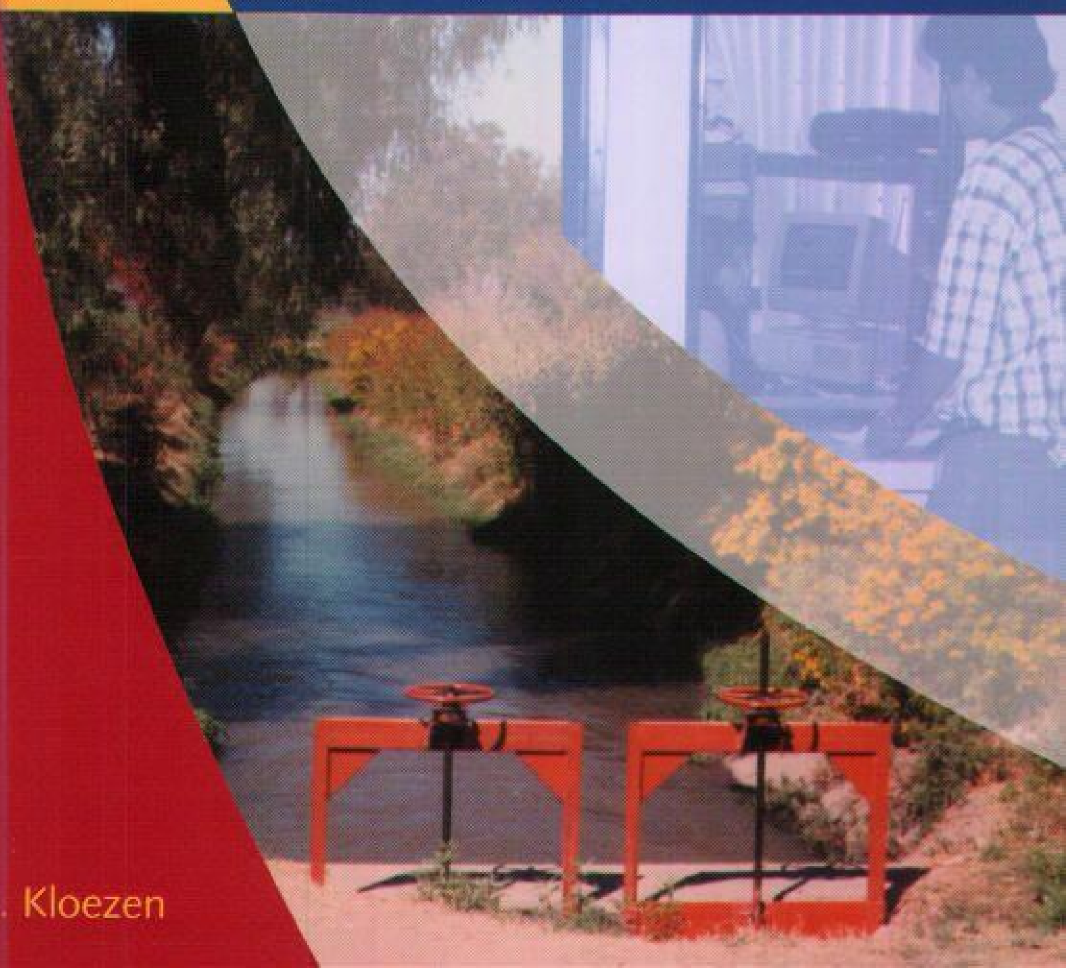
Accounting for water

Institutional viability and impacts of market-oriented irrigation interventions in Central Mexico



Wim H. Kloezen

Propositions

1. As a result of decentralization and market-oriented policies, the Mexican State's rural intervention continues in new forms, in some ways penetrating the countryside more deeply than before the withdrawal of past patterns of heavy-handed state economic intervention.

   Fox 1995; This thesis

2. Ostrom's belief -that co-production and synergy between public officials and citizens in diverse sets of open, nested arenas will lead to higher productivity and to more exposure of all forms of opportunistic behavior- ignores the notion of Du Gay that private and public organizations often have competing management values, targets and ethos. As a result of these differences, public and private organizations aim to be accountable in different ways.

   Ostrom 1996; Du Gay 2000; This thesis

3. Application of internal process indicators help to cross-check the quality and meaning of secondary data needed for comparative performance indicators. As such, internal process indicators and comparative indicators are complementary in assessing irrigation management performance.

   This thesis

4. There is nothing wrong with romanticism. And, there is nothing wrong with instrumentalism. However, the problem starts when romanticism and instrumentalism are merged into a policy that aims to encourage farmers' participation to achieve cost-effective irrigation management.

   This thesis

5. Clear (prescriptive) institutional design principles form an important starting point for local users to negotiate and create institutional flexibility, credibility and transparency and thus institutional viability.

   This thesis

6. The mode and extent of water marketing are shaped by buyers' and sellers' willingness to negotiate social and political solidarity. This shows the limitation of economic incentive models.

   This thesis

7. Unlike common policy assumptions, irrigation management transfer alone has not changed water use patterns within the Alto Río Lerma irrigation district.

   This thesis

8. Market-oriented policy reforms need programs such as irrigation management transfer. However, irrigation management transfer programs do not necessarily need market-oriented policy reforms.

9. Any Mexican PhD thesis on the political construction of water institutions in the context of the Dutch Water Management in the 21st Century Policy (*Waterbeheer 21ste Eeuw*) would be at least twice as long as this Dutch thesis on Mexican water institutions. This is not because Mexican students are less efficient.

10. Als je hen vraagt naar de zin van het leven, antwoorden de meeste mensen met hun levensloop.

György Konrád

11. Hay hombres que luchan un día: y son buenos.
Hay otros que luchan un año: y son mejores.
Hay quienes luchan muchos años: y son muy buenos.
Pero hay que luchan toda la vida: esos son los imprescindibles

Bertolt Brecht

Propositions attached to the thesis
Accounting for Water
Institutional viability and impacts of market-oriented irrigation interventions in Central Mexico
Wim H. Kloezen
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ACCOUNTING FOR WATER

INSTITUTIONAL VIABILITY AND IMPACTS OF MARKET-ORIENTED IRRIGATION INTERVENTIONS IN CENTRAL MEXICO

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Accounting for Water

Institutional viability and impacts of market-oriented irrigation interventions in Central Mexico

Wim H. Kloezen

PROEFSCHRIFT

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Glossary and abbreviations

Spanish terms are given in *italics*.

ANAGSA	*Aseguradora Nacional, Agrícola y Ganadera S.A.* State institution for the provision of subsidies for crop insurance.
ANUR	*Asociación Nacional de Usuarios de Riego*, or National Association of Water Users. The association was initiated in 1994 as a result of the First International Seminar on Transfer of Irrigation Districts (held in Cd. Obregón) and federates all Mexican WUAs. The association's objectives include the promotion of and gaining access to system improvement projects, training, studies, legal and financial assistance for all WUAs and LRSs.
ARLID	Alto Río Lerma Irrigation District. In Spanish called *Distrito de Riego Alto Río Lerma* and often referred to as *Distrito de Riego 011("zero-once").*
article 27	Important land tenure article of the Constitution of 1917, which provides the basis for federal legislation to provide land to *ejidatarios*. The constitutional reform of Article 27 in 1992 under the Salinas administration made it possible to legally sell and rent out *ejido* lands.
BANRURAL	*Banco Nacional de Crédito Rural* (National Bank for Rural Credit). The official rural credit institution for smaller and poorer producers. Since 1989 the bank underwent substantial administrative retrenchment and shrinkage as a result of its reorientation towards only financially solvent farmers who had access to productive lands.
board	WUA board of leaders (president, treasurer, secretary and their replacements), elected from and by the general assembly (see there) of the WUA.
canalero	Ditch tender, or ditch rider, or water guard. Formerly CNA staff, currently directly employed by WUAs.
CNA	*Comisión Nacional del Agua*. The National Water Commission, created in 1989 as an independent institution within the SARH. In 1994 it became an administratively independent body within SEMARNAP. CNA is the national water agency responsible for (among others) managing irrigation districts.
CNC	*Confederación Nacional Campesina*, or National Farmers' Confederation, the largest farmers' union in Mexico. This union is considered as one of the most important vote-delivering corporatist organization tied to the *PRI*, the ruling party until July 2000.
cuota	Irrigation service fee. In Mexican Spanish also referred to as *la tarifa del agua*.

CV	Coefficient of Variation (standard deviation of a population devided by the average of that population).
DOF	*Diario Oficial de la Federación.* The federal newspaper which publishes new acts and admentments to existing acts.
ejidatarios	Members of *ejidos.*
ejidos	Land reform communities, created after 1915 as a result of the Mexican Revolution. *Ejido* lands belong to the State but are worked by *ejidatarios*. The *ejido* system was abolished with the 1992 revision of Article 27 of the Constitution of 1917 (see Article 27).
ET_0	Reference evapotranspiration, calculated through the modified Penman-Montieth equation.
FERTIMEX	*Fertilizantes Mexicanos*. State agency for the provision of subsidies for fertilizers
FIRA	*Fideicomisio Instituido en Relación a la Agricultura*, a trust fund for agriculture constituted by five government funds for agriculture which rediscounts loans of farmers' credit unions on a subsidized basis.
general assembly	In Spanish: *asamblea general.* The assembly of elected *ejidatarios* and private growers' representatives to the WUA.
hydraulic committee	Committee at the level of the irrigation district, comprising representatives of the CNA district office, all WUAs within the district, and the State of Guanajuato. Charged with irrigation planning, monitoring and supervision. In Spanish called *el Comité Hidráulico.*
hacendado	Owner of a large ranch, mainly before the land reform program that was started in 1915. Also referred to as *latifundistas.*
HYV	High Yielding Varieties.
IIMI	International Irrigation Management Institute, one of the sixteen centers supported by the Consultative Group on International Agricultural Research (CGIAR). Currently renamed as International Water Management Institute (IWMI), with its headquarters in Colombo, Sri Lanka. An IIMI national program office for Mexico was opened in 1994.
IMF	International Monetary Fund
IMT	Irrigation Management Transfer. Other commonly used terms are '(management) turnover' and 'disengagement'. In Mexico this process is referred to as '*La Transferencia*'.
IMTA	*Instituto Mexicano de Tecnología del Agua* (The Mexican Institute of Water Technology), which used to be the research institute within CNA. Although still closely related to CNA, it has now become a financially independent research institute, located in Cuernavaca near Mexico City.
irrigation unit	Until irrigation management transfer, irrigation units (*Unidades de Riego*) were sub-sections within irrigation districts, each headed by a CNA 'Head of Unit' (*Jefe de Unidad*). With management transfer, these irrigation were converted into modules (see *module*). In some cases former irrigation units and present modules have the same hydrological boundaries, whereas in other cases irrigation units were split into two or more modules. Presently the term *Unidad de Riego*

refers to small-scale farmer managed irrigation systems, outside the irrigation districts.

IWMI see IIMI.

lateral Secondary irrigation canal, or distributary canal. In Mexican Spanish often called *Canal Lateral*, or *Red Secundaria*.

Ley de Aguas Nacionales The National Water Law, enacted in 1992.

LRS Limited Responsibility Society (*Sociedad de Responsabilidad Limitada, SRL*). An association at the district level, which federates all WUAs within irrigation districts that have officially taken over from CNA the O&M management responsibilities for the main canal infrastructure.

Mm^3 Million cubic meter (equivalent to 811 acre-feet).

module Strictly spoken, the area administered by a WUA. Often used to refer to the user association itself as well. In Mexican Spanish called *el módulo*.

NAFTA North American Free Trade Agreement. A trade agreement between Canada, the United States of America and Mexico. In Spanish called *Tratado de Libre Comercio* (*TLC*).

O&M Operation and Maintenance (of irrigation districts).

PAN *Partido Acción Nacional*, or National Action Party. During the time of this field research, the major center-right opposition party, governing in the State of Guanajuato (where ARLID is located). Since July 2000, the ruling government party.

pequeño propietario Literally 'small landowner', who in contrast to *ejidatarios* can own private land (*pequeña propiedad*). Here generally translated as 'private growers'.

PIM Participatory Irrigation Management. An initiative to promote greater user involvement in irrigation management, stimulated by the World Bank.

prestanombres Literally 'name-lenders'. Refers to the practice of using the name of relatives to exceed land ceilings and to obscure de facto land ownership.

PRI *Partido Revolucionario Institucional*, or Institutional Revolutionary Party, the ruling parting from 1929 until July 2000, when the PRI was defeated by the PAN

private grower See *pequeño propietario.*

private wells Deep tubewells that are owned and managed by (groups) of individual farmers (both *ejidatarios* and private growers). Contrary to public wells (see below), users of these well do not pay a service fee to CNA or the WUAs.

PROCAMPO *Programa de Apoyos Directos al Campo.* The fifteen-year Direct Support to the Countryside Program, launched in 1993, which gives direct grain subsidies based on the plot size. The program targets compensation for the loss in income as a result of the neoliberal reforms.

PROCEDE *Programa de Certificación de Derechos Ejidales y Titulación de Solares Urbanos*, or Ejido Land Rights Certification and Urban House Plots Titling Program.

Procuraduría Agraria Agrarian Attorney General's office, responsible for implementing PROCEDE.

PRONASE	*Productora Nacional de Semillas.* State agency for the provision of subsidies for seeds.
PRONASOL	*Programa Nacional de Solidaridad* (National Solidarity Program). A package of economic programs in the early 1990s, ranging from agricultural credit programs to the distribution of social funds. The program aimed at alleviating poverty and at encouraging community participation, decentralization and democratization. The program played a major role in replacing the public credit formerly channeled to farmers through BANRURAL as well as providing credit to private growers who previously had no access to credit.
public wells	Deep tubewells, which before IMT used to be managed by CNA. At the time of IMT these wells were officially transferred to the WUAs. Users of these wells pay a service fee to these WUAs. The most commonly used Spanish term for these wells is '*pozo oficial*' ('official well'), where 'official' refers to 'public management' (i.e. CNA before IMT).
REPDA	*Registro Público de Derechos de Agua.* Public Registrar of Water Rights. Created in 1992 after the National Waters Law was enacted.
RWS	Relative Water Supply. A non-dimensional indicator that measures total water supply (irrigation and total rainfall) over total crop demand at field level. See Appendix 4.
SAGAR	*Secretaría de Agricultura, Ganadería y Desarrollo Rural.* Ministry of Agriculture, Livestock and Rural Development. Between 1989 and 1994 SAGAR was the parent agency for CNA.
SARH	*Secretaría de Agricultura y Recursos Hidráulicos.* Ministry of Agriculture and Hydraulic Resources. Created in 1976 and until the creation of CNA in 1989 also responsible for managing irrigation districts.
SEMARNAP	*Secretaría de Medio Ambiente, Recursos Naturales y Pesca.* The Ministry of Environment, Natural Resources and Fishery, under which from 1994 onwards CNA falls.
SGVP	Standardized Gross Value of Production (see Appendix 4).
SRH	*Secretaría de Recursos Hidráulicos.* The Ministry of Hydraulic Resources, between 1947 and 1976.
tarifa	see *cuota.*
TLC	see NAFTA.
WUA	Water User Association. In the context of Mexican Irrigation districts often referred to as Civil Associations of Agricultural Producers (*Asociaciones Civiles de Productores Agrícolas*). In Mexican Spanish referred to as *Módulo* (Module, see there).

Preface

I experience the completion of this thesis as if I am finishing a long period of academic and social engagement with farmers' involvement in water management. This period started when I was still studying for my MSc in the 1980s. Many of the former fellow MSc students, colleagues at Wageningen University and at the International Water Management Institute (IWMI) in Sri Lanka who intellectually inspired and supported me during my studies and my later career as a researcher, also contributed to this study. Hence, the acknowledgements on these two pages go far beyond these contributions.

The idea of writing a thesis on the impacts of institutional changes in water management was started in 1995 when Sam Johnson III invited me to join him on his transfer from IWMI headquarters in Sri Lanka to Mexico. In Mexico, IWMI had opened a regional office, primarily to study the process and impacts of the Mexican irrigation management transfer program. I am very grateful to Sam, not only for providing me this marvelous opportunity, but also for being a very supportive mentor, colleague and friend during the first one and a half year of my stay in Mexico. Sam taught me how down to earth economics of water management can be. Furthermore, he and his wife Jane were excellent hosts and company, every time I needed to make the long jump from Celaya (Guanajuato) to Texcoco near Mexico City, where IWMI had an office within the CIMMYT complex.

I had known Carlos Garcés-Restrepo as a respected colleague, both in Asia and in Mexico. However, I really started to enjoy his enormous field experience in water management, and most of all his Latin sense of humor, once he had become my new supervisor after Sam had left Mexico. I benefited a lot from his long stays in ARLID as well as from the countless trips we made together, both in and outside of Mexico.

This study could never have been carried out without the commitment, endurance and insights of my two field assistants, Alfredo Marmolejo and José Jesús Ramírez. They did a tremendous job, running the canals measuring water flows, digging into CNA files, and interviewing water users. Although I know that in your eyes our field work seemed to last forever, I hope and trust that this long period of field observations has also contributed to your appreciation of and fascination for farmers' involvement in water management.

Alfredo, José Jesús and myself were very fortunate to enjoy the frequent company of a three Mexican MSc students, who joined us in the field and to whom I have tried to open up some of the international debates on water management and gender: Edith Carmona, Gabriela Monzalvo and Mauricio Melgarejo. I also wish to thank their professors and mentors, Dr. Enrique Palacios, Dr. Emma Zapata and Ing. A. Exebio from the Colegio de Posgraduados in Montecillo for debating issues of irrigation and agricultural development with us.

I am indebted to the leaders, staff and water users of the 11 WUAs in ARLID. I very much appreciate their willingness to unconditionally share their ideas, experiences, time and tequila with us. Most of what I understand now about water management in Mexico, I learnt from you. I particularly want to thank the leaders, staff and users of Cortazar, Salvatierra, Valle and Irapuato WUAs, where I spent most of my days. A special thanks goes to Agustín Robles, who has taught me more about farmer associations 'in transition' than he will ever realize he did. I was very fortunate to receive the continuous support from CNA staff, both in

Celaya and in Mexico City. I particularly appreciate the very constructive support from the chief engineer of ARLID, Ing. José Rodríquez and his helpful field staff. We never found your doors closed. A lot of the credit for the achievements in IMT in ARLID should go to you personally. I also wish to thank Dr. José Trava for sharing his experience with the initiation of the Mexican IMT program with me.

Els Meuleman joined me to Mexico. I wish to thank her for all the support and patience she gave me. Together we discovered the beauty, culture and history of Mexico, and enjoyed the great hospitality of its people. As our daughter Teska was born in Celaya, Mexico will be in our hearts for the rest of our lives.

I am very pleased to acknowledge my dear 'international colleagues' in Mexico, with whom I could share all my intellectual doubts, first findings and observations that form the basis of this thesis. Rhodante Ahlers, Ellen Rymshaw, Gilbert Levine, Chris Scott and Margreet Zwarteveen and their Mexican research staff have contributed enormously to my understanding of Mexican water management, irrigation performance and institutional change. Together we succeeded in making life in Mexico more than just enjoyable.

