUA co-management, and the lack of investment for hydraulic infrastructure and capacity building of WUAs.

The institutional function that helps to explain the successful irrigation management (SIM) perspective is shown below (see also Table 6.2):

$$SIM = f\,(SIW, LIT, IWE, GIT, COS, SUR)$$

Arguments expressed by participants supporting the SIM view emphasize differentiation between the practices for irrigation water use which have been gradually improving from the 1960s to current times (SIW); a differentiation of irrigation technology such as land leveling, efficient irrigation methods at the parcel level, and lined canals for water distribution which was lacking in the past (LIT); increased cost for water services to make it more suitable for irrigation water management operation (COS); and the implementation of optimizing irrigation and drainage methods (GIT).

Table 6.2 Perceptions of older water managers concerning the evolution and impacts of irrigation water management in the Mexicali Valley.

GENERAL PERCEPTION	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
SIM = Successful irrigation mgmt.		50	
	SIW = Better water use now than in the past	50	-Differentiation among irrigation water users (elitism) and emphasis on FIM factors.
	LIT = More irrigation technology now than in the past	33	
	IWE = More efficient irrigation water use than in the past	50	
	GIT = Growing irrigation tech.	33	
	COS = Higher but suitable cost of irrigation service improving operation as a whole	33	
	SUR = Meaningful learning obtained from alternated periods of surplus and scarcity.	50	
FIM = Failing irrigation mgmt.		50	
	IMU= Imposed WUAs (top-down)	17	
	ALA= Lack of accountability to water users belonging to WUAs	17	
	LAN= Large landholders dominate WUAs	33	
	IMV= Lack of WUAs involvement in transboundary water issues	33	
	IQU = Inequality among users	17	
	BAS = Ineffective basin councils	50	
	TNG = Lack of training for managers and WUAs officials	33	
	EDU = Lack of education (awareness) for saving water	33	
	LOV= Short-term vision of WUAs	33	
	SYS = WUAs' lack of a system view	17	
	DEM= Increasing water demand	50	
	OPE = Irrigation operation problems	50	
	TEC= Lack of irrigation technology.	33	
	INV = Lack of investments	50	
	QLY = Everlasting water salinity	50	
	ICO= Irrigation sector conflicts	50	

Also, respondents emphasized the capacity of local agricultural water users to adapt rapidly to alternated periods of water surplus and scarcity in the lower Colorado

River water course which has left meaningful learning experiences to better face water management adversities (SUR).

A proponent of the successful irrigation management view point expressed himself as follows:

> .....during the 1960s there were some periods of surplus water from the Colorado River followed by long periods of critical scarcity. As such, water management problems have always existed: surplus brings about some sort of irrigation operation problems and experiences for administering water in excess while scarcity shows that water reductions induce a different kind of duties, technical thinking, and needs for infrastructure. These aspects represent a huge learning process for everybody. At the end of the day, irrigation water management reaches more appropriate levels of investment and efficiency since we can now set up better planning processes for measuring, controlling, distributing, and ruling available water resources in the Mexicali Valley." (Int_5).

On the other hand, those respondents arguing that irrigation changes have not been positive at all set up a long list regarding institutional factors that explain the FIM viewpoint which is three times larger than for the SIM standpoint. The FIM list includes fundamental aspects such as the deficient performance of WUAs, capacity building constraints, and an incomplete technological development for irrigation which together have led to internal conflicts among agricultural water users in the Mexicali Valley. The institutional function explaining this matter can be expressed as follows (see Table 6.2):

FIM = *f* (IMU, ALA, LAN, IQU, IMV, BAS, TNG, EDU, LOV, SYS, DEM, OPE, TEC, INV, QLY, ICO)

The FIM point of view represents the failing irrigation management notion. As such, OMGRs interviewees gave emphasis to a broad range of factors including the misguided implementation of official strategies imposed on WUAs and their representatives by using a traditional top-down approach (IMU) and the high level of bureaucracy noticed in the new co-management era between WUAs/SRL and CONAGUA (BUR). In this co-management process, CONAGUA became a regulatory entity at the time it manages the principal water infrastructure (i.e. the Morelos Dam and the head section of the irrigation district including the main canal named "All-Mexican Canal") before delivering water to the SRL which operates the three major canals in the irrigation district (northern, central, and southern major canals), these canals in turn deliver water in each control check point of the twenty-three WUAs (or irrigation modules) that operate secondary and inter-parcel irrigation and drainage network (CONAGUA 1999).

Also, other factors were revealed by respondents such as the lack of accountability of WUAs to their constituency, mostly smallholders (ALA) and the dominance of new large landholders that use command and control irrigation water management by acting as both WUAs' officials and as preferential water users (LAN). This aspect is meant to bring about inequality among individual water users and the prevalence of elitism in the irrigation sector (IQU).

Besides, older water manager participants mentioned the lack of WUAs' involvement in key transboundary water issues affecting their own irrigation performance (IMV) as well as the ineffective participation of WUAs within the (Mexican) Colorado River Basin Council, which functions more as an ineffective forum or formal institution device to "express" opinions than as an effective task force mechanism to address local irrigation and binational water management issues (BAS).

Additional interlinked illustrative factors embrace the idea that training for water users and managers is still a major need that hinders a proper water management in each operation level (i.e. parcel, irrigation module, and irrigation district (TNG). Different from this aspect, although interrelated, respondents mentioned that an effective water-saving education strategy within the irrigation sector is lacking once agriculturists barely begin to understand the significance of considering preventive measures to avoid potential scarcity and to care for the natural environment (EDU).

An explanation to this behavior is the lack of a long-term vision as well as a system view among agricultural water users who do not properly include the ever-increasing water demand trends coming from the urban sector as a result of the high population growth rate in the region (LOV and DEM). Jointly population in Tijuana and Mexicali register 2,755,000 inhabitants growing rapidly at annual rates of five and two and a half percent, respectively (Baja California State Population Council 2008). In the end, all these factors together are inducing irrigation operation problems among irrigation modules in the Mexicali Valley (OPE).

Furthermore, older water managers express technical-operative aspects inducing the FIM view. For example, the lack of irrigation technology at the irrigation canals and wells network as well as into the parcels has hindered annual irrigation plans (TEC). There is still a major need for water users for broadening and accelerating hydraulic infrastructure investment programs that might help to improve irrigation operation, water distribution, and timely access for individuals, and management within and between irrigation modules (INV).

Water quality problems originated at the main source, the Colorado River watercourse entering México, continues to be an international disagreement, particularly in regards to issues related to salinity that, ultimately is in turn directly linked to the agricultural productivity and irrigation performance in the Mexicali Valley (QLY). In the local agricultural realm "water quality" means "water quantity", this due to the fact that agricultural production factors establish technical parameters for crops' tolerance to salts in water and soils.

This fact in turn brings about water management problems in the Mexicali Valley because under conditions of high salts concentration in water in relation to crops' tolerance parameters, an additional quantity of water for leaching salts must be included in the irrigation plans. Such a water volume (leaching water requirements for reaching a potential crop yield as of 100 percent) arrives at an average level of 20 percent of the normal crop consumptive use (i.e. in the case of alfalfa: consumptive use = 159.5 cm + 36.66 cm of required leaching salts water = 196.16 cm of total required water for irrigating this crop) (CONAGUA 1989).

These factors have led to critical internal conflicts in the irrigation district among individual irrigation water users, for instance, surface vs. groundwater users or wheat vs. alfalfa growers or northern vs. southern water users. Such internal conflicts emerge mostly during the periodic critical season of high water demand in the agricultural sector normally observed during March and April of each year (ICO).

An older water manager summarizes the FIM as follows:

> On one hand, I guess that WUAs and irrigators in general are less participative than they were in the past, maybe their age represents a constraint, I don't know exactly why this occurs. On the other hand, I think we created a "water bureaucracy monster." With some exceptions, people inside are just focused on the political aspects for continuing in the power that a WUAs' representative has, they (representatives) seek to manipulate the module instead of administrating it. Technical aspects of the irrigation module are many times left aside, for example, the measure of volumes received and served. There is still a huge challenge to create awareness among module's representatives about operation, efficiency,

scarcity, the system view, long-term vision, equality among users, investment, and of course about the importance of transboundary waters." (Int_1).

Several findings mentioned above show a dominant perspective of older water managers on the progress in the agricultural sector of the Mexicali Valley which differs from that of agriculturists' view (all regions of the valley). This fact in turn illustrates the different perspectives between managers (uppers) and agriculturists (lowers) about agriculture developmental aspects. Such a major finding correlates with Robert Chambers' finding, who asserts that in rural realms each kind of actor visualizes socio-productive advances or regression in a different degree and according to their own reality (Chambers 2000, 58).

In regards to the evolution of irrigation, there is an agreement between agricultural water users' and water managers' perspectives both supporting the idea of parallelism in terms of successful irrigation management and failing irrigation management which, in principle, elucidates a differentiation among irrigation water users. This in turn represents a foundation for appreciating the changing role of agriculturists in irrigation and transboundary water management since it demonstrates the perils of not considering participative processes.

The analysis of general aspects in agriculture and irrigation changes, as seen by older water managers, helps to better understand the kind and impact of institutions followed by agriculturists during the salinity problem and All-American Canal lining conflict. General features are seen differently by water managers and agriculturists. For example, it is noticed that the progress view dominates over the regression one; in fact, the OMGRs' viewpoint does not consider the "regression" view which contrasts with the agriculturists' general statements.

Older water managers enhance the progress view by mentioning significant changes over time in terms of human and professional development, modernization of rural towns, significant technological changes, diversification of the crop's pattern, and higher levels of lands' productivity. This fact also shows the supremacy of the OMGRs managerial standpoint mostly guided by the official governmental perspective.

In addition, the SIM and FIM perspectives co-exist amongst OMGRs' views. Based on the evidence on more specific issues linked to their irrigation operation activity, the managerial perspective expressed recognition up to some degree of advances within the Mexicali Valley's irrigation sector. However, they also see the high extent of bureaucracy, elitism among individual water users, and WUAs' lack of a system view, lack of technology, and lack of investment among many other factors (a longer list than that offered by agriculturists interviewed from the three areas of the valley) leading the FIM. In short, this might represent fundamental factors explaining the differences among agricultural water users in the Mexicali Valley.

All this together helps to explain the water managers' views on the level of participation of agriculturists during the salinity problem (t_1) and All-American Canal lining conflict (t_2) processes as well as the major institutional differences observed between one time and another. Following sections identify and describe the perceptions of water managers on the institutions followed by agriculturists in each case.

THE SALINITY PROBLEM PERIOD (SAL)

Having discussed the views that older water manager participants shared concerning the evolution of agriculture and irrigation in the Mexicali Valley, this section focuses on the perceptions of older water managers regarding the impacts of the salinity of the Colorado River on agricultural production and productivity as well as irrigation in the Mexicali Valley. Also, this section reviews the institutional response of agriculturists to the salinity problem and the conditions for participating and influencing processes towards finding the "permanent and definitive solution to the salinity problem." The salinity crisis of the 1960s-70s represented a critical transboundary water management conflict that brought about social, economic, environmental, and political impacts both at the local and binational level.

The negative impacts of the salinity of the Colorado River water over the Mexicali Valley agriculture are perceptible to water managers once they dealt with high concentrations of salts permanently deposited on individual parcel during the interlude of 1961 to 1973 (SAD). Older water managers observed different extent of impacts or stress depending on the region studied. A descriptive function facilitating the explanation of the damages may be expressed as follows (see also Table 6.3):

$$\mathrm{SAD} = f\,(\mathrm{MIX, AFE, ROU, SAH, YED, ICS, CRI, RED, ABA, SAR})$$

Water delivered to México throughout the Colorado River water course as part of the 1944 International Water Treaty registered such an upstream "deliberated" point source pollution while mixing salty waters coming from the drainage system of agricultural lands in the Wellton Mohawk and Yuma valleys in Arizona. Such a fact was formally known as the salinity of the Colorado River water (MIX). From the hydrology and watershed management perspectives, point source pollution (PSP) unlike non-point source pollution (NPSP) is characterized by easier problem solving once the source of pollution (i.e. agricultural sewage collected by the drainage system) can be punctually detected and traced. In this case, the "regulator" does observe each polluter's discharge (i.e. at the irrigation district level) (Brooks, Folliott, Gregersen, and DeBano 1997, 209).

Table 6.3 Perceptions of older water managers on the impacts of the salinity of the Colorado River in the Mexicali Valley.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
SAD = Damages in agriculture of the Mexicali Valley.	MIX = Disposed of salty waters upstream (salinity of the Colorado River).	50	Social, productive and economic impacts mostly seen in central and southern Mexicali Valley.
	AFE = Extent of stress	50	
	ROU = Existence of salty soils strip along the valley (ruta de sal).	50	
	SAH = High extent of salts pollution in parcels.	50	
	YED = High extent of crops yields reductions.	67	
	ICS = Increasing production costs for individual agriculturists	33	
	CRI = High extent of contraction of agricultural credit to unproductive lands	33	
	RED = High extent of individual parcels size reduction	33	
	ABA = High proportion of agriculturists abandoning agricultural activity	33	
	SAR = Salinity problems remain	67	

Half of this group of respondents pointed out that such an event brought about different extent of damage into the Mexicali Valley depending on the region of the valley and the type of soils' texture and structure where salts were deposited (AFE). As such, the problem was more severe in the central and southern regions which are dominated by silt and clay soils laying over a very impermeable and multi-layers soils' structure. This gives as a result the formation of the named "salty route," which represents a long strip of layered soils oriented from north to south and mostly located all over the central and southern Mexicali Valley (ROU).

Negative productivity and economic impacts over individual parcels were recognized by most of the older water managers (67 percent) as the major issue explaining the detrimental aspects of the salinity. Older water managers report that as a result, the Mexicali Valley suffered drastic reductions in crops yields in approximately 40 percent as well as a reduction of workable lands in the amount of four hectares per household in average which is equivalent to 20 percent of the total individual allotment at those times (YED). These negative impacts provoked increasing production costs because of the need to modifying productive practices for planting and fertilizing as well as the more intensive water use in order to leach deposited salts (ICS).

Moreover, agriculturists had to face a critical period of credit insufficiency. During the salinity crisis, financial organizations classified agriculturists as "unproductive", excluding them from normal financing programs (CRI and RED). An interviewee illustrates the negative impacts of the salinity as follows:

> .....it was a severe impact over lands and crops in the Mexicali Valley! Initially [early 1960s], most agriculturists lost their total production, and then they had to reduce individual parcels' acreage due to salts concentrations spread over the valley. It is important to mention that the effect was differentiated along the valley according to the region one saw: the central and southern regions, which show characteristics of impermeable soils [clays] and elevated water tables, suffered critical situations. So, agriculturists in these areas had to modify productive practices and kind of crops to grow as well as to develop costly investments in order to continue working within the agricultural sector." (Int_6).

A third part of older water managers interviewed mentioned that such a situation pressed agriculturists, mainly those more vulnerable living in the central and southern regions of the Mexicali Valley to abandoning the agricultural activity (ABA). Too many household heads had to temporarily or permanently leave the Mexicali countryside to emigrate towards urban areas in México or to the United States.

Even though the salinity problem had its critical period between 1961 and 1973, two thirds of older water manager participants declared that salinity is still considered a significant problem aggravating water management in the irrigation district (SAR). The "ongoing salinity problem" has its origins in the 1960s and it is directly linked to the following factors: the current high concentration of salts in the Sánchez Mejorada Canal; the unsuitable salts monitoring system used by IBWC/CILA at the Morelos Dam point of delivery and control; and the resulting permanent accumulation of salts over the whole "salty route." In this respect, an interviewee states the following:

> The problem is that even today the well known "ruta de la sal" [salty route] exists and the effects of accumulated salts are still observed in such a region that encompasses a huge agricultural area of impermeable soils located in portions of several irrigation modules belonging to the three major regions of the valley, for example, the modules 8, 10, 11, 12, 14, 15, 16, and 17." (Int_3)

Participation of agriculturists during the salinity problem period

Institutional responses of agriculturists in the Mexicali Valley regarding the salinity problem may be better understood by examining the perceptions of older water managers on the agriculturists' conditions for participating and influencing the "permanent and definitive solution" to the salinity crisis. A high level of participation of agriculturists (HIP) during this process was observed. It seems that there was effective vertical coordination between the social and productive base at the local level (with state and federal governmental agencies) as well as a strong financial capacity of agriculturists to mobilize and participate.

The institutional relationships observed at the time may be articulated as follows (see also Table 6.4):

HIP = f (UNI, ADA, FIC, SOL, CEJ, LOL, PAL, LAU, SAU, PAU, LEA EXS, SSS, SAM).

Table 6.4 Perceptions of older water managers on the high level of participation of agriculturists as an institutional response to the salinity problem.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
HIP = High level of participation in the SAL.	UNI = Unity base at the household level	67	Effective vertical and horizontal coordination among agriculturists and several levels of government in México plus adaptation to adversity.
	ADA = Adaptation to damage	67	
	FIC = Financial capacity of agriculturists	33	
	SOL = High degree of solidarity among agriculturists	67	
	CEJ = Fundamental local/neighborhood leadership	50	
	LOL = Outstanding local leaders	50	
	PAL = Principal leader	50	
	LAU = Local agricultural unions' leadership	83	
	SAU = Strong agricultural unions	83	
	PAU = Principal agricultural union	50	
	LEA = Significant Presidential leadership	33	
	EXS = External support	33	
	SSS = Strong state and federal support	33	
	SAM = Salinity process model	33	

67 percent of older water manager respondents highlighted that the cohesive behavior among agriculturists emerges as a primary factor explaining both the high level of participation and the positive impact of agriculturists in the salinity problem process (UNI). Older water managers confirm that the 'horizontal unification' has deep roots in the unity base originated at the household level as well as in the high level of solidarity which may be explained by the dominant favorable economic conditions shown at the time in the agricultural sector which in turn allows for keeping rural families rooted to related activities within the Mexicali Valley countryside.

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Furthermore, the economic conditions of the agricultural sector at the time facilitated the financial ability of individual agriculturists and agricultural unions as well which were entitled by agriculturists to collect voluntary and previously agreed monetary contributions in order to support political activities and participation in the salinity process (FIC). Such funding gives capacity to afford social mobilization as well as to cover agriculturist unions' expenses. This aspect is raised as a key factor facilitating the high level of social participation of agriculturists during the salinity crises. In this regard, a senior water manager pointed out that:

> Agriculturists by themselves, individually, could not have had the effect they had as a unified and organized manner. Given the enormity of the problem they came together into unions of several kinds in order to jointly voice at the highest level of politics in the country. They showed a huge leadership and financial capacity to mobilizing socially and making pressure on governments to find appropriate solutions. Connectedness between individuals, local leaders, and officials of different levels, even the President of México [Luis Echeverria], was the main feature shown during the political participation of agriculturists in the salinity problem process." (Int_4)

The older water managers' interviews revealed perceptions of outstanding leadership at different stages of the salinity problem process which functioned through the strength of a unified social base and the political links that locals kept with several government levels. The basic kind of leadership was personified in the figure of local authorities like the President of the *Comisariado Ejidal* (CEJ). This person used to be a natural and influential social leader with the ability to call for massive assemblies and also had a significant political power based on his effective representativeness, credibility among constituency, and suitable coordination with leaders and officials of upper-level organizations such as governmental agencies, political parties representatives, and agriculturists' unions.

The economic, financial, and political strength of the several unions gave them a central role as institutional participants in the salinity period (SOL), expressing themselves both formally and informally, with the capacity to claim, complain, demand, and boycott governments of both countries towards finding a fair and suitable solution to the salinity problem in such way that agricultural productivity and social welfare in the Mexicali Valley could be recovered. In this context, the leadership of the President Luis Echeverría was imperative to effectively advance in the process and reach significant achievements to make up for damages occurred in Mexican territory agricultural lands (LEA). The Echeverría administration's guidance is broadly acknowledged by agriculturists as crucial to achieving social cohesion and horizontal and vertical coordination.

Complementary to the unity shown at the household and union levels, it is important to notice what 67 percent of older water managers identified as one of the core factors that agriculturists created to address the salinity problem. The adaptation capacity to survive and mechanisms to defeat damage was the immediate informal institutional response of agriculturists in order to overcome practical problems in field (ADA).

For example, many agriculturists of the central Mexicali Valley, after identifying salt deposits on their lands (noticed in the form of large white stains), began working on practical production practices and tasks for avoiding yield reduction. Such adaptation behaviors included innovative procedures for land management, changing irrigation techniques, combining surface and groundwater sources (with different salt concentrations between sources), modifying planting systems, and finally, in the long run, shifting agricultural plans towards more salt-tolerant crops.

One older water manager emphasized this issue by asserting the following:

> .....agriculturists in the Mexicali Valley have a huge capacity to survive; they are very intelligent and intuitive people. I think that if they could, they might write a large amount of technical books on salinity of soils and water management to prevent damages over several crops [...] after finding a couple of obstacles in the way, they changed cropping patterns, they changed seeds' varieties, they modified the place for planting seeds, they modified soil management practices, etc., and all this was done before they went to do manifestation against the salinity problem at the U.S. port of entry or at the governmental agencies' offices." (Int_1).

Another water manager stated that:

> An initial individual effort was made by them to face such critical problem. They combined irrigation water from wells and canals; they made suitable water mixtures to locally improve water quality. They had to adapt rapidly in order to continue growing their corps." (Int_2).

Another older water manager went further by mentioning that:

> Some people in the valley, those more experienced and technically prepared, immediately proposed and implemented technical responses as to build drains, to activate emergency measures to get financial support to face the problem initially and locally before they would go to the social unification and manifestation against the salinity problem. For instance, some groups of agriculturists got financial support from cotton industries established in Mexicali, as such, the first response was to build drainage infrastructure by using money from private entrepreneurs not from government!!. In this way, the drainage system that you can see today was born and its base design was considered for implementing a colossal rehabilitation program of the Mexicali Valley." (Int_3).

Types and characteristics of institutions followed by agriculturists during the salinity problem. The views of older water managers.

Major findings about the perceptions of older water managers regarding the participation in as well as the institutions followed by agricultural water users of the Mexicali Valley during the salinity process point out that, in line with agriculturists of the three regions reviewed in Chapters 3, 4, and 5, institutions seem to be characterized by informal processes based upon strong agriculturists' customary transactions which enabled them to participate strongly in the salinity problem process (HIP).

This kind of informal participation brought the change and latter implementation of "formal" institutions that modified the 1944 International Water Treaty. This fact fits Schmid's (2004, 12) theory of the situation-structure-performance link and the evolutionary perspective useful to understand institutional change.

Older water managers see that the high extent of harmony among agriculturists embodies an informal institutional social behavior guided by local and national leaderships. This fact in turn converted individual agriculturists and their "alliance" of unions into a unique cohesive social force that had the capacity to call for public massive assemblies to boycott bilateral commerce, for example. They also had a remarkable vertical and horizontal coordination ability to ask federal officials, and even President Luis Echeverría, to directly attend to and resolve the problem.

Furthermore, such a social force was financially independent since they also employed informal mechanisms to collect funds among individual agriculturists. A primary characteristic noticed by older water managers interviewed in the study, not just for the central region but for the entire Mexicali Valley agriculturists, was the comprehensive participation of local leaders who encouraged the emergence of other additional informal but effective social habits.

For instance, respondents mention that during the salinity crisis, agriculturists developed a capacity to adapt rapidly to adverse situation of salty soils. Local agriculturists had to rapidly face the problem in order to keep their lands working and producing, all this was made possible through the modification of traditional water and land management practices. Ultimately, it could be observed by older water managers that several institutions and organizations were in place during the salinity process, yet they stated that informal institutional structures dominated the context and also made formal entities to work towards reaching suitable solutions for local agriculturists during the salinity crisis.

Influence of agriculturists in the salinity problem process.

Older water managers recognized that the high participation and involvement of agriculturists in the salinity problem process gave agriculturists of the Mexicali Valley noteworthy weight as central social actors and enabled them to press both, the Mexican and U. S. federal governments to move forward towards finding a fair binational negotiation in such matters. The institutional function regarding the agriculturists' influence to find a technical solution to the salinity problem (ITS) may be depicted as follows (see also Table 6.5):

$$ITS = f\ (IBI, REQ, REL, CAP)$$

Older water managers underscored that the influence of participation of agriculturists in finding technical solutions to the salinity problem was mainly due to the use of formal (collective action through mobilization of unions) and informal (individual actions supporting public massive manifestations for a commercial boycott) institutional behavior and devices that ensured a strong coordination with governmental agents at different levels. Most respondents (75 percent) mention that technical solutions to salinity of the Colorado River water and soils in the Mexicali Valley were consulted, analyzed, and legitimated jointly by Mexican officials (i.e. secretaries of water resources, agriculture, foreign affairs, and economy), scientists, and agriculturist unions' leaders as well as individual agriculturists. As a result, the modification of the binational framework for transboundary water management, particularly the establishment of the Minute 242 concerning water quality standards was reached to embody the most important "technical solution" to the salinity problem (IBI). In this process agriculturists were directly involved just as it was explained in Chapter 3.

Table 6.5 Perceptions of older water managers on the influence of the institutional response of agriculturists for finding technical solutions to the salinity problem.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
ITS = Influence of participation of agriculturists for reaching technical solutions to the salinity.	IBI = Influential participation of agriculturists in inducing institutional change for binational water management	75	Agriculturists as a key social actor pressing for a solution to the salinity problem.
	REQ = Influential participation of agriculturists in defining the implementation process of infrastructure for recovering water quality in the Colorado River and the Mexicali Valley.	50	
	REL = Influential role of agriculturists in defining and implementing the rehabilitation program.	63	
	CAP = Influential participation of agriculturists for obtaining financial support to continue production.	50	

This induced formal institutional change in the binational water framework (Minute 242) implied the definition and implementation of water quality standards to reduce the concentration of salts in the Colorado River watercourse entering México through the Morelos Dam. The older water managers revealed that agriculturists manifested their gained practical experience on land and irrigation management while they suffered salinity in some agricultural areas of the valley during the salinity crisis and even before this episode. This in turn represented valuable feedback for experts and scientists who used this information to set up and later negotiate technical water parameters. In this regard, an older water manager pointed out the following:

> .....then, pressed by the intensive agriculturists unions' actions and permanent massive manifestations at the U.S. port of entry in Mexicali to commercial boycott, several international agreements came out. First, the design and operation of hydraulic bypass devices such as the Wellton-Mohawk canal to send highly [concentrated] salty water to the Gulf of California throughout Mexican territory but without accounting it in the 1944 Water Treaty; second, the establishment of water quality norms or limits for salinity in the Colorado River water (Minute 242); and third, the huge financial support to invest in irrigation infrastructure for the entire Mexicali Valley." (Int_3)

Another aspect in which agriculturists had an outstanding influence was in building infrastructure programs for recovering irrigation water quality (REQ). This was done by pressuring through socio-political activities seeking to induce the building of the Wellton-Mohawk Canal for conducting salty waters crossing the border coming from the United States to the Gulf of California.

In line with assertions from agriculturists analyzed in previous chapters, most older water managers (63 percent of interviewees) mentioned that direct benefits obtained by agriculturists as a result of their participation in the salinity problem process are those stemming from local infrastructure programs put in practice by the Mexican government in agreement with unions of agriculturists in order to recover productivity of agricultural lands. Implementation of the so-called "Rehabilitation Program" included specific actions and funding to develop projects simultaneously at both the irrigation district and parcel levels. For instance, land fertility improvements through the implementation of irrigation techniques for salt leaching, building large networks of open drainage systems, lands' leveling, and the lining of major and secondary canals (REL).

In addition to the general benefits obtained by agriculturists, they received individual financial support for implementing recovery lands' duties and infrastructure at the parcel level. Also, agricultural credit and technical assistance was given through the administration of unions to buy large machinery and equipment focusing on production and land management (CAP). The situation was described as follows as recalled by an older irrigation water manager:

> The most important benefits gained by agriculturists as a result of their significant participation and influence in setting up solutions to the salinity were the following: first of all, they could show their strong cohesive and political capacity as individuals and leaders; second, they demonstrated their ability to influence the salinity problem process to get financial benefits to implement infrastructure programs; and third, they showed their strength to induce modifications of the Water Treaty and make it more suitable for achieving their productive goals. All these together, agriculturists, leaders, water managers, water agencies' officials, and governmental actors had the vision at such a critical moment to obtain benefits and solve problems which nowadays are still having direct benefits for the regional countryside." (Int_2).

Impact of institutional structures followed by agriculturists of the Mexicali Valley during the salinity problem.

According to the older water managers' perspectives, informal institutions implemented by agriculturists during the salinity period favored their high level of participation which demonstrated to be effective in reaching the main objectives of improving conditions for transboundary water management in the lower Colorado River as well as for irrigation in the Mexicali Valley.

The older water managers' views evidence the impacts of following a dominant informal institutional response to the salinity process that allowed agriculturists to be acknowledged as influential actors that pushed towards getting benefits such as the reestablishment of farm credit programs at the parcel level and the rehabilitation program for recovering lands quality at the irrigation district level.

Also, older water managers mentioned that the rehabilitation program was initially seen as a strategic regional policy that tried to establish a new crop pattern based on grazing and livestock to replace the traditional cotton and wheat production in the Mexicali Valley. The rehabilitation program is considered as one of the major benefits obtained as a result of the strong agriculturists' social participation during the salinity process; as such it is seen as the major benefit of the implemented informal institutions.

Finally, older water managers interviewed recognized that agriculturists were influential in the process of obtaining benefits at a binational level through the modification of the transboundary water management framework, specifically the establishment of the Minute 242. As a matter of fact, informal institutions in place, for example, the locals' social behavior for commercial boycott at the international port of entry in Mexicali, were seen as social procedures created and used by agriculturists and their "union of unions" in order to produce formal institutional change in the binational water management framework.

THE ALL-AMERICAN CANAL LINING CONFLICT (AAC)

This section focuses on the results of the qualitative analysis concerning older water managers' perceptions regarding the All-American Canal lining process. I first discuss the views of old irrigation water managers on the potential negative impacts in agricultural production and irrigation of the All-American Canal lining project as well as the impacts of policies for addressing the All-American Canal lining conflict.

Similar to agriculturists' views discussed in Chapters 3, 4, and 5, older irrigation water managers expect a combination of productive, economic, social, and environmental damages to the Mexicali Valley as a result of the All-American Canal lining project (JEO). Such damages could occur gradually and show a different extent of stress depending on the region of the valley analyzed. Nonetheless, older water managers asserted that as long as the All-American Canal process properly addresses and involves key stakeholders, it might also represent an opportunity to improve water management conditions on both sides of the border. The function that facilitates explanations of threats from the All-American Canal lining project may be read as follows (see also Table 6.6):

$$JEO = f\,(UCY, CYC, MES, DRE, RAF, WEL, ADJ, RED) + IOP$$

Table 6.6 Perceptions of older water managers concerning the potential impacts of the All-American Canal lining project in the Mexicali Valley.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
JEO = All-American Canal lining as a threat to the Mexicali Valley's sustained agricultural development.	UCY = Uncertainty of impacts	33	Productive and economic risks perceived parallel to the opportunity of improving conditions at a local and binational level.
	CYC = Cyclic damages induced by the AAC	17	
	MES = The La Mesa Drain. A technical solution in the past.	17	
	DRE = The La Mesa Drain as affected water source	33	
	RAF = Regional upper aquifer impacts	50	
	WEL = Deeper wells digging	33	
	ADJ = Water adjustments for agriculturists	67	
	RED = Reduction of growing areas	17	
	IOP = Opportunity for mutually improving water management conditions.	33	

Older water manager participants perceive potential deterioration of natural resources (i.e. water sources and land) as a result of the implementation of the All-American Canal lining project. However, they express uncertainty about the specific damages that individual agriculturists could experience at the parcel or household level as a result of the canal seepage cut back (UCY), due to the physical and socio-productive characteristics of the agricultural sector which differ from one place to another in relation to type of soils, water sources availability and quality, types of crops, socio-economic conditions as well as the distance of individual agriculturists from the project setting.

Also, older water managers mentioned that at the beginning the canal seepage was seen as a persistent problem for agriculturists at the time the All-American Canal was built and put into operation in 1942. Cyclic damages may have been observed since the beginning when the All-American Canal seepage impacted the agricultural activity of the northeastern Mexicali Valley which brought about flooding over nearby parcels, still damaging agricultural lands for more than ten years during the 1950s. Today, older water managers see that the danger is coming back as a potential shortage for agriculturists of the Mexicali Valley and to be initially felt in the northern and northeastern regions of the valley (CYC). An interviewee who served as manager in CONAGUA for many years explained the following in this respect:

> .....definitively, the All-American Canal lining will bring out problems that initially will affect the irrigation district in Mexicali since such seepage represents a water source. There is some uncertainty about the real quantity, it has varied over the time, first a lot of water and flooding areas and now, after La Mesa drain and the wells were built it is clear that there is a much lower water table in the area (northern). I directly evaluated the seeping volumes by using the wells' line, and however, at this moment there are several studies establishing either 75 or 80 or 83 or 100 millions of cubic meters per year....the point is that there is no agreement on it. But, there is no doubt; the impact will be seen among agriculturists in the whole irrigation district, not just in the northern area."(Int_1).

As a result of such initial flooding problems, the La Mesa and the Culiacán Drains were built in the Mexican side adjacent to the borderline in order to intercept the excess of water seepage coming from the All-American Canal (MES). The solution to this transboundary water problem gave origin to the seeping water, which since then has been used by agriculturists to irrigate about 2,000 hectares (CONAGUA 2001). This means that initial flooding problems became fresh water sources used for irrigation in large extensions of land in the northern Mexicali Valley.

Also, half of interviewed older water managers identified the impending diminishing quantity and quality of the Colorado River aquifer into its Mexican portion, and this is said to have an immediate impact over more than 19,000 hectares of agricultural land located at the northeastern area of the valley (RAF). As a result of the expected reduction of surface and groundwater sources, older water managers foresee the need of digging deeper wells in order to compensate potential damages (WEL). But this in turn might bring together increasing needs for hydraulic infrastructure investments so that groundwater could be pumped from deeper zones.

Based on the foreseen previous risks, most of the older water managers (67 percent) have had the same opinion that agriculturists express in regards to a key issue that might affect agricultural productivity and irrigation management in the Mexicali Valley. That is, making "water adjustments" among agricultural water users through irrigation water allotments at the individual parcel and irrigation module level as well as at the whole irrigation district levels (ADJ). This is so given the particular feature in the irrigation district (including Mexicali and San Luis Rio Colorado valleys) which operates through an interconnected hydraulic system that usually mixes surface and groundwater sources.

Furthermore, reductions in the crop growing area at the individual parcel level might also take place as a result of the implementation of the All-American Canal lining project (RED). Nonetheless, opportunities to overcome the potential adverse conditions exist as well as investment projects and short-term sufficient financial support.

An older irrigation water manager went further on by pointing out the following:

> Most agriculturists do not identify the AAC issue as a generalized problem. They do not envision the hydraulic [irrigation] system as a whole, with physical connections between surface and groundwater sources. Instead, they segment the nature and operation of the irrigation district and, as such, they do not understand at all how the 'whole valley' could be affected by the lining project [...] if they would think that way, then they might understand the imminent measure of making water adjustments so that the production and productivity would keep advancing normally." (Int_4).

On the other hand, the older water managers, in agreement with some northern Mexicali Valley agriculturists, consider that the All-American Canal process might also represent an opportunity for mutually improving productive conditions between water users on both sides of the border (IOP). As a matter of fact, key local actors such as agricultural water users must play an effective and significant role in this process just as they did during the salinity problem episode. In this regard, despite the importance of this kind of stakeholder, agriculturists have not had effective or extensive participation in the debate over the All-American Canal lining.

Participation of agriculturists in the All-American Canal lining conflict

Older water managers noticed that in contrast to what occurred during the salinity problem, the participation of agriculturists of the Mexicali Valley in the All-American

Canal lining conflict is characterized by a significant disarticulation among irrigators as well as a lack of vertical coordination with water agencies involved in this issue. The following institutional function includes factors explaining a weak participation of agriculturists (DAS) in the All-American Canal lining process (see also Table 6.7):

$$DAS = f\,(APA, LIN, MIN, TRA, PLA, ALE, LED, ELE, LES, NOF)$$

Table 6.7 Perception of older water managers on institutional responses of individual agriculturists to the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DAS = Weak defense of agriculturists against the All-American Canal lining project	APA = Generalized apathy on the part of agriculturists of the whole Mexicali Valley.	83	-No vertical coordination of agriculturists and federal government.
	LIN = Lack of information	67	
	MIN = Misleading information	50	
	TRA = Lack of transparency on the part of federal governmental agencies	50	-Horizontal social disarticulation of the agricultural sector.
	PLA = Presidential lack of accountability to locals	50	
	ALE = Aging leadership in the Mexicali Valley countryside.	33	
	LED = Dispersed and disarticulated leadership in the Mexicali Valley	33	
	ELE = External, urban-based leadership facing the AAC issue	67	
	LES = Lack of external economic and technical support for agriculturists	33	
	NOF = Lack of agriculturists' financial capacity.	67	

It seems that to most of the older water managers (83 percent of respondents) there is a generalized apathy among agricultural water users regarding this transboundary water conflict, which is shown through a noticed lack of interest and motivation to participate in the All-American Canal lining dispute (APA). Instead, agriculturists tended to prioritize their day-to-day operative functions above any other activity. Also, older water managers consider that the lack of information in relation to the All-American Canal lining issue together with the observed governmental officials' tendency to mislead agriculturists are amongst the drivers for not participating in the process (LIN).

Such an institutional behavior of agriculturists is intertwined with the lack of transparency in the process handled by water agencies and this in turn represents fundamental factors linked to the agriculturists' apparent apathy (TRA). Ultimately, older water managers mentioned that all these factors together explain the agriculturists' weak participation and involvement in the All-American Canal lining conflict.

Older water managers also identified the lack of formal (official) information shared by water agencies about critical aspects as neither opportune nor systematically widespread among irrigation water users. According to the older water managers' views, agriculturists frequently received deceiving information about the All-American Canal lining project such as the physical impacts and the details of the litigation process (MIN). In short, governmental agencies tend to minimize imminent problems. As an interviewee explained it:

> The influence of agriculturists in the AAC process is minimal. This is so because of their unnoticed participation as key stakeholders and this in turn is so due to the very little information they receive about such a process. They do not have the tools to participate and to make decisions about the issue, they do not know with accuracy what would happen if the project is implemented, they have too many doubts about who might result affected and at what degree, etc. This is the real problem; the weak participation of agriculturists is the issue." (Int_5).

Lack of presidential leadership and the lack of accountability to agriculturists on the part of governmental agencies are congruent with the mechanisms that are used to make information lacking or confusing (PLA). The lack of leadership and accountability to locals by presidents Vicente Fox and Felipe Calderón was noticed by older water managers when they were compared with that of other presidential administrations. Older water managers noticed that no other presidents showed such a lack of accountability and misunderstanding of transboundary water conflicts that directly threaten the Mexicali Valley's agriculture. Such an insensitive attitude shown by presidents coming from the National Action Party (PAN), resulted in a weak, disarticulated, and ineffective role of federal agencies facing the All-American Canal issue.

Not only presidential but also local leadership was missing and weak. Older water managers emphasized that aging is becoming the most prevalent characteristic in society that obstructed participation of the Mexicali Valley agriculturists in the All-American Canal issue (ALE). Individual and collective leaderships are practically absent and the agriculturists' past political power to mobilize and articulate social and governmental forces is totally diminished. A dispersed leadership among irrigation water users is at the same time "fragmented" representing a barrier to build up a unified, strong participation that would exhibit the importance of irrigation water users as social and productive actors (LED).

Moreover, 67 percent of interviewed older water managers pointed out that such a lack of leadership and strong political organization within the agricultural sector in the Mexicali Valley gave place to the participation of other social actors' leadership within the urban sector. Urban-based groups took the All-American Canal lining issue on behalf of the regional society and prepared and lobbied for an injunction process against the United States government (ELE). This fact shows a significant change in the kind of traditional social actors and organizations voicing and claiming transboundary water conflicts.

In July, 2005, an urban-based local entrepreneurs' organization, the Mexicali Economic Development Commission (CDEM), promoted a civil action against the United States Department of the Interior requesting to stop the All-American Canal lining project arguing that it might bring social, economic, and environmental damages on the Mexican side, disputing legal rights over the canal seepage. Nevertheless, in April, 2007, the federal court of San Francisco lifted the injunction and the American side became the "winner" of the legal trial (Cortez-Lara, Donovan, and Whiteford 2009, 135).

In line with the agriculturists' views, an additional major factor supporting the older water managers' perception on the disarticulation and weakness of the agricultural sector refers to the lack of financial and technical support provided by governmental agencies for them to participate in the AAC conflict. The key tasks of organizing, participating, and leading the AAC issue is difficult for agriculturists given the unfavorable economic conditions in the sector (LES).

Most of the respondents affirmed that another related factor explaining the unnoticed participation of agriculturists of the Mexicali Valley in this current transboundary water conflict is the nonexistent financial capacity of agricultural water users to incursion in a unified fashion (NOF). They mentioned that in the new era, after the irrigation water transfer in the Mexicali Valley, the voluntary contribution included in the irrigation water fees disappeared from the agricultural water users' accounts and this fact has halted their financial capacity to afford their unions and leaders' mobilization. An elder irrigation water manager pointed out that:

> Now, [there] just remain a few leaders in the Mexicali Valley. They don't really do anything significant that would give recognition to the agriculturist as an important actor in the 'All-American' conflict. When the salinity [problem] occurred, agriculturists had a huge self-financial capacity coming from a portion of their own irrigation water fees. The money was used to support agriculturists' participation in the conflict as well as to help unions and leaders to call for crowded meetings, to ultimately find fair and suitable solutions for all parties. Now, this money is no longer available and this represents a key factor that limits the agriculturists' participation in the AAC process." (Int_2).

Participation of WUAs and SRL in the All-American Canal lining conflict

This section discusses the categories of factors affecting both the involvement of agriculturists in irrigation and the effective management of irrigation systems while considering socio-economic, socio-cultural, historical, and political-legal aspects as well as technical and agro-ecological factors.

It is emphasized that if more naturally occurring factors were to be included as those influencing agriculturists' involvement and, consequently, the effective management of irrigation systems, then the situation would become more complex. Such an assertion supports the concepts raised by Ostrom et al. (1999: 278) about the limitations and opportunities of agricultural water users for participating and influencing transboundary water management issues. In this regard, the OMGRs' views, in line with that of agriculturists from all regions of the valley, indicate that WUAs in the Mexicali Valley lack capacity to keep being involved and, at this point, they have no effective representation for participating in the All-American Canal lining issue.

The institutional function that facilitates the explanation of the weak participation of agriculturists in the All-American Canal lining process through the representation of WUAs (ELU) is annotated as follows (see also Table 6.8):

$$ELU = f\,(IMU, WUA, COT, BUR, SYS, ALA, GIA, LAN, LAC, LIC, FIN, ALT)$$

Table 6.8 Perceptions of older water managers on the institutional responses of agriculturists' WUAs to the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
ELU = Low level of participation of agricultural WUAs in the AAC process.	IMU = Top-down imposed WUAs	33	WUAs not effectively involved with any representation in the AAC process.
	WUA =Water Users' Associations lack of participation in round tables 1 (SAL) and 5 (AAC)	33	
	COT = Lack of combative WUAs	50	
	BUR = Bureaucracy of co-management	67	
	SYS = Lack of a system view of WUAs	17	
	ALA = WUAs' lack of accountability to individual users	33	
	GIA = Groups of interest and apathy within WUAs	33	
	LAN = Large landholders command WUAs	33	
	LAC = Lack of formal coordination mechanisms.	50	
	LIC = Lack of coordination with IBWC/CILA.	67	
	FIN = Need to formally participate in the All-American Canal lining issue.	33	
	ALT = Alternatives to All-American Canal lining issue offered by WUAs.	67	

Although being part of the water transfer process early 1990s, older water managers recognized that WUAs were imposed from the "top" (IMU); this fact brought about several initial "technical" problems and constraints for the proper irrigation water management functioning. For instance, the deteriorated irrigation infrastructure received from the government by agriculturists along with the legal limitations to formally participate in transboundary water management issues affected local irrigation. Thus, the way that the water transfer process took place in the Mexicali Valley speaks of the original failures impeding agricultural water users' representatives' effective participation in the All-American Canal lining issue.

An example of this is that WUAs' representatives do not participate in formal mechanisms established by IBWC/CILA to attend and discuss both the salinity and All-American Canal issues (round tables number 1 and 5, respectively, which function as binational technical steering committees). As such, agricultural water users as a whole have lost their combative capacity to formally express their needs (WUA and COT). An interviewee mentioned the following:

> Irrigation modules' representatives and officials are more focused on local operation and collection of irrigation service fees than in any other aspect. They do not participate in 'external' issues that undoubtedly affect irrigation operation performance as well. They systematically disregard the binational problems such as the salinity and the All-American Canal conflicts. In fact, the modules have not had any activity for seeking financial support to carry out the needed technical studies on the social, economic, productive, and environmental impacts of the project as well as the potential alternatives they might implement. Our umbrella organization, the Irrigation Society [SRL], should do this given its high-level administrative status as representative of all irrigation water users in the Mexicali Valley." (Int_5).

Additionally, the respondents (67 percent) mentioned that the normal day-to-day hydraulic operative problems which WUAs are responsible for solving block their capabilities to promote and stimulate an effective collective action focused on transboundary water management aspects. The heavy bureaucratic co-management between WUAs/SRL and CONAGUA is a structural feature that hinders operative efficiency for irrigation management at the time it affects the development of proper mechanisms for effective representation of agricultural water users in transboundary water issues (BUR). Two core aspects that impeded the participation of agricultural water users are the increasing costs for social mobilization as well as the lack of political leadership in the Mexicali Valley. Instead, local irrigation operative tasks are now the focus of this co-management while fundamental linked issues are left aside. As a respondent stated:

> They [WUAs' representatives] are more occupied in the irrigation service, main and secondary irrigation canals operation, and collection of water administration fees. This is done in 'coordination' with the Irrigation District [officials]. However, they aren't really engaged in the All-American conflict, or maybe, but just a little. At least here in my module [central Mexicali Valley area] the transboundary water issues are disregarded, moreover, both together [WUA and CONAGUA] just think of how to increase irrigation water fees." (Int_2).

Older water managers highlighted the lack of a system view that WUAs show while operating the irrigation district (SYS). It appears that the complexity of the irrigation system is not well understood by some irrigators' representatives even though they still exist in a time when conflicts is at different levels among WUAs (including twenty-three irrigation modules within the irrigation district), between wells and canals users, between irrigators and environmentalists, and between irrigators and urban users. Moreover, this fact is considered by older water managers as one additional aspect inducing the agricultural water users' disarticulation and disintegration as a unified social force that might participate in transboundary water issues.

Also, older water managers self-criticized their own function within the irrigation system when expressing a perceived lack of accountability to some agriculturists such as small-scale producers due to the frequent pressures that powerful large landholders impose in directives of WUAs. This fact in turn is acknowledged as a constraint to agriculturists' participation as a strong group in the All-American Canal issue since they (small-scale agriculturists) do not "feel" a proper support coming from uppers like the

WUAs (ALA). Instead, WUAs' representatives tend to show a "strong" accountability to upper agencies such as CONAGUA or even to some kind of influential and powerful growers, that is, those operating large extensions of land.

Groups of interests within WUAs are often observed. This factor induced apathy and blocked out necessary social cohesive power to participate as a unified sector in the All-American Canal lining conflict (GIA). This behavior is said to be induced by WUAs' representatives, who "control" their operation and most times are large-scale growers who use significant volumes of water (LAN).

In addition, the lack of coordination between WUAs/SRL and some governmental water agencies represents another aspect related to the ineffective participation of agriculturists in the All-American Canal lining issue (LAC). Such a lack of coordination is in turn explained by the deficient level of information that water users have about formal mechanisms to strengthen institutional links between WUAs/SRL and key water agencies like IBWC/CILA which is traditionally focused on transboundary issues. As stipulated in the 1944 Water Treaty, the Mexican Section of IBWC/CILA receives 90 percent of the water allotment coming from the Colorado River at the Morelos Dam or Northern International Boundary (NIB) point of delivery and the remaining ten percent is received at the Sánchez Mejorada Canal or Southern International Boundary (SIB) point of delivery. Next, IBWC/CILA contacts officials from CONAGUA which delivers water to agricultural water users at hand represented by the SRL and WUAs.

Despite the fact that the majority (67 percent) of older water managers' respondents noticed the need for joint analysis and action that might trigger their respective responsibilities (LIC), they mentioned that there is a lack of a systematic formal coordination and dialogue between IBWC/CILA and WUA officials. Their normal water operation duties links them each other, however, there are a generalized perception of no institutional collaboration for working in critical transboundary water issues.

Older water managers recognize the need for a deeper involvement of WUAs' representatives in transboundary water conflicts since they directly affect irrigation and agricultural development (FIN). For this to occur, WUAs have to formally embrace the AAC issue in such manner that the problem could be raised by them to upper officials and to the several governmental agencies involved. Older water managers suggest a mechanism of participation based on a democratically defined design that facilitates the implementation of technical alternatives through the establishment of water management plans (at both irrigation module and irrigation district level). Such plans must consider not only local aspects but also interlinked transboundary water issues.

In the specific case of the All-American Canal disagreement, most of the older water managers interviewed (67 percent) stressed additional domestic alternatives that the irrigation sector in Mexicali could develop in order to reduce imminent impacts of the lining project. These alternatives should consider increasing water use efficiency in both the major and secondary irrigation network as well as at the parcel level. They also mentioned the need for implementing a large infrastructure plan including the following: lining major canals and inter-parcel network, building water reservoirs in appropriate places in the irrigation district, replacing water delivery devices, expanding drip and sprinkler irrigation systems, improving and repositioning of deep wells, and installing parcel-level drainage pipe-tiles. Older water managers estimate that through these actions the global water savings could reach levels of ten to 15 percent of the total water used in the Mexicali and San Luis Rio Colorado valleys (ALT).

However, all this investment effort will not help if such a plan does not include capacity building programs to improve water management within WUAs. In addition, institutional responses of agriculturists to reduce conflicts over highly contested transboundary waters will be necessary.

In this regard, an interviewee belonging to water agencies stated the following:

> .....what I can say about the SRL and WUAs involvement in the All-American Canal lining conflict is that they have been discussing preventive alternatives including the establishment of irrigation water adjustments [reductions] for individual allotments of agriculturists as well as local water efficiency programs." (Int_4).

Another one added:

> We have to support potential areas that will suffer the impact of the All-American Canal lining project in some way [...] When water shortage comes to play, we always state shortage to alfalfa producers. Additionally, one of the main alternatives we have envisaged is to promote shared infrastructure investments at any level. Also, we see the need for establishing several physical water banks in some places of the valley so that we could store water both in paperwork and in the field, that is, we should design a surplus/scarcity control among the irrigators so that an internal market mechanism might be implemented. This in turn, might represent an opportunity to improve our water management methods." (Int_3).

It is important to emphasize that growing demand for scarce water resources in the lower Colorado River region is pressing water users and that water use efficiency programs are needed on both sides of the border. In fact, the All-American Canal lining is part of a larger water saving plan in southern California (4.4 Plan). On their part, both, CONAGUA and SRL/WUAs implement permanent irrigation water efficiency programs in Mexicali.

Nevertheless, the focal point in this analysis is that the water use efficiency programs in Mexicali have not induced major impacts to other water users. However, should this happen, they are immediately compensated (with additional sources of water) by the irrigation system. The transboundary conflict under analysis emerged because the All-American lining project will induce externalities to Mexico given that the seepage water has been crossing the border and feeding surrounding wetlands and the upper aquifer in the Mexicali Valley for more than 60 years.

Views of older water managers in the Mexicali Valley of institutions used by agriculturists during the All-American Canal lining conflict

In line with the perceptions of agriculturists (all regions), older water managers asserted that the characteristics of institutions followed by agricultural water users in the Mexicali Valley during the salinity and the All-American Canal processes are significantly different. Regarding the All-American Canal case, the set of human relationships followed by agriculturists constrained their ability to participate in such a process. This in turn resulted in a weak defense against the All-American Canal lining project (DAS and ELU).

Formal and informal institutions which played a part in the All-American Canal lining case (AAC) were characterized by agriculturists' behaviors mostly guided by formal institutions embodied in SRL/WUAs usually unrelated to the All-American Canal issue. Agricultural water users were not effectively involved in the case. Therefore, they do not reach the necessary vertical coordination with state and federal agencies so that they could have an effective representation in the AAC process.

Apathy and lack of leadership are the leading habits shown by agriculturists and WUAs' representatives with respect to the All-American Canal issue. This, together with the lack of financial capacity within the irrigation sector for supporting specific activities to enhance participation and collective action made the SRL/WUAs an ineffective institutional structure. Bureaucratic co-management between WUAs and CONAGUA made them lose representativeness in the AAC process. Although entitled to participate and defend any aspect regarding water management affecting the irrigation sector and agriculture, SRL/WUAs showed accountability to federal water agencies as well as a lack of coordination with key transboundary water agencies such as IBWC/CILA-Mexican section.

Older water managers stressed these facts to illustrate the kind of institutional arrangements followed by agriculturists during the All-American Canal lining conflict. As such, the dominating formal institutions put into practice by agricultural water users, brought them to remain under the influence of urban-based leadership which was unsuccessful against the All-American Canal lining project.

Influence of agriculturists in the All-American Canal conflict.

Congruent with the low level of participation that agriculturists and WUAs show in the case of the All-American Canal lining conflict, their influence to induce a solution in which they would get benefits was also unobserved (DIT). The institutional function that illustrates this situation is suggested as follows (see also Table 6.9):

DIT = f (ORG, LOZ, CIL, LIC, ELE, CTE)

Table 6.9 Perceptions of older water managers on the influence of the institutional response (low participation) of agriculturists' WUAs for finding solutions to the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DIT = Influence of participation of agriculturists in finding solutions to the All-American lining conflict.	ORG =Deteriorated agriculturists' social organizations	33	Agricultural sector as a whole and WUAs with neither economic nor political power to influence suitable solutions.
	LOZ =Agriculturists losing social organization capacity.	17	
	CIL = Loss of capacity for inducing positive change	50	
	LIC = Lack of coordination with IBWC/CILA.	67	
	ELE =External, urban-based leadership facing the All-American Canal lining issue.	50	
	CTE =The United States must compensate México for damages.	33	

According to the views of older water managers, there was no influence of agriculturists in the All-American Canal lining issue. This is in part explained by the deteriorated social organization within the agricultural sector (ORG) whose traditional agriculturists' unions are "virtually diluted" and without political and economic power to negotiate or even dialogue with governmental agencies about issues related to irrigation in the Mexicali Valley (LOZ).

Current formal institutional structures that represent irrigators' interests, the WUAs and SRL, function more as water operation devices that follow strategies established by governmental agencies than as formal organizational structures facing the agricultural water users' concerns.

Half of the older water managers interviewed declared that local agriculturists' leaders participation with state and federal Congresses and even within the Assembly of Senators is no longer a common event. As a result, they have lost influence to voice and induce formal institutional change as they did during the salinity problem period (CIL). This fact in turn explains the lack of political power of agriculturists to influence transboundary water issues and to keep in touch with key water agencies such as the International Boundary and Water Commission-Mexican section (LIC). Instead, other social actors representing the urban area lead the issue and represented regional interests, even those of the agriculturists (ELE).

In this regard, older water managers make the following two assertions:

> Nowadays, in the middle of the All-American Canal conflict, I see a more disorganized participation of the agricultural sector than in the past, I feel that the problem is mostly minimized and regionalized on the part of water agencies. I also feel a weak participation and influence of agriculturists and for this reason they have no power to make pressure upon official representatives." (Int_5).

The other one added:

> I was there in some meetings where the All-American Canal issue was dealt with. In one of the meetings two federal representatives [deputies] that are part of the Hydraulic and Borderlands Affairs Commissions [of course, there was no local representatives] came here and exposed their concerns and their "willingness" to solve the problem. However, nothing occurred, they never returned to this place and local agriculturists did not have the power to ask them to come again and to accomplish their previous commitments." (Int_1).

Older water managers show that they understand the needs of the irrigation sector and the problems that the All-American Canal lining project might cause to the Mexicali Valley. As such, older water managers tend to be tied to the agriculturists' interests and concerns since they (older water managers) often have family ties because they used to live in the Mexicali Valley countryside. In addition, as experienced "professionals," older water managers proposed technical alternatives to ameliorate the All-American Canal lining negative effects in the Mexicali Valley.

For example, they mentioned that in addition to what they believe the agricultural water users should do, the Mexican government must seek and promote mechanisms to get financial support for irrigation infrastructure that might improve water use and management efficiency. They added that funding could come from the several sectors direct or indirectly impacted by the project (i.e. agriculturists, state government, federal government, urban users in Mexicali and Tijuana) as well as in the form of compensation from the United States government.

Given that the rights acquired over the canal seepage was a controversial issue for Mexican agriculturists, the older water managers expressed their point of view on the motivations (for the United States) as well as the impacts (for the Mexicali Valley). Therefore, in line with some agriculturists, the older water managers considered that the compensatory approach is the most appropriate way to avoid further damages to the local irrigation sector and, ultimately, to agriculture of the Mexicali Valley (CTE). However, other agriculturists (i.e. those working in the northern Mexicali Valley) do not accepted the *compensatory* perspective. Instead, they pursued the implementation of the *Precautionary Principle* approach which suggested that the project should be stopped while the risks for the area are thoroughly assessed, considering officials' and users' inputs from both sides of the border.

Views of older water managers of the impacts of the institutional structures used by agriculturists during the All-American Canal lining conflict

The impacts of the institutions used by agriculturists of the Mexicali Valley during the All-American Canal lining conflict to address transboundary water management issues, irrigation, and local agricultural development are highlighted by older water managers. They affirm that the overall formal institutions used during the

All-American Canal lining conflict hindered the agriculturists' participation and made them ineffective actors in the process. It is said that if they had participated in the process, then the likelihood of agriculturists obtaining compensation for the potential damages in the form of investments for improving irrigation water management could have been better.

Evidence suggests that prevailing formal institutional structures during the All-American Canal issue impeded agriculturists from attaining importance as social actors; instead they were frequently disregarded. Older water managers affirmed that the lack of social organization of individual agriculturists made them lose the capacity to form a unified force that might have induced a positive change. This kind of informal institutional behavior is now absent in the rural realm during the All-American Canal episode. Instead, the formal structures of SRL/WUAs were the unique organizational devices "representing" the agriculturists' interests and, as such, they lacked leadership. There were also ineffective mechanisms to coordinate with key water agencies related to the issue such as IBWC/CILA-Mexican section.

Likewise, agriculturists and their WUAs were irrelevant actors in the process of influencing positive change at a binational level. For example, they were not formal participants in the IBWC/CILA's roundtables 1 and 5, which were constituted as the special steering committee for addressing current salinity issues and the All-American Canal lining transboundary water conflict. This shows that formal institutional structures followed by agriculturists such as the administrative transactions represented by the WUAs is seen by older water managers as an institutional behavior that denotes loss of political power to influence local and transboundary water management affecting irrigation in the Mexicali Valley.

Furthermore, older water managers insist that agriculturists and their WUAs and Irrigation Society (SRL) are key stakeholders who no longer represent a social force with capacity to induce institutional change on transboundary water issues, as an older water manager summarized: "...just as they used to be in the past during the salinity crisis."

NEWER WATER MANAGERS' PERCEPTIONS: ADDITIONAL SALIENT ISSUES.

In this section, I analyze perspectives of the three newer water managers (NMGRs) interviewed in order to elucidate differences in relation to the perceptions of older water managers (OMGRs) regarding the salinity problem and All-American Canal lining issues. Also, I discuss how NMGRs see the institutional participation and the influence of agricultural water users in the Mexicali Valley in such issues as transboundary water management that directly affects local agriculture and irrigation.

Even though there are several coincidences between the expressed perspectives, there are also differences that deserve analysis. On one hand, the OMGRs showed significantly broader experience on these issues currently under study, exposing more ties to agriculturists' interests. On the other hand, NMGRs expressed a more managerial perspective based upon their uppers' policy approach. This feature was noticed while reviewing the institutional functions obtained in which, often, NMGRs expressed similar views as OMGRs but not as strongly in each institutional function of both cases (see Appendices C and D).

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This section focuses on additional factors and the major differences between institutional explanatory functions embracing the main topics reviewed: the major changes in the agricultural and irrigation sectors, the salinity crisis, and the All-American Canal lining conflict.

Views of newer water managers concerning agriculture and irrigation

Newer water managers recognized that progress and regression can be seen as alternative processes in the Mexicali Valley whereas older water managers, who included more explanatory factors, just emphasized the progress view (PRO). In this regard, newer water managers mentioned that the PRO standpoint is rooted in the structural diversity of cropping patterns as well as the technology improvements for crop production and irrigation. In addition, the 1944 Water Treaty is seen as an institutional device that allows for continued development of the regional countryside.

On the other hand, the regression view (REG) held by NMGRs recognizes that difficulties such as low relative prices of agricultural products together with commercialization constraints faced by agriculturists and the remarkable loss of organizational capacity of the agricultural sector have brought about critical problems, mostly for small-scale growers.

Also, NMGRs mentioned that the evolution of irrigation is based on two core factors which are considered to explain the successful irrigation management view (SIM). The first is more efficient water use compared with that of past times and other regions of the country. The second is the growing irrigation technology in the Mexicali Valley, which in turn is linked to increasing efficiency and successful irrigation management. Conversely, failures in irrigation management (FIM) are also mentioned and this is said to be observed in the operation, administration, and conservation tasks carried out by the SRL/WUAs. Newer water managers interviewed emphasized that organizational constraints among individual irrigators as well as among the twenty-three irrigation modules are inducing managerial problems at the irrigation district level. An interviewee makes the following reflections on these issues:

> We consider that the Mexicali Valley case has served as an example or development model based on an ensured water source, the Colorado River flow. This fact has allowed for an 'impressive' agricultural development of this region [...] It is from the diversification of crops and the efficient operation of the water system through the 1944 Water Treaty and afterwards that the Mexicali Valley is now what it is!! [...] However, every advance or progress is always accompanied by problems and, in this sense, a good, benefit or progress for someone often brings about a bad to other. Such is the case of agricultural development that brings together water sources pollution, pesticides damages for humans, increasing water demands and scarcity, commercialization problems, etc." (Int_1).

THE SALINITY PROBLEM ISSUE: NMGRs' views

The newer and older water managers' views regarding the salinity problem and the way how agriculturists faced it appear to be analogous. Newer water managers articulated just a few arguments to explain the negative impacts of the salinity in agriculture and irrigation of the Mexicali Valley, participation of agriculturists in the conflict, and influence of agriculturists towards finding solutions. For instance, newer water managers highlighted the damages in the Mexicali Valley due to the salinity of the Colorado River (SAD) while expressing descriptive aspects like the following:

> "....it was a 'technical' need of the U.S. users for mixing sewage with cleaner 'white' waters and then delivered them as polluted water downstream into México, as part of a unilateral solution to domestic problems. As a result, salinity over Mexican agricultural lands began and brought about a drastic reduction in crops' yields as well as of agricultural lands in the Mexicali Valley." (Int_2).

Also, the salinity problem is considered as a critical transboundary water conflict that even nowadays is still having costly consequences for local agriculturists. Yet, newer water managers emphasized the high level of adaptability as a habit that local agricultural water users used as a valuable social process to face productivity adversities that the salinity crisis brought about (ADA).

In regards to the agriculturists' high participation during the salinity problem period (HIP), 67 percent of newer water managers respondents highlighted the highly effective diplomacy put into practice by the Mexican government which was tightly coordinated. This was so because of the high degree of agriculturists' participation characterized by a strong, unified force that helped governmental agents and agencies to defend and negotiate a "definitive solution" to the salinity problem. This fact gave local agriculturists recognition as key actors pushing both the state and national governments to obtain compensation. In this regard, agriculturists were highly influential and, as such, the main beneficiaries of the negotiation process (ITS and IBI).

For example, newer water managers mentioned that agriculturists were thoroughly informed about the process, having significant and direct participation in the definition of the technical parameters to be included in the "updated" international water framework between the United States and México (Minute 242) as well as building of the Wellton-Mohawk Canal bypass device to carry out drainage water through Mexican territory into the Gulf of California (REQ).

In this same aspect, newer water managers' point of view is in line with that of older water managers as well as agriculturists who recently raised the issue through voice of their representatives within the Colorado River and Baja California's Basin Council

(Consejo de Cuenca del Río Colorado y de Baja California, CCRC y BC). They insisted on the significance of such an achievement when Mr. Juan Salgado Becerra, an elder agriculturist and representative of the agricultural water users in the CCRC y BC recalled that:

> "......I am a lucky man; I am one of the participants and defenders of the agriculturists during the salinity problem, one of the few that are still alive and updated. And I want to ask here to the new federal officials that you must keep always in mind that those achievements were too costly to us and that you officials must now defend the idea of maintaining the flow of the Wellton-Mohawk Canal that nowadays feeds one of the most important wetlands in the region, the Santa Clara Wetlands placed just at the end of the Colorado River." (Part of his speech at the CCRC y BC meeting, December the 9th, 2009).

Finally, newer water managers mentioned that another benefit for agriculturists as a result of their high extent of participation and technical and political influence in the salinity problem is related to their daily productive activity. Such a benefit refers to financial support and official intervention to implement the Mexicali Valley's rehabilitation program in order to recover productivity of agricultural lands (REL).