Several colleagues from IWMI, Wageningen University and other research institutes paid short visits to ARLID, among others to discuss some preliminary results of this study: Chris Perry, Mark Svendsen, Bob Young, Joost Oorthuizen, David Molden, David Seckler, Ian Makin, Gez Cornish and Jeroen Vos. I couldn't have thought of a better mix of nice people to serve as a mirror. Douglas Vermillion and Douglas Merrey at IWMI have been excellent reviewers of my work. They were never tired enough to share with me their methodological and conceptual insights on how to study institutional aspects of water management.

After my return to Holland, my former and new colleagues at Wageningen University provided a welcome environment to write up this thesis. I am very grateful to my supervisor Linden Vincent. With her enthusiastic and personal touch, Linden succeeded in encouraging me to complete this thesis, even when I thought that my personal circumstances had made it virtually impossible to do so.

It is my pleasure to thank Peter Mollinga, Robina Wahaj, Gerardo van Halsema, Joost Oorthuizen, Rutgert Boelens, Alex Bolding and Margreet Zwarteveen of the Irrigation and Water Engineering group in Wageningen for their eagerness to exchange ideas on and experiences with researching the social, political and institutional aspects of irrigation development, and for sharing their work, engagement and criticisms with me.

José Janssen and Nanco Dolman helped me with some of the graphs and maps and as such taught me how to open the black-boxes of the MS-Office suite. I also wish to thank Maria Teresa Garcés for helping me with the Spanish summary.

Although the subject of Mexican water management is not exactly their daily business, my colleagues at Oranjewoud have been very supportive in encouraging me to complete this thesis. I particularly like to thank Klaas Strijbis for allowing me to take a short study leave during the final stage of my thesis.

I wish to address my last words to two women who were hardly involved in the long process that this thesis took, but without whom I would never have found the energy and motivation to complete it. Without the friendship and dear company of José Janssen the writing stage of this thesis would have been a lonely and empty exercise. Similarly, the love, great joy and laughter of my daughter Teska have shown me what really matters.

Wim Kloezen
April 2002

1 Viability and impact of institutional interventions: an introduction

1.1 Aims and background of the study

Research aims

The main concerns of this thesis are the reality, the viability and the impacts of recently established institutional arrangements for irrigation management in Central Mexico. These arrangements were the result of a series of state planned market-oriented intervention programs in the irrigation sector. The first aim of this thesis is to analyze the realities of these arrangements, rather than their normative (and often prescriptive) design principles. Relevant questions that relate to this are how these irrigation reforms are linked to a wider set of political and economic reforms; how they were implemented at the local level; how water users and irrigation managers have adopted, rejected or transformed these reform programs; and how viable the new institutional arrangements for water management are. This is done by applying an interdisciplinary research approach, which integrates concepts of technical, institutional, political and economic dimensions.

A second aim of this study is to identify the results and impacts of these reforms in terms of changes in water use practices, access to and spatial distribution of water, and land and water productivity. The third aim of this research is to explore various methods to assess the viability and impact of the institutional arrangements that were established during the process of the design, implementation and local modification of the intervention programs. Finally, the fourth aim of this study is to fill in some of the empirical void in the literature on Mexican irrigation management transfer, and thereby contribute to a more in-depth insight in the meaning and content of an irrigation management transfer model that is so widely advocated.

Market-oriented reforms as a panacea for poor irrigation performance?

During the last decade, many countries throughout the world have attempted to improve their generally poor performance record of agency-managed irrigation systems by implementing policy programs to transfer some system management responsibilities to local user organizations. The promotion of transfer (or 'turnover') of irrigation management responsibilities to farmers is referred to hereafter as irrigation management transfer (IMT). The general belief behind these programs is that improvement in irrigation performance can be reached through the introduction of greater farmer involvement in irrigation management (Vermillion 1991 and 1997, Meinzen-Dick *et al.* 1995). In addition, greater farmer involvement could also imply giving farmers greater financial responsibility, and in some cases greater financial autonomy. Not only would these help (it is believed) to encourage farmers to use water more efficiently, it particularly would help the government to reduce public investments in irrigation management (Small 1989, Small and Carruthers 1991, Svendsen 1993, Perry *et al.* 1997).

Improvement in irrigation performance through greater farmer involvement in irrigation management is not new on the international irrigation policy agenda, dating back to the 1980s[1]. However, the financial crises that many governments have faced since the early 1990s, have accelerated the attention for farmer participation, particularly in the case of agency managed systems.

Among the international IMT programs, the Mexican program has been one of the most ambitious. This intervention program basically aimed at reducing government investment in the operation and maintenance (O&M) of large scale irrigation districts and at the same time optimizing the use of water and other scarce resources needed for irrigation management. The rationale behind these ambitions can be understood by simply looking at the poor performance of the large scale Mexican irrigation districts. From 1950 the percentage of O&M costs paid by the users declined from 95 percent to 37 percent in 1990. As a result, the irrigation districts deferred maintenance, leading to a serious reduction in productivity and total outputs and decline in the sustainability of the infrastructure (Johnson 1997b).

The three main strategies that the Mexican government followed in the early 1990s to try to overcome these problems were: to transfer the managerial and financial responsibilities of most O&M tasks from government agencies to newly to be established water user associations (WUAs); to provide these WUAs with secure and tradable water use rights; and to treat water as an economic good.

Together, these strategies have totally reshaped the institutional environment for the provision of irrigation services to the users, in an attempt to do this in a more viable way for both users and the government. This new institutional environment comprises the enabling legal and policy environment (new laws, rules and regulations, policy implementation strategies); new and old actors, with irrigation management entities responsible for providing the irrigation management services; and, the government and non-government organizations that support those irrigation management entities through the delivery of goods and services.

These new arrangements for managing water did not come on their own, but were accompanied by a much wider set of programs of financial and institutional reforms, which can and have been influenced by wider neo-liberal economic ideologies since the 1980s. The IMT program requires not only radical reduction in the role of public institutions, cost-recovery and financial autonomy, but also requires 'market-oriented' reforms that reshape processes for water management, create possibilities for water markets, and also reform the wider provision of inputs and markets.

The challenge of this study lies in the search on how IMT programs and other reforms are linked. As such, this IMT study is quite unique as most proponents (policy makers and scholars) of IMT programs, generally tend to look at IMT 'on its own' as if IMT were isolated from its wider ideological and institutional context. As a result, the World Bank and international donor agencies often propagate IMT as an institutional model that can be copied to countries as different as Mexico, Turkey and Pakistan, without sufficiently linking this model to the political and institutional conditions of these countries. Similarly, opponents of IMT often reject management transfer on mere ideological grounds, as they regard IMT as one of the elements of neo-liberal reform programs. However, IMT does not necessarily have to be linked to neo-liberal reforms, but neo-liberal reforms certainly require programs like IMT. This thesis attempts to unpack these different forces and their related concepts and show how they have shaped the reality of irrigation management under the IMT program in Mexico, and how they can be used to study the mechanisms and impacts of institutional reform programs in the irrigation sector.

The locale of this study is the Alto Río Lerma irrigation district (ARLID), a large irrigation district where the IMT program was implemented in 1992, rather than the central offices of the irrigation agency where the IMT program was designed. Field research for this study took place from October 1995 to May 1998. The study was part of a broader, nationwide research program by IWMI-Mexico (see glossary) in collaboration with several Mexican institutes and organizations, including the University of Montecillo Chapingo, the CNA, the Ministry of Agriculture and local water user associations. During the time of this study, IWMI worked in four large-scale irrigation districts, i.e. Comarca Lagunera in central north Mexico, the Bajo Río San Juan and Bajo Río Bravo districts in North-east Mexico, bordering the United States, and ARLID. I designed, conducted and coordinated the research program in ARLID, which is the subject of this thesis.

1.2 Research debates

This book addresses a wide audience, as it could be useful for policy makers, scholars and practitioners of irrigation involved in four debates. Some readers might participate in only one of these debates. Many, however, are involved in several of them, as these debates are highly related. The 'general' reader would be someone interested in irrigation reforms, institutional reforms and (irrigation) impact assessments, particularly in Mexico. However, general readers do not exist, as (like myself) everyone uses its own conceptual framework, methods and professional experiences to judge reality. The remaining sections of this chapter elaborate on the kind of concepts and methods used to study the realities of IMT in Mexico. However, first the academic and policy debates and research approaches that this thesis contributes to are described.

Interdisciplinary approaches to irrigation

This study deals with irrigation management. Without wanting to review and classify the wide body of literature on irrigation, it is important to understand how irrigation is perceived in this study. This study is an example of the Wageningen school of studying irrigation management. This school perceives irrigation management as a sociotechnical phenomenon and integrates concepts from technical, social and economic sciences. Many of the ideas of this school were initially built on the work by Uphoff (1986a), Chambers (1988), Huppert (1989), Keller (1990) and Uphoff *et al.* (1991) who define irrigation as a sociotechnical system. This means that in addition to recognizing the *physical* dimension of irrigation management (i.e. irrigation structures, canals and water flows), they are also aware of *organizational* requirements to make irrigation systems work (i.e. the effective organization of cooperation and activities needed to operate infrastructure among water users)[2]. Their contribution lies primarily in describing, classifying and making typologies of irrigation activities as well as to show how these activities can be organized by irrigation management organizations. To some extent they also attempted to link organizational categories to more physical classifications of irrigation systems (size, levels, and control structures[3]).

Although the Wageningen school has in part adopted some of these ideas, it argues that the concept of irrigation as a sociotechnical phenomenon should be thoroughly expanded. Whereas these above authors are looking at inter-relationships from the perspective of practical water management and their schematization for development planning, analysis and intervention, the Wageningen school has moved beyond them in its attempt to understanding specifically the social and political dimension of irrigation operations and management. This dimension manifests itself, for instance, by the way political and socio-economic processes and environments like the introduction of IMT and water marketing influence the way people manage their irrigation systems. Much of the current conceptual groundwork done by staff and students of the Wageningen school is to show how technical, organizational and political processes are inter-related[4].

Furthermore, the Wageningen school attempts to go beyond the more reductionist and schematic nature of the socio-physical approach to study irrigation performance, as is propagated for instance by Small and Svendsen (1990 and 1992), Oad and Sampath (1995) and Jurriëns (1996). Finally, the Wageningen school recognizes to some extent the neo-institutional approach to studying institutional dynamics of resource management (Ostrom 1990 and 1992), but at the same time sees its weakness in its understanding of how technology and physical conditions shapes institutions within their local context.

As is extensively discussed by proponents of this Wageningen school (see for instance Froentjes en de Ruiter 1991, Kloezen and Mollinga 1992, Zaag 1992, Vincent 1997, Bentum 1995, Pradhan 1996, Bolding *et al.* 1996, Mollinga 1998, Manzungu 1999 and Wahaj 2001), another contribution of this school is its understanding that irrigation technology should not be treated as a black-box.

The position of the Wageningen school, which is also chosen for this thesis, is that the design, construction, re-shaping, use and effects of irrigation systems embody technical as well as social and economic dimensions that are interlinked, and therefore can be perceived as social constructs. These social constructs manifest themselves, for instance in the form of organization of individual and collective labor input that is required, the type of irrigation organization, and informal social relationships among users and irrigation staff that is required to effectively operate and maintain irrigation structures and canals. This means that irrigation systems are designed with so called requirements-for-use in mind. As stated by Mollinga (1998), 'the purposes that technologies have to serve, and the institutional forms through which these purposes should be achieved, are reflected in the technical design characteristics of irrigation systems'. Another manifestation of irrigation as a social construct is that they have social (e.g. improved livelihoods), economic (e.g. economic growth) and technical (e.g. over-exploitation of available water resources) effects.

In this thesis irrigation is studied at the interfaces between technical and social approaches. Particularly, an exploration is made of the institutional dimensions of irrigation systems and their management in both operational delivery and administration, and the internal and external processes of creating viable institutions in the context of institutional transformation. Thus, institutional arrangements for irrigation are seen as a social construct and a social process. This means that the design of irrigation technology (including its social requirements-for-use) is an outcome of a social and political process. This process is on going, which means that both the manifestations of irrigation technologies and their social, institutional and organizational requirements are continuously reproduced, re-interpreted and modified. One of the most important sets of requirements-for use of irrigation technologies that are studied in this thesis, are the new institutional arrangements for water management that have come along with a series of Mexican market-oriented intervention programs.

Mexican IMT debate

Another topic of this thesis is IMT and other market-oriented irrigation reforms in Mexico. For three reasons the recent Mexican experience with farmer participation in irrigation received worldwide attention from policy makers, researchers and irrigation practitioners alike. First, because of its scale and speed of implementation. The transfer program was started in 1992, but by May 1999, 3.16 million hectares had been transferred to 419 WUAs, representing 93 percent of the area served by the 81 irrigation districts in the country (CNA 1999). Second, because of the relative high degree of financial and managerial autonomy that the new WUAs received and the consequently high level of financial self-sufficiency. Third, because the program was accompanied by a relatively sophisticated new water law (enacted in 1992). This law provides, among others, the creation of WUAs, the granting of water use concessions to them, and the definition of clear responsibilities and authority of all the management institutions involved in irrigation.

These achievements are applauded by many policy makers and others involved and interested in the Mexican transfer program. This explains why the Mexican *model*[5] of IMT is highly 'on demand' worldwide, not so much by the future participants of irrigation management transfer programs, but certainly by many state governments and international loan agencies[6]. However, irrespective of the importance that is attached to the Mexican IMT case, there are relatively few empirical reports on the actual experiences, practices and impacts of this program. Instead, most empirical 'evidence' (all unanimously positive) is based on impressions from short study tours (e.g. Ujjankop 1995, Mishra 1995) to generally the same pilot districts and WUAs; on general reports from international seminars that are supported by international organizations or banks (e.g. Gorriz and Groenfeldt 1994; Gorrriz *et al.* 1996); on interviews with a very select group of policy makers and senior agency staff (e.g. Frederiksen 1996; Saleth and Dinar 1999); or on reviews that synthesize this type of evidence (e.g. Hatcho and Tsutsui 1998). Other reports are biased in favor of the IMT program as they were written by (former) agency staff involved in the design and implementation of the program (e.g. Palacios-Vélez 1994c, Espinosa de León and Trava-Manzanilla 1992). Hopefully, this thesis contributes to filling this empirical gap and indeed helps to demythologize some of the discussions on the Mexican irrigation reforms.

Debate on viability and impacts of market-oriented reforms and interventions

Worldwide there has been quite some debate on the pro's and con's of IMT programs in general, and because of its scale on the Mexican IMT program in particular. The three leading questions around which this debate is organized are: does IMT help the government to reduce its expenditures in irrigation?; will the WUAs survive?; and, does IMT help to improve O&M performance? Out of a genuine concern about the future and impacts of these and similar reforms, this thesis attempts to contribute to answering these questions.

Several studies have started to answer these questions and to identify the strengths, weaknesses and problems of the recent institutional arrangements that were introduced by the transfer programs in a number of countries, including Mexico (see for instance Svendsen *et al.* 1997, Frederiksen and Vissia 1998, Vermillion and Sagardoy 1999, and several contributions in Johnson *et al.* 1995). However, in assessing the viability of the new institutional arrangements, these studies generally focused on the *formal* institutional and policy frameworks, enabling water rights systems and financial mechanisms of cost-recovery at the macro or country level. Generally, many of these studies have a normative and prescriptive (policy) character, leaving *actual* local practices, reactions and outcomes of institutional intervention programs largely unstudied.

Yet, from these studies it becomes apparent that there are several problems with the institutional conditions under which new irrigation organizations have to operate. For instance, both water users' associations (WUAs) and irrigation agencies face problems with filling the institutional void in the provision of both irrigation and non-irrigation services to water users. Generally, under pre-transfer arrangements the provision of these services was totally controlled by a number of government agencies. After transfer, WUAs or other local water management entities, sometimes still in partnership with slimmed-down agencies, are challenged to adequately continue and improve the provision of these services to the users.

However, it is not sufficient to only focus on arrangements for the provision of irrigation services. To enable the new local management organizations to adequately provide irrigation services, they themselves also need legal, financial and technical assistance, which they sometimes receive from government agencies, but often have to hire from third parties such as commercial companies. In order to get access to this type of assistance (or institutional service) and to be able to provide irrigation to their users, local management organizations have to develop relationships with government agencies, private companies, other local user organizations and of course with the recipients (or users) of their services.

From debate to analysis

One of the reasons for doing this study, was to demythologize the –in my view- basically ideologically driven debate on the pro's and con's of the current Mexican irrigation reforms. This, I thought, was important as it would not only help us to show what the impacts of these reforms were on both the welfare of the water users and the irrigation sector, but also to provide conceptual and methodological tools to better understand similar reforms in and outside of Mexico.

This thesis, I hope, will contribute to this understanding in the following ways. First, by looking at irrigation intervention as one of the planned policy *processes* that were implemented to contribute to achieving the goals of a much wider set of market-oriented reforms. This is in contrast with much of the conventional development oriented intervention approach on irrigation, which generally looks at irrigation interventions as an isolated *instrument* for planning and managing irrigation in a prescriptive way. This is the position which many aid donors and national agencies, particularly those under pressure to account for performance on short time horizons, have found it expedient to adopt (Bond and Hulme 1999).

The second way in which I hope to contribute to the intervention debate is by departing from the more normative and linear design models of intervention used in the above prescriptive policy frameworks. Instead, the approach chosen for the analysis in this thesis shows how different relevant actors have developed practices and strategies to locally adopt, modify or reject (elements of) institutional intervention programs.

The conceptual and methodological rationale and starting point of this thesis lies within the policy environment of which I, as a researcher with a policy oriented research institute like IWMI (see glossary), have been part of for several years. Much of the debates within this policy environment embarks on those current 'less state, more market' policy debates that are dominated by notions from neo-liberal interventionism, neo-institutional economics and rational choice theories. Although I have been part of that policy discussion and have adopted important notions of these theories, in this thesis I also aim to constructively criticize them.

Methodological debate on intervention impact assessments

How can one observe the way irrigation staff and users cope with new institutional arrangements for irrigation management and how can one assess the impacts of these arrangements on local irrigation management?

Although the Mexican IMT program has received a lot of attention worldwide, very little groundwork has been done on developing methodologies that can provide answers to these questions. Several researchers from IWMI-Mexico (including myself) have started to develop and test an impact assessment methodology, aiming at systematically documenting impacts of the IMT program in four irrigation districts (e.g. Johnson 1997a, Kloezen *et al.* 1997, Levine *et al.* 1998). Also in this thesis I will apply and evaluate these methodologies to show the impacts of IMT on irrigation performance levels.

However, a clear limitation of this methodology is that it does not help us to observe the processes and mechanisms that explain the measured levels of impacts. On the other hand, the small number of more critical studies that primarily focus on the social and political dimensions of the IMT implementation process (e.g. Whiteford and Bernal 1996, Pérez-Prado 1994), unfortunately hardly attempt to assess the impacts of the intervention in terms of irrigation performance. So in short: there is a felt need to report on both the process and the outcomes of the IMT program in a more systematic way. This requires some re-orientation on the kind of methodologies that can be used for such a purpose.