THE ALL-AMERICAN CANAL LINING CONFLICT: NMGRs' views

In regards to the All-American Canal lining conflict during the 1990s-2000s, all interviewed newer water managers appeared to be in line with agriculturists (from all regions) and older water managers' views about the imminent damages that the All-American Canal lining project would bring out to the Mexicali Valley (JEO). The institutional function depiction is shown as follows (see also Table 6.10):

$$JEO = f\,(UCY, CYC, DRE, RAF, RED, WET, CON, COI, NEM) + IOP$$

Table 6.10 Perceptions of newer water managers on the potential impacts of the All-American Canal lining project in the Mexicali Valley.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
JEO = All-American Canal lining as a threat to the Mexicali Valley's sustained agricultural development.	UCY = Uncertainty about the impacts.	66	- Perceived productive, economic, social, and environmental threats. - Opportunity to improve conditions at the local and binational level (win-win situation).
	CYC = Cyclic damages induced by the AAC.	66	
	DRE = The La Mesa Drain as todays' affected water source	100	
	RAF = Regional upper aquifer impacts.	100	
	RED = Reduction of growing areas.	100	
	WET = Impacts on wetlands.	66	
	CON = Controversy on seepage water rights.	66	
	COI = Seeking an international cooperative approach.	33	
	NEM = Good neighbor principle lost	33	
	IOP = Opportunity for mutually improving conditions.	33	

In addition to those factors expressed by older water managers in the previous section, the newer water managers emphasized environmental perils as well as the confusion provoked between water users from both sides of the border due to gaps in the current binational water framework. The risk of losing a large wetlands area together with other natural ecosystems is seen by 66 percent of the newer water manager respondents as one of the major concerns and is considered as a significant factor inducing stress at a binational level over contested waters (WET).

Additionally, newer water managers mentioned that property rights to water seepage belong to many actors, including agriculturists, a critical controversial issue between users in both countries (CON), for instance, in regard to the interpretation of the "*Prior Appropriation Approach.*" For this reason, property rights over the All-American Canal seepage became an international controversy brought to litigation at the U.S.

federal courts by the Mexicali Economic Development Commission (CDEM) and Citizens United for Resources and the Environment (CURE).

Such a controversy was partially due to the contrasts in the interpretation of the *Prior Appropriation Approach*: according to the United States, the surface water that flows through the All-American Canal, belongs to the United States because it represents the first user; as for México the current All-American Canal seepage is not a surface water source but groundwater that instead was first used by Mexican agriculturists and the regional environment (CDEM 2005).

It seems for newer water managers that such dissimilar positions appear to be hindering the achievement of a cooperative behavior that IBWC/CILA promoted in order to negotiate a "win-win" situation instead of the compensatory approach or litigation (COI). Ultimately, this conflict also blocked the establishment of the "Good Neighbor Principle (NEM)." In this regard, a newer water manager involved in binational water management issues directly said that:

> .....another aspect causing high pressure over scarce and contested water resources in this region is without a doubt its environmental use. We have valuable ecosystems, maybe better valued by the international community than by locals. An important area of wetlands and other water ecosystems linked to the All-American Canal seepage is going to disappear. We are facing the issue [AAC] and we disagree with the perspective of mitigation/compensation. We'd better prefer to talk in terms on the context of international cooperation, which is, we are trying to induce a win-win situation. However, the controversy over water rights and the litigation process is blocking the implementation of this approach." (Int_3).

Newer water managers articulated similar views to those expressed by older water managers in regard to agriculturists' institutional participation in the All-American Canal lining conflict (DAS). Additionally, newer water managers emphasized explanatory factors included in the institutional function shown below, which generally states the lack of vertical coordination between agriculturists with state and federal agencies showing a diminished leadership of agriculturists as key agents of change:

$$DAS = f\,(APA, LIN, LES, VIR, FAR, DCY, ELE, SUE)$$

Newer water managers highlighted the generalized apathy shown by irrigators during the All-American Canal episode (APA), demonstrated by a lack of a unified and effective agriculturists' participation in the All-American Canal conflict. At the same time, newer water managers mentioned that the All-American Canal lining "virtual conflict" (VIR) is partly explained by the nature and understanding that agriculturists have about the case itself, just as an interviewee asserts:

> ....At this moment [2008] the All-American [canal lining] conflict is neither a virtual nor an ongoing real problem; instead, it refers to a case of 'potential' damage. The impacts are not still felt in the agricultural area and this fact explains why there is no participation to solve the problem." (Int_1).

This assertion recalls the process of strong, effective participation of agriculturists during the salinity problem due to the characteristics of the conflict at the time when the salinity of the Colorado River water had already caused damages over agricultural lands in the Mexicali Valley. Agriculturists responded through informal customary transactions or habits such as the amalgamation of a union of unions as well as a commercial boycott as the core informal institutional device.

Moreover, newer water managers mentioned that water agencies like the Mexican National Water Commission and the International Boundary and Water Commission-Mexican Section appear to be the "proper, and maybe, unique" instances to review and solve the conflict. Under this perception, newer water managers stressed the idea that irrigation water users are not seen by such agencies as key actors that could influence the negotiation process (FAR). This is evident despite an implemented diplomatic acknowledgement by the International Boundary and Water Commission (IBWC) and the Mexican Secretary of Foreign Affairs, who failed to reach a suitable solution for both countries (DCY). This in turn, induced the involvement of social actors other than agriculturists, such as the Mexicali Economic Development Commission and Citizens United for Resources and the Environment (ELE).

As a result, such urban-based and environmentalists groups initiated an unsuccessful civil action against the U.S. government (SUE). On April 6, 2007, the 9th Circuit Court of Appeals in San Francisco lifted the injunction issued in July 2005 which had impeded the lining of the All-American Canal. This federal court rejected all the litigants' arguments. Among other reasons, the Judge Sidney R. Thomas said that the 1944 Water treaty states that the Mexican government is allowed 1.5 million acre-feet of water from the Colorado River annually and is entitled to no more (Perry 2007).

In the middle of this complex issue, individual agriculturists were considered minor social actors working toward a solution. In this regard, a newer water manager linked to transboundary water issues went further by establishing that:

> There is not enough information; still there is 'confusion' about the seepage water property rights; for Americans, water is entitled to them, conversely, for Mexicans water is entitled to them; for Americans water seepage is classified as surface water while for Mexicans this is a groundwater source [...] I think that the problem is different from that of the salinity just because there is no problem yet, that is, this [the AAC] is right now just a potential problem. By now we don't have any real and direct impact [...] For me, the complexity of the process altogether with the remarkable loss of the agriculturists' political and economic power representing the main reason for them to be excluded as an influential social group. Besides, the lack of agriculturists' involvement and influence on the AAC issue is due to their diminished level of organization. Agriculturists are not participating in the AAC process because the work of the commission [IBWC/CILA] is made through technical committees or task forces where there are only official advisors from CONAGUA and other governmental agencies;

there are no agriculturists' representatives in there. These task forces' work as supports for our diplomatic action in seeking cooperative measures [...] It is important to notice that even though the issue has been presented at the highest diplomatic level [presidential], there has not been the expected positive result, so different to the salinity era. [...] For this reason some citizens' groups such as CDEM have taken legal actions within the United States, although unsuccessfully." (Int_1).

Besides, newer water managers agree with older water managers and agriculturists' views regarding the role of WUAs in the Mexicali Valley which appears to be a weak formal institutional device to participate and influence the All-American Canal process (ELU). The WUAs were not effectively and systematically involved, not were they coordinated with key water agencies such as the IBWC in regards to the All-American Canal issue. Thus, WUAs were not properly representing the local irrigators' interests in the context of this transboundary water conflict that could affect their irrigation. This fact informs about the ineffective participation and lack of influence of agricultural water users in this issue (DIT) either as individual agriculturists, organized irrigators, key actors and agents of positive change, or, at least, key defenders of their own current and future development.

> We [officials] need to encourage agriculturists to be more participative just as some NGOs have demonstrated to be in regards to environmental aspects [...] Agriculturists have shown a lack of integral propositions and this represents a constraint to them to participate in technical committees. They should be more open-minded to seek for cooperative behavior so that both agriculture and other sectors could be beneficiated. For example, we see how the AAC issue would bring about critical problems referred to water shortage for agriculture and, on the other hand, we also see that there is an inefficient irrigation management. In other words, it is true that there could be affected agricultural lands but it is also true that there is a current wasteful use of irrigation water in the Mexicali Valley." (Int_3).

CONCLUSION

The views of older water managers and newer water managers show that agriculturists' institutions have changed from effective mechanisms in the salinity crisis period (t_1) to ones less so in the All-American Canal lining conflict (t_2). In this chapter I find that older water managers showed a broader knowledge over the analyzed issues at the same time they offer deeper argumentation and a larger number of explanatory factors than those of newer water managers.

I also find that the effects of salinity of the Colorado River water and the All-American Canal lining project are similar in scope although with different characteristics both affecting irrigation and agricultural development in the Mexicali Valley. As such, the institutional responses of irrigators evidenced significant changes over time (t_1 vis-à-vis t_2). For instance, water managers noticed that agricultural water users showed a loss of economic and political power that reduced their capacity to organize, participate, and influence transboundary water issues that affect their own agricultural activity and irrigation. For both kinds of water managers studied in this chapter, major differences between the salinity problem and the All-American Canal lining conflict can be explained through the following depiction (see also Table 6.11):

$$\text{DIF} = f\,(\text{DIP, DIS, DOR, DAL, DIG, CIL, LUN, LAC, SOS, BEC})$$

Water managers perceive a difference between the institutional behaviors of different presidents of México during the salinity and All-American Canal episodes, focusing on Luis Echeverría (Institutional Revolutionary Party, PRI) and Vicente Fox and Felipe Calderón (National Action Party, PAN), respectively. Leadership is mostly assessed in terms of the level of accountability to locals and characteristics of their official intervention for improving the Mexicali Valley agriculturists' adverse situation while facing the All-American Canal lining issue. Agriculturists of all regions of the valley as well as water managers recognized that during the salinity crisis, president Luis Echeverría showed strong leadership and, overall, a skillful diplomacy, whereas presidents Vicente Fox and Felipe Calderón were criticized due to the fact that they disregarded the sustainability and future development of the region (DIP).

Table 6.11 Perceptions of older and newer water managers in the Mexicali Valley concerning major institutional differences between the salinity problem and the All-American Canal lining conflict.

THEME	EXPLANATORY FACTORS	FREQUENCY (% OF TOTAL RESPONDENTS)	MAJOR FINDINGS
DIF = Major institutional differences between the SAL and AAC.	DIP = Extent of presidential leadership and accountability to locals.	11	- Reduced extent of agriculturists' organization and local leadership.
	DIS = SAL and AAC as different issues	44	
	DOR =Extent of agriculturists' organization.	55	
	DAL =Extent of agriculturists' leadership.	55	
	DIG =Type of groups making pressure on SAL and AAC.	22	
	CIL = Capacity for influencing changes.	44	- Reduced capacity of agriculturists to influence change.
	LUN = Extent of unity and participation.	33	
	LAC = Extent of interest in the AAC.	33	
	SOS = Socio-productive structure (due to the high level of lands rented.	22	
	BEC = Degree of economic constraints in local agriculture.	11	

Such a different presidential behavior had direct repercussions in the level of organization and strength of agriculturists as a unified force as well as in the predominance of local leadership (DOR and DAL). During the salinity crisis agriculturists showed unity embodied in the informal institutional structure of "union of unions" which was self-financed and headed by local leaders that enjoyed high levels of credibility.

On the other hand, during the All-American Canal conflict, an organizational, economic, and financial disarticulation within the irrigation sector was clearly noticed along with the lack of effective representation of WUAs and SRL in the issue. As a result, a major change took place: strong agriculturists' unions during the salinity period were replaced by urban-based groups representing the interests of "all" water users in the All-American Canal lining issue (DIG). Hence, the capacity shown by agriculturists in the past to influence the definitive solution to the salinity is now significantly weakened in the context of the All-American Canal conflict (CIL, LUN, and LAC).

In general, newer water managers are in line with older water managers' perceptions about the themes and sub-themes emerged from the qualitative analysis as well as with the kind of explanatory factors for each institutional function. Yet, newer water managers always showed fewer arguments and factors supporting their views. That is, older water managers tended to express a better understanding of transboundary water issues and, as such, offer broader explanations on the causes, effects, behaviors, and alternatives included in the institutional explanatory functions.

It seems to be a logical outcome given older water managers' deep and integrated knowledge about issues based on their own experience of working in the Mexicali Valley while living through the two periods of analysis, the salinity and All-American Canal issues. This in turn enables older water managers to understand the problems and to be concerned with agriculturists' socio-productive conditions

CHAPTER 7

CONCLUSIONS

CHANGING ROLE OF AGRICULTURAL WATER USERS BETWEEN THE SALINITY AND THE ALL-AMERICAN CANAL LINING DISAGREEMENTS

This research is about the impact of institutional arrangements followed by agriculturists in the Mexicali Valley during two critical transboundary water conflicts that affected irrigation and agricultural development: the salinity problem (t_1) and All-American Canal lining (t_2) issues. The kind and impacts of institutions followed by agriculturists to participate and influence decision-making in such events at the local and binational level have changed over time so much that agricultural water users are acknowledged as key stakeholders pushing out to reach solutions to critical cross-border water conflicts in the past salinity crisis. Nonetheless, now, they show different institutional behaviors and diminished influence during the All-American Canal lining conflict. This fact in turn informs on the occurrence of factors that favor or halt suitable process for transboundary and irrigation water management in the region.

Schmid (2004) states that an institutionalized combination of several perspectives that link the physical, legal, social, economic, and political aspects around water issues should consider the bottom-up approach as a necessary condition to face the complexity of managing cross-boundary waters, moreover if irrigation water is involved. This study emphasizes the aspects left aside in the studies and the literature: the institutional aspects that determine the context of efficiency and, in this dominion, the study focuses on the changing role of key actors such as agricultural water users in reaching efficiency to manage transboundary waters which in turn may affect irrigation in the Mexicali Valley.

The reported qualitative research provides an analysis of the views and meanings of agriculturists and water managers regarding the evolution of agriculture and irrigation, transboundary water management issues, and socio-productive processes in the Mexicali Valley, México. This study suggests that such agriculturists' socio-productive processes, forms of organizing, and institutions changed over time influenced by the context or situation in place and this in turn have impacted, to a different extent, local agriculture and irrigation.

Considering that socio-organizational and institutional features determine management capabilities, the first question I explored reflects the characteristics of institutions used by agriculturists in each case, the salinity and the All-American Canal. Next, guided by the second and third central questions, I explored institutional arrangements followed by agriculturists to see how they affected the agriculturists' productive activity and irrigation water management and also how this impact showed different levels of stress according to particular areas of the valley, that is, the northern, central, and southern Mexicali Valley. Finally, the fourth research question investigated the influence of agriculturists for inducing institutional change at both the local and binational water management levels.

Schmid (2004) states that institutional impact analysis attempts to explain how alternative formal and informal institutions affect commodity transactions and substantive economic outcomes of wealth and its distribution, whereas institutional change analysis requires an evolutionary model. The author affirms that "individuals are born into an institutional world that shapes their thinking, and their thinking shapes the institutional world." As such, change analysis is essentially about the learning process combined with the existing rules for making rules; it must explain change in informal institutions and culture as well as formal institutions created by legislatures.

Key findings of this study are quite thought provoking. Based on the primary (agriculturists' and water managers' interviews) and secondary data analyzed in this study I draw the following general conclusions as related to research questions previously established (see Appendices B, C, and D):

1. It appears that the social, demographic and economic contexts in the Mexicali County (including rural and urban areas) have changed significantly between t_1 and t_2 so that both industrial and urban developmental aspects are currently gaining momentum.

2. It is noticed that there are opposite views among agriculturists concerning agricultural development and irrigation evolution in the Mexicali Valley. Some consider that agricultural development and irrigation are declining while others say the contrary. This is related to the observed social polarization and high extent of elitism among agricultural water users.

3. During the salinity problem period, a unified, strong participation and leadership among agriculturists was noticed as the hallmark of informal institutions that they created.

4. Conversely, the All-American Canal lining episode, weak participation from a disarticulated agricultural sector represented by formal institutions such as water users' associations and irrigation society who were replaced by urban-based groups such as the Mexicali Economic Development Commission dominated.

5. There are different levels of stress perceived in both the salinity problem and the All-American Canal lining conflict depending on the region of the valley studied. The salinity affected mostly the central and southern areas whereas the All-American Canal lining project is seen as posing more risks initially in the northern Mexicali Valley.

6. Convergences and disagreements exist between agriculturists and water managers regarding views of impacts of agriculturists' participation. Major convergences refer to perceptions about agriculturists' institutional effectiveness in the salinity problem as well as on their minimal institutional participation and no impact during the All-American Canal lining conflict.

7. By comparing t_1 and t_2, it appears that agriculturists have lost economic, political, and organizational power to participate and influence institutional change concerning transboundary water issues.

8. There are significant differences between older water managers' and newer water managers' perceptions as well as between water managers and agriculturists about the impacts of institutions followed by agricultural water users in the Mexicali Valley. Older water managers are more tied to agriculturists' concerns and the newer water managers appear to keep a more managerial stance.

Such findings show that while comparing t_1 and t_2, agricultural water users' institutions, socio-organizational and productive conditions in the Mexicali Valley have changed. Prevailing informal institutions and procedures created by agriculturists during t_1 were effective structures for participating and influencing local and transboundary water management policies that directly affect irrigation functioning and agricultural development in the Mexicali Valley.

Conversely, for the t_2 case, the dominant formal institutions based on the SRL/WUAs voice (or inactivity) were ineffective institutional devices encouraging participation and influencing transboundary water issues that are directly linked to local irrigation functioning and, ultimately, to the well-being of the agricultural sector in the Mexicali Valley. In sum, the changing role of agriculturists between the salinity and All-American Canal episodes may be explained by the kind of institutions they put in practice.

ENVIRONMENT FOR INSTITUTIONAL IMPACT AND CHANGE IN IRRIGATION AND TRANSBOUNDARY WATER MANAGEMENT.

The general aspects analysis related to the evolution of agriculture and irrigation in the Mexicali Valley represents a background that allows for a better understanding of the kind, impact, and change of institutions followed by agriculturists during t_1 and t_2 transboundary water episodes. General features expressed by agriculturists in this regard help explain the significant change in the extent of agriculturists' participation as well as the impacts of institutions during the salinity and All-American Canal processes.

Findings show that water managers embrace a dominant view of progress in the agricultural sector of the Mexicali Valley which differs from that of agriculturists (in all regions of the valley). This in turn confirms a concept raised by Chambers (2000, 58) which informs on the different perspectives between uppers (i.e. managers) and lowers (i.e. agriculturists) regarding agricultural developmental aspects and in which each type of actor can visualize socio-productive advances or regression in a very different degree and according to their own reality.

In regards to the evolution of irrigation, agreement exists between agricultural water users' and water managers' views both supporting the idea of parallelism between successful irrigation management and failing irrigation management perspectives which, as a principle, elucidates the existence of irrigation users categories in the Mexicali Valley.

Also, research about general aspects regarding evolution of agriculture and irrigation in the Mexicali Valley as seen by water managers and agriculturists helps to clarify types and impacts of institutions followed by agriculturists during t_1 and t_2. Water managers and agriculturists perceive such general aspects issues differently. For example, the progress view dominates over the regression one for water managers while the opposite is true for agriculturists. Furthermore, older water managers interviewed do not r

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mentioned the "regression" view. This contrasting perception between interviewees shows the dominance of the water managers' managerial perspective.

In addition, the successful irrigation management and failing irrigation management perspectives co-exist in the older water managers' views. Convinced by the weight of the evidence in the field regarding more specific issues linked to their own activity, the managerial perspective expressed the recognition of significant advances in irrigation in the Mexicali Valley. Albeit they also see how a high degree of bureaucracy, the elitism among individual water users, WUAs' lack of a system view, lack of technology, and lack of investment among many other factors (a longer list than that offered by agriculturists) support their failing irrigation management perspective.

The aforementioned might represent fundamental factors explaining the differences among agricultural water users belonging to the regions of the Mexicali Valley, that is, the northern, central, and southern areas. All this together, as a general framework, helps to explain both the agriculturists and the water managers' views on the extent of participation of agriculturists during $t_1$and t_2 as well as the major institutional impacts and changes observed between both time frames (see Appendices C and D).

In summary, the empirical findings from this qualitative research indicate that the social polarization and differentiation among irrigators in the Mexicali Valley may be embraced by the concept of "structural inequity" (Galtung 1980, 64). This in turn is meant as a basis for appreciating the changing role of agriculturists in the Mexicali Valley regarding local irrigation and transboundary water management.

DO INSTITUTIONS MATTER FOR IRRIGATION AND TRANSBOUNDARY WATER MANAGEMENT IN THE MEXICALI VALLEY?

The institutional analysis approach used in this research is characterized by a combination of perspectives: it attempts to explain the emergence of institutions according to an evolutionary trend that emphasizes not taking the individual preference function as given; it assumes that an individual, through cognition and learning processes, builds up new conceptions and habits (Hodgson 1998). Also, the institutional analysis shows the necessity for "creative thinking," which can be interpreted as an emerging broad approach that combines a variety of perspectives (Acheson 2000). Embraced by this theoretical-methodological stance, institutions are generally regarded as regularities and social behaviors or, the rules of the game in society (Schotter 1981; Ostrom 1990) including the humanly devised constraints that shape human interactions (North 1990). Hence, power issues emerge as an elemental standpoint in the analysis.

Schmid (1995) elaborates on aspects of factual statements and value judgments to understand institutions. The former aspect explains how the world works, the latter what people ought to do, that is, the potentialities of policy change. Considering that natural resources are fundamental for economic development and that they tend to be scarce, issues such as externalities and transaction costs are central in institutional analysis as well as for understanding fundamental institutions.

CPRs are a suitable laboratory to observe sources of human interdependence (Ostrom 1998). The author formulates "design principles" that characterize all robust CPR institutions. By basic design principles she means "essential elements or conditions that help to account for the success of these institutions in sustaining CPRs and gaining the compliance of generation after generation of appropriators to the rules in use. These design principles play an important role because they can affect incentives in such a way that appropriators will be willing to commit themselves to confirm to operational rules devised in such systems to monitor each other, obey the rules, and to replicate CPR institutions across generational boundaries.

Schmid (2004) adds that in this context institutions can be understood as the human relationships that structure opportunities or constraints. A constraint on one person is an opportunity for another. They also affect beliefs and preferences and provide order and predictability to human interaction. Thus, the evolution of institutions is a function of both formal and informal processes.

The underlying issue regarding natural resource use and exploitation according to Schmid (1995) is scarcity. Thus, incompatible use goods (IUG) and high exclusion costs goods (HEC) embrace the dominant sources of human interdependence. The author asserts that assigning property rights is not enough without effective accompaniment of regulatory institutions. Yet the effectiveness of institutions is a function of the nature of natural resources in question as well as sources of human interdependence (situation).

Considering that more naturally occurring factors are the ones influencing the involvement of agriculturists in use of water resources and the effective management of irrigation systems, then the situation becomes more complex. This fact justifies the assertions coming from studies that have theoretically elaborated on the limitations and opportunities of agriculturists for participating and influencing transboundary water management as particular types of CPRs (Ostrom et al. 1999, 278; van Laerhoven and Ostrom 2007). While analyzing CPRs, the authors do find that most successful resource management practices often involve small to relatively large groups within a single country. Besides, they find that particular transboundary settings - such as shared large international basins - represent a challenge to addressing problems because of the nature of the inherent difficulty to manage resources.

Taking into account such a setting constraint, other authors insist that management and conflict resolution concerning transboundary resources depend on the cooperation of appropriate international institutions as well as those working at the national, regional, and local level (Axelrod 1984; Dawes 1990; Meidinger 1998; Yaffee 1998).

This research suggests that while analyzing institutional issues around irrigation and transboundary water management in the lower Colorado River basin, as a type of international CPR, the salinity and All-American Canal issues may bring about on the changing role of the Mexicali Valley' agriculturists regarding irrigation and transboundary water management into this particular setting.

Institutional structures, agriculturists, and the salinity problem.

I attached the findings on the salinity problem issue to the specific institutional analytical framework explained in Chapter 2 regarding the situation, structure, and performance links (Table 2.2). The situation in this case expresses three main features or sources of human interdependence for the good under study (transboundary common pool resource): a) incompatibility in use (IUG), b) high exclusion cost (HEC) and its variant of cooperation choices (PD), and c) economies of scale.

Taking into consideration the lack of factor ownership regarding water quality standards for sharing transboundary waters between the United States and México during t_1, the major institutional structures show a variety of alternatives that include the following: binational bargaining options, administrative (regulation) and customary transactions, definition of property rights for water quality, collective action, cost sharing rules for implementing water infrastructure programs, and, finally, institutional change or adaptation of the binational water framework (International Water Treaty).

In Chapters 3, 4, and 5, I analyzed the agriculturists' perceptions about the salinity crisis issue. Gathered data confirms that the features of institutions and social behaviors followed by agriculturists in the Mexicali Valley during this episode, showed a broad variety of human relationships which together enabled them to create opportunities towards achieving a high extent of participation. Such institutions are characterized by informal processes based on strong agriculturists' customary ideologies or habits that gave as a result the later implementation of formal institutions such as the internal contracts to develop the well-known "Rehabilitation Program of the Mexicali Valley," or, at an international level, the *addendums* to the 1944 Water Treaty (Minute 242).

For instance, during t_1 the high degree of unification and coalition within the agricultural sector represented an informal institutional behavior guided by local and national leaderships which enjoyed a high level of credibility among agriculturists. This fact made individual agriculturists and unions of different sort a much more cohesive social force that had the ability to call for massive public meetings to boycott bilateral commerce between the United States and México. Also, they showed significant coordination capabilities to ask federal government officials (including the president) for directly solving the problem and establishing formal commitments towards solving the critical salinity problem.

Furthermore, such a group or "union of unions" showed a high extent of autonomy since they employed formal and informal independent financing mechanisms to collect funding to support their several political activities and social participation. This specific process had similar characteristics to a fundraising mechanism which was voluntarily given through a portion of the water fees (five Mexican cents per liter served at the individual parcel level or on the normal irrigation water allotment basis) of each irrigation schedule along the agricultural productive cycle.

These funds were jointly administered by federal water agencies and the agriculturists' unions. Although a combination of institutions and organizations were in place at the time, informal processes and groups dominated the scene and also made pressure upon formal entities to mobilize towards finding suitable solutions to the salinity problem with the overall aim of getting compensation and beneficiating the local agricultural sector in the Mexicali Valley.

On the other hand, the data shows the impacts of institutional arrangements created and followed by agriculturists in the Mexicali Valley on transboundary water management, irrigation, and agricultural development during t_1. The impacts were consistent with positive repercussions for the whole Mexicali Valley. From the agriculturists' standpoint, their institutions favored the high level of participation and this in turn appeared to be an effective mechanism for reaching the main objectives of recovering the productive status that agriculturists used to have prior to the salinity crisis period, thus, improving irrigation water management and regional agricultural productivity.

Evidence of the impacts of implementing informal institutions during the salinity crisis allowed agriculturists to gain acknowledgement as influential social and political actors that pushed towards getting direct local benefits such as the definition and implementation of financial programs at the parcel level as well as at the macro level for the whole irrigation district in the Mexicali Valley.

Furthermore, agriculturists were influential in the process of obtaining benefits at the binational level through the stimulation they cause for modifying the legal framework regarding transboundary waters, specifically, the establishment of Minutes 218, 241, and 242 of the 1944 International Water Treaty, all of them related to the salinity problem. In fact, informal institutional structures such as the customary transactions represented by the "confederation" of formally established agriculturists' unions that promoted boycott represented a standard operation procedure used by agriculturists that ultimately produced formal institutional change in the local and binational legal frameworks for irrigation and transboundary water management, respectively.

Salinity seen through the other mirror

In Chapter 6, the data show that for water managers, similar to what interviewed agriculturists affirmed, the institutions created by agriculturists during the salinity problem were characterized by informal institutional processes based upon strong agriculturists' customary transactions that enabled agriculturists to strongly participate in such a process. This kind of participation gave as a result the change and later implementation of formal institutions. This fact fits Schmid's (2004) concept of the situation-structure-performance link and the evolutionary model to understand institutional change.

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To illustrate this point, here is emphasized how older water managers see that the high extent of existing harmony among agriculturists embodies an informal institutional social behavior guided by local and national leaderships. This fact makes individual agriculturists and their respective unions to form a strong informal cohesive social force named "union of unions". Besides, agriculturists' main characteristic observed by older water managers in the entire Mexicali Valley during t_1 was the local leaders' high level of participation that enhanced other informal but effective social behaviors and operation procedures for managing water and lands in the productive arena as well as for participating in massive meetings. For instance, agriculturists developed a capacity to adapt to an adverse situation created by salinity on their lands. Local agriculturists addressed the problem by modifying several water and land management practices in order to keep up production on their lands.

Also, informal institutions followed by agriculturists proved to be effective devices for reaching the main objectives such as improving conditions for agriculturists in the Mexicali Valley. Evidence about such impacts is that informal institutions allowed agriculturists to gain acknowledgement as key actors pushing towards getting benefits such as the definition and implementation of supportive agricultural credit programs at the parcel level. Water managers mentioned that the rehabilitation program was initially seen as a strategic regional policy that intended to establish a new crops pattern based on grazing and livestock to replace the traditional cotton and wheat production in the Mexicali Valley. The rehabilitation program is acknowledged as one of the major benefits obtained as a result of the strong agriculturists' social participation during t_1.

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Water managers also recognize that agriculturists were influential in the process for obtaining benefits at the binational level while encouraging modifications to the transboundary water management framework. In fact, informal institutional structures such as customary habits were crucial towards achieving this purpose.

Institutional structures, agriculturists, and the All-American Canal lining conflict.

I also attached the findings on the All-American Canal lining conflict to the specific institutional analytical framework explained in Chapter 2 (Table 2.3). The situation in this case expresses two main features or sources of human interdependence for the good under study: a) incompatibility in use (IUG), and b) high exclusion cost (HEC) and its variant of interdependent binary choices (PD).

In view of the nonexistent factor ownership regarding transboundary groundwater resources between the United States and México during t_2, the major institutional structures elicited a variety of alternatives that include the following: binational bargaining options, administrative (regulation and litigation) and customary transactions, collective action and potential claims in international courts, and, finally, market mechanisms after defining property rights.

Analyzed data in Chapters 3, 4, and 5 regarding the All-American Canal lining conflict, shows that according to interviewed agriculturists, the characteristics of institutions employed by agriculturists of the Mexicali Valley during t_1 and t_2 differs significantly. Agriculturists participating as individuals and as formal organizations (i.e. water users' associations and irrigation society), operated institutional structures that tended to constrain them in order to create opportunities for having a broader participation in the All-American Canal lining conflict, exposing a noticeable weak defense of the issue.

Such combination of formal and informal institutions was characterized by processes attached in the agriculturists' behavior which was mostly guided by formal institutions embracing organizational figures like water users' associations (WUAs) and irrigation society (SRL), which systematically eluded and excluded the All-American Canal lining conflict from their normal operation procedures and managerial responsibilities. Social disarticulation within the agricultural sector and the lack of political and economic power hindered the agricultural water users involvement in t_2, thus, blocked the effective representation and influence towards finding a proper solution for them not become affected.

A generalized apathy and lack of leadership together with the nonexistent financial capacity within the irrigation sector to participate in such issues represented an unfavorable condition for individual agriculturists to voice their concerns rather than the constituency used to rest on water users' associations representation as the formal institutional structure they could count on. Yet, heavy bureaucracy in the co-management processes between WUAs/SRL and CONAGUA made them lose representativeness in such a process. Instead, WUAs and SRL show a remarkable accountability to federal water agencies as much as a lack of coordination with those key transboundary water agencies like the International Boundary and Water Commission-Mexican Section. Such institutional behavior brought agricultural water users to remain under the umbrella of external leadership which represented the hallmark of the low level of participation and weak defense of the All-American Canal issue on the part of agricultural water users.

The impacts of institutions followed by agriculturists during t_2 on transboundary water management, local irrigation, and agricultural development evidenced that dominant formal institutional structures hindered their participation and made them appear as ineffective actors towards reaching the objective of being considered as a voice that might be heard by negotiators for improving water management conditions in the Mexicali Valley.

Findings of this study for the t_2 case show that agricultural water users appeared to be irrelevant actors within the process of influencing positive change at a binational level. For example, agriculturists did not induce, participate, and influence a needed modification of the legal framework regarding transboundary groundwater management issues, which is currently nonexistent and that ultimately gave place to the All-American Canal lining conflict. Formal institutional structures in which agriculturists were engaged during t_2 are seen as a social behavior that shows the agriculturists' loss of economic and political power to influence transboundary water management issues affecting agriculture in the Mexicali Valley. As such, this key stakeholder is no longer a social actor with capacity to produce formal institutional change at the binational level.

The All-American Canal water seepage seen through another magnifying glass/perspective

In line with the agriculturists' standpoints, in Chapter 6 the data shows that as for water managers, formal institutions embraced by agriculturists during t_2 seemed to obstruct the agriculturists' participation and made them ineffective actors for reaching the main objective of being considered in the All-American Canal process. Agriculturists could have obtained compensation for potential damages in the form of investments for improving irrigation water management and agricultural development in the Mexicali

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Valley. Hence, the prevailing formal institutional structures blocked agriculturists from attaining significance as social and political actors; as such, they were frequently disregarded as irrelevant in this process.

Water managers revealed that the lack of social organization of individual agriculturists induced them to lose capacity to form a unified force that might have influenced a much needed positive change. These kind of habits (rather than being promoted) were absent in the rural realm during t_2 and as a result, formal structures of WUAs/SRL were unique organizational devices representing the agriculturists' interests.

In the same manner, agriculturists and their WUAs/SRL were irrelevant actors in the process of influencing positive change at the binational level. For example, they were not formal participants of the International Boundary and Water Commission's roundtables 1 and 5, which were constituted as special steering committees for analyzing the (current, remaining) salinity issues as well as the All-American Canal lining conflict, respectively. This shows that formal institutional structures followed by agriculturists are seen by water managers as an institutional behavior that indicates loss of political power to influence local and transboundary water management affecting irrigation and agriculture in the Mexicali Valley. Moreover, both older water managers and newer water managers stated that agriculturists and their WUAs/SRL are key stakeholders; nonetheless, they no longer represent a social force with capacity to produce formal institutional change at a binational level.

Even though older water managers and newer water managers share some similar opinions, there are also significant differences between them about their perceptions on the role of agriculturists in irrigation and transboundary water management. For example, older

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older water managers show significantly broader experience on such issues under study by frequently exposing more elaborate arguments characterized by being much more tied to the agriculturists' interests and concerns. On the other hand, newer water managers (i.e. belonging to the International Boundary and Water Commission-Mexican Section and the Mexican National Water Commission) expressed a more managerial perspective based on their uppers' policy approach. To illustrate this point, below is cited a statement from an influential federal official. Former Secretary of Environment and Natural Resources and current Secretary of Agriculture, Mr. Alberto Cárdenas (member of the National Action Party), said during a recent visit to the Mexicali Valley:

> ".....it is necessary to save more water in the agricultural sector in about 50 percent of the current use, since here the water is being wastefully used. [...] It is an urgent necessity to increase irrigation water use efficiency through new techniques, technologies and better management practices. Although it is worth to mention that the Mexicali Valley is working under different conditions to that of the rest of the country, here, with just little water agriculturists could be very competitive and make a difference." (La Crónica de Baja California news 2008, August 19, A1).

The other main local irrigation water manager in the Mexicali Valley, Mr. Carlos Castro, General Manager in the SRL, pointed out the following during his participation in a plenary meeting of the Colorado River and Baja California's Basin Council (CCRC and BC):

> "Water is critical for strategic regional development not just for agriculture. We agricultural water users manage about 86 percent of the total availability coming from the Colorado River system; also we utilize such water inefficiently. We all know that it is necessary to increase efficiency in about five percent in the short-term so that pressures coming from rapid population growth and climate change cannot reach us and water availability remains still sufficient for everybody." (Part of his speech at the CCRC y BC meeting, December the 9th, 2009)

As it may be read, the above assertion is mostly presented in general terms and under an overall managerial view based on the efficiency water use standpoint

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(Svendsen, Wester, and Molle 2005, 16). This feature can be better understood while reviewing the institutional functions obtained in which NMGRs often expressed not only almost the same but also less explanatory factors for the two cases under study. To illustrate this, two frequent responses from water managers are cited below. For instance, an interviewed newer water manager pointed out the following regarding the All-American Canal lining conflict:

> Agriculturists must focus on their own productive activity; they should try to be more efficient when using their individual water allotments and according to the official irrigation plan. If they were more aware of potential water scarcity then they would be more concentrated in improving the several irrigation duties such as assuring good irrigation canals functioning, building inter-parcel canals, implementing water control devices and improving water use in their lands instead of spending time in mobilizations for avoiding the AAC lining. This is a task entitled to governmental water agencies." (Int_3).

By his part, an older water manager expressed his opinion on the same regard (All-American Canal lining issue) as follows:

> I think that agriculturists should participate more directly in the All-American Canal conflict. If they don't, then they would be the people that should have to solve critical problems later. They should apply their outstanding learning obtained during the salinity crisis in order to get a fair treatment within the current All-American conflict; ultimately, all of us depend on the good functioning of the agricultural sector once this brings out more jobs, investment, food, and regional development. Agriculturists have always been and unavoidably going to be, the foundation of our economy, this is an important agricultural area, and we all must keep this in mind all the time." (Int_2).

IMPLICATIONS

The implications of knowing the changing role of agriculturists in irrigation and transboundary water management issues in this research are that such knowledge may help currently operating agricultural water users as well as other key stakeholders such as water managers and agencies to look at the institutional structures that better fit a specific si

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situation in place and, ultimately, to find a way out towards reducing current and potential conflicts over the ever-increasing contested transboundary waters in the lower Colorado River region.

The primary aim is to encourage cooperation among several water users and between countries to find effective mechanisms that may facilitate the task of reaching the fundamental goals of getting an equitable, efficient, and sustainable use of water at the local, regional, and binational level. Regarding the suitable institutional structures to put into practice, this study suggests that since transboundary water conflicts are an ever-lasting issue that in turn are also intertwined to the local irrigation in the Mexicali Valley, the effective inclusion and representation of key stakeholders like agricultural water users into such processes might facilitate the achievement of the mentioned fundamental objectives. In the same vein, it is important to call for significant changes in key organizations directly related to transboundary water issues such as the International Boundary and Water Commission-Mexican Section who must promote the participation of agriculturists in the round tables one (salinity issues) and five (All-American Canal lining issues).

There exists a combination of formal and informal institutional arrangements that took place during t_1. However, it was observed a clear predominance of informal customary habits that were put in practice during the salinity period and they were effective in promoting a high degree of agriculturists' social participation, thus, obtaining direct benefits to the irrigation and agricultural sectors. On the other hand, formal institutional structures followed by agricultural water users during t_2 appear to be ineffective devices that do not help the agricultural sector to participate and influence the

All-American Canal issue, thus, given the physical interconnections of the lower Colorado River transboundary water system, the major goals in the irrigation sector of the Mexicali Valley were not reached (see Appendices C and D). Here, it is important to rethink the role of agriculturists WUAs and SRL so that they might participate beyond operative tasks through their voicing and representation into transboundary water issues given that they depend on these water sources for operation.

Main findings of this study concur with Schmid's (2004) statements about the significance of the institutional arrangements as enabling or constraining towards achieving a particular productive goal. The author adds that an organization is a means for collective action like that of CPRs' management for individual members within a boundary. He also mentions that an organization is some boundary of people with shared institutions and mutual recognition of opportunity sets. Organizations are systems of relationships for coordinating individual actions according to some decision rule of persuasion a mix of authority and custom. This institutional behavior was present in t_1 and absent in t_2. The key point is to recover the self-financial capacity that agriculturists had in t_1 which in turn might help to increase their capacity to organize themselves and effectively participate in transboundary issues that affect local irrigation.

An urgent need for recovering and strengthening the local actors' participation in transboundary water issues has been argued by other authors who established that the potential for success in the process of binational resource management along the U.S.-Mexican border increases with an informal, regional "bottom-up" approach rather than with a more traditional "top-down" diplomatic or regulatory approach. The focal point of this argument, is that the bottom-up, local people-centered approach emphasizes social processes, builds relationships, and strives for consensus through shared value formation and the co-evolution of perceptions and preferences, which in turn tends to favor integrated water resource management (Browning-Aiken et al. 2004).

Others authors recommend acting in congruence with "substantive stakeholder representation" instead of just "stakeholder participation." This appears to be a better way to achieve equitable, efficient, and sustainable water management (Wester, Merrey, and de Lange 2003, 798; Wester, Shah, and Merrey 2005, 232). This is what happened in the salinity problem case whereas during the All-American Canal lining conflict agriculturists in the Mexicali Valley could not effectively promote it. Milch and Varady (1998) elaborate on the use of the top-down paradigm to try to solve transboundary water conflicts in the United States-México border region. They go on to say that "local agents [officials] lack of the capacity and motivation to be effective, and local informal institutional arrangements that might have become the basis of formal institutions for cooperation are largely ignored." This later assertion describes what occurred during the All-American Canal lining conflict.

Furthermore, in line with the findings of this study, Schmid (2004, 99) states that an institutionalized combination of several perspectives that link the physical, legal, social, economic, and political aspects around water issues should consider the bottom-up approach as a necessary condition to face the complexity of managing cross-boundary waters. Ultimately, this study suggests that institutional aspects determine the context of efficiency and this in turn, in this case, determines the changing role of agricultural water users in irrigation and transboundary water management. All this together encourages increasing the effectiveness of managing transboundary waters as well as reducing critical issues impacting irrigation and agriculture in the Mexicali Valley.

SUMMARY

The institutional analysis used in this research on the salinity problem and the All-American Canal lining conflict facilitates the understanding of the changing role of agriculturists in the Mexicali Valley in irrigation and transboundary water management in the lower Colorado River. Such a role is a reflection of both the kind of institutions in place as well as the way how agricultural water users organize themselves. Besides, such a methodological tool is useful in informing about the evolution of institutions and processes that became this key stakeholder powerless over time (t_1 *vis á vis* t_2) to induce positive change.

This research also makes it possible to discern the main disagreements and convergences between the two categories of water managers studied (older and newer) and between agriculturists and water managers in regards to the perceptions concerning the extent of stress that each transboundary water issue entailed to the Mexicali Valley, México.

Finally, this research also shows the impacts of institutional arrangements, formal and informal, followed by agricultural water users to face remarkable events in the recent history of locals' lives, the salinity and All-American Canal lining issues, both affecting irrigation and agricultural development in the Mexicali Valley, México. At the end, the valuable learning obtained from institutional arrangements created by agricultural water users during the salinity crisis and All-American Canal lining episodes might help local agriculturalists induce the necessary institutional adaptation and evolution so that they can properly face the everlasting challenges of living and working in a transboundary setting as well as achieving equitable, sustainable, and efficient irrigation water use.

APPENDIX A

SEMI-STRUCTURED INTERVIEW QUESTIONS AND CONSENT FORMS IN ENGLISH AND SPANISH

Interview guide to be implemented among water users and irrigation units' representatives (former and current) in the Mexicali Valley

1. How would you describe the evolution of the state of this Mexicali Valley sub-region's agricultural sector since the 60s to date?
   a. What are the strengths and weakness to continued development of the regions' agricultural sector?

2. How would you describe the water situation in this sub-region of the Mexicali Valley?
   a. From your point of view, what are the main pressures on water availability?
   b. What specific weight can you give to transboundary issues like the salinity problem during 1960-70 (SAL)?

3. What can you say about the agriculturists' participation in the SAL of the 60s-70s in this particular sub-region of the Mexicali Valley?
   a. What was the nature of such participation?
   b. What kind of organizations emerged?
   c. What kind of leadership?
   d. Who was mostly involved?

4. What can you share with me about the land productivity and irrigation water use during the SAL?

5. How would you evaluate the influence of agriculturists' in solving the SAL?
   a. What kind of benefits do you get from your involvement on it?

6. Are you aware of the All-American Canal conflict (AAC)? Tell me about it.
   a. How do you think this project might impact this sub-region's irrigation and land productivity?

7. What can you say about this sub-region agriculturists' participation in the AAC?
   a. What is the nature of such participation?
   b. Who represents agriculturists' interests in this conflict?
   c. What kind of leadership exists?
   d. Who is mostly involved?

8. I would like to learn from you about agricultural Water Users Associations (WUAs). WUAs include irrigation modules within this sub-region of the Mexicali Valley. How do you perceive the WUAs' participation and influence on water issues in this sub-region?
   a. At what levels do WUAs seem to be most effective (local, national, bi-national), Why?
   b. What is (are) the process (es)/mechanism(s) of participation of WUAs?

9. How would you describe WUAs' participation in transboundary water issues?
    a. How effective would you say WUAs are regarding impacting agriculturists' irrigation operative performance and land productivity in this sub-region?

10. Can you describe the process (es)/mechanism(s) of individuals' participation of WUAs?

11. What has been/is the nature of the relationships of WUAs with the Mexican section of the International Boundary and Water Commission (CILA)? How so?
    a. Nowadays, what is the role of WUAs within the CILA's task group number one (SAL) and number five (AAC)?

12. What are the major similarities and differences that you can see regarding the participation and influence of agricultural water users in transboundary water issues like the SAL and the AAC?
    a. What institutional structures and organizational characteristics have been addressed by agriculturists in the context of the SAL?
    b. What institutional structures and organizational characteristics have been addressed by agriculturists in the context of AAC?

13. How do agriculturists contribute to the formation and effectiveness of the institutional structures implemented during the SAL and AAC, respectively?

14. What, if any, opportunities do you see for improved conflict resolution concerning transboundary water issues?

15. How would you evaluate the following as avenues for positive change and why?
    a. Binational legal framework?
    b. Organizational issues?
    c. Mexicali Valley physical conditions?
    d. Local human resources (technical expertise)?
    e. Mexicali valley's economic situation?

16. In your opinion, what, if anything, is the main constraint to achieve successful bi-national water management and/or conflict resolution?
    a. Binational legal framework?
    b. Organizational issues?
    c. Mexicali valley physical conditions?
    d. Local human resources (technical expertise)?
    e. Mexicali valley's economic situation?

17. What benefits may flow to agricultural sector of this Mexicali Valley's sub-region as a result of a better bi-national water management?
    a. Socio-economic?
    b. Environmental?
    c. Technological?
    d. Organizational?

18. There are several national and binational agencies either focused on or related to water management in the U.S.-Mexico border region (i.e. a-e). Which, if any, do you or your organization collaborate or work with?
    a. CILA (IBWC)

b. COCEF (BECC)/BANDAN (NADBANK)
c. CONAGUA
d. AU (WUAs)
e. other (s)

19. Finally, from your standpoint, what are your short, mid, and long-term perspectives in regards to the U.S.-Mexico binational water management in this particular Mexicali Valley's sub-region? Why?

20. Is there anything else that you would like to share with me?

Thank you very much.

Alfonso Andres Cortez-Lara
Doctoral dissertation researcher

Michael D. Kaplowitz, Ph. D.
Major Professor (MSU)

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Informed Consent Statement

Hello, my name is Alfonso Andres Cortez-Lara. I am working on my doctoral dissertation research at Michigan State University in the United States. We would like to learn from you about how you perceive the transboundary water issues related to both the Salinity problem and the All-American Canal conflict in the Lower Colorado River region.

Our dialogue will take approximately 50-60 minutes. There are no correct or wrong answers. You do not have to answer any questions you do not like and you are free to leave the discussion at anytime without any problems or worries.

Rest assured that your identity and responses will be kept confidential and that your privacy will be protected to the maximum extent allowable by law. We will not use your name, only a code number in our register, data analysis, and reports. We will be careful not to describe you or your activities in ways that would allow someone to guess your identity and we will keep our data in a secure location.

I would like to accurately record everything you have to say. To help me do so, I will use an interview guide to conduct our conversation and record your comments.

We want to underline that your participation in this interview is voluntary. You are under no obligation to finish the interview or answer any question that you don't like. We hope that the information we learn from you will help us better understand how we can help agricultural water users and organizations like those you belong to and in general to the agro-hydraulic society in the Mexicali.

Do you have any questions? **Yes / No**

If you have questions later about this study, please contact any of the people on the information sheet [hand them the information sheet].

If you have any questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you many contact Peter Vasilenko, Ph.D., Chair of the Human Research Protection Program. Social Science, Behavioral, Education Institutional Review Board (SIRB). His information is also on the information sheet.

Based on this information,

Do you understand your rights?	Yes / No
Do you have any questions?	Yes / No
Are you willing to be interviewed now?	Yes / No

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MEXICALI VALLEY STUDY
(CONTACT INFORMATION SHEET)

If you have question about this study you may contact any of the following people:

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Guía de entrevista para implementar entre asociaciones de usuarios del agua y representantes de los módulos de riego (anteriores y actuales) en el Valle de Mexicali.

1. Cómo describiría la evolución del campo en la sub-región del Valle de Mexicali en el sector agrícola de los años 60's a la fecha?
   a. Cuáles son las fortalezas y debilidades para continuar el desarrollo de la región en el sector agrícola?

2. Cómo describiría la situación del agua en esta sub-región del Valle de Mexicali?
   a. Desde su punto de vista, cuales son las principales trabas en la disponibilidad del agua.
   b. Cuál es la importancia que le da a las cuestiones transfronterizas como el problema de la Salinidad (SAL)?

3. Que es lo que me puede mencionar acerca de la participación de los agricultores en la salinidad de los años 60´s-70´s en esta sub-región del Valle de Mexicali?
   a. Como caracteriza aquella participación?
   b. Que tipos de organizaciones surgieron?
   c. Cual fue el tipo de liderazgo?
   d. Quien estuvo más involucrado?

4. Que me puede mencionar acerca de la productividad de la tierra y el uso del agua de riego durante la salinidad (SAL)?

5. Como evaluaría la influencia de los agricultores al resolver el problema de la salinidad (SAL)?
   a. Que tipo de beneficios directos obtuvo por su participación?

6. Usted conoce del problema del Canal Todo Americano (ACC)? Que me puede platicar sobre eso.
   a. Como impactara en el agua de riego y en la productividad de la tierra de esta sub-región?

7. Que me puede decir acerca de la participación de los agricultores de esta sub-región en el Canal Todo Americano (AAC)?
   a. Como caracteriza aquella participación?
   b. Quien representaba los intereses de los agricultores en ese conflicto?
   c. Qué tipo de liderazgo existe?
   d. Quien esta mas involucrado?

8. Me gustaría que me mencionara acerca de las Asociaciones de Usuarios del Agua (AU). Las Asociaciones de Usuarios del Agua incluyen a los módulos de riego dentro de la sub-

región del Valle de Mexicali. Como percibe la influencia y la participación de las Asociaciones de Usuarios del Agua en las cuestiones del agua en esta sub-región?

   a. A que niveles las Asociaciones de Usuarios del Agua parecen ser más efectivas (local, nacional, binacional), Porque?
   b. Cuales es el (son los) proceso(s) o mecanismo(s) de participación de las Asociaciones de Usuarios del Agua?

9. Como describiría la participación de las Asociaciones de Usuarios del Agua en cuestiones transfronterizas del agua?
   a. Que tan efectivas diría usted que son las Asociaciones de Usuarios del Agua respecto al impacto que tienen en el manejo y gestión del riego de los agricultores y de la productividad de la tierra en esta sub-región?

10. Podría describir los procesos o mecanismos de participación de las Asociaciones de Usuarios del Agua?

11. Cual ha sido/ o Como se caracterizan las relaciones de las organizaciones de los módulos de riego con la sección mexicana de la Comisión Internacional de Limites y Aguas (CILA)? De qué manera?
   a. En la actualidad, Cual es el rol de las Asociaciones de Usuarios del Agua dentro del grupo de trabajo No. 1 (Salinidad) y la número 5 (Canal Todo Americano)?

12. Cuáles son las mayores similitudes y diferencias que usted ve de la participación y la influencia de los agricultores usuarios del agua en cuestiones transfronterizas del agua como la (Salinidad) y el (Canal Todo Americano)?
   a. Cuáles son las estructuras de las instituciones y las características de las organizaciones con las que se han dirigido los agricultores en el asunto de la Salinidad?
   b. Cuáles son las estructuras de las instituciones y las características de las organizaciones con las que se han dirigido los agricultores en el asunto del Canal Todo Americano?

13. Como contribuyeron los agricultores a la formación y a la efectividad de las estructuras institucionales implementadas durante la Salinidad y el Canal Todo Americano, respectivamente?

14. Cuales, si hay algunas, serian las oportunidades que usted vea de mejorar la resolución del conflicto en cuanto a las cuestiones transfronterizas del agua?

15. Como evaluaría las siguientes como medios de cambios positivos y porque?
   a. Marco legal binacional?
   b. Cuestiones organizacionales?
   c. Las condiciones físicas del Valle de Mexicali?
   d. Recursos humanos locales (experiencia técnica)?

e. La situación económica del Valle de Mexicali?

16. En su opinión, Cual, si es que hay alguna, es la principal coacción para alcanzar el éxito en el manejo binacional del agua y/o en la resolución del conflicto?
    a. Marco legal binacional?
    b. Cuestiones organizacionales?
    c. Las condiciones físicas del Valle de Mexicali?
    d. Recursos humanos locales (experiencia técnica)?
    e. La situación económica del Valle de Mexicali?

17. Cuales beneficios desembocarían en el sector agrícola de la sub-región del Valle de Mexicali como resultado de un mejor manejo bi-nacional del agua?
    a. Socio-económico?
    b. Ambiental?
    c. Tecnológico?
    d. Organizacional?

18. Hay varias agencias nacionales y binacionales enfocadas o relacionadas con el manejo del agua en la región de la frontera de E.U.-México (i.e. a-e). En Cual, si hay alguna, usted o su organización colabora o trabaja con ellas?
    a. CILA (IBWC)
    b. COCEF (BECC)/ BANDAN (NADBANK)
    c. CONAGUA
    d. Asociaciones de Usuarios del Agua (WUAs)
    e. Otras

19. Finalmente, desde su punto de vista, cuales son a corto, medio, y largo plazo sus perspectivas con respecto al manejo binacional del agua de E.U.-México en particular en esta sub-región del Valle de Mexicali? Porque?

20. Hay alguna cosa más que le gustaría compartirme?

Muchas gracias.

Alfonso Andrés Cortez-Lara
Investigador de tesis doctoral

Michael D. Kaplowitz. Ph. D.
Asesor principal (MSU)

Acuerdo de Consentimiento

Buenos días, mi nombre es Alfonso Andrés Cortez-Lara. Ahora estoy realizando mi investigación doctoral para la Universidad Estatal de Michigan, Estados Unidos. La información que usted nos brinde permitirá aprender de su experiencia con respecto a los temas críticos del manejo de aguas transfronterizas tales como la Salinidad del Río Colorado y el conflicto del Canal Todo Americano. El propósito de este estudio es comprender mejor las respuestas institucionales de los agricultores del Valle de Mexicali para enfrentar conflictos derivados del manejo de aguas transfronterizas. Esperamos identificar estrategias útiles para el manejo del agua.

La conversación durará aproximadamente 60 minutos. En este ejercicio no existen respuestas correctas, ni incorrectas. No tiene que contestar a ninguna pregunta que no le guste y tiene la libertad de dejar la entrevista en cualquier momento sin problemas. Su identidad y respuestas serán estrictamente confidenciales y su privacidad será protegida al máximo, tanto como la ley lo permite. No utilizaremos su nombre, sino un código numérico para identificarle en nuestro registro, en los análisis y reportes correspondientes. Seremos cuidadosos de no describir sus actividades en forma tal que permita que alguien pueda ubicar su identidad y mantendremos nuestros datos siempre en lugar de acceso restringido. La confidencialidad será mantenida en las publicaciones.

Su participación en esta entrevista es voluntaria. Es importante reiterarle que Ud. no está bajo ninguna obligación de terminar la entrevista o de contestar alguna pregunta que no le guste. Esperamos que la información que recibamos de su parte sirva para entender mejor cómo nosotros podemos apoyar a usuarios agrícolas, asociaciones de usuarios del agua y en general a todas aquellas agencias relacionadas con el manejo y gestión del agua en el Valle de Mexicali.

¿Tiene alguna pregunta? Si / No

Si posteriormente Ud. tuviera alguna pregunta con respecto a este estudio, por favor siéntase libre de contactar directamente a cualquiera de las personas indicadas en la hoja con información de contactos que le entregaré. Si tuviera alguna duda con respecto a sus derechos como participante de esta investigación, o está descontento en algún momento con este estudio, puede contactar al Dr. Peter Vasilenko, Encargado del Programa de Protección de Investigación con Sujetos Humanos (SIRB por sus siglas en inglés).

Finalmente, quisiera tomar nota cuidadosa de todo lo que usted diga. Para ello, voy utilizar una guía de entrevista y además quisiera grabar sus comentarios y aportaciones a efecto de asegurar que yo no cometa errores mientras escribo lo que Ud. expresa ahora.

Yo voluntariamente acepto participar en este estudio y a que nuestra conversación sea grabada.

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Firma del participante **Fecha**

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(HOJA DE INFORMACIÓN DE CONTACTOS)

Si usted tiene alguna pregunta sobre este estudio puede contactar a cualquiera de las siguientes personas:

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APPENDIX B

CODING SYSTEM FOR ORGANIZING DATA TABLES

Table B.1 Coding system: Irrigation and transboundary water management in the northern Mexicali Valley (NAH).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	1. Mexicali Valley change/evolution?	Agricultural sector progress/4	**PRO**	Agricultural activity in the Mexicali Valley shows permanent economic growth through time.
		Agricultural sector regression/5	**REG**	Agricultural activity in the Mexicali Valley shows permanent economic decay through time.
		Crops diversification/4	DIV	Crops structure changed from unique crops like cotton to expanded to grow grains and produces
		Minimum progress/3	MIP	Agricultural sector shows improvement although not felt at all among original landholders but among new landholders.
		Agricultural lands rented/5	REN	Growing area of agricultural lands rented. High extent of agricultural lands under rental contract is observed and reaches more than 80 percent which induced changes in the agricultural sector social and productive structure.
		Larger agricultural operations scale/3	LAR	The Mexicali Valley shows new larger agricultural lands' operations which are changing from an original individual allotment of 20 hectares per household up to 200 ha in average as a sustainable size for continuing production.
		High production costs/5	HIC	Growing high production cost is noticed for most production inputs.
		Lower prices/4	LOP	Lower prices for agricultural products are noticed.
		High productivity of lands/4	HIL	Higher lands' productivity in the Mexicali Valley.
		Industry predominance/3	IND	Industrial and agri-industrial activities have been growing in the Mexicali's countryside.
		Reduced credit for agriculture/5	CRE	Proportion of financial support for agricultural activities in now significantly reduced for small farmers and the proportion warranty/credit is too high to small farmers.
		Commercialization problems/3	COM	Commercialization problems for small farmers are noticed for most agricultural products especially grains.

NAH: Northern region agriculturist household; RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol

Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	1. Mexicali Valley change/ evolution?(cont'd)	Technology improvement/3	TIM	Technology improvement for lands' labor is the most important change observed in Mexicali.
	2. Irrigation change?	Successful irrigation water management/7	**SIM**	Irrigation water management (operation, administration, and conservation) by agricultural users (WUAs) is improving.
		Failing irrigation water management/2	**FIM**	Irrigation water management (operation, administration, and conservation) by agricultural users (WUAs) is still struggling activity and is due most of the time to organizational problems of individual irrigators.
		Spendthrift irrigation water/8	SIW	Irrigation water use in the past was notoriously wasteful when compared with that of current times
		Lack of irrigation technology/6	LIT	Irrigation technology in Mexicali was lacking of the necessary land's leveling, efficient methods, and lined canals in the past.
		Efficient water use/7	IWE	In recent times irrigation water is being used more efficiently although it is still suboptimal.
		Growing irrigation technology/7	GIT	Today, there exists suitable irrigation technology such as land leveling and lined canals to perform the activity, however it is still suboptimal.
		Costly water service/4	COS	Improvement in irrigation water management implied much higher water costs accruing to individual agricultural users (operation and energy costs).
		Costly water service/2	COS	Higher water costs accruing to individual agricultural users affect individual incomes.
		Water users inequality/2	IQU	Equality among irrigation water users is lacking in terms of support coming from both WUAs' officials (i.e. Ejido Netzahualcóyotl vs. Toro/Sahara large private enterprises), which shows an extent of elitism for water use.
		Internal water conflicts/1	ICO	Conflicts among groundwater and surface irrigation users are/might be noticed in times of critical high demand seasons within agricultural areas (March-April).
		Increasing water demands/2	DEM	Considering same hectares, growing rural and urban population, and gradual downward allotment for agriculturists (currently of 117 lps/ha).
	3. Importance of transboundary waters?	Mexicali Valley transboundary waters importance/2	TWI	Transboundary waters represent a unique and vital resource for agriculture in the Mexicali Valley which depends mostly on this source.
1	4. Problems emerged with SAL?	Salinity of agricultural lands/6	**SAD**	Damage in agriculture due to the salinity of the Colorado River and other inter-linked factors was significant and meant drastic reductions in seeds shoot, plant growth and development, crop yields, credit for producing as well as increasing production costs.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	4. Problems emerged with SAL? (cont'd)	Mixed salty waters upstream/6	MIX	Disposed of salty waters upstream (salinity of the Colorado River). Water delivered to Mexico during a period encompassing almost 13 years (1960-1973) was intentionally polluted upstream the Colorado River while mixing them with salty waters coming from agricultural lands in the Yuma Valley, U.S. (point source pollution).
		Yields reduction/5	YED	High extent of crops yields reductions. Yields in main crops (wheat) showed significant reductions in this area of the valley of about 65 percent.
		Salts route formed/4	ROU	Formation of a salty soils strip along the valley. A long strip of salty soils running north to south was formed in the central area of the Mexicali Valley as a result of the salt pollution which is known as "the salty route" (or ruta de la sal).
		Increasing costs/3	ICS	Increasing production costs for individual agriculturists. Increasing costs during the salinity problem were noticed while increasing water use for salts leaching and for modifying productive practices (planting, fertilization, etc.).
		Salty soils/5	SAH	Significant portions of salty soils were formed within individual parcels when the salinity occurred.
		Credit insufficiency/3	CRI	High extent of contraction of agricultural credit to unproductive lands. Official and private credit for agriculture was reduced during the salinity problem period.
		Salinity problem remains/6	SAR	Salinity problems remain. Salinity of the Colorado River and agricultural lands in the Mexicali Valley still remains today a critical problem. It is mostly observed at the southern international boundary point of delivery (Sánchez Mejorada Canal), failures in the monitoring system at the northern international boundary (Morelos Dam), and the resulting permanent salts accumulation along the salty route in the Mexicali Valley.
	5. Agriculturists participation during SAL?	High level of participation in SAL /8	**HIP**	High level of participation in SAL. High level of participation of agriculturists was noticed throughout a united force of agriculturists belonging to different unions forming extremely crowded meetings (tens of thousands of people).
		High level of solidarity/8	SOL	Solidarity was the main characteristic of the agriculturists' mobilization while SAL.
		Unity base/7	UNI	Unification of individuals was originated at the household level due to economic conditions allowed keeping farmers' families were rooted in the countryside.
		Strong agricultural unions/9	SAU	Participation of the agricultural sector during the salinity problem was present mainly through well organized, strong, and meaningful leader representation of agricultural unions that as unified forces used to express, complain, claim, demand, and boycott governmental agencies from both countries towards finding suitable solutions.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	5. Agriculturists participation during SAL? (cont'd)	Significant presidential leadership/9	LEA	President Luis Echeverría Alvarez is acknowledged as a governmental leader that offered meaningful support (credit and technical assistance), guideness and representation (in bilateral negotiation) to obtain solutions to the salinity problem on behalf of the Mexicali Valley agriculturists (i.e. rehabilitation program and Wellton-Mohawk by-pass).
		Local agriculturists unions' leadership/8	LAU	There were local organizations such as CCI, CNC, UAR, and CNPPR that understood the problem, voiced, and fought against it as defenders of the agriculturists' interests.
		Principal agricultural union/6	PAU	The Central Campesina Independiente (CCI) was the most important union involved in the salinity process while promoting agriculturists' participation.
		Outstanding local leaders/7	LOL	Local leadership is identified and personified by individuals such as Alfonso Garzón, Rodolfo Fierro, Salvador Solorio, Miguel Monje, Dr. Cevallos, and Luis Granados among many others.
		Principal leader/8	PAL	Alfonso Garzón Santibáñez is acknowledged as the main acting leader in the salinity movement.
		Fundamental local leadership/8	CEJ	Fundamental leadership rested in the person of an Ejido authority named the "President of the Comisariado Ejidal" who had broad political power, natural social leadership, and capacity to call for mass meetings.
		Financial capacity of agriculturists/7	FIC	A contribution of about five Mexican cents included in the irrigation water fees were voluntarily given by agriculturists to their respective unions through the Comisariado Ejidal-SRH coordination. This fund gave agriculturists capacity to afford their unions' representatives mobilization/operation expenditures.
		Politics behind SAL/4	POS	Politics behind the salinity problem pointed toward a premeditated negotiation between high level officials of both governments to solve the problem originated in the U.S. and later compensate Mexico for damages throughout modernizing the Irrigation District.
2-3-4	6. Influence of agriculturists to resolve the salinity?	Influence of agriculturists for reaching technical solutions to the salinity/7	**ITS**	Influence of agriculturists for reaching technical solutions to the salinity problem. Participation of agriculturists, both as individuals and as unions or "unions of unions" ensured communication with high level governmental agents, thus they influenced to find technical solutions to the salinity problem.
		Influential participation in inducing institutional change for binational water management/4	IBI	Influential participation of agriculturists in inducing institutional change for binational water management. Participation of agriculturists in the salinity problem showed their influence to press for change in the institutional binational legal frameworks for water management (i.e. Minute 242).