The kind of intervention impact assessment method that is used for this thesis goes beyond the commonly used method of comparing outputs of irrigation management before and after the intervention took place. It also looks at the enabling agro-ecological and institutional conditions, actors, practices, strategies, principles and mechanisms involved in these implementation; at day-to-day functioning of the institutional arrangements for irrigation management under post-transfer conditions and processes; and it identifies how these determine the strengths and weaknesses of these arrangements.

The following four sections of this chapter discuss the interdisciplinary approach to study the process, viability and impacts of the planned intervention programs that introduced new institutions and organizations responsible for managing water. This framework is divided into three sets of conceptual and methodological discussions, which will be further elaborated in the following sections:

1. concepts of viability of the institutional arrangements in irrigation (section 1.3);
2. concepts of market-oriented policies for irrigation (section 1.4);
3. observing local practices and strategies of institutional interventions (section 1.5);
4. assessing impacts of planned institutional interventions (section 1.6).

1.3 Analyzing the viability of institutional arrangements

Policy, institutional intervention, institutions and organizations

Policy is a central concept in this thesis. The perception on the definition of policy used here in the context of Mexican reforms in the irrigation sector is a broad one and closely follows that of Weaver (1996) in his work on the political economy of forestry production in Northern Mexico. Irrigation policy, in this thesis, is seen as a planned impetus, energizer, or reflection of constructed and coordinated (induced) change in order to control the production, distribution, and use of irrigation resources. Viewed in this manner, the stage for ongoing irrigation policy making is set by the history of past policies and the socio-economic and political relations among relevant international and national organizations that formulate and implement irrigation reforms. Policy and policy making, then, are the product of negotiations among these organizations. This means that also the implicit or explicit representation of irrigation policies (in the form of an irrigation act, water rights, establishment of new WUAs, O&M rules and regulations, and so forth) should be seen as the outcome of an ongoing process.

Institutional reform programs, like IMT, deal with planned intervention strategies aiming at affecting or reshaping the administration and management of resources. This is done by transforming existing institutions or by introducing new institutions, generally (but not necessarily) with new actors involved. Planned intervention refers to *formal* (i.e. government led) design and implementation of better or new institutions[7]. Hence, it implies institutionalization of change.

In this thesis, the concept of *institution* refers to a set of norms, rules, bylaws, procedures, roles and arrangements that actors collectively understand, agree upon and follow in order to achieve pre-determined results and impacts. They can be formal and official (planned) or informal (contingent; emerging from daily practice and interaction). New institutions under planned institutional reform programs like IMT are formal by their origin. However, after they have been introduced, they can be adopted, rejected, followed and modified in an endless number of ways. Often, the result of this can be that new, locally adapted, less formal (and often less visible) institutions emerge, with different norms, rules and arrangements and generally also other actors involved. Both formal and informal institutions can vary in size and complexity (e.g. few or many rules involved; simple or complex networks), scale (from individual to global) and style (Thompson 1998)[8]. Furthermore, their approach can be either top-down, bottom-up, or both, but always orchestrated by central authorities[9].

Institutions always involve relationships, which can be social, political, physical, economic, legal and human (skills, capacity, identity, values) in nature. Hence, (planned) institutional reforms create new forms or patterns of interactions and relationships between all actors involved. These actors can be individuals or organizations, who together form a network. In large scale irrigation systems, like ARLID, the two most important irrigation organizations are (sometimes newly established) water user associations and the (local) government organization, often an irrigation agency[10].

Institutional reforms can deal with introducing new institutional arrangements for WUAs, or for government agencies, or for both. Often, these reforms comprise of packages of new arrangements for each of these organizations (e.g. a set of new rules for the WUAs, in addition to a set of new rules and roles for the agency). However, almost always these reform packages also include a set of new norms, rules and regulations that stipulate the new patterns of interactions between these different organizations.

Institutional viability, as used in this thesis, simply refers to achieving a situation in which institutions will persist. Viability in this sense refers to the situation where (new) norms rules, roles, procedures and arrangements to achieve results and impacts are collectively permanently entrenched in the minds, behavior, practices and interactions of all individual and groups involved in these institutions. As can be learnt from Douglas (1987, cited in Musch 2001), norms, rules, roles, procedures and arrangements do not automatically add up to viable institutions. Only if they can persist without incentives of material self-interest, do they really become entrenched in the minds of people, with the effect of regulating processes.

Although institutions comprise more than just organizations, in irrigation much of the discussion on institutional viability focuses on viable irrigation organizations. For instance, a key question to policy makers engaged with the introduction of IMT in Mexico, was whether the newly established WUAs would survive. Although there existed a major concern about the sustainability of the irrigation agency (particularly at the local and regional level) as a result of IMT, this concern was only shared with staff members and unions within these agencies. International policy makers and researchers seemed to put more importance on the viability of the WUAs. Related questions brought up, then, included which factors help these groups to stay together; what are the factors within the organization that determine organizational viability, and which factors beyond the boundaries of these organizations help these organizations to survive?

In irrigation management literature there are at least four approaches that deal with these question of organizational and institutional viability[11]. These are what I would call here: the prescriptive and instrumental institutional design model approach; the neo-institutional approach to viable organizations; an extended approach for studying viability of institutional arrangements; and the approach that links institutions to physical environment and technology. These are reviewed below to show their strengths and limitations for studying the execution and local impact of institutional intervention in the Mexican irrigation sector.

Prescriptive institutional design models for IMT

The first group of people that write about the institutional changes that result from introducing farmer participation in irrigation and IMT are researchers who are primarily interested in the policy conditions and consequences of institutional reform programs. They generally work for international research institutes (like IWMI, IFPRI, FAO), or are closely associated to these institutes. Much of their work done on institutional changes in the irrigation sector is either initiated or co-funded by international loan agencies. Rather than analyzing the dynamics and processes of institutional reform, their main goal is to develop, present, and if possible test out institutional design principles and methodological frameworks that can be applied by policy makers and others responsible for introducing new institutional arrangements for water management.

The prime focus of these papers is to come up with some sort of institutional guidelines (though not blue-prints) that should help implementers of new institutions to check under which conditions these institutional options can be applied. In that sense they are highly instrumental: they are aimed at "getting the arrangements right" in such ways that they provide incentives for people to work on improvements in irrigation management. Common principles that are included in these guidelines include issues that deal with membership, collective choice arrangements, water rights, financial accountability and transparency, conflict resolution, size and scale of the organizations and monitoring of performance.

Examples of these papers include the work by Vermillion (1991, 1996), Meinzen-Dick *et al.* 1994, Meinzen-Dick *et al.* (1995), Merrey (1996), EDI (1996), Svendsen *et al.* (1997), Groenfeldt (1999) and Vermillion and Sagardoy (1999). In this respect, contributions to the discussion on the Mexican IMT program are focused to designing institutional arrangements and to instructing implementers of IMT at the local level on which steps to take to implement these arrangements as closely as possible to the plan (CNA 1994, Palacios-Vélez 1994c, Gorriz *et al.* 1996). In these contributions, irrigation intervention is seen as a development project, comprising a set of strong formal procedures, instructions and (participatory) management techniques (Craig and Porter 1997). Here, the underlying assumption is that defining better rules or principles, formalizing or legislating them, translating them into corresponding procedures, will automatically result in the planned effects (Boelens 2002).

These frameworks for institutional designs are handy check lists and have proved their practical relevance for identifying, describing and classifying different types of organizations and their management arrangements. However, they generally lack the potential to analyze the dynamics, mechanisms and processes that explain why organizations work as they worked in unique local institutional environments. The instrumental character of these models and approaches make them very appealing and influential in international policy debates on farmer participation and (joint) management of irrigation systems, as they help policy makers to support their argument for what they perceive is the rationale for farmer participation in water management. By some, it is seen as "...a way of bringing irrigation management into line with proven management theory" (Groenfeldt and Sun 1997). This explains why more and more these principles are used by policy makers as formal frameworks or prescriptions for 'effective institutions and organizations', particularly in the contexts of government retrenchment from irrigation (financial) management responsibilities.

Neo-institutional approach to viable irrigation institutions

The most extensive body of recent literature on institutional changes in irrigation stems from the neo-institutional approach to describing arrangements that "craft organizations". In general, this literature is concerned with the role of users in the crafting of institutional principles and arrangements for effective (and often collective) mobilization of resources that are necessary for local irrigation management.

This approach has been particularly useful as it has helped both researchers and practitioners in irrigation to analyze and design institutional arrangements. Often cited papers that follow this approach are the ones by Ostrom (1990, 1992, 1996, 1998, 1999), Nugent (1993), Tang (1992), Lam (1996), Steenbergen (1997) and many others[12]. Most of this work was developed to better understand the (internal) sustainability of locally managed (i.e. farmer managed) small scale irrigation institutions. Generally, they use a neo-institutional economics approach or rational choice and game theories to conceptualize and describe collective action in the allocation and distribution of irrigation water, as well as to identify the necessity in the provision of external support services that should help to sustain management organizations. This approach primarily focuses on the following institutional design principles and rule-creating incentives:

- arrangements of inclusion and exclusion of group members;
- rules and rights of property, allocation, distribution and use of resources and benefits;
- arrangement for selection leadership and user representation;
- internal monitoring and auditing of everyday management, including financial;
- arrangements of conflict resolution and sanctioning of defaulter.

Particularly the work by Ostrom (1990, 1992, 1999) has made quite some contributions to understanding the system of institutional principles and arrangements for collective action in resource mobilization in irrigation. This has made the approach to some extent useful for this the study in this thesis: it will help to organize and *describe* the internal (i.e. within the WUAs) arrangements for collective action in water management. However, the approach is also limited in its potential to analyze the processes and mechanisms that influence the viability of the new institutional arrangements.

Moore (1990) criticizes how these neo-institutional and rational choice approaches are organized around the following assumptions:

1. human behavior is intentional, and economically strategic, i.e. rational and aimed at utility maximizing, rather than political and rooted in culture and ideology ;
2. the rationale of action is typically the individual's or group's (predominately material) self-interest[13];
3. different people (notwithstanding their cultural background) understand and thus operationalize self-interest in the same way;
4. the information necessary to make fully rational choices is adequate and equally distributed;
5. human behavior is a product and expression of a choice that can be made between alternative courses of action, rather than of coercion.

Moore (1989 and 1990), Mosse (1997) and Mollinga (2001), who all have conducted extensive field studies on irrigation, criticize these assumptions by arguing that practice, interaction and strategies of resource mobilization cannot only be understood by applying instrumental rationality to institutional problems. Elements of culture, ideology, group identity, and social and political coercion could be equally important to explain behavior of (individual and groups of) water users and irrigation practices.

A major criticism by Moore (1990) is that these approaches generally exclude analysis of the way pre-existing and social and political institutions affect the rationality of alternative strategies. As a consequence, the relationship between for instance WUAs with other groups and movements (such as e.g. state agencies and farmer cooperatives) and the wider social, political and legal processes and institutions, are hardly considered and analyzed. Instead, irrigation management is deconstructed into transaction costs and other concepts of neo-institutional economics[14], primarily within the organizational boundaries of a WUA.

Finally, another shortcoming of these approaches is that they tend to be weak in their understanding of how technology and physical and environmental constraints shape institutions and their viability (see below). Although they recognize that environmental conditions affect the physical operation of particular systems, they still treat irrigation technology as a black-box and fail to link technology, environment and institutions.

Despite these shortcomings, many policy makers find the neo-institutional approach, and the institutional design principles that are derived from them, very appealing. In fact, their appeal to policy makers lies explicitly in its character to produce stereotypical assumptions about institutional and management behavior and constraints in complex situations, rather than explaining the causes of major changes in the institutional environment (*ibid.*). Therefore, analysis of viability of institutional arrangements for irrigation management should comprise both internal and external mechanisms and relationships, and should show how these are linked.

An extended approach for studying viability of institutional arrangements

In studying the viability of the new arrangements for water management that were introduced as part of the IMT process in Mexico, ideas and concepts of institutional viability as proposed by Ostrom and others above are used where applicable. These are partly useful to describe the organizations and their resource mobilization activities. However, in order to overcome the shortcomings that were discussed above, the conceptual framework on institutional design has to be modified and extended.

To enable examination of the actual (i.e. day-to-day) working of institutional arrangements for irrigation management and their influence on the viability of irrigation organizations, the following concepts of the wider socio-economic and political environment have to be added to the neo-institutional approach discussed above:

- *supporting conditions and services* such as policy strategies and laws that both shape and support the formulation and implementation of new institutional arrangements;
- *individual actors* and *organizations* involved in new institutional arrangements, both providing and receiving irrigation services;
- *practices and strategies* chosen for coping with the implementation and impacts of new institutional arrangements;

- *socio-economic and political relationships, networks and interactions* between these actors and organizations that provide and receive irrigation services. These relationships networks will be defined in terms of accountability between the different providers and receivers of irrigation services (see below);
- *mechanisms and processes* that shape accountability in institutional relationships between the service providers and service receivers. These concept are discussed in the following sub-section.

Participation and accountability
Unpacking institutional arrangements by understanding the above mechanisms helps us to unblur the, in my view, rather a-dynamic, a-political and romantic nature of the concept of user participation, which has dominated so much of the mainstream irrigation development discourse over the past two decades. Particularly in the case of IMT, the seemingly unconditional support for 'participatory irrigation management' as an instrumental tool to cut back government expenditures and at the same time improve irrigation performance is striking[15]. These advocates of participatory management fail to see how participation and effective management are deeply contradictory. Effective management often requires meeting certain objectives, many of which were already established long before the interventions began, maintaining central control; participation means fostering local control (Craig and Porter 1997).

Rather than uncritically follow the position that user involvement in the management of local natural resources is something positive and thus should be stimulated, this thesis perceives users involvement in terms of fostering autonomous control over decision making and access to resources in water management. This will help to better understand the influence that users can assert over the structure and management of institutional interventions in irrigation. It concerns the degree of control that users exercise over the WUAs and local irrigation agencies that provide them with irrigation services. Hence, it deals with the efficacy of the accountability systems that link users to producers of irrigation services (Brett 1996).

Here, a key concept is *accountability*. In irrigation management accountability is defined as the extent to which the performance of all managers and irrigation staff having responsibilities at different levels of an irrigation management organization are monitored and controlled by the water users, i.e. by those who have the right to receive an irrigation service (Uphoff *et al.* 1991). In the case of IMT in Mexico, the irrigation management organizations are both the WUAs and the irrigation agency, with their own managers and leaders (see chapters 2 and 4).

Generally, notions of accountability are built into or part of institutional design principles and planned arrangements. However, these principles and arrangements are not fixed and static. Rather, like all institutional arrangements, also mechanisms of accountability are continuously transformed and reproduced. Accountability does not come on its own, but has to be earned through a continuous process of negotiation and reformulation of arrangements (Vellema 2002). In this thesis, this notion of accountability as a process and as an outcome of negotiations is central to the analysis of viability of irrigation institutions.

Several *levels* and *types* of accountability are distinguished. Levels of accountability refers to the question: who is accountable to whom? As will be discussed in detail in the following chapters, in ARLID there are several levels of accountability: between WUAs and the water users; between the agency and the water users; between the agency and the WUAs; between the federation of WUAs and individual WUAs; between the agency and the federation of WUAs [16].

Most irrigation literature focuses on those types of accountability that are closely related to the official operation, maintenance and cost-recovery tasks of the management organizations. Consequently, *operational accountability* is the most common one used. For instance, van Hofwegen (1996) defines accountability in terms of monitoring and controlling whether or not agreed services levels ("ASL") are met. These service levels deal with operation and maintenance tasks, and are monitored against internally set O&M standards (i.e. between providers and recipients of irrigation services within the physical and organizational boundaries of the system). These agreed levels can be formal (e.g. through O&M regulations and manuals) or informal (oral agreements).

Another type of accountability that is dealt with in this thesis, is *financial accountability*. Financial accountability refers to the extent in which users (i.e. buyers or payers) can monitor and control if providers of irrigation services (generally an irrigation agency and a WUA) are liable to show that there has been proper financial management and adherence to financial targets and budgets in the situation where these providers depend on user fees for a significant portion of the resources used for O&M.

Operational and financial accountability can be related. This is the case when targets of financial management are not restricted to budgets and financial control, but also include O&M targets. For instance, when irrigation organizations depend financially on fees collected from farmers, they have a clear stake in providing their clients with an effective irrigation service, in terms of improved O&M (Small and Carruthers 1991, Svendsen 1993, Oorthuizen and Kloezen 1995).

There is, however, a third type of accountability that will be examined in this thesis. This is what is called here, *socio-economic and political accountability*. This is the type that is least acknowledged in irrigation literature. It refers to the extent that providers of irrigation services are liable to show that they have followed agreed upon arrangements for decision making, user representation, leadership selection, and equity and democratization targets. Hence, it deals with the situation in which performance of irrigation service provision is not monitored and controlled along the lines of agreed upon operational and financial service levels, but rather by socio-economic and political dependency relations between those who provide and those who receive an irrigation service. An example that shows how the provision of irrigation services can be hampered by lack of control over political accountability is the "water for votes" kind of agreement: water users that will receive a (better) irrigation service if they elect the local landlord for the president of a WUA. Unlike operational and financial accountability, the relationship between the cost (a vote, loyalty) and the benefit (access to water) is less transparent and hardly ever are expressed in terms of agreed service levels. Although most irrigation practitioners will know examples from the field, these field experiences are hardly ever documented[17]. The study of these three forms of accountability form the core structure of this thesis.

The mechanisms that are studied to unpack the three forms of accountability are [18]:

1. *mechanisms of hierarchical decision making*: comprising bureaucratic directives, authorization, administrative monitoring, and consultative and bureaucratic control over decision making processes and resource mobilization (chap 4 and 5);
2. *mechanism of democratic and electoral decision making*: comprising user representation, construction and use of bylaws, selection of leadership, and solidarity (chap 4 and 6);
3. *mechanism of social and political bargaining*: with political negotiation, political and moral persuasion, vote pushing, and lobbying (chap 6);
4. *financial and economic mechanisms:* comprising cost recovery, financial transparency, cost of irrigation services, and rent-seeking (chap 7 and 8).

Although these mechanisms include concepts used in neo-institutional and rational choice approaches (e.g. financial accountability; selected leadership), they also include other elements, such as bureaucratic and political coercion, and bribing. Thus, these mechanisms are not only economic, but also social, cultural, political and often historical in nature. The advantage of looking at these mechanisms in this extended way is that they are applicable to how the organizations involved in institutional arrangements for irrigation management are organized both internally and externally, i.e. linked to wider institutions and networks. External linkages that are analyzed in this thesis include the earlier mentioned financial, political, bureaucratic and electoral relationships *between* all groups involved in the institutional arrangements for irrigation management. Examples of these groups are providers of irrigation services such as irrigation agencies, commercial enterprises, farmer cooperatives, hydraulic committees and WUAs, and recipients such as (groups of) farmers and the WUAs.

Institutional viability, physical environment and irrigation technology

One of the arguments used in this thesis is that the viability of the new arrangements for irrigation management under the condition of new market-oriented reforms, does not only depend on the institutional viability as discussed above. I argue that the absolute availability of water[19] can influence not only the type of irrigation institutions and organizations (Martin and Yoder 1988, Wade 1995), but can also strongly influence the institutional viability of the newly established WUAs (Steenbergen 1997)[20]. Particularly in the case of Mexico this is an important factor as WUAs depend for their revenue (and hence existence) entirely on the availability of water. Absolute water scarcity is determined by climatological, water quality, agro-ecological and catchment (i.e. runoff, storage and ground water recharge) conditions.

Furthermore, in addition to absolute water scarcity, the viability of institutional arrangements for irrigation management is also determined by relative water scarcity. Relative water scarcity is determined by the level and regional and local distribution of irrigation demand (Postel 1993) *vis-à-vis* water availability. Irrigation demand is determined by water management activities or changing patterns of water use under certain agro-ecological conditions (Vincent 1997 and Vincent forthcoming), as well as by crop, soil and climatological conditions. Furthermore, demand is influenced by technical (design and re-design of irrigation technology) and social and economic requirements of water use. Within this set of factors, managers and users of the water resource can apply different water management policy, actions and instruments to mediate the level of relative water scarcity.

As was noted by Winpenny (1994) and Vincent (forthcoming), these policies, actions and instruments for mediating water scarcity can be market-based, legal-based and technology and managerial-based. This thesis will explore all these and show their relevance for the viability of particularly the irrigation organizations.

As discussed earlier, an important orientation of the Wageningen school of irrigation is to link irrigation technology to its social requirements for use, and vice versa. Although the aim of this thesis is not to further elaborate these dimensions, some key aspects were studied to show the way the irrigation technology of the ARLID system where this study was conducted has in part shaped the functioning of the new WUAs. Important factors that were analyzed include how the irrigation infrastructure (canals and structures) has shaped the type and level of organizational requirements, and whether these requirements could be met under the kind of market conditions under which post-IMT WUAs had to operate. Similarly, I have looked at the relationship between the design and physical condition of the irrigation infrastructure at the time and shortly after irrigation management responsibilities were transferred from the agency to the users. This, I argue, has influenced the requirement of a certain levels of quality and costs of O&M service that the new organizations had to provide, and hence has defined the room for negotiation for such service levels and the price farmers have to pay to receive these services. Again, the question is whether the 'design' of these organizations under post-IMT conditions could meet the (often negotiated) provision of service requirements.

1.4 Analyzing market-oriented policies for irrigation management

In addition to the concern on the institutional viability, a second concern of policy makers is how to use economic and financial forces as tools to transform the financing and management along more market-oriented lines. The market-oriented irrigation policies in Mexico aim to achieve this in two ways. First, by introducing arrangements for cost-recovery and financial autonomy. This would particularly help to reduce government expenditures by charging for water and irrigation services, while at the same time stimulate more effective use of scarce resources. Second, by allowing the trade of water and water rights among WUAs.

This section gives an overview of the assumptions on which the call to treat water as an economic good is based. Subsequently, an attempt is made to show the limitations of these assumptions and how they can be extended by approaches that do not *only* treat water as an economic good.

Ideas and concepts for retrenchment of government expenditures

Advocates of neo-liberal financial-institutional reforms propose the introduction of quasi-market incentives into the management of large-scale irrigation systems (Repetto 1986, Briscoe 1996, Perry *et al.* 1997, Rosegrant and Binswanger 1994). In order to both reduce the financial burden of central governments and to stimulate effective use of scarce resources, it is argued that funding of both capital investment and O&M should be redirected from public financing to payment and collection by recipients of irrigation services (Small and Carruthers 1991). Central concepts in the reasoning behind these policies are cost-recovery, financial autonomy and financial accountability. In general, one could say that this approach is part of and a further elaboration of the neo-institutional and rational choice theories of irrigation management as discussed and criticized above. They are also based on deductive assumptions on (economic) self-interest, economic incentives to effective use of scarce resources and utility maximization. Below, some of the main assumptions and arguments used in the literature on 'less state, more market' in irrigation are discussed.

It is believed that in an environment of financial autonomy, irrigation performance will improve both by freeing the O&M budget from the constraints imposed by the central government's fiscal difficulties, and by increasing the accountability of the irrigation system managers to the water users (Small and Carruthers 1991), thereby reducing rent-seeking attitudes of both users and staff of management organizations (Repetto 1986).

As is explained in more detail by Svendsen (1993) and Oorthuizen and Kloezen (1995), financial autonomy is defined as a condition where the irrigation management organization rely on user fees for a significant portion of the resources used for O&M, and the management organization has expenditure control over the use of the funds generated from these charges. Central to this argument is the notion of cost-recovery, i.e. charging and collecting irrigation service fees from users. As was discussed in detail by ADB and IIMI (1986), Small *et al.* (1989), Small and Carruthers (1991) and Kay *et al.* (1997), there are many ways of charging and collecting fees from users: direct or indirect means through taxes; area, crop or volumetric based charges; a flat fee or a variable fee; collected by users themselves, or by agency staff, or both; and so forth. Similarly, there are various ways of setting fee levels and of dealing with the administrative costs that are engaged with fee collection. However, whatever the method used, the two crucial questions are always: will the recipient of and payers for irrigation fees have control over the way collected funds are used?, and are they able to use their paying of fees as a tool to make irrigation managers accountable for the quality of irrigation service that they provide?

As was explained above, financial autonomy improves the accountability of the management organization to farmers, because it presumably transforms the position of farmers from mere water users into clients of the organization. Since the organization depends financially on fees collected from farmers, it has a clear stake in providing their clients with an effective irrigation service.

Financial autonomy presumably also provides a strong incentive for cost-effective management. The organization's interest is to reduce costs to keep its budget in the black, while farmers like to keep the fees as low as possible. This mutual interest, it is assumed, stimulates a greater efficiency in resource use, for instance by keeping the transaction costs of arranging, monitoring, regulating access and usage of the resources within the organization low (Steenbergen 1997). In addition, it stimulates to reduce the opportunity costs of change in water institutions (Saleth and Dinar 1999).

This thesis will show to what extent this theory on cost-recovery and financial autonomy holds for the case of IMT in Mexico. How this will be done is discussed after a review of another policy issue in restructuring irrigation management along market-oriented lines. This is the issue of water marketing.

Water as an economic good: the introduction of water markets

To market or not to market water?

Of the alternative (institutional) arrangements proposed to tackle the poor performance of irrigation systems, perhaps the most advocated one in recent times is the shift from administratively based management regimes to market regimes by establishing water markets and tradable water rights (Rosegrant and Binswanger 1994; Kemper 2001). The institutional conditions for water markets to be able to emerge, and consequently the property right regimes that exist, vary widely even if one focuses on the best documented examples of water market development: those in the Southwest of the United States[21]. Worldwide, many countries have started to introduce new water acts, or have modified existing laws, in order to provide market incentives for establishing secure water rights in such a way that should stimulate the reallocation of water through water marketing, rather than through administrative decision making. There exists a wide spectrum of proposed water rights regimes and institutional arrangements needed to stimulate the development of water markets (see e.g. Saleth (1994) for a concise overview).

Since 1992, also Mexico can be added to the list of countries that have given more importance to water trading. This is done through the promulgation of the National Waters Law which, compared to previous water acts, more clearly defines water rights and users concessions. The new act allows users to market these rights and concessions (see chapter 4).

The assumptions and arguments used for advocating the introduction of tradable rights and water markets closely follow the neo-institutional notions of economic self-interest and utility maximization discussed in section 1.3. The most common assumptions and arguments used to advocate water markets include:

- water markets encourage users to allocate and use water more efficiently (Colby 1988; Vargas-Velázquez 1996; Kemper 2001);
- water markets stimulate buyers and sellers to treat water as an economic good and consequently will induce economic efficiency (Briscoe 1996; Smith *et al.* 1997; Perry *et al.* 1997). The assumed reason for this is that through water markets users are stimulated to reallocate water from low to higher valued uses (Cummings and Nercissiantz 1992), for instance by shifting the production of staple crops to export crops;
- water markets encourage crop diversification by increasing the flexibility of farmers in responding to changing prices (Rosegrant *et al.* 1995);
- water markets help to reduce irrigation-related water quality problems (Weinberg *et al.* 1993).

Examples that are used to debate the validity of the above assumptions and arguments for the market development in reallocation of surface water are generally drawn from cases in the Southwest of the United States. To a much lesser extent examples are drawn from other Western countries with a tradition in water marketing such as Israel (Becker 1995) and Spain (Van Bentum 1995). Many of the 'empirical' claims for the success or failure of non-Western surface water markets generally rest on political, ideological and theoretical beliefs. This is convincingly demonstrated by Bauer (1997 and 1998) and Hendriks (1998), who *do* use empirical data to demonstrate that these claims do not necessarily follow what they have observed are the impacts of the Chilean Water Code of 1981 on marketing of water[22]. Both studies demonstrate that water markets are far more limited and static than is often assumed in those policy papers that use the Chilean case to advocate for water markets (e.g. Rosegrant and Gazmuri 1994 and 1996; Rosegrant and Binswanger 1994).

Empirical evidence that supports the success or failure of surface water markets in Mexico are even more scarce. Yet, several authors claim that experiences in Mexico and Chile indicate that water allocation through markets in tradable water rights offers a viable approach to improving the efficiency of water allocation (*ibid.*).

The three concepts that are generally used to support this argument are: the value of water; use cost of water; and, opportunity costs. These concepts are briefly explained below.

Value, use cost, and opportunity cost of water

One of the more comprehensive papers that presents the above pro-market argument is the one by Briscoe (1996). Briscoe states that water has an economic value in all its competing uses and should be recognized as an economic good. He argues that water has a value to consumers, who are willing to pay for it and who will use water so long as the marginal benefits from use of an additional cubic meter exceed the costs so incurred.

Briscoe recognizes that the *value of water* (i.e. the maximum price the user would be willing to pay for it) is difficult to estimate[23] and that the relative value of water varies in different end-uses. Comparison of the value of irrigation water for food grain production in developing countries with values of water for irrigation in industrialized countries, for hydropower, household, industrial, and for environmental purposes, shows that the value of irrigation water in public irrigation systems is typically low. It is about US$ 5.0 /1,000 m^3 whereas the value of water in active water markets is about ten times as high[24].

Briscoe distinguishes between two different types of costs incurred in delivering water: use cost and opportunity cost. The *use cost* typically includes the cost of operating and maintaining the infrastructure for storing and distributing the water[25], and sometimes also includes the "historical costs" related to the construction of the infrastructure[26]. Generally, governments throughout the world keep use costs of publicly financed irrigation systems low. The reasons this are usually political in nature and include (among others): subsidizing low food prices for urban constituencies; stimulating self-sufficiency in the production of staple foods; controlling political unrest that may result from high food prices; poverty alleviation; and so forth. These reasons already partly answer the question why in the past governments did choose not to follow market mechanisms to "get the prices right".

Opportunity cost is defined as the value of water in its highest value alternative. Assessing the opportunity cost is difficult as it relies on a number of assumptions on marginal losses and benefits to different uses. The opportunity costs of irrigation water varies considerably depending on alternative uses. These alternative uses can be found within the irrigation sector as a whole or within a single irrigation system. An example of the latter case is when a farmer who irrigates a low value grain crop foregoes the opportunity of a farmer who wants to irrigate high value crops. Opportunity costs can also vary between different sectors in the economy. This is for instance the case when irrigation foregoes the transfer of water to neighboring industries. Furthermore, the opportunity cost can vary within a season and between different seasons, as water becomes more scarce or abundant as a result of changing river flows and dam storage.

An extended approach to study market forces in irrigation management

So far for the rational economic theory on pricing water along market-lines. In this thesis the example of water markets in ARLID is used to test the main argument for advocating the introduction of market forces in the allocation of water: that water markets stimulate users to rationally value water as an economic good and follow market mechanisms in pricing traded water. An attempt is made to demonstrate that this assumption is limited in its strength to show why prices are set at certain levels, and why transactions in water marketing do not necessarily follow market mechanisms.

In most literature on water markets a comparison is made between two alternative mechanisms of setting prices and allocating water. However, I argue that there is a third mechanism that to a large extent explain why water pricing and water markets are less 'perfect' than advocates of market oriented assume they are. The first mechanism that is generally recognized is the administrative one, in which water pricing, if any, and allocation of water is determined by bureaucratic management decisions. Examples of these are water management regimes that are organized around systems of rotation of irrigation deliveries (either volumetric based, time based, crop based or a combination of these) between different sub-systems. The second, alternative mechanism that is more and more propagated through market-oriented policies, is the setting of water prices and water allocation organized around market forces. The key concept in this latter mechanism is again opportunity costs.

According to Briscoe, true opportunity costs are affected by the mode of water allocation. Using the case studies documented by Maass and Anderson (1978), Briscoe concludes that compared to administrative mechanisms of water allocation, the market allocation of irrigation water is far superior in terms of overall productive efficiency and equity of the losses resulting from water shortage. The reasons, he argues, is that in contrast to the former mechanism, the latter does include the command area related opportunity costs.

Briscoe sees the water market as "a brilliant conceptual solution to the enduring problem of reconciling practical and economic management of water". The problem with pricing irrigation water is that use costs (i.e. financial O&M costs) are much lower than opportunity costs. Whereas in conventional administrative allocation systems water is only priced at its use cost, the assumption of advocates of irrigation policies along market-lines is that in water markets the behavior of the user is not driven by the low use cost of the water but rather by the much higher opportunity cost. According to Briscoe, "this is the genius of the water market approach – it ensures that the user will in fact face the appropriate economic incentive, but de-links these incentives from the tariff (which is set on "common-sense" grounds").

By presenting some first experiences with price setting and water marketing in ARLID (chapter 8), an attempt is made to demonstrate that also socio-political accountability influences the level of water price setting and water marketing. The approach chosen in this thesis is to show that price setting and water marketing are influenced by a *combination* of these three mechanisms:

1. administrative mechanism of decision making;
2. market mechanism (rational choice and economic maximization);
3. socio-political mechanisms.

In addition to applying and testing the concepts that are related to the first of the above three mechanisms, this study will particularly focus on the third mechanism, looking at key reforms in the following ways:

Measure financial performance and level of water trading. Levels of (changes) in cost-recovery, financial autonomy and price setting will be measured by applying financial performance indicators (see section 1.6). In this way it is possible to describe both the changes over time (before and after IMT) and the differences between system levels within the district.

Study financial and market goals as negotiated arrangements. Rather than simply assuming that users and management staff will follow the stipulated institutional arrangements for cost-recovery, financial autonomy and water marketing, this thesis proposes that financial management and water marketing comprises elements and mechanisms that managers and users have (at least in part) negotiated for. This follows the argument made by Moore (1990) and others that economic utility maximization is only one of the forces that shape human behavior. In the case of, for instance fee level setting, socio-economic and political forces as well as cultural (e.g. loyalty to group identity) factors are of equal importance and hence should be included in the analysis of financial viability.

Study daily financial management and water marketing as contingent practices. Similarly, once the financial and marketing arrangements have been negotiated for and set, also everyday practices of financial management and trading are influenced by factors and mechanisms that go beyond the sphere of economic rational choice. One of the main concerns of international policy makers interested in improving the financial performance of large irrigation systems, is the rent-seeking practice (see e.g. Repetto 1986). Repetto and others explain these practices in terms of a search for economic self-interest of those involved in rent-seeking. Also other 'less than perfect' practices in the sphere of financial management, such as poor cost-recovery rates, are often explained in terms of imperfect economic incentives and practices. In this thesis I will try to unfold the economic *and other* mechanisms that explain these 'imperfect' incentives and practices.

Link financial performance and water marketing to the environment and technology. As was explained above, one of the contentions of this thesis is that institutional viability is linked to the physical environment and technology. In this thesis I argue that this is particularly the case for financial viability of irrigation management organizations. In order to support this contention, I will observe how the mode and quality of cost-recovery, financial accountability and financial autonomy are influenced by the conditions of the physical environment (particularly water availability) and the type and physical condition of the infrastructure, and *vice versa*.

1.5 Observing local strategies of institutional interventions

This study is about the reality and local impacts of market-oriented reforms, rather than about their formal institutional design. Hence, this thesis deals with everyday human practices and behavior. It deals with how actors involved in irrigation under post-reform conditions cope with everyday problems and it shows what the impacts are of these practices and problems on performance and viability of their irrigation organizations.

Much of the literature on intervention policies in irrigation follows an instrumentalistic approach, focussing on how agents of interventions can best achieve desired goals. For several reasons this approach is (at least in part) inapplicable for studying everyday local practices and impacts of planned intervention in irrigation.

First, it assumes a linearity between policy design, implementation and impacts of intervention. However, as Long and van der Ploeg (1989) and Long (2001) state, the separation of 'policy', 'implementation' and 'outcomes' is a gross over-simplification of a much more complicated set of processes which involves the reinterpretation or transformation of policy during the implementation process, such as that there is no straight line from policy to outcomes. Particularly Long (1988, 1989, 2001) and his staff and students in rural sociology (Hebinck *et al.* 2001) have provided detail empirical evidence that support the general observation by Long (2001: 27) that (planned) intervention is an on-going transformational process, without 'project' boundaries in time and space, that is constantly re-shaped by its own internal organizational and political dynamic at the local level.

Long and his group conducted intensive studies on planned intervention in large scale irrigation systems. A central approach in their work is to interpret agricultural and social change as an outcome of strategy, struggles and negotiations that take place between individuals and intervening groups, rather than the outcome of the prescriptive execution of top-down irrigation policies. Examples of this in irrigation, include the work by Siriwardena (1989) on farmers' response to planned intervention in a settlement irrigation scheme in Sri Lanka, and by Zaag (1992) on how water users and irrigation managers in the field cope with planned decentralization policies in Western Mexico. They show that the way water users and irrigation managers perceive, adopt and transform intervention policies into daily irrigation practices is a result of *contingent* social and political strategies and interactions between all involved actors, rather than of *planned* strategic conduct. As Long (2001) summarizes these and similar studies: the strategies that local actors devise, and the types of interactions that evolve between them and the intervening parties shape the nature and outcomes of such interventions.

This kind of local interpretation of planned interventions, often leads to what can be perceived as contingency irrigation management (Manzungu 1999): management that is in great influenced by the specific set of local socio-economic and physical conditions, rather than by mere institutional design[27]. Although institutional principles shape the form and direction of human interaction, it does not predict actual day-to-day strategic and operational management.

The second limitation of the conventional (i.e. neo-institutional) approach to look at actual practices and impacts of market-oriented reforms like IMT and water marketing closely follows the criticism earlier made on rational choice. Rather than analyzing actors and their daily practices in terms of rational (economic) decision makers, it is important to perceive their behavior and practices in a wider socio-economic and political context.

A third limitation of most studies on interventions for institutional reforms is a methodological one. In general, reform impact studies focus at impacts at the meso or macro (i.e. regional, national, global) levels, rather than at the implications of reforms at the local level. In addition, most studies use census data to show the performance and impacts of institutional changes, rather than observation and measurement of daily local practices and strategies, and performance. This confronts us with the methodological questions of how to assess the impact of market-oriented reforms in irrigation in terms of performance and activities of users and irrigation managers that operate irrigation systems under these new institutional conditions.

Thus, this thesis looks at day-to-day practices, social interactions and group strategies of coping with the institutional arrangements that were implemented as a result of the intervention programs. It shows who the key strategic actors are in (re)negotiating the prescriptions of the IMT policy, their networks and arenas in which they operate. And, it shows that also non-economic elements shape the direction and results of the behavior of policy implementers and their target-groups.