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	7. Benefits obtained?	Influential participation in defining infrastructure for recovering water quality/5	REQ	Influential participation of agriculturists in defining the implementation process of infrastructure for recovering water quality in the Colorado River and the Mexicali Valley. A main benefit obtained from intensive participation of agriculturists in the salinity problem was to obtain infrastructure for recovering irrigation water quality by inducing the building of the Wellton-Mohawk by-pass.
		Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity of lands /7	REL	Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity of lands. An important benefit gained from intensive participation of agriculturists in the salinity problem was to get infrastructure for recovering lands' productivity by the implementation of the Irrigation District Rehabilitation Program that included lands leveling, building surface drainage system, and lining main irrigation canals.
		Influential participation for obtaining financial support to continue production/3	CAP	Influential participation of agriculturists for obtaining financial support to continue production. Capital (credit and technical assistance) was given as one of the benefits for agriculturists both as individuals and as organizations.
		Corruption and mismanagement of the U.S. compensation and the Mexican financial support funds by Mexican actors/3	COR	High extent of corruption and mismanagement of the U.S. compensation and the Mexican financial support funds by Mexican actors. Corruption among agricultural leaders was noticed during the administration of funds obtained from the salinity problem compensation.
		The role in the incompletion of the rehabilitation program/3	REI	The role of agriculturists in the incompletion of the rehabilitation program. The rehabilitation program in the Irrigation District 014 is still incomplete today, thus there is an inefficient water use in the agricultural sector.
1	8. On the AAC project impacts?	AAC lining project threat/6	**JEO**	The AAC project represents jeopardizes not only for the sustainability of the nearby agricultural activity but also for people living and working beyond the area of influence in Mexicali Valley and the city which depend on scarce water resources totally allotted.
		Uncertainty on impacts/4	UCY	There are a huge uncertainty about what would happen to agricultural lands and environment directly depending on AAC seepage.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	8. On the AAC project impacts? (cont'd)	Cyclic damages/5	CYC	The All-American Canal has impacted agriculture cyclically in this particular area of the valley, first during initial operation the seepage produced flooding (i.e. in Colonia Bórquez, Ejido Netzahualcóyotl, and Ejido Yucatán) from 1945 to 1954 plus 10 more years of recovering; but now, it might represent potential water scarcity.
		Technical compensation/5	MES	La Mesa drain was built in 1954 as part of the technical solution for the All-American Canal induced flooding in the Mexicali Valley which came from its initial operation. Here, the rights over such seepage water were born in favor of Mexican users (the best quality of water in the irrigation district).
		Artificial surface sources affectations/4	DRE	Two main drains which function as seepage interceptors and also as irrigation canals to Modules 4 and 5 (La Mesa Drain and the Culiacán Drain) will be suddenly and dramatically reduced, disappearing eventually as delivery canals for more than 2,000 hectares.
		Opportunity for improving conditions/4	IOP	The All-American Canal lining project also represents an opportunity for improving living and productive conditions both locally and bi-nationally if principal actors like agricultural users are included in the negotiation process.
		Regional upper aquifer impact/6	RAF	Local aquifer's quantity and quality impending gradual reduction is envisaged affecting more than 19,000 hectares belonging to irrigation Modules 4, 5, 6, 7 and 16 at the north-eastern area of the Mexicali Valley.
		Deep wells digging/3	WEL	Deeper wells might be perforated in line parallel to the All-American Canal on the Mexican side to compensate potential damages to the upper aquifer, this since deep groundwater sources is abundant, but costs might rise.
		Reductions in growing area/5	RED	Potential reductions in growing area is expected with the All-American Canal lining project, this considering precedents like the aquifer source reduction during the 1970s, then cotton growers were mandatorily pressed to reduce their cropping size from 20 to 18 hectares and alfalfa growers from 20 to 16 hectares as average.
		Water adjustment/3	ADJ	Potential irrigation water volume adjustment at both regional and district level as a connected system is envisaged if the All-American Canal lining project takes place. This also means reductions in individual and regional irrigated areas.
		No rights irrigators affected/2	NOR	Agriculturists with no rights within the irrigation district who benefits by using the current All-American Canal seepage will be directly affected over the northern portion of the Mexicali Valley (Ejido Netzahualcóyotl).

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	8. On the AAC project impacts? (cont'd)	Wetlands affectations/4	WET	A series of small wetlands formed with the All-American Canal seepage reach an extension of more than 3,400 hectares over Module 16 will disappear.
		Small rural towns affectations/2	RUT	Rural small towns whose sources are the La Mesa Drain and the aquifer might be affected.
		Migration induced/3	MIG	Imminent massive migration is foreseen as the All-American Canal project becomes a reality.
	9. Agriculturists' participation AAC?	Agriculturists weak defense of AAC seepage/9	**DAS**	Lack of a strong and energetic defense of the AAC seepage water by new generation agriculturists is translated as: "Those who keep quiet then give up"; "Those who forgot their history then might make again the same mistakes"
		Presidential lack of accountability/8	PLA	Vicente Fox's Presidential leadership of was lacking in terms of interest and accountability to locals when dealing with the All-American Canal lining conflict.
		Federal Government lack of accountability/7	GLA	A significant lack of accountability to local agriculturists is noticed on the part of the federal and state governmental agencies (CONAGUA, CILA, SAGARPA) on the AAC.
		Lack of transparency/8	TRA	Federal and state governmental agencies lack of transparency when dealing with the AAC.
		Information is lacking/8	LIN	Critical information about AAC issues is neither enough, opportune nor widespread mainly by governmental agents.
		Information misleading/7	MIN	Critical information about AAC issues is often misleading on the part of governmental agencies. Some time some governmental voices express significant impacts while others say exactly the opposite.
		Generalized apathy/8	APA	LIN and MIN induce lack of interest and motivation among confused agriculturists of the Mexicali Valley engaged in their productive activity.
		Localized apathy/4	APS	Apathy is mostly observed among agriculturists operating in the San Luis Valley and the Southern portion of the Mexicali Valley.
		Aging leadership in the countryside/8	ALE	Local aged or missed leadership at the individual and organization level is losing its power to call for agriculturists.
		Disperse leadership in the countryside/9	LED	Disperse and no impact leadership is observed within the agricultural sector.
		External leadership for AAC/6	ELE	Shifts in people and organizations focused on voicing and claiming agriculturists' concerns regarding water conflicts that mainly affect them. Today, CDEM, an entrepreneurs' organization whose members belongs mostly to users others than agriculturists.

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Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	9. Agriculturists' participation AAC? (cont'd)	Lack of external support to agriculturists/5	LES	Lack of external support (either government or urban users) to agriculturists to lead the AAC conflict.
		No financial capacity of agriculturists/8	NOF	Voluntarily given financial contributions included in the irrigation water fees was recently eliminated. This fact reduces agriculturists' capacity to afford their unions' representatives mobilization/operation expenditures.
		Influence of agriculturists in finding solutions to the All-American lining/8	**DIT**	Null influence of agriculturists in finding solutions to the All-American Canal conflict. New leaders, governmental agencies, and even representatives disregard the significance and importance of individual agriculturists and their WUAs' thinking and voice as an agent for good change.
		Politics behind AAC/3	POC	Politics behind the AAC conflict point toward a premeditated negotiation between high level officials of both governments to solve a technical problem originated in the U.S. to later compensate Mexico for damages through modernizing the Irrigation District 014 in Mexicali.
	10. About irrigation users?	Precursors Water Users' Societies/1	PRU	Precursors Water Users' Societies (WUS) were the first irrigation users groups in the San Luis and Mexicali Valleys organized themselves using a button-up approach to successfully manage water sources coming from the Colorado River from 1938 to 1954, before any official intervention.
		Water rights establishment/1	RIG	Official intervention starts by establishing the irrigation district and by equalizing irrigation water rights per user to 20 hectares, which have been historically variables for private users (20, 50, 100 hectares).
		Official irrigation water management/1	OFF	Official intervention after WUS begun with the National Irrigation Commission (CNI), then the Hydraulic Resources Ministry (SRH), the Agriculture and Hydraulic Resources Ministry (SARH), and finally the National Water Commission (CONAGUA) to give place to the new era of WUAs.
		Lately Water Users' Associations/4	IMU	Lately formed Water Users' Associations (WUAs) in the Mexicali Valley were imposed in 1990 using a top-down approach (IDB, WB, BM). So, current failures in administration and water management (including bi-national waters concerns) come from their origin.
		Bureaucracy of co-management/5	BUR	Large bureaucratic red-tape affects the new era of irrigation water management (CONAGUA-WUAs). This in turns means increasing mobilization costs, and lack of motivation for leaderships.

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Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	10. About irrigation users? (cont'd)	WUAs' lack of accountability/4	ALA	WUAs, as instances for irrigation water management, have shown lack of accountability and support to small landholders; instead they obey and show accountability to upper-bound institutions such as the Mexican National Water Commission (CONAGUA).
		Large landholders command WUAs/7	LAN	New big landholders have the command and control of irrigation water management within WUAs.
		Legal rights/5	LER	WUAs have the complete right and judicial interest to participate and defend agriculturists' interests and to prevent potential damages.
		WUAs elude AAC issues/8	**ELU**	The AAC conflict was not properly attended or faced by water users associations' representatives (WUAs and SRL) neither in time nor in depth. There is no real interest in handling the issue and just until recently it was mentioned in assembly but with no impact towards obtaining benefits for the agricultural sector. Governmental agencies do not promote participation.
		Groups interests and apathy within WUAs/7	GIA	Groups' interests and apathy within water users' associations is noticed and this fact is blocking effective social participation, this in turn constrains power participation of agriculturists as a united force.
2-3-4	11. Formal mechanism for participation?	Lack of information about formal mechanisms/8	LIM	Lack of information about formal links or mechanisms of coordination between WUAs and governmental agencies like CILA which attends transboundary water issues directly affecting agricultural activity. Agriculturists' representatives do not properly inform to constituency about this issue.
		Lack of formal coordination mechanisms/8	LAC	Lack of formal coordination mechanisms between CILA and WUAs to jointly analyze aspects related to transboundary waters affecting agricultural activity.
	12. Agriculturists' organizations links?	Lack of effective coordination with CILA/6	LIC	Links between WUAs and CILA is lacking, despite the importance of having a more fluid and broader communication and coordination efforts with us as users, in first time and place, of transboundary waters coming from the Colorado River.
	13. SAL vs. AAC agriculturists' participation?	Different extent of presidential leadership/5	DIP	Significant differences were perceived by agriculturists between presidents Luis Echeverria Alvarez and Vicente Fox Quesada regarding leadership, intelligence, energy, bravery, patriotism, accountability to locals, and interest on the subject to assist, confront, and fight in defense of the Mexicali Valley agriculturists' perilous conditions.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	13. SAL vs. AAC agriculturists' participation? (cont'd)	Different extent of agriculturists' organization/6	DOR	Strong organization capacity (unions) and organizations accountability was noticed during the salinity period and the opposite was observed during the All-American Canal conflict.
		Different agriculturists' leadership/7	DAL	Political power and representativeness of agriculturists' leaders is missed nowadays. In the past, agricultural leaders were frequently part of a political party (PRI) that always had a chair, voice and decision making power in within chambers of representatives in both state and federal level as well as strong communication with officials.
		Different groups making pressure on SAL and AAC issues/6	DIG	During the salinity problem period, groups of agriculturists such as CCI, CNC, UAR, and CNPPR made pressure to demand the U.S. On the other hand, during the All-American Canal conflict an urban-based group (CDEM) demanded the U.S. against the All-American Canal lining project.
		Loss of capacity for influencing changes/7	CIL	In the SAL era, participation of local agriculturists' leaders in chambers of representatives gave them capacity to influence modifications of local ordinances, nation state rules, federal laws, and international legal frameworks such as the 1944 Water Treaty.
		Similar politics behind SAL and AAC/3	SIP	A similarity between the SAL and the AAC process is observed in terms of the politics behind such issues where a premeditated negotiation between governments takes place to face a technical aspect of water management in the U.S. affecting Mexico and where damage is allowed to then compensate the affected part.
		Changes in socio-productive structure/2	SOS	Lack of agriculturists' participation is mostly explained by the changes in socio-productive structures in the Mexicali Valley due to current high level of lands under rental contract.
	14. Barriers for water management?	Social organization/8	ORG	Human/social and productive organization represent an essential factor to have good water management practices and also to face and overcome conflicts at local and bi-national level.
		Long-term vision/5	LOV	Long-term vision in both the agricultural and the irrigation sectors is missing. Six-year financial planning horizons marked by governmental administrations limit development.
		Stronger economic constraints in agriculture/5	BEC	Economic welfare in the agricultural sector is a fundamental factor limiting effective water management practices in the Mexicali Valley.
		Lack of irrigation technology/4	TEC	Irrigation technology progresses very slowly and this represents an important barrier for development.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	14. Barriers for water management? (cont'd)	Downward spirals/7	DOW	Permanent low crops' prices and high production costs determine gradual bad economic conditions for local agriculturists, this in turn triggers social organization problems and lack of social participation (it has inherent costs). Consequently, a weak agricultural sector to attend and face water management conflicts at local and bi-national level is observed.
		Lack of collaboration/2	COL	Lack of collaboration for transboundary water management as critical issues.
	15. Benefits from best water management?	Increased water availability/3	AVA	Irrigation water availability might be increased and this allows for a better operation and distribution as well as water transfers both among individuals within an irrigation module and among the twenty three water users' associations operating in the Mexicali Valley.
		Aquifer as natural dam/1	NAD	Mexicali has an aquifer that can function as a "natural dam" that transforms irrigation infiltration and irrigation "inefficiencies" into additional water stock for Mexicali.
		Environmental benefits/2	ENV	A better water management leads to protect water sources and to improve local environmental conditions.
		Agricultural sector improvements/3	AGI	Agricultural sector might experience improvements both at household level and in general as economic sector. This might be mainly noticed in production costs reduction (labor, water management, water use, fertilizers use) and increased quality of products (just on time and increased crop yields).
		Increased bargain capacity/1	BAR	Agriculturists might have an increased surplus irrigation water bargain capacity among them as well as with other sectors like industry and cities and even with some U.S. users who also have water needs.
	16. Future of irrigation water management?	Need to state bi-national priorities/3	PRY	Need to state priorities at a local and bi-national level for water management. CILA must change its institutional traditional attitude to become more open-minded to allow public participation.
		Need to state local priorities/4	PRE	Need to state local priorities to increase efficiency at both individual (parcel) and module as well as irrigation district level.
		Need for increasing economic resources/2	REC	Increase economic resources to the agricultural sector are imperative and they could come from several sources like agricultural users, government, and other agents.
1-2-3-4	17. Additional comments?	CESPM investing in the countryside/2	ICE	The local water authority (CESPM) must invest in the improvement of irrigation infrastructure and technology (conduction) as one compensatory mechanism since they are direct beneficiaries of low-priced water transfers from the Mexicali Valley to the city of Mexicali but throughout our leveled lands and lined canals which represent an accruing cost to agriculturists.

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Table B.1 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1-2-3-4	17. Additional comments? (cont'd)	Strategic AAC issue/1	AAS	The AAC theme is a strategic one in which people must be involved in a brave and intelligent manner. We the agriculturists could get mutual benefits without fighting against the project.
		Education for saving water/1	EDU	Water-saving education strategies must have been a central point in water policies several years ago and probably being operationalized by using several perspectives. This could have given a variety of visions about water resources as special good, and involving diverse sectors not just the agricultural one.
		Indifferent governments/7	ING	Contemporary governments (Federal and State) have remained indifferent to agriculture for the past 20 years.
		Accountability toward the next generations/2	NEX	Accountability toward the next generation is a historic and rooted feature within agriculturists' household and this is the fundamental explanation of their permanence in this sector.
		No coordination among governmental powers/2	NOC	Lack of coordination among executive, judicial, and legislative powers to promptly respond to critical situations.

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in the central Mexicali Valley (CAII)

Table B.2 Coding system: Irrigation and transboundary water management in the central Mexicali Valley (CAH)

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	1. Mexicali Valley change/ evolution?	Agricultural sector progress/3	**PRO**	Agricultural activity in the Mexicali Valley shows permanent economic growth through time.
		Agricultural sector regression/7	**REG**	Agricultural activity in the Mexicali Valley shows permanent economic decay through time.
		Crops diversification/1	DIV	Crops structure changed from unique crops like cotton expanded to grow grains and produces
		Agricultural lands rented/9	REN	Growing area of agricultural lands rented. High extent of agricultural lands under rental contract is observed and reaches more than 95 percent which induced changes in agricultural sector social and productive structure.
		Larger agricultural operations scale/7	LAR	The Mexicali Valley is experiencing new larger agricultural lands' operations which are changing from an original allotment of 20 hectares per household up to 500 ha in average as a sustainable size for continuing production.
		High production costs/8	HIC	Growing high production cost is noticed for most production inputs.
		Lower prices/10	LOP	Lower prices for agricultural products are noticed.
		High productivity of lands/2	HIL	High lands' productivity in the Mexicali Valley.
		Industry predominance/2	IND	Industrial (agri-industries) activities have been growing in the Mexicali Valley.
		Reduced credit for agriculture/7	CRE	Proportion of financial support for agricultural activities in now significantly reduced for small farmers and the proportion warranty/credit is too high to small farmers.
		Bureaucracy in credit/3	BUC	High extent of bureaucracy in the credit process
		Commercialization problems/4	COM	Commercialization problems for small farmers are noticed for most agricultural products. especially grains.
		Loosing organizational capacity/2	LOZ	In the past, ejidos used to organize to produce.
		Technology imp./3	TIM	Technology improvements for lands' labor are the most important change observed.
	2. Irrigation change?	Successful irrigation water management/4	**SIM**	Irrigation water management (operation, administration, and conservation) by agricultural users (WUAs) is improving.
		Failing irrigation water management/6	**FIM**	Irrigation water management (operation, administration, and conservation) by agricultural users (WUAs) is a still struggling activity and is due most of the time to organizational problems of individual irrigators.

CAH: Central region agriculturist household; RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol

Table B.2 (cont'd).

Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	2. Irrigation change? (cont'd)	Spendthrift irrigation water/1	SIW	Irrigation water use in the past was notoriously wasteful when compared with that of current times.
		Lack of irrigation technology/2	LIT	Irrigation technology in Mexicali was lacking of the necessary land's leveling, efficient methods, and lined canals in the past.
		Efficient water use/2	IWE	In recent times irrigation water is being used more efficiently than en the past.
		Inefficient water use/2	IWI	In recent times irrigation water use is still suboptimal.
		Growing irrigation technology/6	GIT	Today, there exists suitable irrigation technology such as land leveling and lined canals to perform the activity, however it is still suboptimal.
		Irrigation technology insufficient/3	IIT	Nowadays there exists irrigation technology needs such as land leveling, lined canals and underground pipe tiles drainage systems to perform the activity, thus, it is still suboptimal.
		Lack of investment/2	INV	Lack of broad programs of co-investment state, federal and users.
		Lack of coordination/1	CIC	Lack of coordination between CILA and CONAGUA affects irrigation operation in this sub-region
		Earthquakes area/1	ERQ	A dynamic earthquakes area in this sub-region predominates and affects irrigation infrastructure.
		Costly water service/3	COS	Improvement in irrigation water management implied much higher water costs accruing to individual agricultural users (operation and energy costs).
		Water users inequality/2	IQU	Equality among irrigation water users is lacking in terms of support coming from both WUAs' officials, which shows an extent of elitism for water use.
		Internal water conflicts/2	ICO	Conflicts among groundwater and surface irrigation users are/might be noticed in times of critical high demand seasons within agricultural areas (March-April).
		Increasing water demands/3	DEM	Considering same hectares, growing rural and urban population, and gradual downward allotment for agriculturists (currently of 117 lps/ha).
	3. Importance of transboundary waters?	Mexicali Valley transboundary waters importance/4	TWI	Transboundary waters represent a unique and vital resource for agriculture in the Mexicali Valley which depends mostly on this source.
		Mexicali Valley's aridity/1	MAC	The main features in Mexicali are their arid climate condition which means there is no yearly significant rainfall and high temperatures, thus, they mostly depend upon the Colorado River.
1	4. Problems emerged with SAL?	Salinity of agricultural lands/9	**SAD**	Damage in agriculture due to the salinity of the Colorado River and other inter-linked factors was significant and meant drastic reductions in seeds shoot, plant growth and development, crop yields, credit for producing as well as increasing production costs.

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Table B.2 (cont'd).

Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	4. Problems emerged with SAL? (cont'd)	Mixed salty waters upstream/3	MIX	Disposed of salty waters upstream (salinity of the Colorado River). Water delivered to Mexico during a period encompassing almost 13 years (1960-1973) was intentionally polluted upstream Colorado River while mixing them with salty waters coming from agricultural lands in the Yuma Valley, U.S. (point source).
		Treaty misinterpretation/1	MIS	The U.S. made an unilateral interpretation of the 1944 Water Treaty in regards to the quality of water to be delivered to Mexico
		Yields reduction/5	YED	High extent of crops yields reductions. Yields in main crops showed significant reductions of about 80 percent (cotton) and 70 percent (wheat).
		Salts route formed/6	ROU	Formation of a salty soils strip along the valley. A long strip of salty soils running north to south was formed in the central area of the Mexicali Valley as a result of the salt pollution which is known as "the salty route" (or ruta de la sal).
		Increasing costs/3	ICS	Increasing production costs for individual agriculturists. Increasing costs during the salinity crisis were noticed while increasing water use for salts leaching and for modifying productive practices (planting, fertilization, etc.). During administration of president Diaz Ordaz.
		Salty parcels/4	SAH	High extent of salts pollution in individual parcels. Significant areas of salty soils were formed into individual parcels during the salinity problem period due to the nature of hard stratification of soils.
		Credit insufficiency/2	CRI	High extent of contraction of agricultural credit to unproductive lands. Official and private sources of credit for agriculture were reduced during the salinity problem period. This particularly occurred during the Diaz Ordaz administration.
		Salinity problem remains/5	SAR	Salinity of the Colorado River and agricultural lands in the Mexicali Valley still remains today a critical problem. It is mostly observed at the southern international boundary point of delivery (Sanchez Mejorada Canal), failures in the monitoring system at the northern international boundary (Morelos Dam), and the resulting permanent salts accumulation along the salty route in the Mexicali Valley.
		Reduction of agricultural lands/3	RED	High extent of individual parcels size reduction. Reduction of agricultural lands was noticed during the salinity problem due to localized affectations over significant areas of individual parcels (2 hectares as average).
		Abandoning agricultural lands/2	ABA	High proportion of agriculturists abandoning agricultural activity. A significant number of agriculturists abandoned their parcels and stopped up production both temporarily and permanently when the salinity problem took place.

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Table B.2 (cont'd)

Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	4. Problems emerged with SAL? (cont'd)	Adaptation to damages/4	ADA	Adaptation to damage was noticed as an immediate response of individual agriculturists to avoid yields reduction (furrow irrigation methods, planting at the bottom to avoid contact of salt with plant's root as well as developing tolerant crops to grow).
	5. Agriculturists participation during SAL?	High level of participation in SAL /9	**HIP**	High level of participation in SAL. High level of participation of agriculturists was noticed throughout a united force of agriculturists belonging to different unions forming remarkable crowded meetings (tens of thousands of people). "Crisis use to joint people"
		High level of solidarity/8	SOL	Solidarity was the main characteristic of the agriculturists' mobilization during the salinity.
		Unity base/2	UNI	Unification of individuals was originated at the household level due to economic conditions that allowed farmers' families were rooted in the Mexicali's countryside.
		Strong agricultural unions/8	SAU	Participation of the agricultural sector during the salinity problem was present mainly through well organized, strong, and meaningful leader representation of agricultural unions that as unified forces used to express, complain, claim, demand, and boycott governmental agencies from both countries towards finding suitable solutions.
		Significant presidential leadership/10	LEA	President Luis Echeverria Alvarez is acknowledged as a governmental leader that offered meaningful support (credit and technical assistance for organized emerging agri-industries and livestock operations), guideness and representation (in bilateral negotiation) to obtain solutions to the salinity problem on behalf of Mexicali Valley agriculturists (rehabilitation program and Wellton-Mohawk Canal). No support was received from Gustavo Diaz.
		Strong state and federal support/5	SSS	Strong support coming from state and federal agencies (governments) was noticed.
		Local agriculturists unions' leadership/6	LAU	There were local organizations such as CCI, CNC, UAR, and CNPPR that understood the problem, voiced, and fought against it as defenders of the agriculturists' interests.
		Principal agricultural union/3	PAU	The Central Campesina Independiente (CCI) was the most important union involved in the process while promoting participation of agriculturists in the salinity problem.
		Outstanding local leaders/7	LOL	Local leadership is identified and personified by individuals such as Alfonso Garzón, Hipólito Rentería, Celestino Salcedo, Francisco Aguilar, Rodolfo Fierro, Salvador Solorio, Miguel Monje, Dr. Cevallos, Ovidio Lara, and Luis Granados among others.
		Outstanding external support/1	EXS	External support (moral and economic) coming from commerce and industry was noticed while the SAL conflict
		Principal leader/5	PAL	Alfonso Garzón is acknowledged as the main acting leader in the salinity movement.
		Failing leaders/1	FAL	Rodolfo Fierro Márquez is mentioned as one harmful leader for agriculturists.

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Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	5. Agriculturists participation during SAL? (cont'd)	Fundamental local leadership/4	CEJ	Fundamental leadership rested in the person of an Ejido authority named the "President of the Comisariado Ejidal" who had broad political power, natural social leadership, and capacity to call for mass meetings.
		Financial capacity of agriculturists/8	FIC	A contribution of about five Mexican cents included in the irrigation water fees were voluntarily given by agriculturists to their respective unions through the Comisariado Ejidal-SRH coordination. This fund gave agriculturists capacity to afford their unions' representatives mobilization/operation expenditures.
2-3-4	6. Influence of agriculturists to resolve the salinity?	Influence of agriculturists for reaching solutions to the salinity/10	**ITS**	Influence of agriculturists for reaching technical solutions to the salinity problem. Participation of agriculturists, both as individuals and as unions or "unions of unions" ensured communication with governmental high level agents, thus, influenced to find technical solutions to the salinity problem.
		Influential participation in inducing institutional change for binational water management/7	IBI	Influential participation of agriculturists in inducing institutional change for binational water management. Participation of agriculturists in the salinity problem showed their influence to press for change in the institutional binational legal frameworks for water management (i.e. Minute 242).
	7. Benefits obtained?	Influential participation in defining infrastructure for recovering water quality/4	REQ	Influential participation of agriculturists in defining the implementation process of infrastructure for recovering water quality in the Colorado River and the Mexicali Valley. A main benefit obtained from the intensive participation of agriculturists in the salinity problem was to obtain infrastructure for recovering irrigation water quality by inducing the building of the Wellton-Mohawk by-pass.
		Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity/10	REL	Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity of lands. An important benefit gained from intensive participation of agriculturists in the salinity problem was to get infrastructure for recovering lands' productivity by the implementation of the Irrigation District Rehabilitation Program that included lands leveling, building surface drainage system, and lining main irrigation canals.
		Influential participation for obtaining financial support to continue production/8	CAP	Influential participation of agriculturists for obtaining financial support to continue production. Capital (credit and technical assistance) was given as one of the benefits for agriculturists both as individuals and as organizations.

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Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	7. Benefits obtained? (cont'd)	Corruption and mismanagement of the U.S. compensation and the Mexican financial support funds by Mexican actors/6	COR	High extent of corruption and mismanagement of the U.S. compensation and the Mexican financial support funds by Mexican actors. Corruption among agricultural leaders was noticed during the administration of funds obtained from the compensation to the salinity.
		The role in the incompletion of the rehabilitation program/2	REI	The role of agriculturists in the incompletion of the rehabilitation program. The rehabilitation program in the Irrigation District 014 is still incomplete today, thus there is an inefficient water use in the agricultural sector.
1	8. On the AAC project impacts?	AAC lining project threat/7	**JEO**	The AAC project represents jeopardizes not only for the sustainability of the nearby agricultural activity but also for people living and working beyond the area of influence in Mexicali Valley and the city which depend on scarce water resources totally allotted.
		Uncertainty on impacts/3	UCY	There are a huge uncertainty about what would happen to agricultural lands and environment directly depending on AAC seepage.
		Cyclic damages/1	CYC	The All-American Canal seepage has impacted agriculture cyclically in this particular area, first during initial operation of the canal the seepage produced flooding in Col. Bórquez, Ejido Netzahualcóyotl and Ejido Yucatan from 1945 to 1954 plus 10 more years of recovering; but now, it might represent potential water scarcity.
		Artificial surface sources affectations/4	DRE	Two main drains which function as AAC seepage interceptors and also as irrigation canals to Modules 4 and 5 (La Mesa Drain and the Culiacán Drain) will be suddenly and drastically reduced, disappearing eventually as delivery canals for more than 2,000 hectares.
		Rights on the AAC seepage/1	RAC	The U.S. government has the right over this water (All-American Canal seepage).
		Regional upper aquifer affectations/6	RAF	Local aquifer's quantity and quality impending gradual reduction is envisaged affecting, initially, to more than 19,000 hectares belonging the irrigation Modules 4, 5, 6, 7 and 16 at the northeastern area of the Mexicali Valley, but damages are expected to occur later in the whole irrigation district (system view).
		Deep wells digging/2	WEL	Deeper wells might be perforated in line parallel to the All-American Canal on the Mexican side to compensate potential damages to the upper aquifer, this since deep groundwater sources is abundant, but costs might rise.

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Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	8. On the AAC project impacts? (cont'd)	Reductions in growing area/5	RED	Potential reductions in growing area is expected with the AAC, this considering precedents like the aquifer source reduction during the 1970s, then cotton growers were mandatorily pressed to reduce cropping size from 20 to 18 hectares, alfalfa growers from 20 to 16 hectares, and wheat growers from 20 to 14 hectares.
		Water adjustment/6	ADJ	Potential irrigation water volume adjustment at both regional and district level as a connected system is envisaged if the All-American Canal takes place. This also means reductions in individual and regional irrigated areas.
		No rights irrigators affected/0	NOR	Agriculturists with no rights within the irrigation district who benefit by using the canal seepage will be directly affected over the northern portion of the Mexicali Valley (Ejido Netzahualcóyotl).
		Wetlands affectations/2	WET	A series of small wetlands formed with the All-American Canal seepage reach an extension of more than 3,400 hectares over Module 16 will disappear.
	9. Agriculturists' participation AAC?	Agriculturists weak defense of AAC seepage/8	**DAS**	Lack of a strong and energetic defense of the All-American Canal seepage water by new generation agriculturists is translated as: "Those who keep quiet then give up"; "Those who forgot their history then might make again the same mistakes"
		Source of information/1	SOI	Indirect sources of information are the ways how agriculturists get informed about the AAC (TV, Press, radio).
		Federal agencies weak defense of AAC seepage/7	DAR	Lack of a strong, energetic, and effective defense by governmental agencies such as CONAGUA, CILA, and SAGARPA against the All-American Canal lining project.
		Presidential lack of accountability/6	PLA	Vicente Fox's Presidential leadership was lacking in terms of interest and accountability to locals when dealing with the All-American Canal issue.
		Federal Government lack of accountability/6	GLA	A significant lack of accountability to local agriculturists is noticed on the part of federal and state governmental agencies such as CONAGUA and CILA when dealing with the AAC.
		State Governor intervention/3	GBC	The Baja California's State Governor appears to have some extent of intervention/participation in the All-American Canal issue; however, his role is neither clear nor effective.
		Lack of transparency/1	TRA	Federal and state agencies lack of transparency when dealing with the AAC issue.
		Information is lacking/2	LIN	Critical information about the All-American Canal lining issues is neither enough, opportune nor widespread mainly by governmental agents.
		Assembly informing/3	ASY	Some meetings have taken place in the Ejido to talk about the issue and to ask for support.

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Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	9. Agriculturists' participation AAC? (cont'd)	Information misleading/1	MIN	Critical information about the AAC issues is often misleading on the part of governmental agencies. Some time governmental voices express significant impacts and others say exactly the opposite.
		Generalized apathy/9	APA	LIN and MIN induce lack of interest and motivation among confused agriculturists of the Mexicali Valley engaged in their productive activity.
		Aging leadership in the countryside/3	ALE	Local aged or missed leadership at the individual and organization level is losing power to call for agriculturists.
		Disperse leadership in the countryside/6	LED	Disperse and no impact leadership is observed within the agricultural sector (Momo Hernandez).
		External leadership for AAC/3	ELE	Shifts in people and organizations focused on voicing and claiming regarding water conflicts that mainly affect to agricultural users. Today, CDEM, an entrepreneurs' organization whose members belongs mostly to users others than agriculturists are dealing with All-American Canal issues.
		Lack of external support to agriculturists/2	LES	Lack of external support (either government or urban users) to agriculturists to lead the AAC conflict.
		No financial capacity of agriculturists/7	NOF	Voluntarily given financial contributions included in the past in normal irrigation water fees was recently eliminated. This fact reduces agriculturists' capacity to afford their unions' representatives mobilization/operation expenditures.
		Influence of agriculturists in the All-American lining/2	**DIT**	Null influence of agriculturists in finding solutions to the All-American Canal conflict. New leaders, governmental agencies, and even representatives disregard the significance and importance of agriculturists and their WUAs' thinking and voice as an agent for good change.
		Politics behind AAC/3	POC	Politics behind the AAC conflict point toward a premeditated negotiation between high level spheres of both governments to solve a technical problem originated in the U.S. to later compensate Mexico for damages through modernizing the Irrigation District 014.
		Politicians' campaigns issue/1	POL	It is well known that the AAC issue has been frequently used during politicians' campaigns without searching into its resolution.
	10. About irrigation users?	Lately Water Users' Associations/6	IMU	Lately formed Water Users' Associations (WUAs) in the Mexicali Valley were imposed in 1990 using a top-down approach (IDB, WB, BM). So, current failures in administration and water management (including bi-national waters concerns) come from their origin.
		Bureaucracy of co-management/5	BUR	Large bureaucratic red-tape affects the new era of water management (CONAGUA-WUAs). This in turns means increasing mobilization costs, and lack of motivation for leaderships.

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Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	10. About irrigation users? (cont'd)	WUAs' lack of accountability/6	ALA	WUAs, as instances for irrigation water management, have shown lack of accountability and support to small landholders; instead they obey and show accountability to upper-bound institutions such as CONAGUA.
		WUAs' lack of system view/1	SYS	Lack of system view as a district has provoked disintegration
		Large landholders command WUAs/4	LAN	New big landholders have the command and control of irrigation water management within WUAs.
		Legal rights/1	LER	WUAs have the complete right and judicial interest to participate and defend agriculturists' interests and to prevent potential damages.
		WUAs elude AAC issues/6	**ELU**	The AAC conflict was not properly attended or faced by water users associations' representatives (WUAs and SRL) neither in time nor in depth. There is no real interest in handling the issue and just until recently it was mentioned in assembly but with no impact towards obtaining benefits for the agricultural sector. Governmental agencies do not promote participation.
		WUAs role/2	ROL	WUAs have had the role of pressing the state government to intervene and to pressure federal government
		Alternatives to AAC/4	ALT	Alternatives to the AAC on the part of WUAs are to induce efficiency throughout implementing drip and sprinkler irrigation methods, which might save 30 percent.
		Groups interests and apathy within WUAs/4	GIA	Groups' interests and apathy within water users' associations is noticed and this fact is blocking effective social participation, this in turn constrains power participation of agriculturists as a united force.
2-3-4	11. Formal mechanism for participation?	Lack of information about formal mechanisms/2	LIM	Lack of information about formal links or mechanisms of coordination between WUAs and governmental agencies like CILA which attends transboundary water issues directly affecting agricultural activity. Agriculturists' representatives do not properly inform to constituency about the issue.
		Lack of formal coordination mechanisms/2	LAC	Lack of formal coordination mechanisms between CILA and WUAs to jointly analyze aspects related to transboundary waters affecting agricultural activity.

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Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	12. Agriculturists' organizations links?	Water agencies links/3	WAL	WUAs show permanent links with several agencies according to management/operation tasks: first, the irrigation society (SRL) which operates the water users' major irrigation networks; second, the National Water Commission (CONAGUA throughout the Irrigation District 014 and the Hydraulic Committee), which is the planning and regulatory agency; and third, the city's water authority named State Commission of Public Services of Mexicali (CESPM).
		Lack of effective coordination with CILA/2	LIC	Links between WUAs and CILA is lacking, despite the importance of having a more fluid and broader communication and coordination efforts with us as users, in first time and place, of transboundary waters coming from the Colorado River.
	13. SAL vs. AAC agriculturists' participation?	Different presidential leadership/2	DIP	Significant differences were perceived between presidents Luis Echeverria Alvarez and Vicente Fox Quesada regarding leadership, intelligence, energy, bravery, patriotism, accountability to locals, and interest in the issue to assist, confront, and fight in defense of the Mexicali Valley agriculturists' perilous conditions.
		Different extent of agriculturists' organization/5	DOR	Strong organization capacity (unions) and organizations accountability was noticed during the salinity problem period.
		Different agriculturists' leadership/7	DAL	Political power and representativeness of agriculturists' leaders is missed nowadays. In the past, agricultural leaders were frequently part of a political party (PRI) that always had a chair, voice and decision making power within chambers of representatives in both state and federal level as well as strong communication ties with officials.
		Different groups making pressure/2	DIG	During the salinity problem period, groups of agriculturists such as CCI, CNC, UAR, and CNPPR made pressure to demand the U.S. On the other hand, during the All-American Canal conflict an urban-based group (CDEM) demanded the U.S. against the AAC project.
		Loss of capacity for influencing changes/7	CIL	Participation of local agriculturists' leaders in chambers of representatives gave them capacity to influence modifications of local ordinances, nation state rules, federal laws, and international legal frameworks such as the 1944 Water Treaty.
		Changes in socio-productive structure/3	SOS	Lack of agriculturists' participation is mostly explained by the changes in socio-productive structures in the Mexicali Valley due to high level of lands under rental contract.
	14. Barriers for water management?	Social organization/5	ORG	Human/social and productive organization represents an essential factor to have a good water management practices and also to face and overcome conflicts at local and bi-national level.
		Operation problems/2	OPE	Planning and operation problems are frequent in irrigation modules.

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Table B.2 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	14. Barriers for water management? (cont'd)	Agriculturists inequality/1	EQU	Equality among agriculturists is lacking in terms of support coming from both WUAs' officials and governmental agencies, which shows an extent of elitism where alfalfa producers are being beneficiated.
		Long-term vision/3	LOV	Long-term vision in both the agricultural and the irrigation sectors is missing. Six-year financial planning horizons defined by governmental administrations limit development.
		Economic constraints in agriculture/2	BEC	Economic welfare in the agricultural sector is a fundamental factor limiting effective water management practices in the Mexicali Valley.
		Lack of irrigation technology/3	TEC	Irrigation technology is progressing very slowly, for example, the lack of underground pipe tiles for draining salty waters and surplus irrigation water in this area represent a production barrier.
		Downward spirals/5	DOW	Permanent low crop prices and high production costs determine gradual bad economic conditions for agriculturists, this in turn triggers social organization problems and lack of social participation (it has inherent costs); as a result of a weak sector to attend and face water management problems/conflicts at local and moreover at a bi-national level is observed.
		Lack of collaboration/1	COL	Lack of collaboration for transboundary water management as critical issues (SAL and AAC).
	15. Benefits from best water management?	Increased water availability/3	AVA	Irrigation water availability might be increased and this allows for a better operation and distribution and water transfers both among individuals within an irrigation module and among the twenty two water users' associations in the Mexicali Valley.
		Water transfers/2	TNS	Water transfers for second crops, intra and inter-module, and module-city might take place.
		Environmental benefits/1	ENV	A better water management leads to protect water sources and to improve local environmental conditions.
		Agricultural sector improvements/2	AGI	Agricultural sector might experience improvements both at household level and in general as economic sector. This might be mainly noticed in production costs reduction (labor, water management, water use, fertilizers use) and increased quality of products.
		Education for saving water/1	EDU	Water-saving education strategies must have been a central point in water policies several years ago and probably being operationalized by using several perspectives. This could have given a variety of visions about water resources as special good, and involving diverse sectors not just the agricultural one.
		Indifferent governments/8	ING	Contemporary governments (Federal and State) have remained indifferent to the agricultural activity for more than 20 years.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.3 Coding system: Irrigation and transboundary water management in the southern Mexicali Valley (SAH).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	1. Mexicali Valley change/ evolution?	Agricultural sector progress/3	**PRO**	Agricultural activity in the Mexicali Valley shows permanent economic growth through time.
		Agricultural sector regression/5	**REG**	Agricultural activity in the Mexicali Valley shows permanent economic decay through time.
		Crops diversification/2	DIV	Crops structure changed from unique crops like cotton expanded to grow grains and produces
		Minimum progress/1	MIP	Agricultural sector shows improvement although not felt at all among original landholders but among new landholders.
		Agricultural lands rented/4	REN	Growing area of agricultural lands rented. High extent of agricultural lands under rental contract is observed and reaches more than 70 percent which induced changes in agricultural sector social and productive structure.
		Larger agricultural operations scale/2	LAR	The Mexicali Valley is experiencing new larger agricultural lands' operations which are changing from an original allotment of 20 hectares per household up to 150 ha as average as a sustainable size for continuing production.
		High production costs/3	HIC	Growing high production cost is noticed for most production inputs.
		Lower prices/3	LOP	Lower prices for agricultural products are noticed.
		Industry predominance/2	IND	Industrial (agri-industries) activities have been growing.
		Reduced credit for agriculture/3	CRE	Proportion of financial support for agricultural activities in now significantly reduced for small farmers and the proportion warranty/credit is too high to small farmers.
		Bureaucracy in credit/3	BUC	High extent of bureaucracy in the credit process is gaining moment
		Commercialization problems/1	COM	Commercialization problems for small farmers are noticed for most agricultural products especially grains.
		Loosing organizational capacity/1	LOZ	In the past, the ejidos used to organize themselves to produce in high scale and diversified production processes (agriculture and livestock, agri-industries).
		Technology improvements/3	TIM	Technology improvements for lands' labor are the most important change observed in the Mexicali Valley area.
		Human resources improvement/1	HUM	Human resources improvements both as rural society and as technical personnel quality are observed.
		Rural population/1	POP	Concentration of rural population in several small towns has taken place in recent years.
	2. Irrigation change?	Successful irrigation water management/3	**SIM**	Irrigation water management (operation, administration, and conservation) by agricultural users (WUAs) is improving.

SAH: Southern region agriculturist household; RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol

Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	2. Irrigation change? (cont'd)	Failing irrigation water management/5	**FIM**	Irrigation water management (operation, administration, and conservation) performed by agricultural water users' associations (WUAs) is a still struggling activity due to organization problems among individual irrigators.
		Spendthrift irrigation water/2	SIW	Irrigation water use in the past was notoriously wasteful when compared with that of current times
		Lack of irrigation technology/2	LIT	Irrigation technology in Mexicali was lacking of the necessary land's leveling, efficient methods, and lined canals in the past.
		Efficient water use/1	IWE	In recent times irrigation water is being used more efficiently than en the past.
		Inefficient water use/1	IWI	In recent times irrigation water use is still suboptimal.
		Growing irrigation technology/5	GIT	Today, there exists suitable irrigation technology such as land leveling and lined canals to perform the activity, however it is still suboptimal.
		Irrigation technology insufficient/3	IIT	Nowadays there exists irrigation technology needs such as land leveling, lined canals and open drainage system to perform the activity, thus, it is still suboptimal.
		Lack of investment/3	INV	Lack of broad programs of co-investment state, federal and users.
		Lack of coordination/1	CIC	Lack of coordination between CILA and CONAGUA affects irrigation operation in this sub-region
		Costly water service/2	COS	Improvement in irrigation water management implied much higher water costs accruing to individual agricultural users (operation and energy costs).
		Water users inequality/2	IQU	Equality among irrigation water users is lacking in terms of support coming from both WUAs' officials, which shows an extent of elitism for water use.
		Internal water conflicts/1	ICO	Conflicts among groundwater and surface irrigation users are/might be noticed in times of critical high demand seasons within agricultural areas (March-April).
		Increasing water demands/2	DEM	Considering same hectares, growing rural and urban population (Mexicali, Tijuana and U.S.), and gradual downward allotment for agriculturists (currently of 117 lps/ha).
	3. Importance of transboundary waters?	Mexicali Valley transboundary waters importance/2	TWI	Transboundary waters represent a unique and vital resource for agriculture in the Mexicali Valley which depends mostly on this source.
1	4. Problems emerged with SAL?	Salinity of agricultural lands/4	**SAD**	Damages in agriculture of the Mexicali Valley. Damages due to the salinity were significant and meant drastic reductions in seeds shoot, plant growth and development, and crop yields as well as increasing production costs. Also contraction of credit for "unproductive farmers."

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Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	4. Problems emerged with SAL? (cont'd)	Mixed salty waters upstream/3	MIX	Disposed of salty waters upstream (salinity of the Colorado River). Water delivered to Mexico during a period encompassing almost 13 years (1960-1973) was intentionally polluted upstream Colorado River while mixing them with salty waters coming from agricultural lands in the Yuma Valley, U.S. (point source).
		Yields reduction/3	YED	High extent of crops yields reductions. Yields in main crops showed significant reductions of about 80 percent (cotton) and 70 percent (wheat).
		Increasing costs/2	ICS	Increasing production costs for individual agriculturists. Increasing costs during the salinity problem were noticed while increasing water use for salts leaching and for modifying productive practices (planting, fertilization, etc.).
		Salty parcels/3	SAH	Significant portions of salty soils were formed within individual parcels when SAL due to the nature of hard stratification throughout the soil depth.
		Salinity problem remains/2	SAR	Salinity of the Colorado River and agricultural lands in the Mexicali Valley still remains today a critical problem. It is mostly observed at the southern international boundary point of delivery (Sanchez Mejorada Canal), failures in the monitoring system at the northern international boundary (Morelos Dam), and the resulting permanent salts accumulation along the salty route in the Mexicali Valley.
		Reduction of agricultural lands/1	RED	High extent of individual parcels size reduction. Reduction of agricultural lands was noticed during the salinity problem period due to localized affectations over significant portions of individual parcels (4 hectares as average).
		Adaptation to damages/1	ADA	Adaptation to damage was noticed as an immediate response of individual agriculturists to avoid yields' reduction (i.e. furrow irrigation methods, planting at the bottom to avoid contact with salts and plants roots as well as developing tolerant crops to grow).
	5. Agriculturists participation during SAL?	High level of participation in SAL /6	**HIP**	High level of participation in SAL. High level of participation of agriculturists was noticed throughout a united force of agriculturists belonging to different unions forming remarkable crowded meetings (tens of thousands of people). "Crisis use to joint people"
		High level of solidarity/4	SOL	Solidarity was the main characteristic of the agriculturists' mobilization during the salinity.
		Unity base/3	UNI	Unification of individuals was originated at the household level due to economic conditions that allowed farmers' families were rooted in the Mexicali's countryside.
		Strong agricultural unions/3	SAU	Participation of the agricultural sector during the salinity problem was present mainly through well organized, strong, and meaningful leader representation of agricultural unions that as unified forces used to express, complain, claim, demand, and boycott governmental agencies from both countries towards finding suitable solutions.

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Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	5. Agriculturists participation during SAL? (cont'd)	Significant presidential leadership/5	LEA	President Luis Echeverria Alvarez is acknowledged as a governmental leader that offered meaningful support (credit and technical assistance for organized emerging agri-industries and livestock operations), guideness and representation (in bilateral negotiation) to obtain solutions to the salinity problem on behalf of Mexicali Valley agriculturists (rehabilitation program and Wellton-Mohawk Canal). No support was received from Gustavo Díaz Ordaz, his predecessor.
		Strong state and federal support/3	SSS	Strong support coming from state and federal agencies (governments) was noticed.
		Local agriculturists unions' leadership/5	LAU	There were local organizations such as CCI, CNC, UAR, and CNPPR that understood the problem, voiced, and fought against it as defenders of the agriculturists' interests.
		Principal agricultural union/2	PAU	The Central Campesina Independiente (CCI) was the most important union involved in the process while promoting participation of agriculturists in the salinity problem.
		Outstanding local leaders/4	LOL	Local leadership is identified and personified by individuals such as Alfonso Garzón and Rodolfo Fierro.
		Outstanding external support/3	EXS	External support (moral and economic) coming from commerce and industry was noticed during the salinity problem period
		Principal leader/5	PAL	Alfonso Garzón Santibáñez is acknowledged as the main acting leader during the salinity.
		Financial capacity of agriculturists/5	FIC	A contribution of about five Mexican cents included in the irrigation water fees were voluntarily given by agriculturists to their respective unions through the Comisariado Ejidal-SRH coordination. This fund gave agriculturists capacity to afford their unions' representatives mobilization/operation expenditures.
		Politics behind SAL/1	POS	Politics behind the salinity problem pointed toward a premeditated negotiation between high level officials of both governments to solve a technical problem originated in the U.S. to later compensate Mexico for damages throughout modernizing the Irrigation District 014.
2-3-4	6. Influence of agriculturists to resolve the salinity?	Influence of agriculturists for reaching technical solutions to the salinity/5	**ITS**	Influence of agriculturists for reaching technical solutions to the salinity problem. Participation of agriculturists, both as individuals and as unions or "unions of unions" ensured communication with governmental high level agents, thus, influenced to find technical solutions to the salinity problem.
		Influential participation for institutional change (binational framework)/4	IBI	Influential participation of agriculturists for inducing institutional change in binational water management. Participation of agriculturists in the salinity problem showed their influence to press for change in the institutional binational legal frameworks (i.e. Minute 242).

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Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	7. Benefits obtained?	Influential participation in defining infrastructure for recovering water quality/1	REQ	Influential participation of agriculturists in defining the implementation process of infrastructure for recovering water quality in the Colorado River and the Mexicali Valley. A main benefit obtained from the intensive participation of agriculturists in the salinity problem was to obtain infrastructure for recovering irrigation water quality by inducing the building of the Wellton-Mohawk by-pass.
		Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity of lands /4	REL	Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity of lands. An important benefit gained from intensive participation of agriculturists in the salinity problem was to get infrastructure for recovering lands' productivity by the implementation of the Irrigation District Rehabilitation Program that included lands leveling, building surface drainage system, and lining main irrigation canals.
		Influential participation for obtaining financial support to continue production/2	CAP	Influential participation of agriculturists for obtaining financial support to continue production. Capital (credit and technical assistance) was given as one of the benefits for agriculturists both as individuals and as organizations.
		The role in the incompletion of the rehabilitation program/1	REI	The role of agriculturists in the incompletion of the rehabilitation program. The rehabilitation program in the Irrigation District 014 is still incomplete today, thus there is an inefficient water use in the agricultural sector.
1	8. On the AAC project impacts?	AAC lining project threat/7	**JEO**	The AAC project represents jeopardizes not only for the sustainability of the nearby agricultural activity but also for people living and working beyond the area of influence in Mexicali Valley and the city which depend on scarce water resources totally allotted.
		Uncertainty on impacts/1	UCY	There are a huge uncertainty about what would happen to agricultural lands and environment directly depending on AAC seepage.
		Opportunity for improving conditions/3	IOP	The AAC lining project also represents an opportunity for improving living and productive conditions both locally and bi-nationally if principal actors like agricultural users are included in the negotiation process.
		Rights on the AAC seepage/1	RAC	The U.S. government states it has the right over this water seepage.
		Regional upper aquifer affectations/2	RAF	Local aquifer's quantity and quality impending gradual reduction is envisaged affecting, initially, to more than 19,000 hectares belonging the irrigation Modules 4, 5, 6, 7 and 16 at the northeastern area of the Mexicali Valley, but damages are expected to occur later in the whole irrigation district (system view).

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Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	8. On the AAC project impacts? (cont'd)	Deep wells digging/3	WEL	Deeper wells might be perforated in line parallel to the All-American Canal on the Mexican side to compensate potential damages to the upper aquifer, this since deep groundwater sources is abundant, but costs might rise.
		Reductions in growing area/2	RED	Potential reductions in growing area is expected with the AAC, this considering precedents like the aquifer source reduction during the 1970s, then cotton growers were mandatorily pressed to reduce cropping size from 20 to 18 hectares, alfalfa growers from 20 to 16 hectares, and wheat growers from 20 to 14 hectares.
		Water adjustment/3	ADJ	Potential irrigation water volume adjustment from 117 to 100 lps at both regional and district level as a connected system is envisaged if the All-American Canal project takes place. This also means reductions in individual and regional irrigated areas.
		Artificial surface sources affectations/2	DRE	Two main drains which function as AAC seepage interceptors and also as irrigation canals to Modules 4 and 5 (La Mesa Drain and the Culiacán Drain) will be suddenly and drastically reduced, disappearing eventually as delivery canals for more than 2,000 hectares.
		Wetlands affectations/1	WET	A series of small wetlands formed with the All-American Canal seepage reach an extension of more than 3,400 hectares over Module 16 will disappear.
		Small rural towns affectations/1	RUT	Rural small towns whose sources are the La Mesa Drain and the aquifer might be affected.
		Good neighbor stand/1	NEM	The good neighbor principle is missing when dealing with transboundary waters.
		U.S. must compensate Mexican agricultursists/2	CTE	The U.S. must compensate Mexico for damages and must also invest in irrigation infrastructure in the Mexicali Valley.
	9. Agriculturists' participation AAC?	Agriculturists weak defense of AAC seepage/3	**DAS**	Lack of a strong and energetic defense of the AAC seepage water by new generation agriculturists is translated as: "Those who keep quiet then give up"; "Those who forgot their history then might make again the same mistakes"
		Federal agencies weak defense of AAC seepage/4	DAR	Lack of a strong, energetic, and effective defense by governmental agencies such as CONAGUA, CILA, and SAGARPA against the All-American Canal lining project.
		Presidential lack of accountability/4	PLA	Vicente Fox's Presidential leadership was lacking in terms of interest and accountability to locals when dealing with the All-American Canal issue.
		Federal Government lack of accountability/3	GLA	A significant lack of accountability to local agriculturists is noticed on the part of federal and state governmental agencies such as CONAGUA, CILA, and SAGARPA when dealing with the AAC.

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Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	9. Agriculturists' participation AAC? (cont'd)	Lack of transparency/2	TRA	Federal and state governmental agencies lack of transparency when dealing with the AAC issue
		Information is lacking/1	LIN	Critical information about the All-American Canal lining issues is neither enough, opportune nor widespread mainly by governmental agents.
		Information misleading/1	MIN	Critical information about the AAC issues is often misleading on the part of governmental agencies. Some time governmental voices express significant impacts and others say the opposite.
		Generalized apathy/2	APA	LIN and MIN induce lack of interest and motivation among confused agriculturists of the Mexicali Valley engaged in their productive activity.
		Aging leadership in the countryside/3	ALE	Local aged or missed leadership at the individual and organization level is losing its power to call for agriculturists meetings.
		Dispersed leadership in the countryside/3	LED	Dispersed and without impact leadership is observed within the agricultural sector (a meaningful remaining leader is Gerónimo Hernández).
		External leadership for AAC/1	ELE	Shifts in people and organizations focused on voicing and claiming regarding water conflicts that mainly affect to agricultural users. Today, CDEM, an entrepreneurs' organization whose members belongs mostly to users others than agriculturists are dealing with the AAC issue.
		Lack of support /3	LES	Lack of external support to agriculturists to lead the AAC conflict.
		No financial capacity of agriculturists/3	NOF	Voluntarily given financial contributions included in the past in normal irrigation water fees was recently eliminated. This fact reduces agriculturists' capacity to afford their unions' representatives mobilization/operation expenditures.
		Influence of agriculturists in the All-American lining/4	**DIT**	Null influence of agriculturists in finding solutions to the All-American Canal conflict. New leaders, governmental agencies, and representatives disregard the significance of agriculturists and their WUAs' thinking and voice as an agent for good change.
		Politics behind AAC/2	POC	Politics behind the AAC conflict point toward a premeditated negotiation between high level spheres of both governments to solve a technical problem originated in the U.S. to later compensate Mexico for damages through modernizing the Irrigation District 014.
	10. Irrigation users?	Lately Water Users' Associations/2	IMU	Lately formed Water Users' Associations (WUAs) in the Mexicali Valley were imposed in 1990 using a top-down approach (IDB, WB, BOM). So, current failures in administration and water management (including bi-national waters concerns) come from their origin.
		Bureaucracy of co-management/2	BUR	Large bureaucratic red-tape affects the new era of water management (CONAGUA-WUAs). This in turns means increasing mobilization costs, and lack of motivation for leaderships.

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Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	10. Irrigation users? (cont'd)	WUAs' lack of accountability/3	ALA	WUAs, as instances for irrigation water management, have shown lack of accountability and support to small landholders; instead they obey and show accountability to upper-bound institutions such as CONAGUA.
		WUAs' lack of system view/1	SYS	The lack of a system view on the part of WUAs to see the irrigation district as an interconnected entity has provoked social and productive disintegration.
		Large landholders command WUAs/2	LAN	New big landholders have the command and control of irrigation water management within WUAs.
		WUAs elude AAC issues/6	**ELU**	The AAC conflict was not properly attended or faced by water users associations' representatives (WUAs and SRL) neither in time nor in depth. There is no real interest in handling the issue and just until recently it was mentioned in assembly but with no impact towards obtaining benefits for the agricultural sector. Governmental agencies do not promote participation.
		WUAs role/1	ROL	WUAs have had the role of pressing the state government to intervene and to pressure federal government
		Alternatives to AAC/3	ALT	Alternatives to the AAC on the part of WUAs are to induce efficiency throughout implementing drip and sprinkler irrigation methods, which might save 30 percent.
		Groups interests and apathy within WUAs/2	GIA	Groups' interests and apathy within water users' associations is noticed and this fact is blocking effective social participation, this in turn constrains power participation of agriculturists as a united force.
2-3-4	11. Formal mechanism for participation?	Lack of information about formal mechanisms/2	LIM	Lack of information about formal links or mechanisms of coordination between WUAs and governmental agencies like CILA which attends transboundary water issues directly affecting agricultural activity. Agriculturists' representatives do not properly inform to constituency about this issue.
		Lack of formal coordination mechanisms/2	LAC	Lack of formal coordination mechanisms between CILA and WUAs to jointly analyze aspects related to transboundary waters affecting agricultural activity.
		Need to formally embrace the AAC theme/1	FIN	Need for embracing the AAC issues within the WUAs' assembly (as a formal institution) so that the problem could be raised by representatives to another level of authority such as nation states or federal agencies. The idea is to create synergies to traditional top-down and a new bottom-up approach, the later, based on formal institutions of agriculturists' constituency.

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Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	12. Agriculturists' organizations links?	Water agencies links/2	WAL	WUAs show permanent links with several agencies according to management/operation tasks: first, the irrigation society (SRL) which operates the water users' major irrigation networks; second, the National Water Commission (CONAGUA throughout the Irrigation District 014 and the Hydraulic Committee), which is the planning and regulatory agency; and third, the city's water authority named State Commission of Public Services of Mexicali (CESPM).
		Lack of effective coordination with CILA/2	LIC	Links between WUAs and CILA is lacking, despite the importance of having a more fluid and broader communication and coordination efforts with us as users, in first time and place, of transboundary waters coming from the Colorado River.
	13. SAL vs. AAC agriculturists' participation?	Different presidential leadership/2	DIP	Significant differences were perceived between presidents Luis Echeverria Alvarez and Vicente Fox Quesada regarding leadership, intelligence, energy, bravery, patriotism, accountability to locals, and interest in the issue to assist, confront, and fight in defense of the Mexicali Valley agriculturists' perilous conditions.
		Different extent of organization/4	DOR	Strong organization capacity (unions) and organizations accountability was noticed during the salinity problem period.
		Different agriculturists' leadership/5	DAL	Political power and representativeness of agriculturists' leaders is missed nowadays. In the past, agricultural leaders were frequently part of a political party (PRI) that always had a chair, voice and decision making power within chambers of representatives in both state and federal level as well as strong communication ties with officials.
		Different groups making pressure/1	DIG	During the salinity problem period, groups of agriculturists such as CCI, CNC, UAR, and CNPPR made pressure to demand the U.S. On the other hand, during the All-American Canal conflict an urban-based group (CDEM) demanded the U.S. against the AAC project.
		Loss of capacity for influencing changes/4	CIL	Participation of local agriculturists' leaders in chambers of representatives gave them capacity to influence modifications of local ordinances, nation state rules, federal laws, and international legal frameworks such as the 1944 Water Treaty.
		Similar politics/ 1	SIP	A similarity between the SAL and the AAC process is observed in terms of the politics behind such issues where a premeditated negotiation between governments takes place to face a technical aspect of water management in the U.S. affecting Mexico and where damage is allowed to then compensate the affected part.
		Changes in socio-productive structure/1	SOS	Lack of agriculturists' participation is mostly explained by the changes in socio-productive structures in the Mexicali Valley due to high level of lands under rental contract.

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Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	14. Barriers for water management?	Social organization/4	ORG	Human/social and productive organization represents an essential factor to have a good water management and also to face and overcome conflicts at local and bi-national level.
		Irrigation operation problems/3	OPE	Planning and operation problems are frequent in irrigation modules.
		Agriculturists inequality/3	EQU	Equality among agriculturists is lacking in terms of support coming from both WUAs' officials and governmental agencies, which shows an extent of elitism where alfalfa producers are being beneficiated.
		Long-term vision/2	LOV	Long-term vision in both the agricultural and the irrigation sectors is missing. Six-year financial planning horizons defined by governmental administrations limit development.
		Economic constraints in agriculture/2	BEC	Economic welfare in the agricultural sector is a fundamental factor limiting effective water management practices in the Mexicali Valley.
		Lack of irrigation technology/1	TEC	Irrigation technology is progressing very slowly, for example, the lack of underground pipe tiles for draining salty waters and surplus irrigation water in this area represent a production barrier.
		Downward spirals/2	DOW	Permanent low crop prices and high production costs determine gradual bad economic conditions for agriculturists, this in turn triggers social organization problems and lack of social participation (it has inherent costs); as a result of a weak sector to attend and face water management problems/conflicts at local and moreover at a bi-national level is observed.
		Lack of collaboration/2	COL	Lack of collaboration for transboundary water management as critical issues (SAL and AAC).
	15. Benefits from best water management?	Increased water availability/2	AVA	Irrigation water availability might be increased and this allows for a better operation and distribution and water transfers both among individuals within an irrigation module and among the twenty two water users' associations in the Mexicali Valley.
		Irrigation water transfers/2	TNS	Water transfers carried out among agricultural water users' associations within and out side the irrigation district (i.e. intra-module, inter-module, and module-city) are taking place for using water in additional cropping plans and for supplying urban users' eventual scarcity.
		Environmental benefits/2	ENV	Better water management practices in the irrigation district leads to protect water sources and to improve local environmental conditions.
		Agricultural sector improvements/2	AGI	Agricultural sector might experience improvements both at household level and in general as economic sector. This might be mainly noticed in production costs reduction (labor, water management, water use, fertilizers use) and increased quality of products (crop yields).

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.3 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	15. Benefits from best water management? (cont'd)	Increased bargain capacity/1	BAR	Agriculturists might have an increased surplus irrigation water bargain capacity among them as well as with other sectors like industry and cities and even with some U.S. users who also have water needs.
	16. Future of water mgmt?	Need for increasing economic resources/1	REC	Increase economic resources to the agricultural sector are imperative and they could come from several sources like agricultural users, government, and other agents.
1-2-3-4	17. Additional comments?	CESPM investing in the countryside/1	ICE	The local water authority (CESPM) must invest in the improvement of irrigation infrastructure and technology (conduction) as one compensatory mechanism since they are direct beneficiaries of low-priced water transfers from the Mexicali Valley to the city of Mexicali but throughout our leveled lands and lined canals which represent an accruing cost for agriculturists.
		Strategic AAC issue/1	AAS	The AAC theme is a strategic one in which people must be involved in a brave and intelligent manner. We the agriculturists could get mutual benefits without fighting against the project.
		Family self-consuming/1	SEC	A proportion of the normal land allotment 1/20 ha should be used for production of vegetables for self-consuming which might induce rural people to stay in the countryside.
		Organic fertilizers/1	FOR	Organic fertilizers (chicken, cows and vegetable residuals) must be included in the agricultural policy for increasing yields and reducing production costs as well as protecting environment. This in turn might strengthen integral productive chains.
		Indifferent governments/4	ING	Contemporary governments (Federal and State) have remained indifferent to agriculture for the past 20 years.

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Table B.4 Coding system: Irrigation and transboundary water management in the Mexicali Valley. Older water managers (OMGRs).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	1. Mexicali Valley change/ evolution?	Agricultural sector progress/6	**PRO**	Agricultural activity in the Mexicali Valley shows permanent economic growth throughout years.
		Crops diversification/3	DIV	Crops structure change from unique crops like cotton to expand to grow grains and produces
		International Water Treaty/1	IWT	The 1944 International Water Treaty triggered the Mexicali Valley development and evolution
		Agricultural lands rented/3	REN	Growing area of agricultural lands rented. High extent of agricultural lands under rental contract is observed and reaches about 50-60 percent which induces changes in agricultural sector social and productive structure.
		Larger agricultural operations scale/2	LAR	The Mexicali Valley is experiencing new larger agricultural lands' operations which are changing from an original allotment of 20 hectares per household to 150 ha in average as a sustainable size to continuing producing.
		High productivity of lands/2	HIL	Higher lands' productivity in the Mexicali Valley and mostly in the north-northeast region.
		Loosing organizational capacity/2	LOZ	In the past, ejidos used to organize to produce
		Technology improvements/4	TIM	Technology improvements for lands labor is the most important change observed.
		Mexicali Valley development model/2	MOD	The Mexicali Valley has gained attention at international level as a production system model for adaptation to change for using the Colorado River water and for changing its productive structure from unique Cotton crop to more than 50 diverse crops nowadays.
		Human resources improvement/1	HUM	Human resources improvements both as rural society and as technical personnel to help the Mexicali Valley activity
		Population in rural areas/1	POP	Concentration of rural population in several significant small towns has taken place due to growing public services
		Urban population dominance/1	URB	Urban population dominance even in the countryside small towns
	2. Irrigation change?	Successful irrigation water management/3	**SIM**	Irrigation water management (operation, administration, and conservation) by agricultural users (WUAs) is improving.