1.6 Analyzing impacts of institutional interventions on irrigation performance

The choice of research methodology for this thesis integrates observing local processes and practices of institutional intervention with their impacts on irrigation performance.

One of the objectives of the IWMI research program in Mexico to which this study contributed, was to observe and measure the impacts of the Mexican IMT program. This study was also part of the global IWMI research program on developing irrigation performance indicators for both internal operational performance assessments of irrigation systems and comparative indicators to assess impacts of interventions in the irrigation sector.

However, from the start of my research in Mexico I realized that applying performance indicators and measuring financial and O&M effects at several levels within the irrigation district would not be sufficient to understand the processes and dynamics that explain why certain levels of performance were achieved or not. Nor would they help explain why users and irrigation managers alike cope with the newly introduced institutional arrangements in the way we observe they cope. Hence, the choice to apply a mixture of methods and data collection techniques, borrowed from both technical and social sciences, was born and worked out in the way described below.

THE MEANING AND PURPOSE OF PERFORMANCE AND IMPACT ASSESSMENTS

By using a set of indicators, changes in quantitative irrigation performance levels are measured. This study mainly focuses at performance assessments at the levels of the selected irrigation district, several of its sub-systems as well as the level the selected water user associations and other management agencies within the boundaries of the district.

Abernethy (1989, cited in Murray-Rust and Snellen 1993) defines performance as:

The performance of a system is represented by its measured levels of achievements in terms of one, or several, parameters which are chosen as indicators of the system's goal.

While Abernethy focuses on the performance of the irrigation *system*, Murray-Rust and Snellen (1993) propose a definition for the (effective) performance of an irrigation *organization*, measured by two complementary criteria:

- *the degree to which the organizations' products / services respond to the needs of its customers; and*
- *The efficiency with which the organization uses resources in supplying these needs.*

Hence, the performance of an organization (i.e. the effectiveness of its activities) is a measure both of the degree of fulfillment of the output objectives and the management of the available resources. Small and Svendsen (1990 and 1992) distinguish between three types of performance measures:

- *internal process measures* of performance relate to a system's internal operations and procedures in the creation of intermediate and final outputs (*Am I doing things right?*);
- *output measures* of performance examine the quantity and quality of the system's final output;
- *impact measures* of performance pertain to the effects of the system's outputs on the larger environment (*Am I doing the right thing?*).

As is noted by Bos *et al.* (1994), this distinction is useful because it helps to understand that performance means different things to different people and has different purposes for different groups with interests in irrigation. Different categories of groups of water users, system managers, planning and monitoring agencies, researchers and policy makers will have different purposes for applying performance assessments.

An impressive body of literature on irrigation performance assessments methodologies has expanded rapidly over the last two decades, each having its own assessment purpose, looking at different dimensions and perspectives and using their own sets of performance indicators[28]. Of these methodologies three approaches are of particularly interest to this study: internal performance assessments of O&M, comparative performance assessments, and institutional performance assessments. I will discuss these below.

INTERNAL OPERATIONS ASSESSMENTS

In conventional irrigation science, the most commonly used method of assessing irrigation performance, is to measure actual levels relative to daily, weekly, monthly or seasonally set management targets by managers of irrigation systems. The purpose of such assessment methods is to evaluate the system's internal operations and procedures by using internally agreed service levels (Van Hofwegen 1996; Bos 1997) and internally set standards and indicators (Small and Svendsen 1990 and 1992). This evaluation approach is both technical and descriptive as it characterizes internal patterns, strengths and weaknesses with respect to certain stated management targets (Guda and Lincoln 1987). As such, it provides detailed information on management strategies and constraints. It therefore can help system managers to monitor the quality of operational performance (Murray-Rust and Snellen 1993).

Examples of typical internal process indicators include:

- Conveyance, distribution, field and application, and project efficiencies (Bos and Nugteren 1990; Molden and Gates 1990; Wolters 1992).
- Reliability and dependability of water distribution (Abernethy 1986; Molden and Gates 1990; Oad and Sampath 1995).
- Equity or spatial uniformity of water distribution (Abernethy 1986; Levine and Coward 1989; Sampath 1988; Sharma *et al.* 1991; Molden and Gates 1990; Wahaj 2001).
- Adequacy and timeliness of irrigation delivery (Levine 1982; Abernethy 1986; Molden and Gates 1990; Oad and Sampath 1995; Meinzen-Dick 1995).

Many authors have applied one or more of these and other indicators at particular irrigation systems[29]. Beyond doubt, all are useful as they provide important information about operational performance processes of the particular systems studied. However, the indicators mentioned above have shown some limitations as well, which include:

- Different authors propose to use different types and sets of indicators. In other cases, similar indicators are used but the definition of these indicators and the methodologies or tools to measure them differ. Although some efforts have tried to standardize internal operations indicators (Bos *et al.* 1994, Burt and Styles 1999), proposals for new sets of indicators or other methodologies to measure indicators are still emerging. As a result, comparisons across systems or over time are hardly possible[30].
- These indicators are based on the existence of clearly defined management goals and operational targets. However, in many irrigation systems, these goals and targets are either absent, or are too widely defined and inconsistent with one another (e.g. Brewer *et al.* 1997).
- As pointed out by Small and Svendsen (1990), measuring internal operations indicators following a goal-model approach, implies that subjectivity enters the performance evaluation both in the establishment of the goals and targets themselves, and in the way differing goals are weighted. System managers, policy makers, farmers, and researchers might all set different goals and targets, especially in systems where both are not yet (or poorly) defined, or where goals have changed as a result of dramatic changes in, for instance, cropping patterns, water availability or the political and economic systems.
- Generally, these indicators address how the input (water) is used, but do not provide information on to what wider hydrological, agricultural, economic, social, and environmental impacts the inputs have led.
- Most of the performance assessment exercises described in literature were done in the context of intensive research programs, often to test new indicators introduced by researchers, rather than proposed by system managers. As a consequence, little is known about how system managers perceive the usefulness of these indicators for daily system operation, and how easy it is to apply these indicators for day-to-day monitoring purposes.
- Measurement of most internal operations indicators requires complicated data collection procedures. Monitoring systems are normally not set up to collect these required data. As a consequence, applying the indicators requires additional staff, skills, and equipment, which are generally not available within irrigation systems, or which are hard to obtain.

COMPARATIVE IMPACT ASSESSMENTS

The second approach discussed here compares system characteristics and outputs of irrigated agricultural systems found in one place or period with those found elsewhere or different periods. Comparative indicators aim to help system managers, researchers and policy makers to compare outputs and impacts of interventions in individual systems *relative to* outputs in other systems or system levels (Molden *et al.*, 1998; Sakthivadivel *et al.* 1999).

This type of evaluation approach stays deliberately close to the objectives of most technical and institutional intervention policies and programs, meaning that the indicators used are essentially economic output oriented in nature. It assesses system performance by applying comparative indicators using *relative standards* rather than internally set operational standards. Unlike internal operational indicators, application of comparative indicators does not aim to make a normative judgment on the quality of irrigation performance. Comparative indicators simply provide information about the level of performance at a given system level relative to other system levels, or relative to time. Comparative indicators are based on inputs (such as land and water) into a given system, and outputs from that system (such as actual volume of water used relative to the crop demand, or productivity per unit of water and land).

So far, application of these indicators in several systems world wide has demonstrated that, compared to internal process indicators, data collection procedures required for measurement of external performance are relatively cheap and less time and resource consuming (*ibid.*). Generally, comparative indicators are only measured at higher system levels, such as modules or the entire district.

Table 1.1 Performance indicators applied in this study

Comparative indicators	Entire district	Cortazar module	Salvatierra module	Selected canals	Selected fields
Relative water supply (ratio)	✓	✓	✓	✓	✓
Relative irrigation supply (ratio)	✓	✓	✓	✗	✗
Water delivery capacity (ratio)	✓	✓	✓	✗	✗
Output per cropped area ($/ha)	✓	✓	✓	✗	✓
Output per unit command ($/ha)	✓	✓	✓	✗	✗
Output per unit irrigation supply ($/m^3)	✓	✓	✓	✗	✗
Output per unit water consumed ($/m^3)	✓	✓	✓	✗	✗
Gross return on investment (%)	✓	✓	✓	✗	✗
Part of canal network maintained (%)	✓	✓	✓	✗	✗
Maintenance expenditure ($/ha)	✓	✓	✓	✗	✗
Financial self sufficiency (%)	✓	✓	✓	✗	✗
Internal operations indicators					
Actual supply over planned supply (%)	✓	✓	✓	✓	✓
Actual supply over concessioned supply (%)	✓	✓	✓	✗	✗
Actual supply over reported supply (%)	✗	✗	✗	✓	✓
Actual RWS over planned RWS (%)	✓	✓	✓	✗	✓
Actual RWS over reported RWS (%)	✓	✓	✓	✗	✓
Spatial distribution of RWS (ratio)	✗	✗	✗	✓	✗
Fee collection rate (%)	✓	✓	✓	✗	✗

Note: ✓ = applied ✗ = not applied

A list of comparative and internal process indicators used in this thesis is presented in table 1.1 The selected internal operations indicators basically follow the irrigation management targets of CNA mentioned in section 5.3 of this thesis. Definitions of the comparative indicators are given in Appendix 4, as well as in Molden *et al.* (1998), Kloezen and Garcés-Restrepo (1998a), Sakthivadivel *et al.* (1999), and Burt and Styles (1999)[31].

Assessing the viability of institutional arrangements for irrigation management

Comparative indicators help system managers, policy makers and researchers to point out *where* problems occur and if more detailed studies are required. However, they do not identify the factors and processes that *cause* these problems. Internal operations indicators help to describe the level of system specific performance levels and often also help to indicate where the reasons for poor internal performance can be found. However, they do not provide information on the causes and mechanisms that lie behind poor performance levels. Both approaches are used to *measure* effects of management practices under certain institutional arrangements (like IMT), but they do not measure the viability of these arrangements. However, it is not sufficient to only measure viability indirectly in terms of effects. One also has to observe *directly* how irrigation organizations and users cope with institutional arrangements. As was argued in section 1.5, the method used to 'assess' or 'monitor', the viability of institutions is to daily observe actual practices, strategies, social interactions and networks of all actors and intervening groups involved.

1.7 Research design and data collection techniques

Research design

Much of the empirical data presented in this thesis were collected as part of the author's work with the Mexico office of IWMI. The field study for this thesis began in October 1995 and was ended by mid-1998.

ARLID was chosen because it was one of the first of the large scale irrigation districts that had been transferred from agency management to joint agency-farmer management. Hence, it was possible to observe the first experiences with the new institutional arrangements and with additional observations to measure the impacts of IMT on irrigation performance. Moreover, it was reported that some of the WUAs in ARLID were so far enthusiastic about IMT, while others had expressed their concerns. Hence, in ARLID IMT had received a mixed reception at the part of the users.

ARLID provided the opportunity to study how and why different WUAs within a single irrigation district had reacted to and coped with a similar institutional policy model. This meant, it was assumed, that they were applying more or less similar water allocation and distribution rules; that they were using basically a similar type of irrigation infrastructure; that they were conditioned by a same level of water availability; and that they were dealing the same local irrigation agency. Given all these similarities in institutional and physical conditions, it would be interesting to observe if and how these WUAS coped differently with the same set of newly introduced institutional arrangements for water management.

Informants at CNA and the University at Chapingo had mentioned that particularly Cortazar and Salvatierra WUAs were reacting quite differently to IMT, in terms of the way the WUAs operate, and in terms of the effects of IMT on irrigation performance. Rather than wanting to do a mere comparative research on two WUAs, the idea for selecting two different organizations was that this would help to map out *diversity* in the way people cope with interventions. In addition to some other criteria, it was decided that these two WUAs were a good starting point to start doing intensive field research.

Other criteria that were used to select these two WUAs were: the availability of some initial information on the differences in module management as a result of IMT; their locality within the district; their past experiences with academic and action research; and related to that, the availability and access of baseline data, and their accessibility relative to the city of Celaya where the CNA district office is located.

In order to assist me with the daily water measurement program (see below), I hired and trained two field assistants, who were located in Cortazar and Salvatierra, respectively. I also trained them to assist me with some of the process documentation, interviewing and survey work for this and some other studies in ARLID.

Limitations
Although the design, implementation and outcomes of irrigation reform and intervention programs cannot be separated, this thesis primarily focuses on the implementation and impacts of these programs. Although an attempt is made to contextualize IMT policies in their wider political economic environments, only little attention is paid on how these policies were politically constructed before being implemented. The two reasons to this choice are pragmatic. First, as virtually all my time was spent in the irrigation district, which is five hours drive to Mexico City where most people involved in formulating the IMT policy work. Second, to keep the study focused on local experiences.

Primary data collection

Data collected include primary sources in the two modules and secondary sources with respect to the files kept by the respective WUA and CNA at regional, state, and central levels. Furthermore, other organizations related to the agriculture sector were visited periodically to collect additional information, and to cross-check data collected from the WUAs and CNA. Primary field data collection activities included four components:

Process documentation and participatory observations
Small research offices were opened in the buildings of the WUAs in Cortazar and Salvatierra. This enabled daily interaction with WUA leaders, module staff, ditch tenders, CNA officers, farmers and others, and provided an excellent venue for monitoring and documenting the process of institutional interventions in the research area. According to Mosse (1998) process monitoring helps researchers to describe the unplanned impact or unexpected changes of planned intervention. Moreover, it helps to explain why or how observed outcomes were achieved, particularly as it is aimed at understanding relationships between different actors involved in the intervention process.

During the entire period, numerous intensive participatory observations and unstructured interviews (Bernard 1988) related to daily practices of water management were made. Daily field visits provided opportunities to meet water users and discuss all kinds of topics with them. Furthermore, meetings of the general assemblies of WUAs, the Hydraulic Committee and the Limited Responsibility Society were attended. Frequent visits to the CNA district office were made to discuss issues with CNA staff at all levels. Finally, several workshops and seminars were organized, which provided opportunities to present and discuss preliminary results and observations with a wide range of actors involved in irrigated agriculture.

Figure 1.1 Schematic representation of selected distributary canals and measurement points in the Cortazar module

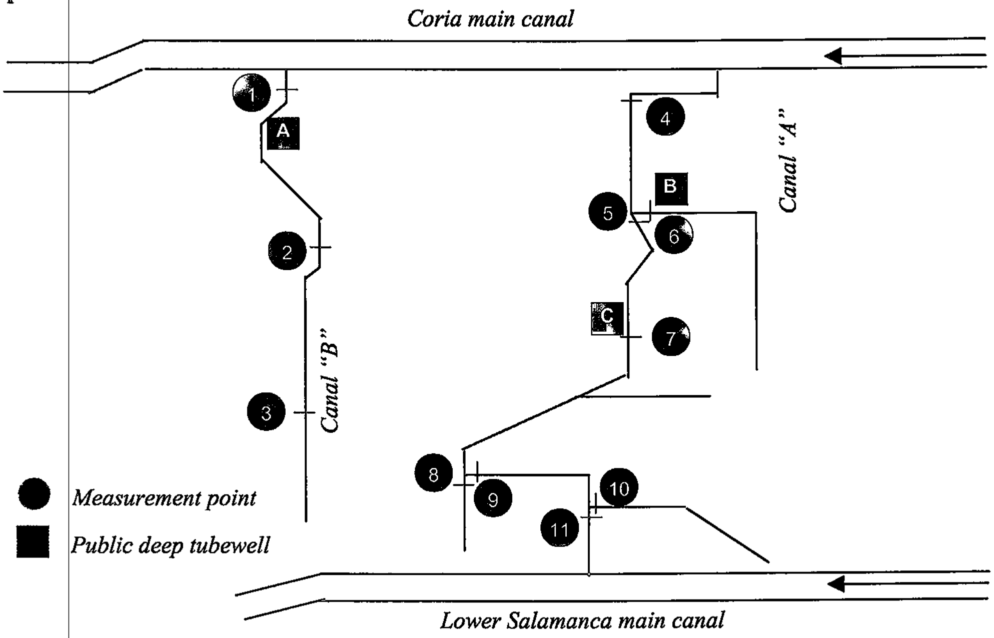
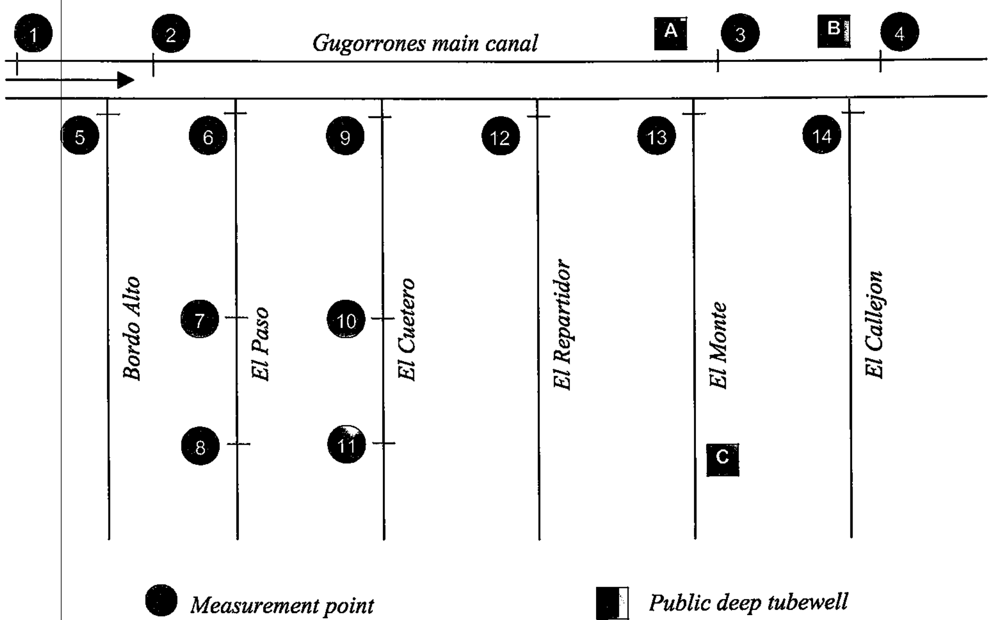


Figure 1.2 Schematic representation of measurement points in the Gugorrones main canal, and its distributaries, in the Salvatierra module



Water measurement program

In order to monitor irrigation performance in different sections within selected canals, as well as to selected fields, a daily water measurement program for both surface and ground water irrigation was established in Cortazar and Salvatierra modules. These measurements provided complementary quantitative support to the daily observations on irrigation activities, and hence provided evidence of the level of performance under post-IMT conditions. Only in this way it was possible to test the general belief (i.e. no actual measurements) among many policy makers and irrigation managers that IMT had resulted in more effective use of water.

In Cortazar two distributary canals were monitored. Lateral "A" commands 650 hectares, while lateral "B" serves 352 hectares. Eleven control points were selected, calibrated and the Q-h relation established (see Appendix 2 for an example of a rating curve). As discharge characteristics may change because of for instance canal maintenance, each sub-season the calibration procedures were repeated. At these calibrated points, flow measurement readings were made twice a day during the winter and summer sub-seasons. These readings were entered in a spreadsheet and converted into discharges, volumes and water depths for periods of 12 hours. In order to calculate the irrigation depths per canal section (i.e. between two measurement points), size measurements were made of all the plots within each section.