OMGRs: Older water managers; RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol

Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	2. Irrigation change? (cont'd)	Failing irrigation water management/3	**FIM**	Irrigation water management (operation, administration, and conservation) by agricultural users (WUAs) is still struggling and most times is due to organization problems of individual irrigators.
		Spendthrift irrigation water/5	SIW	Irrigation water use in the past was notoriously wasteful when compared with current times considering the surplus era
		Surplus era/2	SUR	The surplus era (1979-1987) signified a splitting up in the evolution of irrigation in the Mexicali Valley: surplus and later scarcity means a meaningful learning to adaptation for survival.
		Lack of irrigation technology/4	LIT	Irrigation technology in Mexicali was lacking of the necessary land's leveling, efficient methods, and lined canals in the past.
		Efficient water use/5	IWE	In recent times irrigation water is being used more efficiently than en the past.
		Growing irrigation technology/4	GIT	Nowadays there exists suitable irrigation technology such as land leveling and lined canals to perform the activity, however it is still suboptimal.
		Irrigation technology insufficient/2	IIT	Nowadays there exists irrigation technology needs such as land leveling, lined canals and open drainage system to perform the activity, thus, it is still suboptimal.
		Quality water problems/1	QLY	Quality of water coming from the Colorado River and used for irrigation continues being a factor for conflict at local and international level.
		Lack of investment/2	INV	Lack of broad programs of co-investment state, federal and users.
		Lack of water for environment/1	LEN	No water available for environment is another pressing factor affecting irrigation water management
		Costly water service/1	COS	Improvement in irrigation water management implied much higher water costs accruing to individual agricultural users (operation and energy costs).
		Water users inequality/2	IQU	Equality among irrigation water users is lacking in terms of support coming from both WUAs' officials, which shows an extent of elitism for water use.
		Internal water conflicts/1	ICO	Conflicts among irrigation users are noticed in times of critical high demand seasons within agricultural areas. Also internal conflicts between wells and superficial water users.
		Increasing water demands/2	DEM	Considering same hectares, growing rural and urban population (Mexicali, Tijuana and U.S.), and gradual downward allotment for agriculturists (currently of 117 lps/ha).
	3. Importance transboundary waters?	Mexicali Valley transboundary waters importance/3	TWI	Transboundary waters represent a unique and vital resource for agriculture in the Mexicali Valley which depends mostly on this source.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	3. Importance of transboundary waters?(cont'd)	Mexicali Valley's aridity/2	MAC	The main features in Mexicali is its arid climate conditions which mean there is no significant rainfall and high temperatures, thus, there is high dependence on Colorado River transboundary waters.
1	4. Problems emerged with SAL?	Salinity of agricultural lands/4	**SAD**	Damage in agriculture due to the salinity of the Colorado River and other inter-linked factors was significant and meant drastic reductions in seeds shoot, plant growth and development, crop yields, credit for producing as well as increasing production costs.
		Mixed salty waters upstream/3	MIX	Water delivered to Mexico during a period encompassing almost 13 years (1960-1973) was intentionally polluted upstream Colorado River while mixing them with salty waters coming from agricultural lands in the Yuma Valley, U.S. (point source).
		Yields reduction/5	YED	High extent of crops yields reductions. Yields in main crops showed significant reductions of around 40 percent.
		Salts route formed/2	ROU	Existence of salty soils strip along the valley.A long strip of salty soils running north to south was formed in de central area of the Mexicali Valley as a result of the salts pollution which is known as "the salty route" (ruta de la sal).
		Increasing costs/2	ICS	Increasing production costs for individual agriculturists. Increasing costs during SAL were noticed while increasing water use to salts leaching and for modifying productive practices (planting, fertilization, etc.).
		Salty parcels/5	SAH	High extent of salts pollution in individual parcels. Significant portions of salty soils were formed over individual parcels during the salinity problem due to the nature of hard stratification of agricultural soil.
		Credit insufficiency/1	CRI	High extent of contraction of agricultural credit to unproductive lands. Official and private credit agencies for agriculture drastically reduced financing during SAL.
		Different extent of affectation/1	AFE	Different degree of damages was noticed. Central sub region the most damaged.
		Salinity problem remains/1	SAR	Salinity of the Colorado River and agricultural lands in the Mexicali Valley still remains nowadays as a critical problem mostly noticed at the southern international boundary point of delivery (Sanchez Mejorada Canal), failures in the monitoring system at the northern international boundary (Morelos Dam), and the resulting permanent salts accumulation along the salty route and the southern sub-region of the Mexicali Valley.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	4. Problems emerged with SAL? (cont'd)	Reduction of agricultural lands/3	RED	High extent of individual parcels size reduction. Reduction of agricultural lands was noticed during the salinity problem due to localized affectations over significant portions of individual parcels (4 hectares as average).
		Abandoning agricultural lands/1	ABA	High proportion of agriculturists abandoning agricultural activity. A significant number of agriculturists abandoned their parcels and stopped up productive activity both temporary and permanently when the salinity problem took place.
		Adaptation to damages/4	ADA	Adaptation to survive to damage was noticed as an immediate response of individual agriculturists to avoid yields reductions (land management, changing irrigation methods, combining surface and groundwater sources, planting at the bottom to avoid salts contact with plant and shifts to tolerant crops).
	5. Agriculturists participation during SAL?	High level of participation in SAL /5	**HIP**	High level of participation in SAL. High level of participation of agriculturists was noticed throughout a united force of agriculturists belonging to different unions forming crowded meetings and "union of unions."
		High level of solidarity/5	SOL	Solidarity was the main characteristic of the agriculturists' mobilization while SAL.
		Unity base/4	UNI	Unity was originated at the household level and this was so because economic conditions allowed keeping farmers' families rooted in the countryside.
		Strong agricultural unions/5	SAU	Participation of agricultural sector in SAL was given mainly throughout well organized, strong, and meaningful representation of agricultural unions that as unified forces (Comité de Defensa del Valle de Mexicali) used to express, complain, claim, demand, and boycott governmental agents towards finding suitable solutions.
		Significant presidential leadership/2	LEA	President Luis Echeverria Alvarez is acknowledged by agriculturists as a government meaningful leader that offered significant support (credit and technical assistance, guideness and representation (in bilateral negotiation) to get solutions to SAL in the Mexicali Valley (rehabilitation program and Wellton-Mohawk).
		Strong state and federal support/3	SSS	Strong support coming from state and federal agencies (governments) was noticed such as SRE and SRH.
		Salinity problem model/1	SAM	The salinity problem represents a model for diplomacy and international negotiation between U.S and Mexico.
		Local agriculturists unions' leadership/3	LAU	There were local organizations such as CCI, CNC, UAR, and CNPPR that understood the problem, voice, and fight against it as defenders of the agriculturists' interests.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	5. Agriculturists participation during SAL? (cont'd)	Principal agricultural union/1	PAU	The Central Campesina Independiente (CCI) was the main union involved in the process and promoting participation.
		Outstanding local leaders/3	LOL	Local leadership is identified and personified in people like Rodolfo Fierro, Manuel Lizarraga, Mario Vindiola, etc.
		Outstanding external support/2	EXS	External support (moral and economic) coming from commerce and industry was noticed while the SAL conflict
		Principal leader/2	PAL	Alfonso Garzón Santibáñez is acknowledged as the main leader acting in the SAL movement.
		Fundamental local leadership/1	CEJ	Fundamental leadership rest in the person of an Ejido authority named the "President of the Comisariado Ejidal" who had broad political power (more than the private sector), natural social leadership, and capacity to call for mass meetings.
		Financial capacity of agriculturists/3	FIC	A contribution of around five Mexican cents per liter included in the irrigation water fees where voluntary given by agriculturists to their respective unions throughout the Comisariado Ejidal-SRH coordination. This fund gave agriculturists capacity to afford their unions' representatives mobilization/operation expenditures.
2-3-4	6. Influence of agriculturists to resolve the salinity?	Influence of agriculturists for reaching technical solutions to the salinity/4	**ITS**	Influence of agriculturists for reaching technical solutions to the salinity problem. Participation of agriculturists both as individuals and as unions or "unions of unions" ensured communication with governmental agents of high level, thus they had influence to find technical solutions to the salinity problem.
		Influential participation in inducing institutional change for binational water management/5	IBI	Influential participation of agriculturists in inducing institutional change for binational water management. Participation of agriculturists in the salinity problem showed their influence to press for change in the institutional binational legal frameworks for water management (i.e. Minute 242).
	7. Benefits obtained?	Influential participation in defining infrastructure for recovering water quality/2	REQ	Influential participation of agriculturists in defining the implementation process of infrastructure for recovering water quality in the Colorado River and the Mexicali Valley. A major benefit gained from the intensive participation of agriculturists in the salinity problem was to obtain infrastructure for recovering irrigation water quality by inducing building the Wellton-Mohawk bypass.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	7. Benefits obtained? (cont'd)	Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity of lands /5	REL	Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity of lands. An important benefit gained from intensive participation of agriculturists in the salinity problem was to get infrastructure for recovering lands productivity by the implementation of the Irrigation District Rehabilitation Program that included lands leveling, building surface drainage system, and lining main irrigation canals.
		Influential participation for obtaining financial support to continue production/4	CAP	Influential participation of agriculturists for obtaining financial support to continue production. Capital (credit and technical assistance) was given as one of the benefits to agriculturists both as individuals and as organizations.
		Corruption and mismanagement of the U.S. compensation and the Mexican financial support funds by Mexican actors/1	COR	High extent of corruption and mismanagement of the U.S. compensation and the Mexican financial support funds by Mexican actors. Corruption among agricultural leaders was noticed during the administration of funds gotten from the compensation to the salinity.
1	8. On the AAC project impacts?	AAC lining project threat/4	**JEO**	The AAC project represents jeopardizes not only for the sustainability of the nearby agricultural activity but also for people living and working beyond the area of influence in Mexicali Valley and the city which depend on scarce water resources totally allotted.
		Uncertainty on impacts/2	UCY	There are a huge uncertainty about what would happen to agricultural lands and environment directly depending on AAC seepage.
		Cyclic damages/1	CYC	The AAC has cyclically impacted agriculture of this particular area, first when initial operation the seepage produced flooding (Col. Bórquez, Ej. Netzahualcóyotl) from 1945 to 1954 plus 10 more years of recovering; but now, it might signify potential water scarcity.
		Technical compensation/2	MES	La Mesa drain was built in 1954 as part of the technical solution to the AAC flooding which came from its initial operation. Here, the rights over such seepage water were born in favor of Mexican users (the best quality of water in the irrigation district).
		Opportunity for improving conditions/2	IOP	The AAC lining project also represents an opportunity for improving living and productive conditions both locally and bi-nationally if principal actors like agricultural users are included in negotiation process.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	8. On the AAC project impacts? (cont'd)	Rights on the AAC seepage/2	RAC	The U.S. government states it has the right over this water (AAC seepage).
		Regional upper aquifer affectations/4	RAF	Local aquifer's quantity (uncertainty about the amount of water of around 80 Mm3) and quality (refreshing waters) impending gradual reduction is envisaged and this will affect hectares belonging to the irrigation Modules at the north-east portion of the Mexicali Valley.
		Deep wells digging/2	WEL	Deeper wells might be perforated in line parallel to the AAC in the Mexican side to compensate potential damages to upper aquifer, this since deep groundwater sources is abundant and of better quality, but costs might rise.
		Reductions in growing area/3	RED	Potential reductions in growing area is expected with the AAC, this considering precedents like the aquifer source reduction during the 1970s, then cotton growers were mandatory pressed to reduce from 20 to 18 hectares, alfalfa growers from 20 to 16 hectares, and wheat growers from 20 to 14 hectares.
		Water adjustment/5	ADJ	Potential irrigation water volume adjustment from 117 to 100 lps at both regional and district level as a connected system is envisaged if AAC take place. This also means reductions in individual and regional irrigated area.
		No rights irrigators affected/2	NOR	Agriculturists with no rights within the irrigation district but using the AAC seepage will be directly affected over the northern portion of the Mexicali Valley (Ej. Netzahualcóyotl).
		Artificial surface sources affectations/2	DRE	Two main drains which function as AAC seepage interceptors and also as irrigation canals to Modules 4 and 5 (La Mesa Drain and the Culiacán Drain) will be suddenly and dramatically reduced and even disappear as delivery canals for more than 2,000 hectares.
		U.S. must compensate/2	CTE	U.S. Must compensate Mexico for damages and must invest in irrigation infrastructure
	9. Agriculturists' participation AAC?	Agriculturists weak defense of AAC seepage/5	**DAS**	Lack of an effective defense of the AAC seepage water by agriculturists mostly with just the participation of people living and working nearby the AAC.
		Federal agencies weak defense of AAC/2	DAR	Lack of an effective defense by governmental agencies (CONAGUA and CILA) of the AAC water seepage. Argument: problem is localized at the northern region, could be transitory.
		Federal agencies responsible/2	FAR	Federal agencies (CONAGUA and CILA) are responsible to face the AAC problem not the irrigation users.
		Presidential lack of accountability/1	PLA	Presidential leadership of Vicente Fox was lacking in terms of interest and accountability to locals when talking/treating the AAC issue.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	9. Agriculturists' participation AAC? (cont'd)	Presidential lack of accountability/1	PLA	Presidential leadership of Vicente Fox was lacking in terms of interest and accountability to locals when talking/treating the AAC issue.
		State Governor intervention/1	GBC	The Baja California's Governor is having some extent of intervention/participation in the AAC issues.
		Lack of transparency/2	TRA	Federal and state governmental agencies lack of transparency when talking/treating the AAC issue
		Information is lacking/2	LIN	Critical information about the AAC issues is neither enough nor opportune nor widespread mainly by governmental agents.
		Information misleading/2	MIN	Critical information about the AAC issues is often misleading on the part of governmental agencies. Some time voices express significant impacts and others say exactly the opposite.
		Generalized apathy/4	APA	LIN and MIN induce lack of interest and motivation among confused agriculturists of the Mexicali Valley engaged in their productive activity.
		Aging leadership in the countryside/3	ALE	Local aged or missed leadership at the individual and organization level is losing power to call for agriculturists.
		Disperse leadership in the countryside/4	LED	Disperse and no impact leadership is observed within the agricultural sector (Gerónimo Hernández).
		External leadership for AAC/3	ELE	Shifts in people and organizations focused to voice and claim in regards to water conflicts that mainly affect to agricultural users. Nowadays, CDEM, an entrepreneurs' organization whose members belongs mostly to users others than agriculturists.
		Lack of external support to agriculturists/3	LES	Lack of external support (either government or urban users) to agriculturists to lead the AAC conflict.
		No financial capacity of agriculturists/2	NOF	Voluntary financial contribution included in the irrigation water fees was recently eliminated. This fact reduces agriculturists' capacity to afford their unions' representatives mobilization/operation expenditures.
		Influence of agriculturists in finding solutions to the All-American lining/3	**DIT**	Null influence of agriculturists in finding solutions to the All-American Canal conflict. New leaders, governmental agencies, and even representatives disregard the significance and importance of the individual agriculturists and their WUAs' thinking and voice as an agent for good change.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	10. Irrigation users?	Precursors Water Users' Societies/1	PRU	Precursors Water Users' Societies (WUS) were the first irrigation users groups in the San Luis and Mexicali Valleys organized themselves using a button-up approach to successfully manage water sources coming from the Colorado River during 1938 to 1954, before the official intervention.
		Official irrigation water management/1	OFF	The official intervention after WUS begun with the National Irrigation Commission (CNI), then The Hydraulic Resources Ministry (SRH), the Agriculture and Hydraulic Resources Ministry (SARH), and finally the National Water Commission (CONAGUA) to give place to the new era of WUAs.
		Lately Water Users' Associations/3	IMU	Lately formed Water Users' Associations (WUAs) in the Mexicali Valley were imposed in 1990 using a top-down approach (IDB, WB, BOM). So, current failures in water management (including bi-national waters concerns) come from their origin.
		Water Users' Associations/3	WUA	Water Users' Associations have neither influence nor participation in Mesas tecnicas 1 and 5, WUAs or individual agricultural users are more domestic operatives.
		Lack of combative WUAs/4	COT	Water users have lost their combative capacity due to their lack of motivation.
		Bureaucratic co-management/5	BUR	Large bureaucracy affects the new era of irrigation water management (CONAGUA-WUAs). This in turns means increasing mobilization costs, and lack of leadership.
		WUAs' lack of accountability/1	ALA	WUAs, as instances for irrigation water management, have shown lack of accountability and support to small landholders, instead they obey and show accountability to uppers like CONAGUA.
		WUAs' lack of system view/4	SYS	Lack of system (integral) view as a district has provoked disintegration. It should be more issues considered when talking about water (environment and irrigation operation in a coordinated fashion with officials).
		Large landholders command WUAs/3	LAN	New big landholders have the command and control of irrigation water management within WUAs.
		Legal rights/2	LER	WUAs have the complete right and judicial interest to participate and defend agriculturists' interests and to prevent potential damages.
		WUAs elude AAC issues/4	**ELU**	The AAC conflict was not properly addressed by water users associations' representatives (WUAs and SRL). There is no interest in treating the issue and just until recently it was mentioned in assembly but with no impact towards obtaining benefits for the agricultural sector. Governmental agencies do not promote participation.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	10. Irrigation users? (cont'd)	WUAs role/2	ROL	WUAs have had the role of pressing the state government to intervene and to pressure federal government
		Alternatives to AAC/2	ALT	Alternatives to the AAC on the part of WUAs are to induce efficiency throughout implementing drip and sprinkler irrigation methods, which might save 30 percent.
		Groups interests and apathy within WUAs/4	GIA	Groups' interests and apathy within water users' associations is noticed and this fact is blocking effective social participation, this in turns constraints power participation of agriculturists as united force.
2-3-4	11. Formal mechanism for participation?	Lack of information about formal mechanisms/2	LIM	Lack of information about formal links or mechanisms of coordination between WUAs and governmental agencies like CILA which attends transboundary water issues directly affecting agricultural activity. Agriculturists' representatives do not properly inform to constituency on this issue.
		Lack of formal coordination mechanisms/3	LAC	Lack of formal coordination mechanisms between CILA and WUAs to jointly analyze aspects related to transboundary waters affecting agricultural activity. Communication is noticed just when agriculturists ask for information to CILA.
		Need to formally embrace the AAC theme/2	FIN	Need for embracing the AAC issues within the WUAs' assembly (as formal institution) so that the problem could be raised by representatives to another level of authority such as nation states or federal agencies. The idea is to create synergies to traditional top-down and a new bottom-up approach, the later, based on formal institutions of agriculturists' constituency.
	12. Agriculturists' organizations links?	Water agencies links/4	WAL	WUAs show permanent links with several agencies accordingly management/operation tasks: first, the irrigation society (SRL) which operates the water users major irrigation networks; second, the National Water Commission (CONAGUA throughout the Irrigation District 014 and the Hydraulic Committee), which is the planning and regulatory agency; and third, the city water authority named Commission of Public Services of Mexicali (CESPM).
		Lack of effective coordination with CILA/4	LIC	Links between WUAs and CILA is lacking. CONAGUA does determine who participates in the "Mesas de Discusión Técnica number 1 (salinity) and 5 (All-American Canal issues)" (Round tables or steering committees for the SAL and AAC).
	13. SAL vs. AAC agriculturists' participation?	Different presidential leadership/1	DIP	Significant differences between presidents Luis Echeverria and Vicente Fox considering leadership, intelligence, energy, patriotism, accountability to locals, and interest in the issues, face, and fight to defend the Mexicali Valley agriculturists' perilous conditions.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	13. SAL vs. AAC agriculturists' participation? (cont'd)	Different issues/4	DIS	The SAL and the AAC are different issues, two different situations, two different conditions, and two different scales. SAL was acknowledged after it produced problems while AAC is acknowledged as potential damage. Also SAL is acknowledged as a generalized problem while AAC is more focused on northern.
		Different extent of agriculturists' organization/5	DOR	In the SAL times strong organization capacity (unions) and organizations accountability was noticed.
		Different agriculturists' leadership/5	DAL	Political power and representativeness of agriculturists' leaders is missed nowadays. In the past, agricultural leaders were frequently part of a political party (PRI) that always had a chair, voice and decision making power in within chambers of representatives in both state and federal level as well as strong communication with officials.
		Different groups making pressure/2	DIG	In the SAL era, groups dominated by ejidatarios or agriculturists belonging to CCI, CNC, UAR and FPP pressed to demand the U.S. while currently small groups dominated by agricultural and urban entrepreneurs (CDEM) demanded de U.S. for the AAC with no influence to solve the conflict.
		Loss of capacity for influencing changes/4	CIL	Participation of local agriculturists' leaders in chambers of representatives gave them capacity to influence modifications of local ordinances, nation state rules, federal laws, and international legal frameworks such as the 1944 Water Treaty.
		Changes in socio-productive structure/2	SOS	Lack of agriculturists' participation is mostly explained by the changes in the socio-productive structure in the Mexicali Valley which is due to the high level of lands rented.
		Different extent of unity and participation/3	LUN	Lack of unity with the AAC.
		Lack of interest in the AAC/3	LAC	Lack of interest in the AAC
2-3-4	14. Barriers for water management?	Social organization/1	ORG	Human/social and productive organization represents an essential factor to have a good water management and also to face and overcome conflicts at local and bi-national level.
		Training for water users/4	TNG	Training for irrigation water users (management) is still a major need.
		Binational WUAs involvement/1	IMV	Lack of WUAs involvement in transboundary water issues
		Technical personnel/3	TEM	Lack of professional work teams for water management.

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Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	14. Barriers for water management? (cont'd)	Basins councils/1	BAS	Basins Council (Colorado river in Mexico) might be the opportunity to eliminate the centralized view as the meetings become more like task forces than voice expression.
		Irrigation operation problems/2	OPE	Planning and operation problems are frequent in irrigation modules.
		Recycling water constraints/2	REU	Reusing waste waters in agriculture might favor environment and also reduce operative pressures in the countryside.
		Long-term vision/2	LOV	Love-term vision in both the agricultural and the irrigation sectors is lacking. Six-years financial planning horizons limit development.
		Economic constraints in agriculture/1	BEC	Diminished economic welfare in the agricultural sector is a fundamental factor limiting effective water management in the Mexicali Valley.
		Lack of irrigation technology/4	TEC	Irrigation technology is an important barrier that is progressing very slowly (i.e. desalination).
		Downward spirals/1	DOW	Permanent low crop prices and high production costs and lack of credit determine gradual bad economic conditions for agriculturists, this in turns triggers social organization problems and lack of social participation (it has costs); as a result a weak sector to attend and face water management problems/conflicts at local and moreover bi-national level is observed.
		Lack of awareness for saving/1	SAV	Lack of awareness for saving scarce water resources by agriculturists
	15. Benefits from best water management?	Increased water availability/1	AVA	Irrigation water availability might be increased and this allows for a better operation and distribution and transfer water resources both among individuals within an irrigation module and among the twenty two water users' associations in the Mexicali Valley.
		Equality in distribution/3	ETY	Equality in irrigation water distribution can be reached.
		Water transfers/2	TNS	Water transfers for second crops, intra and inter-module, and module-city take place.
		Agricultural sector improvements/3	AGI	Agricultural sector might experience improvements both at household level and in general as economic sector. This might be mainly noticed in production costs reduction (labor, water management, water use, fertilizers use) and increased quality of products (just on time and increased crop yields).

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.4 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	15. Benefits from best water management? (cont'd)	Increased bargain capacity/1	BAR	Agriculturists might have an increased surplus irrigation water bargain capacity among them as well as with other sectors like industry and cities and even with some U.S. users who also have water needs.
	16. Future of irrigation water management?	Potential scarcity/2	POT	Potential scarcity if irrigation technology does not advance more rapidly.
		Need for increasing economic resources/2	REC	Increase economic resources to agricultural sector are imperative and they could come from several sources like agricultural users, government, and other agents.
		Integrated Water Resources/3	IWR	Integrated Water Resources Management at local and binational level is possible for this region as potentialities for water availability can be jointly explored.
1-2-3-4		Improved water resources management/1	IMP	Besides the difficulties, the agriculturist's capacity to adapt to change and to survive will bring an improved water resources management at local and binational level.
	17. Additional comments?	Strategic AAC issue/2	AAS	The AAC theme is a strategic one in which people must be involved in a bravery and intelligent manner. We could get mutual benefits without fighting.
		Education for saving water/2	EDU	Water saving education strategies must have been a central point in water policies since many years ago and this must be implemented by using several perspectives giving a variety of visions to water as a special good, and involving diverse sectors not just the agricultural one.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.5 Coding system: Irrigation and transboundary water management in the Mexicali Valley. Newer water managers (NMGRs).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	1. Mexicali Valley change?	Agricultural sector progress/2	**PRO**	Agricultural activity in the Mexicali Valley shows permanent economic growth throughout years.
		Agricultural sector regression/1	**REG**	Agricultural activity in the Mexicali Valley shows permanent economic decay throughout years.
		Crops diversification/1	DIV	Crops structure change from unique crops like cotton to expand to grow grains and produces
		International Water Treaty/1	IWT	The 1944 International Water Treaty triggered the Mexicali Valley development and evolution
		Lower prices/2	LOP	Lower prices for agricultural products are noticed.
		Commercialization problems/1	COM	Commercialization problems for small farmers are noticed for most agricultural products mostly grains.
		Loosing organizational capacity/2	LOZ	In the past, ejidos used to organize to produce
		Technology imp./1	TIM	Technology improvements for lands labor is the most important change observed.
		Mexicali Valley development model/2	MOD	The Mexicali Valley has gained attention at international level as a production system model for adaptation to change for using the Colorado River water and for changing its productive structure from unique Cotton crop to more than 50 diverse crops nowadays.
	2. Irrigation change?	Successful irrigation water management/3	**SIM**	Irrigation water management (operation, administration, and conservation) by agricultural users (WUAs) is improving.
		Failing irrigation water management/2	**FIM**	Irrigation water management (operation, administration, and conservation) by agricultural users (WUAs) is still struggling and most times is due to organization problems of individual irrigators.
		Lack of irrigation technology/2	LIT	Irrigation technology in Mexicali was in the past lacking of the necessary land's leveling, efficient methods, and lined canals in the past.
		Efficient water use/2	IWE	In recent times irrigation water is being used more efficiently than en the past.
		Growing irrigation technology/2	GIT	Nowadays there exists suitable irrigation technology such as land leveling and lined canals to perform the activity, however it is still suboptimal.
		Lack of water for environment/1	LEN	No water available for environment is another pressing factor affecting irrigation mgmt.

NMGRs: Newer water managers; RQ: Major research question explored; GIR: General aspects. Introductory referential question; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol

Table B.5 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
GIR	3. Importance of transboundary waters?	Mexicali Valley's aridity/1	MAC	The main features in Mexicali is its arid climate conditions which mean there is no significant rainfall and high temperatures, thus, there is high dependence on Colorado River transboundary waters.
1	4. Problems emerged with SAL?	Salinity of agricultural lands/2	**SAD**	Damage in agriculture due to the salinity of the Colorado River and other inter-linked factors was significant and meant drastic reductions in seeds shoot, plant growth and development, crop yields, credit for producing as well as increasing production costs.
		Mixed salty waters upstream/2	MIX	Water delivered to Mexico during a period encompassing almost 13 years (1960-1973) was intentionally polluted upstream Colorado River while mixing them with salty waters coming from agricultural lands in the Yuma Valley, U.S. (point source).
		Treaty misinterpretation/1	MIS	The U.S. made an unilateral interpretation of the 1944 Water Treaty in regards to the quality of water to be delivered to Mexico
		Yields reduction/2	YED	High extent of crops yields reductions. Yields in main crops showed significant reductions of about 80 percent (cotton) and 70 percent (wheat).
		Salinity problem remains/1	SAR	Salinity of the Colorado River and agricultural lands in the Mexicali Valley still remains nowadays as a critical problem mostly noticed at the southern international boundary point of delivery (Sanchez Mejorada Canal), failures in the monitoring system at the northern international boundary (Morelos Dam), and the resulting permanent salts accumulation along the salty route and the southern sub-region of the Mexicali Valley.
		Reduction of agricultural lands/2	RED	High extent of individual parcels size reduction. Reduction of agricultural lands was noticed while SAL due to localized affectations over significant portions of individual parcels (4 hectares in average).
	5. Agriculturists participation during SAL?	High level of participation in SAL /3	**HIP**	High level of participation in SAL. High level of participation of agriculturists was noticed throughout a united force of agriculturists belonging to different unions.
		High level of solidarity/1	SOL	Solidarity was the main characteristic of the agriculturists' mobilization while SAL.
		Unity base/2	UNI	Unity was originated at the household level and this was so because economic conditions allowed keeping farmers' families rooted in the countryside.
		Adaptation to damages/2	ADA	Adaptation to damage was noticed as an immediate response of individual agriculturists to avoid yields reduction (furrow irrigation methods, planting at the bottom to avoid salts contact with plant and tolerant crops changes).

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.5 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	5. Agriculturists participation during SAL? (cont'd)	Strong agricultural unions/2	SAU	Participation of agricultural sector in SAL was given mainly throughout well organized, strong, and meaningful representation of agricultural unions that as unified forces (Comité de Defensa del Valle de Mexicali) used to express, complain, claim, demand, and boycott governmental agents towards finding suitable solutions.
		Significant presidential leadership/1	LEA	President Luis Echeverria Alvarez is acknowledged by agriculturists as a government meaningful leader that offered significant support (credit and technical assistance, guideness and representation (in bilateral negotiation) to get solutions to SAL in the Mexicali Valley (rehabilitation program and Wellton-Mohawk by-pass).
		Strong state and federal support/1	SSS	Strong support coming from state and federal agencies such as the Secretary of Foreign Affairs (SRE) and Secretary of Hydraulic Resources (SRH) was observed.
		Salinity problem model/1	SAM	The Salinity problem represents a model for diplomacy and international negotiation between U.S and Mexico.
		Local agriculturists unions' leadership/2	LAU	There were local organizations like CCI, CNC, UAR, and CNPPR that understood the problem, voiced, and fought against it as defenders of the agriculturists' interests.
		Outstanding local leaders/1	LOL	Local leadership is identified and personified in people like Alfonso Garzón and Rodolfo Fierro.
		Outstanding external support/1	EXS	External support (moral and economic) coming from commerce and industry was noticed while the SAL conflict
2-3-4	6. Influence of agriculturists to resolve the salinity?	Influence of agriculturists for reaching technical solutions to the salinity/4	ITS	Influence of agriculturists for reaching technical solutions to the salinity problem. Participation of agriculturists both as individuals and as unions or "unions of unions" ensured communication with governmental agents of high level, thus they had influence to find technical solutions to the salinity problem.
		Influential participation in inducing institutional change for binational water management/5	IBI	Influential participation of agriculturists in inducing institutional change for binational water management. Participation of agriculturists in the salinity problem showed their influence to press for change in the institutional binational legal frameworks for water management (i.e. Minute 242).
		Difficulties to influence change/1	IBM	The way to reach a final solution was not easy for government and agriculturists three minutes were signed to establish a definitive solution to SAL (Minutes 218, 241, and finally 242). Diaz Ordaz did not resolve the problem but LEA.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.5 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	7. Benefits obtained?	Influential participation in defining infrastructure for recovering water quality/2	REQ	Influential participation of agriculturists in defining the implementation process of infrastructure for recovering water quality in the Colorado River and the Mexicali Valley. A major benefit gained from the intensive participation of agriculturists in the salinity problem was to obtain infrastructure for recovering irrigation water quality by inducing building the Wellton-Mohawk bypass.
		Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity of lands /3	REL	Influential role of agriculturists in defining and implementing the rehabilitation program for recovering productivity of lands. An important benefit gained from intensive participation of agriculturists in the salinity problem was to get infrastructure for recovering lands productivity by the implementation of the Irrigation District Rehabilitation Program that included lands leveling, building surface drainage system, and lining main irrigation canals.
		Influential participation for obtaining financial support to continue production/3	CAP	Influential participation of agriculturists for obtaining financial support to continue production. Capital (credit and technical assistance) was given as one of the benefits to agriculturists both as individuals and as organizations.
		Corruption and mismanagement of the U.S. compensation and the Mexican financial support funds by Mexican actors/1	COR	High extent of corruption and mismanagement of the U.S. compensation and the Mexican financial support funds by Mexican actors. Corruption among agricultural leaders was noticed during the administration of funds gotten from the compensation to the salinity.
1	8. On the AAC project impacts?	AAC lining project threat/2	**JEO**	The AAC project represents jeopardizes not only for the sustainability of the nearby agricultural activity but also for people living and working beyond the area of influence in Mexicali Valley and the city which depend on scarce water resources totally allotted.
		Uncertainty on impacts/2	UCY	There are a huge uncertainty about what would happen to agricultural lands and environment directly depending on AAC seepage.
		Cyclic damages/2	CYC	The AAC has cyclically impacted agriculture of this particular area, first when initial operation the seepage produced flooding (Col. Bórquez, Ej. Netzahualcóyotl) during 1945-1954 plus 10 more years of recovering; but now, it might signify potential scarcity.
		Technical compensation/1	MES	La Mesa drain was built in 1954 as part of the technical solution to the AAC flooding which came from its initial operation. Here, the rights over such seepage water were born in favor of Mexican users (the best quality of water in the irrigation district).