Within each lateral, 20 users were selected who were located at head, middle, and tail reaches of canals, representing existing land tenure arrangements (*ejido* versus private) and the water source (canal versus well). In each one of the selected fields the volume delivered for each irrigation was measured. In addition, the cost of production as well as gross value of production was calculated for each of these fields. Wells were also calibrated and monitored daily for both volumes pumped and energy consumption. In figure 1.1, a schematic representation of the research layout for the Cortazar module is provided.

For Salvatierra, the entire Gugorrones main canal, commanding 1,200 hectares, and its six short laterals were selected. Flow measurements were made twice daily at four points in the main canal, and the headwork of each lateral. In addition, in two of the laterals, four additional points were monitored. Within these two laterals, 15 users were selected, and the same measurements were taken as in the case of the selected fields in Cortazar. Figure 1.2 shows the research layout in the case of the Salvatierra module.

In order to observe unauthorized changes in water levels, if any, as well as night irrigation, a data plotter with probe was installed at strategic points in the selected canals and water levels were plotted at 15 minutes intervals during periods of at least one complete irrigation turn (normally 2 weeks).

Farm surveys

A multi-visit household survey was conducted with the 35 water users of the selected fields in the water measurement program. The objective of the survey was to disclose information on the cost of water and energy use, relative to other costs of production and outputs of seasonal production under the kind of market conditions that were introduced with IMT. The other costs of production included costs associated with hiring labor, renting machinery or draft animals, fertilizers and agro-chemicals.

In addition, a structured farm survey was conducted with 125 farmers, scattered over four modules, to collect information on water users' opinion on current experiences with system O&M as well as their opinion on the impact of IMT on daily O&M practices, WUA management and access to inputs, information and other support services[32]. The following criteria were used for the development of the sample frame:

- Given the logistic difficulties associated with the size of the irrigation district, and the consequent research costs, it was not possible to include all 11 modules of ARLID as sub-target populations. Instead, it was decided to divide farmers of the district in groups of modules that share the same characteristics in terms of cropping pattern, tenancy (*ejidatario* versus private grower) and condition of the irrigation infrastructure. From each group, one module was selected and had to represent the other modules in the group. Four groups were formed and of each group one module was selected for the survey (see Appendix 3 for details).

- The main parameter of the survey done in ARLID was the O&M service provided by the WUAs. The survey did not include parameters of interest like the impact of IMT on yields, cost of production, cropping pattern and agro-chemicals. As a consequence, the sample size could be relatively small and was estimated at 125 farmers.

- Within each group only the following stratum was used: *ejidatarios* versus private growers. The 125 farmers were first allocated proportional to the total number of farmers within each group. Subsequently, in each group the selected stratum was allocated proportional to the number of *ejidatarios* and private growers, respectively (Appendix 3).

- It was decided to select farmers geographically within each module in order to represent farmers in the head, middle and tail end reaches of the selected modules, as well as to account for the proportional distribution of farmers with and farmers without private wells. Rather than pre-select plots from a map, it was decided to pre-select canals (and areas within these canals) and try to locate farmers that meet the criteria of the sample frame and the geographical distribution mentioned above.

Semi-structured interviews on irrigation support services

Information was also collected on the access to and provision of services that WUAs and individual farmers needed to support irrigation. In addition to the daily process observations and documentation, this information was collected from the WUAs by using a semi-structured questionnaire. These questionnaires were explained and handed out to leaders and management staff of all 11 WUAs during one of the hydraulic committee meetings. Subsequently, multiple visits were made to these WUAs to discuss their answers and fill in information gaps.

SECONDARY DATA COLLECTION

The study also uses a wide range of secondary data, particularly for the purpose of time series analysis. Time series data for the cropping seasons 1982-97 stem from records kept by CNA at irrigation district, regional, and central levels, as well as from the 11 WUAs at the module level. These data included cropping patterns, crop yields, farm gate prices, climate data from seven selected stations within and near the district, monthly and seasonal canal flows at different system levels, dam storage and releases, cost and volumes of maintenance work done, irrigation fees collected and planned, and actual O&M budgets. Where possible, daily or weekly records were used and aggregated, rather than using seasonal or annual summary reports published by the agency and the WUAs.

CNA as well as most WUAs use computers to enter, monitor, and process their data. CNA and the WUAs always gave full and unconditional access to these as well as other files, which provided excellent transparency of the data used for this study. Several tools were applied to check the quality of the secondary data[33]. Aggregation of module level data provided a cross-check for data collected at the district level. Secondary data were further cross-checked by data collected from other sources like rural development banks. Primary flow data allowed cross-checking on the quality of officially reported canal flows at different hydrologic control points in the system during a period of four irrigation seasons. Similarly, primary information from the farmer household survey was used to cross-check the quality of secondary production data (yields, farm gate prices, etc) that was aggregated by the WUAs (module level) and CNA (district level).

CALCULATION OF PERFORMANCE INDICATORS

The basis of process monitoring of operational performance comprises the data collected by the ditch tenders at the field level. A number of indicators were also applied for selected secondary canals, and fields.

In order to establish total crop water requirement for each selected canal section and field, the FAO's CROPWAT[34], and its complement CLIMWAT software packages were utilized (FAO 1996). Required data on humidity, wind speed and hours of sunshine were taken from two nearby stations given in CLIMWAT. Rainfall as well as the maximum and minimum temperature data were collected from five weather stations within or near the district, and from the two selected WUA offices.

In order to calculate the total crop water requirement ($ET_{CROPWAT}$)[35], cropping patterns of each selected module, canal section and field were established through field observations. For each crop that was irrigated within these sections and fields, data on crop characteristics were collected, including crop variety[36], growing period, planting date, crop coefficient (Kc) values for each crop development stage and soil type.

For all system levels (district, module, selected canals and selected fields) and irrigation seasons, crop production values are expressed in standardized values of a base or main crop. This makes comparison between different cropping patterns possible. To do this, yields of the various crops grown were converted into 'equivalent' yields following the procedure defined in Appendix 4. For the winter season, wheat was chosen as the 'equivalent' base crop; for the summer sorghum was chosen.

Unless explained otherwise, all prices are local farm gate prices. Also, all prices have been converted to constant July 1994 US dollars, with an exchange rate of 3.5 pesos per US dollar. Nominal peso prices are given only if these clarify the impact analysis. Especially for the time series analysis, it proved to be important to express prices in both constant US dollar prices and nominal pesos prices as by December 1994 Mexico faced an economic crisis, which was followed by a devaluation of the peso against the dollar (from 3.5 pesos per dollar in 1994 to 7.8 pesos per dollar in July 1996). Moreover, the crisis was followed by an inflation rate of approximately 50 percent in 1995. The start of the crisis fell exactly in the middle of the four post transfer years reported here.

1.8 Thesis outline

Chapter 2 provides general background information on the location, history, lay-out and different groups of users of the Alto Río Lerma irrigation district. It also provides a brief description of the two module area, canals and WUAs that were selected for this study. The empirical chapters 3 to 9 are basically organized around the conceptual discussion presented in sections 1.3 to 1.6.

Chapter 3 provides a detailed description of the historical and political economic context in which the recent market-oriented irrigation reforms were formulated. The chapter follows the assertion that institutional intervention programs like the Mexican IMT program and the introduction of water markets do not come on their own, but are generally preceded, accompanied and followed by other intervention programs that share the same ideological legitimization.

In chapter 4 an account is given of how the recent institutional arrangements under irrigation management transfer and water marketing were formulated and implemented, both at the national level and at the level of the case study.

Chapter 5 deals with the issue of operational accountability and O&M practices under post-transfer conditions. It provides a detailed analysis of both the official institutional arrangements for O&M in ARLID and the actual irrigation practices. From these practices one can observe how and to what extent the new arrangements for O&M have been adopted or modified by both the new irrigation managers and the users. The chapter concludes with a discussion on the impact of these arrangements and practices on water use, spatial distribution of water, and on land and water productivity.

Chapter 6 gives a detailed account of the practices, processes and mechanisms that both strengthen and weaken socio-economic and political accountability in the context of the new institutional arrangements for local water management.

In chapter 7 an analysis is made of the financial viability of the post-transfer institutional arrangements for irrigation management. This is done by giving detailed accounts of practices and mechanisms of financial accountability, transparency, autonomy and rent-seeking. Furthermore, the chapter provides a detailed analysis of the impact of irrigation management transfer on both the financial self-sufficiency of the WUAs and the change in cost of water to farmers.

In chapter 8 the focus of analysis is shifted from IMT towards issues of water trading. It assesses how the new arrangement of providing WUAs with water use concessions have affected the practice of water trade, both between individual water users and between WUAs. It shows how WUAs and farmers perceive the concepts of cost and value of water in the context of the new arrangements.

Chapter 9 returns to the official objectives of the IMT program and assesses the program's impact on irrigation performance in terms of changes in water distribution, ground water use, system maintenance and improvement, land and water productivity, and the provision of a series of non-irrigation related services to farmers.

Chapter 10 summarizes the key empirical findings of IMT and water markets in ARLID. It first deals with the question whether institutional design principles matter at all in ARLID. It then discusses the mechanisms that have influenced the viability of the new institutional arrangements. Subsequently, in the chapter a revisit is made to some of the conceptual and methodological considerations on studying the viability of institutional arrangements for local water management under market-oriented conditions. The chapter continues with a discussion on policy implementation for designing and implementing market-oriented intervention program similar than the ones studies for this thesis. An assessment is made whether or not the Mexican model can be applicable for other countries. Furthermore, it discusses if and how programs of institutional modernization should be linked to programs that aim to introduce modernization in irrigation technology. Finally, the chapter concludes with a discussion on the research orientation that universities and international research institutes could take while studying the institutional arrangements for local water management and their impacts on irrigation performance and practices of water control.

Notes

1. See for instance Uphoff (1986a and 1992), Repetto (1986), Jopillo and de los Reyes (1988), Chambers (1988), Korten and Siy (1988) and Merrey 1996.
2. For concise reviews of these early literatures reference can be made to most PhD theses on irrigation written in Wageningen (e.g. the recent thesis of Mollinga, Pradhan, Manzungu, and Wahaj) and the work by Coward (1980), Uphoff (1986a) and Chambers (1988). On the technical dimension of irrigation management reference can be made to Clemmens (1987) and Plusquellec *et al.* (1994).
3. See for instance the papers that try to link size of irrigation systems to the numbers of staff required (Hunt 1988). According to Hunt, there is no clear empirical correlation between the size of the system and the length of the canal system and the type of administrative structures. Others tried to link the size of the system to the type of organization and authority in order to asses whether a system can be transferred from government to farmer management (e.g. farmer, agency or joint management) (Merrey and Bulankulama 1987). Others have started to link design characteristics of (physical) irrigation control structures and management requirements (e.g. Horst (1998) and Murray-Rust and Snellen (1993)).
4. Much of that theoretical groundwork is developed and discussed by Mollinga (1998).
5. I deliberately use the term *model* here, as this is how the Mexican IMT experience is often referred to in international seminars on IMT programs. In chapter 4 I try to unravel this 'model'.
6. The high level of attention that the Mexican IMT case has received explains why, for instance, the international network on Participatory Irrigation Management (PIM) was launched in Mexico in 1994. During the first years of existence, this network was coordinated and financially supported by the World Bank and primarily involved national and international policy makers and local implementers of PIM policies worldwide. The network's mission is *'to facilitate PIM through the exchange of people, ideas, and training materials'*, in which the Mexican case of irrigation management transfer has become the key example.
7. Particularly in literature on farmer managed irrigation, the term '*crafting institutions*' is more in vogue than '*designing institutions'*. More than the term *design* (as it generally refers to a one-shot decision, bases on a model), the term *crafting* has a more dynamic connotation as it refers to process, ongoing investment, in an uncertain and ever changing environment (Ostrom 1992).
8. These styles are, for instance: market-oriented, hierarchical, egalitarian, or fatalistic styles (Thompson 1998). Thompson argues that, contrary to general new-institutional focus on scale, it is style that distinguishes the institutions that are managing natural resources.
9. A typical model of introducing farmer participation in irrigation management in many countries, is that a top-down approach is used in the process of designing a program, formulating legal frameworks, reforming agencies, and rehabilitating infrastructure (Groenfeldt and Sun 1997). In addition, a bottom-up approach in often propagated when WUAs are to be organized, while understanding and local (political, social en often financial) commitment to adopt the program has to be strengthened. As will be described in chapter 3, the Mexican IMT program followed this approach as well. Only rarely potential users are involved (either invited or through own initiative) from the beginning of the reform in for instance designing the new institutional arrangements, such as the legal framework. One of the exceptions might be the case of the construction of a new institutional framework of the irrigation sector in Ecuador, starting in 1994. Here, several support and farmer entities have taken the initiative of actively contributing, analyzing and discussing various options of the legal framework as well as IMT (CNRH *et al.* 1996, Boelens *et al.* 1998).
10. In most cases of large scale irrigation, the local government agency with responsibilities for water management is some sort of irrigation agency. However, in other cases these responsibilities lay with a public works ministry, a ministry of administration, or a ministry of agriculture. As will be demonstrated in chapter 3, in Mexico the responsibility for managing irrigation districts has shifted several times between these different types of agencies.
11. I am aware of other approaches to understanding sustainability of institutions and organizations than the neo-institutional en political-economic ones mentioned here and used in this thesis.

Particularly the Cultural Theory could provide an interesting critique to the neo-institutional approaches that are so popular amongst irrigation policy makers. Cultural Theory looks at styles and identity of institutions. See the work by e.g. Douglas (1992) and Thompson (1998). According to Mollinga (2001), the cultural theoretical critique against new institutionalism is that there are more repertoires for transactional human behavior than the utility maximizing one used by rational choice and other new institutionalist approaches. Another current debate is the one on Social Capital, which originate from the work by Coleman (1990) and Putnam (1993), who look at action and the structure of relations between and among persons and organizations, primarily within networks in civil society. Important concepts in this debate are civic engagement, social trust, communication, tradition, social norms and social obligations. However, as Harris and de Renzio (1997) argue, it largely fails to explain the mechanisms or processes whereby networks of civic engagement lead to more effective government, nor does it appear to explain variations among apparently similar types of organizations.

12. As the work by Ostrom and her colleagues and students at the Workshop in Political Theory and Policy Analysis is widely known and appreciated, I decided not to review this in depth.
13. Although, at the same time, as Mollinga (2001) notes (citing another paper of Moore), concern for the welfare of the collectivity often dominates over issues of individual self-interest in shaping political attitudes and actions.
14. This does not mean that analysis of transactions costs is of no importance for understanding the viability of institutional arrangements, because (as the examples in chapter 7 show) they are. However, the notion that these costs in themselves are also politically and socially constructed is missed by most researchers in the school of rational choice theory.
15. See for instance Gorriz and Groenfeldt (1995), Meinzen-Dick *et al.* (1995), Groenfeldt and Sun (1997), Groenfeldt (1999).
16. In fact, in this case study several other levels could have been distinguished as well. Examples of these include: between the central agency and the local agency; between the central agency and individual WUAS (particularly in the case of IMT pilot WUAs). However, I focused my work on the levels mentioned in the main text.
17. Documentation of this type of accountability are for instance Wade (1982 and 1989), Moore (1989), Kloezen (1995), Oorthuizen (1998) and Mollinga (1998).
18. See Huppert and Urban (1998) for similar suggestions.
19. I will deal with the concept of relative water availability in detail in many other parts of this thesis (see particularly section 1.4 and chapters 5 and 9).
20. Steenbergen (1997:17) calls this 'the integrity of the resource base'.
21. See Colby (1988) for an excellent overview of experiences with the different water codes in the Western United States.
22. Unlike non-western surface water marketing, empirical examples of marketing of groundwater are well documented. Examples include Meinzen-Dick and Sullins (1993), Shah (1993), Strosser and Kuper (1994) and Strosser (1997).
23. Briscoe provides several useful reference to methods used to estimate the value of water in different end uses. These include Gibbons (1986), Arrow *et al.* (1993) and Griffin *et al.* (1995). See also Bhatia (1997), who argues that the value of agricultural output from irrigation should take factors of poverty alleviation, food security and employment generation into consideration as well.
24. Briscoe shows that price elasticity of water demand in irrigated agriculture is low (and negative). He warns that this does not mean that demand is not reduced as prices change, but rather that demand is reduced less when prices increase. The reason for this low elasticity, he further argues, is that buyers' reactions to price changes depend on the original low price, which are generally artificially held low in the case of irrigation water. Hence, the higher the original price of water, the higher the decline in demand when prices are increased.
25. Another way of looking at use costs is to consider the marginal cost of water. This is the cost that will have to be incurred if capacity needs to be expanded to produce an additional unit of water. Briscoe argues that for a society as whole, welfare is maximized when water is priced at its marginal costs, and when water is used until the marginal costs is equal to the marginal benefit.

26. As Briscoe states, it can be argued that the value of the asset is not correctly measured by its historic costs, but rather by the cost that would be incurred in replacing the asset.
27. Many policy makers get frustrated by contingency management as a reaction to their institutional design principles, as they perceive that this hampers, what they often call, "getting the process right". Typical reactions that follow their frustrations are: (1) complete denial – they argue that users do follow their design principles and their subsequent guidelines, (2) they react to this in terms of imperfect institutional designs, often resulting in yet another, even more prescriptive guidelines (i.e. a further technocratization of institutional designs), and (3) they blame the incapability ("we have to educate the farmers") and unwillingness of both users and managers, often resulting in expensive motivation and training programs.
28. For overviews, see Rao (1993), Bos *et al.* (1994) and Bos (1997).
29. See for instance the studies by Jurriëns (1996) on performance assessments in India, and Bos and Chambouleyron (1998) on irrigation performance in Mendoza, Argentina.
30. See for example Oad and Sampath (1995) and Meinzen-Dick (1995).
31. Burt and Styles (1999) give a full description of these comparative indicators, which they applied to 17 irrigation systems in ten developing countries. The authors also provide some suggestions for modifications of the indicators and propose three new indicators.
32. The questionnaire used for the survey in ARLID is based on the farmer questionnaire designed by the Irrigation Management Reform Group at IWMI (of which I formed part), but has been considerably modified to meet local circumstances at ARLID.
33. Cross-checking secondary (or official government) data is necessary given the often rather unsatisfactory quality of these data. According to Gill (1993), the problem of "unreliability, gaps, over-aggregation, inaccuracies, mutual inconsistencies and lack of timely reporting" are especially marked in the realm of natural resource management, since the relevant variables are often unusually hard to quantify and the necessary data difficult to collect and verify. See also Polly Hill's (1984) often quoted article on the poor quality of official socio-economic statistics.
34. The program is based on the calculation of reference evapotranspiration (ETo) through the modified Penman-Montieth equation (Doorenbos and Kassam 1986).
35. In order to make clear that I calculated the crop water requirement through the FAO CROPWAT method, I prefer to use the expression $ET_{CROPWAT}$. Other common expressions found in the literature are ETm and ETcrop. $ET_{CROPWAT}$ = kc. ET_0, where kc is the crop coefficient for a certain crop development stage, and ET_0 is the Penman-Montieth reference evapotranspiration.
36. Particularly for wheat, a distinction had to be made between the most common varieties as these varieties have different growing periods and hence different crop water requirements. For examples on crop water requirements of two wheat varieties, see table 5.3.