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.5 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	8. On the AAC project impacts? (cont'd)	Opportunity for improving conditions/1	IOP	The AAC lining project also represents an opportunity for improving living and productive conditions both locally and bi-nationally if principal actors like agricultural users are included in negotiation process.
		International cooperation seek/1	COI	CILA is seeking for International cooperation (win-win game) instead of negotiation and mitigation for solving AAC.
		Rights on the AAC seepage/1	RAC	The U.S. government states it has the right over this water (AAC seepage).
		Controversy on water rights/2	CON	There is a controversy between the U.S. and Mexico on the AAC's seepage property rights when applying the "Prior Appropriation" approach.
		Regional upper aquifer affectations/3	RAF	Local aquifer's quantity (72 Mm3 equivalent to ten percent of total recharge in the aquifer considering all sources of recharge) and quality (refreshing waters) impending gradual reduction is envisaged and this will affect some hectares belonging to the irrigation Modules 4, 5 at the north-east portion of the Mexicali Valley.
		Reductions in growing area/3	RED	Potential reductions in growing area is expected with the AAC, this considering precedents like the aquifer source reduction during the 1970s, then cotton growers were mandatory pressed to reduce from 20 to 18 hectares, alfalfa growers from 20 to 16 hectares, and wheat growers from 20 to 14 hectares.
		Artificial surface sources affectations/3	DRE	Two main drains which function as AAC seepage interceptors and also as irrigation canals to Modules 4 and 5 (La Mesa Drain and the Culiacán Drain) will be suddenly and dramatically reduced and even disappear as delivery canals for more than 2,000 hectares.
		Wetlands affectations/2	WET	A series of small wetlands formed with the AAC seepage reaching an extension of more than 3,400 hectares over the Module 16 will disappear.
		Good neighbor principle/1	NEM	The good neighbor principle is missed when talking about transboundary waters (SAL and AAC).
	9. Agriculturists' participation AAC?	Agriculturists weak defense of AAC seepage/2	**DAS**	Lack of an effective defense of the AAC seepage water by agriculturists.
		Inexistent or virtual problem/2	VIR	Lack of involvement thus impact of agriculturists participation is partly explained by the nature of the conflict: just a virtual or potential problem, not a real problem….yet.
		Federal agencies responsible/2	FAR	Federal agencies (CONAGUA and CILA) are responsible to face the AAC problem not the irrigation users.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.5 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	9. Agriculturists' participation AAC? (cont'd)	Diplomacy failing/2	DCY	The AAC has reached the high level of negotiation (DOS and SRE and later between presidents) but diplomacy has failed.
		Lack of transparency/1	TRA	Federal and state governmental agencies lack of transparency when talking/treating the AAC issue
		Information is lacking/2	LIN	Critical information about the AAC issues is neither enough nor opportune nor widespread mainly by governmental agents.
		Generalized apathy/1	APA	LIN and MIN induce lack of interest and motivation among confused agriculturists of the Mexicali Valley engaged in their productive activity.
		External leadership for AAC/2	ELE	Shifts in people and organizations focused to voice and claim in regards to water conflicts that mainly affect to agricultural users. Nowadays, CDEM, an entrepreneurs' organization whose members belongs mostly to users others than agriculturists.
		CDEM's Legal action fails/2	SUE	CDEM's legal action against the U.S. government received indirect support (as a friend in court) from the Mexican Federal government, however, they fails.
		Lack of external support to agriculturists/2	LES	Lack of external support (either government or urban users) to agriculturists to lead the AAC conflict.
		Influence of agriculturists in finding solutions to the All-American lining/1	**DIT**	Null influence of agriculturists in finding solutions to the All-American Canal conflict. New leaders, governmental agencies, and even representatives disregard the significance and importance of the individual agriculturists and their WUAs' thinking and voice as an agent for good change.
	10. About irrigation users?	Lately Water Users' Associations/1	IMU	Lately formed Water Users' Associations (WUAs) in the Mexicali Valley were imposed in 1990 using a top-down approach (IDB, WB, BOM). So, current failures in administration and water management (including bi-national waters concerns) come from their origin.
		Water Users' Associations/2	WUA	Water Users' Associations have neither influence nor participation in Mesas técnicas 1 and 5, just as ONG's have in the mesa técnica 4 on environmental issues. WUAs or individual agricultural users are more reactive than proactive actors.
		WUAs' lack of system view/1	SYS	Lack of system (integral) view as a district has provoked disintegration. It should be more issues considered when talking about water (environment and irrigation operation in a coordinated fashion with officials).

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.5 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
1	10. About irrigation users? (cont'd)	WUAs elude AAC issues/2	ELU	The AAC conflict was not properly faced by water users associations' representatives (WUAs and SRL) neither in time nor in depth. There is no interest in treating the issue and just until recently it was mentioned in assembly but with no impact towards obtaining benefits for the agricultural sector. Not promoting participation.
		WUAs role/1	ROL	WUAs have had the role of pressing the state government to intervene and to pressure federal government
		No alternatives to water efficiency/1	NAL	WUAs lack of promoting more initiatives for increasing irrigation water management.
2-3-4	11. Formal mechanism for participation?	Lack of formal coordination mechanisms/2	LAC	Lack of formal coordination mechanisms between CILA and WUAs to jointly analyze aspects related to transboundary waters affecting agricultural activity. Communication is noticed just when agriculturists ask for information to CILA.
		Need to formally embrace the AAC theme/1	FIN	Need for embracing the AAC issues within the WUAs' assembly (as formal institution) so that the problem could be raised by representatives to another level of authority such as nation states or federal agencies. The idea is to create synergies to traditional top-down and a new bottom-up approach, the later, based on formal institutions of agriculturists' constituency.
	12. Agriculturists' organizations links?	Water agencies links/2	WAL	WUAs show permanent links with several agencies accordingly management/operation tasks: first, the irrigation society (SRL) which operates the water users major irrigation networks; second, the National Water Commission (CONAGUA throughout the Irrigation District 014 and the Hydraulic Committee), which is the planning and regulatory agency; and third, the city water authority named State Commission of Public Services of Mexicali (CESPM).
		Lack of effective coordination with CILA/2	LIC	Links between WUAs and CILA is lacking. CONAGUA does determine who participates in the "Mesa Técnica number 1 (salinity) and 5 (All-American Canal)" (Round tables or steering committees for SAL and AAC conflicts.
	13. SAL vs. AAC agriculturists' participation?	Different issues/1	DIS	The SAL and the AAC are different issues, two different situations, two different conditions, and two different scales. SAL was acknowledged after it produced problems while AAC is acknowledged as potential damage.
		Different extent of agriculturists' organization/1	DOR	In the SAL times strong organization capacity (unions) and organizations accountability was noticed.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.5 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	13. SAL vs. AAC agriculturists' participation? (cont'd)	Different agriculturists' leadership/1	DAL	Political power and representativeness of agriculturists' leaders is missed nowadays. In the past, agricultural leaders were frequently part of a political party (PRI) that always had a chair, voice and decision making power in within chambers of representatives in both state and federal level as well as strong communication with officials.
		Loss of capacity for influencing changes/1	CIL	Participation of local agriculturists' leaders in chambers of representatives gave them capacity to influence modifications of local ordinances, nation state rules, federal laws, and international legal frameworks such as the 1944 Water Treaty.
		Changes in socio-productive structure/1	SOS	Lack of agriculturists' participation is mostly explained by the changes in socio-productive structures in the Mexicali Valley in turns due to high level of lands' rent.
	14. Barriers for water management?	Social organization/1	ORG	Human/social and productive organization represents an essential factor to have a good water management and also to face and overcome conflicts at local and bi-national level.
		Training for water users/1	TNG	Training for irrigation water users is still a major need.
		Centralized policies/1	CEN	Centralized policies for water management halt development in the local water sector, including irrigation.
		Basins councils/1	BAS	Basins Council (Colorado river in Mexico) might be the opportunity to eliminate the centralized view as the meetings become more like task forces than voice expression.
		Irrigation operation problems/1	OPE	Planning and operation problems are frequent in irrigation modules.
		Recycling water constraints/1	REU	Reusing waste waters in agriculture might favor environment and also reduce operative pressures in the countryside.
		Governance problems in society/1	GOV	Lack of responsibility on the part of the society to facilitate governance. Not all problems can be solved or faced by governmental agencies; instead co-management must be triggered, promoted, and maintained by both government and society.
		Long-term vision/1	LOV	Love-term vision in both the agricultural and the irrigation sectors is lacking. Six-years financial planning horizons limit development.
		Lack of irrigation technology/1	TEC	Irrigation technology is an important barrier that is progressing very slowly (i.e. desalination).
		Need to state local priorities/1	PRE	Need to state local priorities to increase efficiency at both individual (parcel) and module as well irrigation district.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

Table B.5 (cont'd).

RQ	IQ	Code name/FREQ	Sym	Definition (theme/concept/idea)
2-3-4	14. Barriers for water management? (cont'd)	Integrated Water Resources/1	IWR	Integrated Water Resources Management at local and binational level is possible for this region as potentialities for water availability can be jointly explored.
		Education for saving water/1	EDU	Water saving education strategies must have been a central point in water policies since many years ago and this must be implemented by using several perspectives giving a variety of visions to water as a special good, and involving diverse sectors not just the agricultural one.

RQ: Major research question explored; GIR: General aspects. Introductory referential questions; IQ: Interview guide question; FREQ: Frequency of response; Sym: Symbol.

APPENDIX C

INSTITUTIONAL FUNCTIONS AND EXPLANATORY FACTORS

Table C.1 Institutional functions and explanatory factors for northern Mexicali Valley agriculturists (NAH).

Theme	Sub-theme	Institutional function/explanatory factors	Relevant findings
I. General aspects	1) Perception on the major changes in the agricultural sector.	**PRO** = *f* (DIV, LAR, HIL, TIM, IND)	Socio-productive polarization phenomenon
		REG = *f* (HIC, LOP, CRE, COM, EQU, REN)	
	2) Perception on the major changes in irrigation.	**SIM** = *f* (SIW, LIT, IWE, GIT, COS, PRU, RIG, OFF, ALT, ENV, BAR)	Differentiation among irrigation users (elitism)
		FIM = *f* (IMU, BUR, ALA, LAN, GIA, DEM, TWI, IQU, TEC, COS, LOV, ICO)	
II. SAL	3) Salinity damages	**SAD** = *f* (MIX, ROU, SAH, YED, ICS, CRI, SAR)	Productive and economic impacts.
	4) Participation of agriculturists in the salinity problem.	**HIP** = *f* (UNI, FIC, SOL, CEJ, LOL, PAL, LAU, SAU, PAU, LEA) + POS	Effective vertical coordination agriculturists-federal government + POS
	5) Influence of agriculturists in the salinity problem.	**ITS** = *f* (IBI, REQ, REL/REI, CAP/COR) + POS	Central social actor for pressing + POS
III. AAC	6) Expected damages in the Mexicali Valley due to the All-American Canal project.	**JEO** = *f* (UCY, CYC, MES, DRE, RAF, WEL, ADJ, RED, WET, NOR, RUT, MIG) + IOP	Perceived productive, economic, social, and environmental risks + IOP
	7) Participation of agriculturists in the All-American Canal issue.	**DAS** = *f* (APA, APS, LIN, MIN, TRA, PLA, GLA, ALE, LED, ELE, LES, NOF, REN, DOW) + POC	No vertical coordination agriculturists-federal government + POC
		ELU = *f* (IMU, LER, BUR, ALA, GIA, LAN, LIM, LAC, LIC) + POC	WUAs not involved. No effective representation in AAC.
	8) Influence of agriculturists in the All-American Canal issue.	**DIT** = *f* (ING, DOW, ORG, CIL, ELE)	Agriculturists and WUAs with neither economic nor political power. Countryside diminished.
IV. Conclusion: SAL-AAC	9) Institutional differences between the salinity problem and All-American Canal lining conflict.	**DIF** = *f* (DIP, DOR, DAL, DIG, CIL, SOS, BEC) + SIP	Different/reduced presidential and local leadership + SIP

Table C.2 Institutional functions and explanatory factors for central Mexicali Valley agriculturists (CAH).

Theme	Sub-theme	Institutional function/explanatory factors	Relevant findings
I. General aspects	1) Perception on the major changes in the agricultural sector.	**PRO** = *f* (DIV, LAR, HIL, TIM, IND)	Socio-productive polarization phenomenon
		REG = *f* (HIC, LOP, CRE, BUC, COM, LOZ, REN)	
	2) Perception on the major changes in irrigation.	**SIM** = *f* (SIW, LIT, IWE, GIT, BAR, TNS)	Differentiation among irrigation users (elitism).
		FIM = *f* (IMU, BUR, OPE, SYS, LAN, GIA, TWI, EQU, IQU, TEC, INV, CIC, ERQ, COS, LOV, ICO)	Additional factors explaining FIM
II. SAL	3) Salinity damages.	**SAD** = *f* (MIX, ROU, SAH, YED, ICS, CRI, RED, ABA, SAR)	Productive, economic, and social impacts noticed. More critical than in nah.
	4) Participation of agriculturists in the salinity problem.	**HIP** = *f* (UNI, ADA, FIC, SOL, CEJ, LOL/FAL, PAL, LAU, SAU, PAU, LEA, EXS, SSS)	Effective vertical coordination agriculturists-federal government. Adaptation capacity. FAL
	5) Influence of agriculturists in the salinity problem.	**ITS** = *f* (IBI, REQ, REL/REI, CAP/COR)	Central social actor for pressing
III. AAC	6) Expected damages in the Mexicali Valley due to the All-American Canal lining project.	**JEO** = *f* (UCY, CYC, DRE, RAF, WEL, ADJ, RED, WET)	Perceived productive, economic, and environmental risks.
	7) Participation of agriculturists in the All-American Canal issue.	**DAS** = *f* (APA, GBC, LIN, MIN, TRA, PLA, GLA, ALE, SOI, ASY, LED, ELE, LES, NOF, REN, DOW) + POC	No vertical coordination agriculturists-federal government and ELE + POC
		ELU = *f* (IMU, LER, BUR, ALA, GIA, LAN, LIM, LAC, LIC, ROL, SYS, OPE) + POC	WUAs not involved. No effective representation in AAC. No coordination with CILA/IBWC-Mexico + POC.
	8) Influence of agriculturists in the All-American Canal issue.	**DIT** = *f* (ING, DOW, ORG, CIL, ELE)	Agriculturists and WUAs with neither economic nor political power. Countryside diminished.
IV. Conclusion: SAL-AAC	9) Institutional differences between the salinity problem and All-American Canal lining conflict.	**DIF** = *f* (DIP, DOR, DAL, DIG, CIL, SOS, BEC)	Reduced agriculturists' extent of organization and local leadership.

Table C.3 Institutional functions and explanatory factors for southern Mexicali Valley agriculturists (SAH).

Theme	Sub-theme	Institutional function/explanatory factors	Relevant findings
I. General aspects	1) Perception on the major changes in the agricultural sector .	**PRO** = *f* (DIV, LAR, TIM, IND, HUM, POP)	Socio-productive polarization
		REG = *f* (HIC, LOP, CRE, BUC, COM, LOZ, REN)	
	2) Perception on the major changes in irrigation.	**SIM** = *f* (SIW, LIT, IWE, GIT, COS, TNS)	Differentiation among irrigation users.
		FIM = *f* (IMU, BUR, OPE, ALA, SYS, GIA, EQU, IQU, INV, CIC, LOV, ICO)	Additional factors for FIM
II. SAL	3) Salinity damages.	**SAD** = *f* (MIX, SAH, YED, ICS, RED, SAR)	Productive, economic, and social impacts noticed. More critical than in NAH.
	4) Participation of agriculturists in the salinity problem.	**HIP** = *f* (UNI, ADA, FIC, SOL, LOL, PAL, LAU, SAU, PAU, LEA, EXS, SSS)	Effective vertical coordination agriculturists-federal government + POS
	5) Influence of agriculturists in the salinity problem.	**ITS** = *f* (IBI, REQ, REL/REI, CAP)	Central subject for pressing + POS
III. AAC	6) Expected damages in the Mexicali Valley due to the All-American canal project.	**JEO** = *f* (UCY, RAF, DRE, WET, WEL, ADJ, RED, RUT, CTE) + IOP	Perceived productive, economic, social, and environmental risks + IOP
	7) Participation of agriculturists in The All-American Canal issue.	**DAS** = *f* (APA, DAR, LIN, MIN, TRA, PLA, GLA, ALE, LED, ELE, LES, NOF, REN, DOW) + POC	No vertical coordination agriculturists-federal government and ELE + POC
		ELU = *f* (IMU, BUR, WAL, ALA, GIA, LAN, LIM, LAC, LIC, ROL, OPE) + POC	WUAs not involved. No effective representation in AAC + POC.
	8) Influence of agriculturists in the All-American Canal issue.	**DIT** = *f* (ING, DOW, ORG, LIC, CIL, ELE)	Agriculturists and WUAs with neither economic nor political power. Countryside diminished + POC.
IV. Conclusion: SAL-AAC	9) Institutional differences between the salinity problem and All-American Canal lining conflict.	**DIF** = *f* (DIP, DOR, DAL, DIG, CIL, SOS, BEC) + SIP	Different/reduced presidential and local leadership + SIP

Table C.4 Institutional functions and explanatory factors for older water managers (OMGRs).

Theme	Sub-theme	Institutional function/explanatory factors	Relevant findings
I. General aspects	1) Perception on the major changes in the agricultural sector.	**PRO** = *f* (DIV, LAR, HIL, TIM, HUM, POP, URB, IWT, MOD)	Emphasize PRO
		REG = *f* ( )	No REG views
	2) Perception on the major changes in irrigation.	**SIM** = *f* (SIW, LIT, IWE, GIT, COS, SUR)	
		FIM = *f* (IMU, ALA, LAN, IQU, IMV, BAS, TNG, EDU, LOV, SYS, DEM, OPE, TEC, INV, QLY, ICO)	Emphasize FIM
II. SAL	3) Salinity damages.	**SAD** = *f* (MIX, AFE, ROU, SAH, YED, ICS, CRI, RED, ABA, SAR)	Different stress of productive, economic, and social impacts.
	4) Participation of agriculturists in The salinity issue.	**HIP** = *f* (UNI, ADA, FIC, SOL, CEJ, LOL, PAL, LAU, SAU, PAU, LEA, EXS, SSS, SAM)	Effective vertical coordination agriculturists-federal government + FIC + ADA
	5) Influence of agriculturists in the salinity issue.	**ITS** = *f* (IBI, REQ, REL, CAP)	Agriculturists as a significant subject for pressing.
III. AAC	6) Expected damages in the Mexicali Valley due to the All-American Canal lining project.	**JEO** = *f* (UCY, CYC, MES, DRE, RAF, WEL, ADJ, RED) + IOP	Perceived productive and economic risks + IOP
	7) Participation of agriculturists in the All-American Canal issue.	**DAS** = *f* (APA, LIN, MIN, TRA, PLA, ALE, LED, ELE, LES, NOF)	No vertical coordination agriculturists-federal government and ELE + NOF
		ELU = *f* (IMU, WUA, COT, BUR, SYS, ALA, GIA, LAN, LAC, LIC, FIN, ALT)	WUAs not involved. No effective representation in AAC. No coordination with CILA + ALT.
	8) Influence of agriculturists in the All-American Canal issue.	**DIT** = *f* (ORG, LOZ, CIL, LIC, ELE, CTE)	Agriculturists and WUAs with no influence for solving AAC + CTE
IV. Conclusion: SAL-AAC	9) Institutional differences between the salinity problem and All-American Canal lining conflict.	**DIF** = *f* (DIP, DIS, DOR, DAL, DIG, CIL, LUN, LAC, SOS, BEC)	Different/reduced local leadership + LUN

Table C.5 Institutional functions and explanatory factors for newer water managers (NMGRs).

Theme	Sub-theme	Institutional function/explanatory factors	Relevant findings
I. General aspects	1) Perception on the major changes in the agricultural sector.	**PRO** = *f* (DIV, TIM, IWT, MOD)	Dual agricultural productive sector's functioning perception.
		REG = *f* (LOP, COM, LOZ)	
	2) Perception on the major changes in irrigation.	**SIM** = *f* (IWE, GIT)	
		FIM = *f* (IMU, BAS, TNG, EDU, LOV, SYS, DEM, OPE, TEC, INV, QLY, ICO)	Emphasize on FIM
II. SAL	3) Salinity damages.	**SAD** = *f* (MIX, SAH, YED, RED, SAR)	International problem + productive, economic, and social impacts noticed.
	4) Participation of agriculturists in the salinity issue.	**HIP** = *f* (UNI, ADA, SOL, LOL, LAU, SAU, LEA, EXS, SSS, SAM)	Diplomacy + effective vertical coordination agriculturists-federal government.
	5) Influence of agriculturists in the salinity issue.	**ITS** = *f* (IBI, REQ, REL, CAP)	Agriculturists as a significant subject for pressing.
III. AAC	6) Expected damages in the Mexicali Valley due to the All-American Canal lining project.	**JEO** = *f* (UCY, CYC, DRE, RAF, RED, WET, CON, COI, NEM) + IOP	Perceived productive, economic, social, and environmental risks + IOP (no mitigation, no negotiation but cooperation and win-win).
	7) Participation of agriculturists in the All-American Canal issue.	**DAS** = *f* (APA, LIN, LES, VIR, FAR, DCY, ELE, SUE)	No vertical coordination agriculturists-federal government and ELE + VIR
		ELU = *f* (IMU, WUA, LAC, LIC, ROL, FIN)	WUAs not involved. No effective representation in AAC. No coordination with CILA/IBWC-Mexico.
	8) Influence of agriculturists in the All-American Canal issue.	**DIT** = *f* (ORG, LOZ, CIL, LIC, ELE)	Agriculturists and WUAs with no influence for solving AAC.
IV. Conclusion: SAL-AAC	9) Institutional differences between The salinity problem and All-American Canal lining conflict.	**DIF** = *f* (DIS, DOR, DAL, CIL, SOS)	Different/reduced local leadership.

APPENDIX D

COMPARISONS OF INSTITUTIONAL FUNCTIONS AND EXPLANATORY FACTORS

Table D.1 Comparisons: General aspects (evolution of agriculture and irrigation in the Mexicali Valley).

Explanatory factors and frequency of response (%)

Sub-theme	Subject	PRO	DIV	LAR	HIL	TIM	IND	HUM	POP	URB	IWT	MOD
1a) Changes agriculture	NAH	44	44	33	44	33	33	-	-	-	-	-
	CAH	30	10	20	10	30	10	-	-	-	-	-
	SAH	38	25	13	-	30	25	25	38	-	-	-
	OMGRs	100	33	33	50	83	-	50	50	50	67	33
	NMGRs	67	67	67	67	67	67	-	-	-	-	67

Sub-theme	Subject	REG	HIC	LOP	CRE	COM	REN	LOZ	BUC	EQU
1b) Changes agriculture	NAH	56	56	44	56	33	56	-	-	44
	CAH	70	70	70	70	30	50	40	40	-
	SAH	62	50	38	25	25	50	25	13	-
	OMGRs	-	-	-	-	-	-	-	-	-
	NMGRs	33	-	33	-	33	-	33	-	-

Sub-theme	Subject	SIM	SIW	LIT	IWE	GIT	COS	PRU	RIG	OFF	ALT	ENV	BAR	TNS	SUR
2a) Changes irrigation	NAH	78	78	67	78	78	44	56	78	67	67	44	78	-	-
	CAH	40	40	40	30	40	-	-	-	-	-	-	30	30	-
	SAH	38	25	25	25	38	25	-	-	-	-	-	-	25	-
	OMGRs	50	50	33	50	33	33	-	-	-	-	-	-	-	50
	NMGRs	67	-	67	67	67	-	-	-	-	-	-	-	-	-

Sub-theme	Subject	FIM	IMU	BUR	ALA	LAN	GIA	IQU	LOV	SYS	OPE	TEC	INV	ICO	EQU	BAS	EDU	DEM	TWI	COS	CIC	QLY	ERQ
2b) Changes irrigation	NAH	22	22	22	11	22	11	22	11	-	-	11	-	11	-	-	-	22	22	22	-	-	-
	CAH	60	50	60	-	20	30	20	20	30	30	30	20	20	40	-	-	-	10	40	60	-	50
	SAH	62	25	38	50	-	50	50	25	50	62	-	38	50	50	-	-	-	-	-	25	-	30
	OMGRs	50	17	-	17	33	-	17	33	17	50	33	50	50	-	50	33	50	-	-	-	50	-
	NMGRs	33	-	33	-	-	-	-	-	-	33	-	-	-	-	-	-	-	-	-	-	-	-

Table D.2 Comparisons: The salinity problem issue (SAL).

Sub-theme	Subject	Explanatory factors and frequency of response (%)										
3) Salinity damages.		**SAD**	**MIX**	**ROU**	**SAH**	**YED**	**ICS**	**CRI**	**RED**	**SAR**	ABA	AFE
	NAH		**67**	**44**	**56**	**56**	**33**	**33**	**-**	**67**	-	-
	CAH		**30**	**60**	**60**	**90**	**40**	**40**	**50**	**70**	50	-
	SAH		**38**	**-**	**38**	**38**	**38**	**-**	**25**	**25**	-	-
	OMGRs		**50**	**50**	**50**	**67**	**33**	**33**	**33**	**67**	33	50
	NMGRs		**67**	**-**	**-**	**67**	**-**	**-**	**67**	**33**	-	33

Sub-theme	Subject																	
4) Agriculturists participation in the salinity problem.		**HIP**	**UNI**	**ADA**	**FIC**	**SOL**	**CEJ**	**LOL**	**PAL**	**LAU**	**SAU**	**PAU**	**LEA**	**EXS**	**SSS**	FAL	SAM	POS
	NAH		**78**	**-**	**78**	**89**	**89**	**78**	**89**	**89**	**100**	**67**	**100**	**-**	**-**	-	-	44
	CAH		**40**	**40**	**80**	**70**	**30**	**70**	**70**	**50**	**90**	**30**	**90**	**50**	**50**	40	-	-
	SAH		**38**	**38**	**63**	**63**	**-**	**63**	**75**	**63**	**50**	**38**	**75**	**50**	**38**	-	-	-
	OMGRs		**67**	**67**	**33**	**67**	**50**	**50**	**50**	**83**	**83**	**50**	**33**	**33**	**33**	-	-	-
	NMGRs		**67**	**67**	**-**	**-**	**-**	**-**	**-**	**67**	**67**	**-**	**-**	**-**	**33**	-	67	-

Sub-theme	Subject								
5) Agriculturists influence in the salinity issue.		**ITS**	**IBI**	**REQ**	**REL**	**REI**	**CAP**	COR	POS
	NAH		**44**	**56**	**78**	**33**	**33**	33	22
	CAH		**60**	**30**	**100**	**20**	**70**	40	-
	SAH		**50**	**25**	**63**	**25**	**25**	-	-
	OMGRs		**75**	**50**	**63**	**-**	**50**	-	-
	NMGRs		**67**	**67**	**67**	**-**	**-**	-	-

Table D.3 Comparisons: The All-American Canal lining conflict issue (AAC).

Explanatory factors and frequency of response (%)

Sub-theme	Subject	JEO	UCY	CYC	DRE	RAF	WEL	ADJ	RED	WET	IOP	MES	NOR	COI	RUT	CON	MIG	CTE
6) Expected damages in the Mexicali Valley	NAH		44	56	44	67	33	33	56	44	44	56	22	-	22	-	33	-
	CAH		60	10	40	70	20	60	60	20	-	-	-	-	-	-	-	-
	SAH		38	-	50	75	50	88	50	38	38	-	-	-	25	-	-	50
	OMGRs		33	17	33	50	33	67	17	-	38	17	-	-	-	-	-	-
	NMGRs		66	66	100	100	-	-	100	66	33	-	-	33	-	66	-	-

Sub-theme	Subject	DAS	APA	LIN	MIN	TRA	PLA	GLA	ALE	LED	ELE	LES	NOF	REN	DOW	POC	APS	GBC	DAR	ASY	VIR	SUE
7a) Participation in the All-American	NAH		89	89	78	89	89	78	89	100	67	56	89	78	67	33	44	-	-	-	-	-
	CAH		80	30	30	30	30	40	40	60	40	30	70	50	50	30	-	40	-	40	-	-
	SAH		38	25	13	25	38	50	38	38	25	25	38	25	13	25	-	-	50	-	-	-
	OMGRs		83	67	50	50	50	-	33	33	67	33	67	-	-	-	-	-	-	-	-	-
	NMGRs		67	67	-	-	-	-	-	-	67	67	-	-	-	-	-	-	-	-	67	67

Sub-theme	Subject	ELU	IMU	BUR	ALA	GIA	LAN	LIM	LAC	LIC	POC	WUA	LER	COT	ROL	WAL	SYS	OPE	FIN	ALT
7b) Participation of WUAs in the AAC	NAH		44	56	44	78	78	89	89	100	33	-	56	-	-	-	-	-	-	-
	CAH		60	50	50	40	40	30	30	30	30	-	20	-	30	-	30	30	-	-
	SAH		63	75	50	63	50	63	63	50	63	-	-	-	50	63	-	50	-	-
	OMGRs		33	67	33	33	33	-	50	67	-	33	-	50	-	-	17	-	33	67
	NMGRs		-	-	-	-	-	-	67	67	-	67	-	-	-	67	-	-	-	-

Sub-theme	Subject	DIT	ING	DOW	ORG	LIC	CIL	ELE	LOZ	CTE
8) Influence of agriculturists in All-American Canal issue.	NAH		89	67	89	-	89	56	-	-
	CAH		80	40	30	-	50	30	-	-
	SAH		75	75	50	50	75	50	-	-
	OMGRs		-	-	33	67	50	50	17	33
	NMGRs		-	-	67	67	67	-	67	-

AAC

CAH

CCI

CDEM

CESPM

CICESE

CILA

COLEF

CNC

CNPPR

COLSAN

CONAGU

APPENDIX E

GLOSSARY

AAC	The All-American Canal lining conflict.
CAH	Agricultural water users in central Mexicali Valley.
CCI	Central Campesina Independiente (The Mexican Independent Peasants' Union).
CDEM	Comisión de Desarrollo Económico de Mexicali (The Mexicali Economic Development Commission).
CESPM	Comisión Estatal de Servicios Públicos de Mexicali (The Baja California State Public Water Services Commission of Mexicali).
CICESE	Centro de Investigación Científica y de Educación Superior de Ensenada (The Center for Scientific Research and Higher Education of Ensenada).
CILA	Comisión Internacional de Límites y Aguas entre México y los Estados Unidos, Sección Mexicana. (International Boundary and Water Commission between Mexico and the United States, Mexican Section).
COLEF	El Colegio de la Frontera Norte (The Northern Border College, Social and Environmental Research Institute).
CNC	Confederación Nacional Campesina (The Mexican National Peasants' Confederation).
CNPPR	Confederación Nacional de Pequeños Propietarios Rurales (The Mexican National Private Small Rural Owners' Confederation).
COLSAN	El Colegio de San Luís (The San Luis College Social Research Institute).
CONAGUA	Comisión Nacional del Agua (The Mexican National Water Commission).

CABC	Consejo Agropecuario de Baja California, A.C. (Agriculture and Livestock Council of Baja California).
Consejo de Cuenca	Consejo de Cuenca del Río Colorado y de Baja California (The Colorado River and Baja California's Basin Council)
CPRs	Common pool resources
CURE	Citizens United for Resources and the Environment.
Distrito de Riego 014	Irrigation District No. 014, Colorado River (belonging to CONAGUA).
IBRD	International Bank for Reconstruction and Development
IBWC	International Boundary and Water Commission between Mexico and the United States, United States Section.
IDB	Inter-American Development Bank
IIE	The Institute of International Education.
NAH	Agricultural water users in northern Mexicali Valley.
NAFTA	North America Free Trade Agreement.
NIB	Northern international boundary point of water delivery or international Morelos Dam.
NMGRs	Newer water managers.
NPSP	Non-point source pollution
OMGRs	Older water managers.
ppm	Parts per million (or milligrams of salts per liter of water).
PAN	Partido Acción Nacional (The Mexican National Action Party).
PRI	Partido Revolucionario Institucional (The Mexican Institutional Revolutionary Party).
PRD	Partido de la Revolución Democrática (The Mexican Democratic Revolution Party).

PSP	Point source pollution
SAH	Agricultural water users in southern Mexicali Valley.
SAL	The Colorado River salinity problem.
SIB	Southern international boundary point of water delivery or the Sánchez Mejorada Canal.
SRH	Secretaría de Recursos Hidráulicos, former Mexican Hydraulic Resources Secretary.
SRL	Distrito de Riego Río Colorado, Sociedad de Responsabilidad Limitada de Inversión Pública de Capital Variable (Colorado River Irrigation District, Irrigation Society of Public Investment).
UAR	Unión Agrícola Regional (The Regional Farmers' Union).
UCMEXUS	The Center for U.S.-Mexican Studies of the University of California, San Diego.
USGS	United States Geological Survey
WB	The World Bank
WUAs	Agricultural Water Users' Associations.
WUSs	Agricultural Water Users' Societies (former irrigators' associations during the 1950s).

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