2 The Alto Río Lerma irrigation district

2.1 Introduction

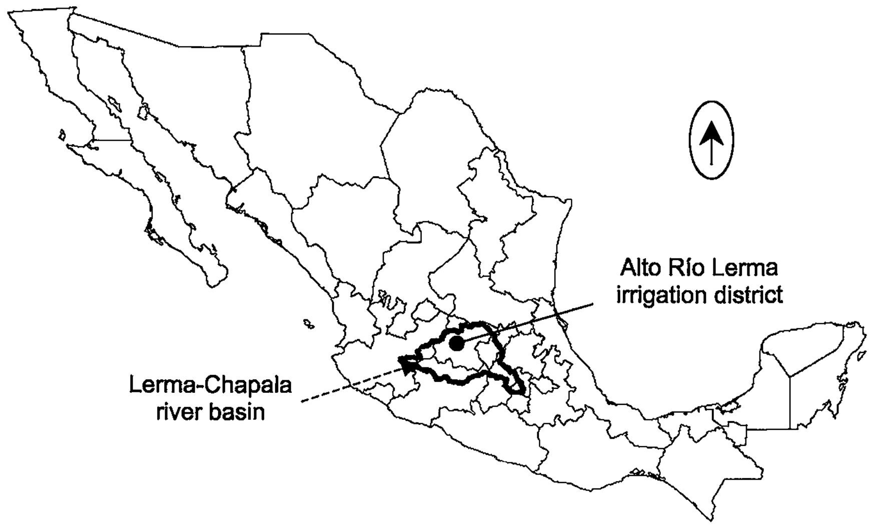
This chapter provides background information on the location, history, lay-out, water availability of the irrigation district that was selected to for this study. It also gives some information on the two most important groups of water users (*ejidatarios* and private growers, respectively) and discusses to what extent these groups have differentiated access to land and water resources. Finally, some general information is provided on Cortazar and Salvatierra modules, which were the two (out of eleven) modules that were selected to make in-depth and detailed observations, to conduct farm surveys, and to make flow measurements.

2.2 Location and history

ARLID is located in the State of Guanajuato, central Mexico (see figure 2.1). It is part of one of the most prosperous agricultural regions of Mexico, called the Bajío. It is characterized by fertile soils, relatively good water availability and consequently high crop yields. As a result, the Bajío, and particularly the area in and around ARLID, are famous for its high density of national and international commercial agricultural enterprises. Its main town is Celaya: a medium size agricultural town of approximately 400,000 inhabitants and with literally hundreds of mechanical workshops, dealers of fertilizers and other agricultural inputs, banks and sellers of irrigation pumps and equipment (nicely called *casas de riego*, irrigation houses). It is also the town where the CNA district office responsible for ARLID is located. If one travels from Celaya to the much smaller city of Salamanca (famous for its huge PEMEX oil refinery), one is struck by the lush irrigation fields as well as by the great number of agricultural firms that put out their billboards to advertise the price they pay for sorghum, maize and wheat produces, and others who advertise with new HYV seeds.

The history of ARLID dates back to pre-Hispanic times when some of the present canals, like the Gugorrones main canal in Salvatierra, were constructed. Under the Spaniards, new irrigation structures like small diversion weirs and storage dams were developed (Roemer 1997). The first reported major work undertaken that shaped the present lay-out of the district, was the change of the river bed of the Lerma. This created the Yuríria lake in 1548 (Aguilar-Sánchez 1993). These and other works stimulated the rapid expansion of the irrigated area in central Guanajuato. According to Aguilar-Sánchez (1993), these first irrigation works helped to meet the increasing food demand of the new large-scale dairy farms (which were established by the Spanish clergy and military as well as by local *hacendados* and *rancheros*) and silver mines (which were discovered between 1554 and 1556). These dairy farms and silver mines depended heavily on the food supplies of the irrigated area, and in turn also motivated the first agricultural traders to come to the Bajío and to found commercially important agricultural centers like Celaya, Salamanca, León, Salvatierra, Irapuato and Acámbaro (see figure 2.2)[1].

Figure 2.1 Mexico and the location of the Alto Río Lerma irrigation district



IRRIGATION INFRASTRUCTURE DEVELOPMENT

Until the start of the 20th century, most of the irrigation infrastructure that was developed during the time of the haciendas and ranches were managed entirely independent from each other. However, three major developments shaped the way the district is currently designed and organized. First, in the 1930s, many of these ancient canals were rehabilitated during the expansion of new hydraulic works that were started after the first water law was promulgated in 1926 (see section 4.2 for further details on these historical developments). The district boundaries were first established in 1938 and approved by the Presidential Degree of 1 August 1938, after which the operation of the new hydraulic works first started in 1939. Second, the district was officially created on 21 February 1953 by Presidential degree (Roemer 1997), with which several smaller irrigation systems were merged into one irrigation district. A series of infrastructural works in the 1960s further integrated these smaller systems into the district. The first phase of these infrastructural developments started in 1964, when the then National Irrigation Commission constructed the Solís dam as well as the Lower Salamanca main canal and some diversion weirs in the river Lerma. The irrigation units of Acámbaro, Salvatierra, Valle, Salamanca, Huanímaro and Corralejo were created.

The second phase took place under the responsibility of the then Ministry of Hydraulic Resources (SRH) and included the construction of the Coria main canal, the rehabilitation of some other weirs and the inclusion of Cortazar, Irapuato and Abasolo into the district (*ibid.*). During a third phase, the Solís dam was made higher and the smaller Purísima dam was constructed under the responsibility of the then Secretary of Agriculture and Hydraulic Resources (SARH) and integrated into the district in 1980 (CNA 1996a.).

The third historical development that determined the current irrigation regime was the promulgation of the National Waters Law in 1992 and as a consequence the transfer of irrigation management responsibilities from the National Water Commission (CNA) to newly created WUAs in November 1992.

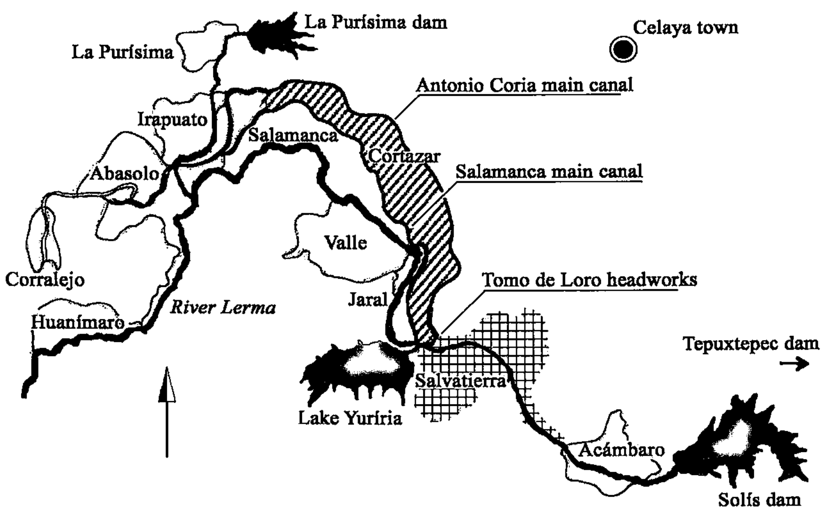
2.3 Lay-out and infrastructure

The district is situated in the upper reach of the 54,421 km^2 Lerma-Chapala river basin (see figure 2.1), which crosses five states and serves nine irrigation districts as well as the huge lake Chapala near Guadalajara (Mestre 1997; Scott and Garcés-Restrepo 1999).

Surface water for the district is provided by four dams with a combined storage capacity of 2,138 million cubic meters (Mm^3) serving 77,697 hectares. Of these dams, Tepuxtepec (538 Mm^3)[2], Solís (1,217 Mm^3) and lake Yuríria (188 Mm^3) are interconnected by the Lerma river. The Purísima dam (196 Mm^3) is fed independently from the other three dams. These storage dams are complemented by five diversion dams located along the Lerma River.

The irrigation district is divided into 11 sub-units called modules[3], each managed by an individual water users association (WUA) and ranging in size from 1,513 hectares to 18,694 hectares (figure 2.2).

Figure 2.2 The Alto Río Lerma irrigation district and its 11 modules



Following the irrigation classification system used by Murray-Rust and Snellen (1993), the district is designed as an open channel, upstream control system with gradually-variable manually operated cross-regulators and canal off-takes in main and secondary canals. Field inlets are normally gated pipes. However, ungated pipes that are closed with mud and stones are also found. Water deliveries are measured at the main intakes of the modules, whereas volumetric supply to secondary canals and fields are estimated by the ditch tenders.

The irrigation network comprises 475 km of main canals and 1,658 km of secondary and tertiary canals[4]. The two most important main canals are the Ing Antonio Coria canal (with design discharge of almost 30 m^3/s and a total length of 117.7 km) and the Lower Salamanca canal (17.5 m^3/s; 60.3 km). There is a network of approximately 1,031 km of drainage canals

(Appendix 1). Generally, main canal capacity is sufficient to allow simultaneous deliveries to all secondary canals within one module area, thus rotation between secondary canals is not necessary. For example, the water delivery capacity[5] of the Coria main canal was 1.3 during the winter 1995-96 winter season. For the selected Gugorrones main canal in Salvatierra module (see below), a water delivery capacity of 2.2 was found[6].

In addition to surface water, there are 1,714 deep tubewells serving an additional 35,075 hectares within the district; thus the district relies on both surface water and groundwater, with their combined use playing a vital role in system operation. The State of Guanajuato is underlaid by 18 different aquifers, three of which are partly exploited by farmers within the ARLID. The estimated total annual recharge of these three aquifers is 500 Mm^3/year[7]. The State of Guanajuato has a high concentration of wells. Approximately 20 percent of all wells in Mexico are found in this State. Over-exploitation of the aquifers is a major problem. Groundwater table fluctuations have been monitored by CNA and point towards a worrisome situation. In 1995, and following a trend over five years, static water tables were falling at an average annual rate of 2 to 5 meters (Muñoz 1996), reaching an average depth of more than 100 meters, with some wells reaching 150 meters in parts of Salamanca module. Unpublished CNA data suggest that the total over-exploitation of the 18 aquifers in the State is 829 Mm^3/year, while it is 117 Mm^3/year for the three aquifers that serve the irrigation district. These volumes correspond to an overexploitation of the aquifers by factors of 1.4 and 1.2 for the State and the district, respectively.

2.4 Water availability

MEXICO'S WATER BALANCE

Irrigation is important to the country's national economy: it produces more than 50 percent of the agricultural gross product, while it only occupies 30 percent of the arable land. With 5.9 million hectares, Mexico has the seventh largest irrigation area in the world. Eighty large-scale irrigation districts serve an area of 3.2 million hectares. In addition, more than 1,300 small reservoirs serve 1.7 million hectares of irrigated land in small farmer managed systems. The remaining surface of approximately 1.0 million hectares is irrigated by an estimated 35,000 wells (Garcés-Restrepo *et al.* 1997).

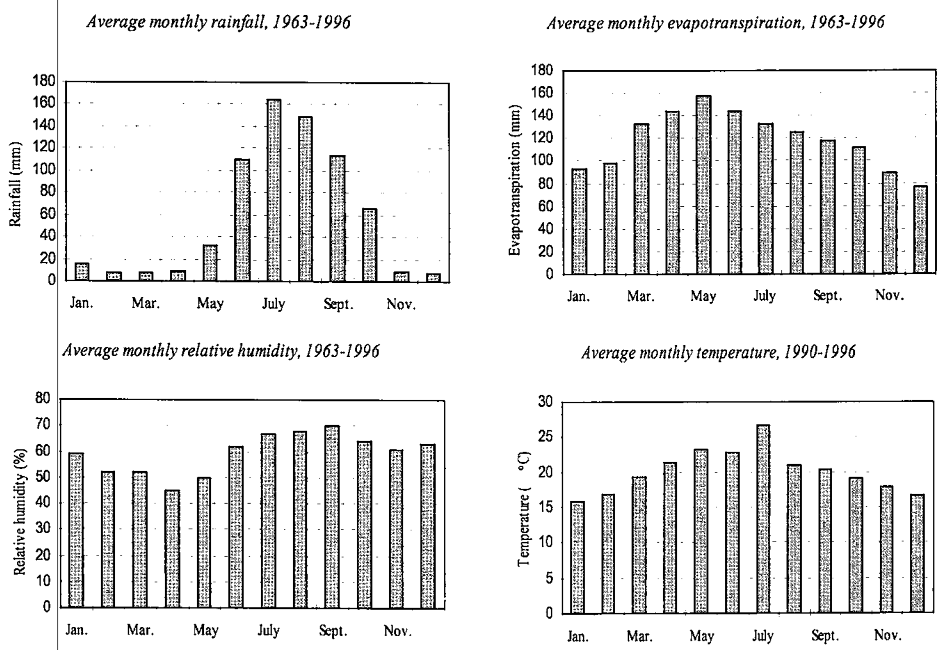
Total surface runoff is approximately 417 km^3/year and the volume of renewable groundwater is estimated at 55 km^3/year (Herrera-Toledo 1997). Total withdrawals of water have increased from 38 km^3/year in 1950 to over 190 km^3/year in 1990 (*ibid.),* which is 40 percent of the total available water[8]. Palacios-Vélez (1994) and Paredes (1997) estimate that total consumption of the entire irrigation sector is 46.5 km^3/year of water, while Seckler *et al.* (1998) estimate a gross withdrawal for irrigation at 65.3 km^3/year based on 1990 data. Seckler *et al.* also project that by the year 2025 the total withdrawal for irrigation will be 105.6 km^3/year (or 22 percent of the total availability, assuming that population growth rates and irrigation efficiencies do not change after 1990).

The major problem with the Mexican national water balance is that it shows high regional differences with enormous deficits in both surface and groundwater sources in important river basins like the Lerma-Chapala in central Mexico. González-Villarreal and Garduño (1994) note that less than one third of the country's water lies within 75% of its area. This is in central and north Mexico, where most of the irrigation districts as well as large cities and industries are located. Whereas in the remaining 25 percent of the area the water availability is more than 5,000 m^3 per capita per year (Paredes 1997), in those areas where demands are high, less than 2,500 m^3 per capita per year is available. Only four percent of the total runoff is found in the northern region, which has about 30 percent of Mexico's total area (Arreguin *et al.* 1996) Moreover, many of those water deficit regions suffer from extremely dry spells in yearly rainfall. Such was the case in the Northern Gulf region in 1994-1996 (Rymshaw 1998) and the Lerma-Chapala basin in 1997-98. Finally, cases of high water pollution and increasing competition between various water sectors as a result of booming cities like Mexico City, Guadalajara and Monterrey have more than ever brought the problem of regional water scarcity to the surface (Tortajada and Biswas 1997; Ongley and Barrios-Ordoñez 1997).

CLIMATE

The climate is moderately subhumid with an average yearly precipitation of 750 mm/year and an average temperature of 19 °C. Yearly evapotranspiration is approximately 1,900 mm/year and relative humidity is about 60 percent. The dry winter season, which receives approximately 80 mm of rainfall, starts in November and ends in April. The average potential evapotranspiration (ET_0) for this season is 704 mm. The summer season lasts from May until November and has a thirty years average of 670 mm of rainfall and an ET_0 of 722 mm. Monthly average climatic data for the district are presented in figure 2.3.

Figure 2.3 Monthly climate data for the Alto Río Lerma irrigation district



RELATIVE WATER AVAILABILITY IN ARLID

The total catchment run-off of the Lerma-Chapala water basin[9], in which ARLID is located, is approximately 4,740 Mm^3/year, while the total estimated demand for irrigation and domestic use is 3,850 Mm^3/year. Of this demand, 52 percent or 2,020 Mm^3/year is made available for the nine irrigation districts, 38 percent to small-scale irrigation systems and 10 percent to domestic and industrial uses. The difference of 890 Mm^3/year between total run-off and demand is almost entirely designated to Lake Chapala. However, with an average annual evaporation of 1,400 Mm^3/year, it is clear that this lake is gradually drying up (CNA 1991).

Of the nine irrigation districts in the basin, ARLID is the largest with a gross command area of 112,772 hectares, covering 33 percent of the area under irrigation districts. Yet, it takes approximately 44 percent (or 880 Mm^3/year) of all the surface water stored for use within the districts (CNA 1991), indicating that the district receives relatively more water than the other eight districts in the basin (table 2.1)[10]. As will be demonstrated in chapters 5 and 8, respectively, this has major impacts for both the way water is allocated to and used by the farmers, and for the potential and meaning of water trading between WUAs.

Table 2.1 Water allocation between the irrigation districts in the Lerma-Chapala water basin

Irrigation	Command area		Water demand		
District	Ha	% of total	Mm^3/year	% of total	m^3/ha/year
Edo de México	17,539	5	90	4	5,131
Alto Río Lerma	**112,772**	**33**	**880**	**44**	7,803
La Begoña	10,487	3	124	6	11,824
Zacapu	*1,214*	0.4	8	0.4	6,590
Cienega de Chapala	45,901	14	170	8	3,704
Maravatio	18,365	5	90	4	4,901
Zamora	18,010	5	200	10	11,105
Rosario-Mezquite	55,403	16	308	15	5,559
Edo Jalisco	57,190	17	150	7	2,623
Total	336,881	100[1]	2,020	100[1]	
Coef Var (%)					48
Average	37,431		224		6,582

Note [1]: as a result of rounding, total percentage does not equal 100.

Both rainfall and the amount of water released from the four dams determine surface water availability to the district. The average yearly rainfall during the time series period between 1982 and 1997 that is used in this study, is 614 mm/year (CV = 20%). This is lower than the 30-year average of 750 mm/year. Although the four dams have a total storage capacity of 2,140 Mm^3, on the average only 1,085 Mm^3 was stored at the start of the agricultural years between 1982 and 1997. Of this storage, a total yearly average of 777 Mm^3 (CV = 29%) was released for irrigation. This is also lower than the long-term average of 815 Mm^3/year. Both data indicate that total surface water availability during the period of analysis of this study is slightly lower relative to long-term averages. Particularly 1983 and 1990 were dry years (figure 2.4).

Figure 2.5 shows how available dam storage is divided over the winter and summer sub-seasons, respectively. Here, water availability is expressed in mm of water available per hectare of (surface irrigation) command area. For the winter season, on average 743 mm/ha-command is released (CV = 38%), while for the summer season an average of 292 mm/ha-command is available (CV = 43%). As will be demonstrated and explained in chapters 5 and

9, the actual supply per hectare irrigated is higher because irrigation intensities per sub-season are below one hundred percent.

Figure 2.4 Changes in the total annual rainfall and irrigation deliveries of ARLID, 1982-1997

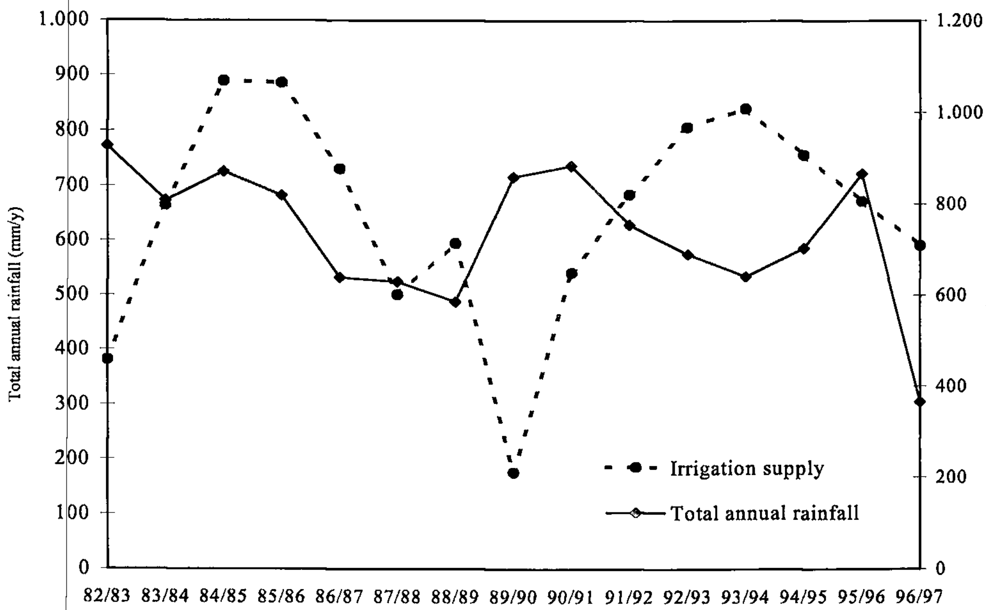
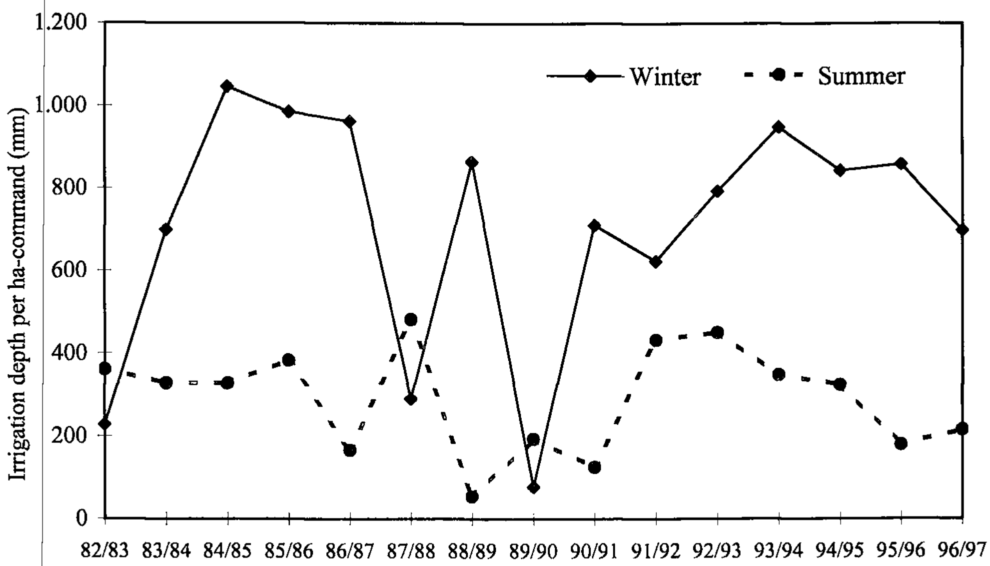


Figure 2.5 Dam releases for the winter and summer sub-seasons in ARLID, 1982-1997



2.5 The water users: ejidatarios and private growers

This is not the place to review the mixed record of the cause and the development of the Revolution of 1910[11], but is clear that the major thrust of this agrarian revolution was to redistribute land by expropriating the haciendas and provide 'land to the tillers', the landless peasant. Lands were granted to the land reform communities called *ejidos*, and their members (*ejidatarios*). Article 27 of the Constitution of 1917 determines who may hold the lands and provides the legal basis for the land distribution program. The nation retains direct ownership of these lands, while *ejidatarios* either in common or individually were given the right to use it (Randall 1996).

Until 1911, fewer than 11,000 haciendas controlled 57 percent of the national territory while 834 of these land owners held 1.3 million km^2, leaving 15 million peasants landless (Thiesenhusen 1996). In 1923, haciendas of more than 1,000 hectares had still 2.1 percent of properties, 58.2 percent of area, and 54.4 percent of value (Randall 1996). In 1992, when an end was made to the Revolution by revising Article 27 of the Constitution of 1917, 27,410 *ejidos* occupied more than half of Mexico's arable land, which is cultivated by 3.1 million *ejidatarios* (Wayne and Myhre 1998)[12]. The land reforms did not mean that former *hacendados* and *rancheros* were expropriated from their lands all together. Article 27 also makes provisions for private ownership of land up to certain limits (see below). Farmers who cultivated these private lands are called "small private growers"[13].

The land redistribution program that was started in the 1920s caused a dramatic redistribution of land in central Guanajuato. At present, this area is dominated by intensive irrigated agriculture, both in the two irrigation districts (ARLID and the much smaller neighboring district of La Begoña) and in the small-scale farmer managed irrigation systems[14]. Census data on the development of land distribution within the district are not available, but the development for the administrative region of Celaya (which partially overlaps with ARLID) can serve as an indication how the disparity between *ejidatarios* and private growers evolved since the land reform program was started.

Between 1915 and 1925 only 109 individual requests for establishing *ejidos* were made in this region, of which only 34 were actually approved. Also in the years between 1923 and 1934 little land was redistributed. Most of the distributed land was rainfed. In Valle de Santiago (to which the present module of Valle belongs), almost 10,000 hectares were handed out to 1,300 *ejidatarios*, but only 512 hectares of this land was irrigated land. The land reform program was speeded up considerably under the presidency of Lázaro Cárdenas (1934-1940). During his presidency the amount of *ejido* land in Valle de Santiago increased to a little over 37,000 hectares, of which 4,387 hectares were irrigated. In 1940 approximately 854,000 hectares were distributed in the entire State of Guanajuato. This was further increased to almost 1,200,000 hectares in 1982. In 1982, thirty-nine percent of the total amount of cultivated land in Guanajuato was cropped by *ejidatarios*, while the private growers cultivated 62 percent of the land (Aguilar-Sánchez 1993).

According to Cummings *et al.* (1989), the land reform program has resulted in sharp disparities between *ejidatarios* and small private growers in terms of access to resources. There are three factors that influenced these disparities. First, especially in irrigation districts maldistribution of land under the agrarian reform is evident. The average holding of a private grower is 37 hectares. This is almost four times the size of an average holding of *ejidatarios*.

In ARLID these disparities are less sharp[15]. There are roughly 24,000 water users in the irrigation district, 72 percent of whom are *ejidatarios* of the 281 *ejidos*, using 55 percent of the land within the district. Twenty-eight percent are classified as small private growers, occupying 45 percent of the land. The average landholding in the irrigation district is 4.8

hectares, with 3.7 hectares, and 7.6 hectares being the averages for the *ejidatarios* and the private growers, respectively (Table 2.1). But the difference in holdings between these two categories of farmers vary from module to module. While in general the average holding of a private grower is larger than the holding of an *ejidatario*, in Salvatierra module private growers cultivate 2.4 hectares, which is 0.25 hectares less than the average holding of an *ejidatario*. Salvatierra module has also the highest concentration of users: 6,054, with an average holding of 2.6 hectares, while Corralejo has only 275 users with an average landholding of 5.5 hectares (Appendix 1). The highest concentration of large land holdings can be found in Abasolo, with an average of 6.8 hectares per user, followed by Irapuato (6.6 ha/user), Valle (5.9 ha/user) and Cortazar (5.8 ha/user).

The second factor that caused social economic disparities in access to land and water, is the way distribution of land was organized under the agrarian code of 1934. Private farmers were permitted to own 150 hectares of land and to select the location of the land, even if it meant retaining title to widely dispersed parcels. The remaining lands were then distributed among the *ejidatarios* (*ibid.*), causing intermixture between *ejidal* lands and private lands. As can be observed from table 2.2, there is not a clear top-tail bias of distribution of land among the modules in ARLID. Also within the modules a high degree of intermixture of lands can be observed, although the typical head-tail end bias of social economic distribution can still be observed along a few distributary canals. On the other hand, it is widely known that legal limitations on the size of individual holdings are ignored or skirted through the practice of distributing titles among members of a family, its retainers, and other willing "name lenders" (*prestanombres*) (Foley 1995). Also in ARLID, and particularly in newer modules that were created in a round of modernization and rapid expansion of irrigation districts in the 1950s, holdings that exceed 500 hectares are common. However, the average holding of private growers range from 2.4 hectares in Salvatierra to 27 hectares in Corralejo (where 11 private growers irrigate 20 percent of all the land).

The third factor that has determined disparities in access to land and water is the differentiated access to groundwater in areas where farmers can supplement surface water with groundwater. In general, the percentage of well owners is higher under private farmers than under the group of *ejidatarios* because the former group often cultivate higher value crops and have better access to credit. As a result they have more opportunities to carry the cost associated with capital investment and pump operation. In areas such as the Comarca Lagunera, more than 70 percent of the wells are in private hands (Palacios-Vélez 1985), while 92 percent of the farmers are *ejidatarios* (Ahlers *et al.* 1998). In ARLID, more than 35,000 hectares are irrigated by wells, but district level census data on the distribution of ownership of wells between private farmers and *ejidatarios* are not reliable. The farm survey done for this study (n=125) shows that of all sampled farmers, 21 percent has access to both ground and surface water and 17 percent uses groundwater without using surface water. The survey also shows that 34 percent of all *ejidatarios* and 50 percent of all private growers have access to groundwater (with or without also having access to surface water) (see table 2.2).

Socio-economic disparities between *ejidatarios* and private growers are not only determined by direct access to land and water but also indirectly by access to credit, inputs, markets and other agricultural support services necessary for profitable irrigated agriculture. Montgomery (1983) argues that, while in principle the administration of irrigation water is highly formalized and tightly regulated, in practice there is a great deal of manipulation of this formal structure. According to her, because of their larger holdings, private growers are more heavily involved in export cropping and, therefore, more lucrative than ejidal farming, they are given priority to water, credit and other inputs. Moreover, she argues that private growers have better access to water by bribing irrigation staff and other forms of political maneuvering. Unfortunately, the author does not provide empirical evidence that would support these observations.

Table 2.2 Land and water distribution between private growers and *ejidatarios* in ARLID

	Average holding (ha)	% of land irrigated by *ejidatarios*	% of land irrigated by private growers	Average holding *ejidatario* (ha)	Average holding private grower (ha)	% of *ejidatario* who use wells[1]	% of private growers who use wells[1]
Entire district	4.8	55	45	3.7	7.6	34	50
Acámbaro	4.6	74	26	4.0	7.5	unknown	unknown
Salvatierra	**2.6**	**85**	**15**	**2.7**	**2.4**	**33**	**57**
Jaral	4.6	48	52	3.0	8.6	unknown	unknown
Valle	5.9	54	46	4.2	11.8	35	80
Cortazar	**5.8**	**53**	**47**	**4.5**	**8.7**	**38**	**38**
Salamanca	5.2	36	64	4.4	5.7	unknown	unknown
Irapuato	6.6	49	51	4.1	15.1	unknown	unknown
Abasolo	6.8	32	68	4.5	8.8	unknown	unknown
Huanímaro	4.4	61	39	3.7	6.4	17	50
Corralejo	5.5	80	20	4.6	27.0	unknown	unknown
Purísima	4.2	78	22	3.7	8.3	unknown	unknown

Note [1]: information on access to groundwater is derived from the farm survey (n=125), 1996.

As was demonstrated above, direct differential access to land and water is less clear in the case of ARLID than elsewhere. Chapter 5 will provide some quantitative evidence on both top-tail end differentiation along the canals and differentiated access to water between *ejidatarios* and private growers. Indirect differentiated access is discussed in sections of several other chapters in this thesis.

2.6 Two selected modules

Although several research activities for this thesis focused on the entire district, detailed studies were conducted in Cortazar and Salvatierra modules. As these two modules differ considerably from each other, a brief description of each of them is given below.

Cortazar module

Cortazar module is located at the center of the district and has a total command area of 18,694 hectares, including 7,760 hectares served by wells. It draws surface water supplies from the Coria main canal that conveys water from the Solís reservoir and the *Toro de Lomo* headwork on the Lerma River (figure 2.2). The main canal runs along the east edge of the module for 72.2 km and irrigates 10,934 hectares on the left bank between the canal and the Salamanca main canal. The module is long and thin and is served by 54 secondary canals with a total length of 222 km. The drainage network extends to 95 km. Groundwater is extracted through 340 deep tubewells, supplying 5,796 hectares from wells installed by private owners and 1,964 hectares supplied from public wells managed by the module. Normally, areas irrigated by canals are different from areas irrigated by wells, but some farmers use both irrigation sources. Although areas have been assigned to most public deep tubewells, often farmers have to make use of the canal infrastructure to be able to transport groundwater to their fields. This complicates the management of surface water (see chapter 5). *Ejidatarios* utilize 53 percent of the land area, under 32 *ejidos* with 1,962 users; 1,028 small private growers farm the remaining 47 percent of the land.

Salvatierra module

Salvatierra module is located upstream of Cortazar in the southern upstream part of the district. It has a total command area of 16,093 hectares and 6,054 users. It draws water from two reservoirs, Tepuxtepec and Solís (figure 2.2) through six canal intakes on the Lerma river. The canal network is 251 km long. The total length of the drainage channels in the module is 208 km. There are 21 public wells and 170 private wells, irrigating 565 hectares and 2,753 hectares, respectively.

Approximately 85 percent of the land is farmed by *ejidatarios* with average landholding of 2.7 hectares grouped in 44 *ejidos*. Fifteen percent of the land is farmed by 972 small private growers with average holdings of 2.4 hectares.

Notes

1. For readers who are interested in the agricultural history of this part of the Bajío, reference can be made to Aguilar- Sánchez (1993), Florescano (1986) and Chías- Becerril (1982).
2. The Tepuxtepec dam primarily serves the generation of hydro-power. However, because of its location it also serves as a storage dam for ARLID. Water from Tepuxtepec is first carried to the Solís dam before it reaches the district. CNA (1996a) estimates that between the two dams 10 percent is lost as a result of conveyance losses and evaporation.
3. Before 1992, irrigation districts were divided into hydraulic units called *unidades*, which at the time of the IMT process were more or less converted into one or more modules (*módulos*). See section 4.2 for further discussion of this change.
4. According to the data from the CNA district office in Celaya, 17 percent of the main canal has concrete lining, 25 percent has masonry, while the 57 percent is earthen canal. For the secondary canals these numbers are 5%, 6% and 89%, respectively.
5. The water delivery capacity (WDC) is defined as the capacity to deliver water at (sub)system head, divided by the peak consumptive use. As both the delivery and the peak consumptive used are expressed in mm/day, the WDC is non-dimensional. For more examples of WDC values, see Molden *et al.* (1998) and Sakthivadivel *et al.* (1999).
6. It is important to note that the water delivery capacity of the Gugorrones main canal reduces rapidly from head to tail as a result of its very poor physical condition..
7. Unpublished data, provided by the CNA office in Celaya. These data are based on a CNA study carried out during the early 1990s. Currently, CNA is in the process of updating the data, but preliminary results could not yet be made available.
8. Another estimate is that the total water abstraction has increased to 186 Mm^3/year, which accounts for 43 percent of Mexico's renewable water resources, while total consumption represents 15 percent of the total renewable water. Hydropower generation accounts for 69 percent and irrigation accounts for over 80 percent of the total consumption (Tortajada and Biswas 1997).
9. River basin development and coordination is a relatively new concept in Mexico. Presently, there are only a handful of River Basin Councils, of which the Lerma-Chapala council is the oldest. The history of this council only dates back to 1989 when the first basin-wide water diagnosis was carried out. This diagnosis pointed towards the problem of "water scarcity, as well as unsuitable

water allocation, pollution, inefficiency of water use, and environmental depredation". On September 1, 1989 a Consultative Council was integrated to follow up and evaluate goals derived from a water agenda formulated by the federal government and the 5 river basin state governments. This Consultative Council became the first river basin council ever in Mexico in January 1993. The council comprises representatives from a wide range of federal ministries and agencies, the 5 state governors as well as user representatives from agriculture, municipal water supply, industry, aquaculture and other uses (Mestre 1997).

10. According to Mestre (1997), a surface water distribution agreement has been in force since 1991, which "established clear mathematical rules for water distribution and reservoir operation, in accordance with users". However, Mestre does not mention what (the assumption behind) these rules are, nor can these be found in the original agreement document (CNA 1991).
11. The Mexican Revolution was started in 1910 with an armed movement, but formally began with the issuance of the Agrarian Law of 1915. This law determines, among other things, the form and procedure for land distribution (Ibarra-Mendívil 1996).
12. The speed of the land redistribution program differs much between each presidency of 6 years. Between 1917 and 1934, a total of almost 11 million hectares were redistributed into approximately six-thousand *ejidos* (Esteva 1984), while during the administration of Lázaro-Cárdenas (1934-1940) 20 million hectares were handed out to 0.75 million *ejidatarios* in eleven-thousand *ejidos* (Cummings *et al.* 1989).
13. The term "small private grower" (*pequeño propietario*) is a misnomer because, under the new Agrarian Law that was enacted in 1992, individual farmers are limited to 100 hectares of irrigated land or its much greater equivalent in less productive rainfed lands or pastures (Cornelius and Myhre 1998). As far as the *ejidos* are concerned, no single *ejidatario* can acquire, through private purchase, more than five percent of the land in any *ejido*. Until 1992, an individual owner could possess up to a maximum of 20 hectares within an irrigation district (Federal water Act of 1972).
14. Although approximately 1.9 million of the 5.9 million hectares of irrigated land in Mexico is found in small-scale farmer managed irrigation systems (called *Unidades de Riego*), little is known about the way these small systems are organized and perform. Although some sources claim that these systems have higher productivity (see for instance Palacios-Vélez 1994a), empirical evidence that support this claim and largely lacking. A study on 54 small-scale reservoir systems in Guanajuato, conducted by Dayton-Johnson (1997a and 1997b) provide productivity data that are much lower than the data on land and water productivity in ARLID, reported in chapters 5 and 9 of this thesis. Scarce official sources on small-scale irrigation systems in Mexico and Guanajuato include CNA (1994) and SARH (n.d.; 1994a; 1994b).
15. The less than average social economic differentiation along the division between the *ejido* sector (in Mexico often referred to as 'the social sector') and the private sector that can be observed in ARLID does by no means imply that in general in the State of Guanajuato this type of class differentiation did not increase. As is demonstrated by Aguilar-Sanchez (1993), particularly in the 1950s and 1960s private growers had in general access to more land of a better quality, better access to water and more access to training, credit, new technologies and off-farm labor opportunities. However, in his case the disparities are caused by differentiated access to lands between irrigation districts (like ARLID), small-scale farmer managed irrigation systems, or rainfed agriculture, rather than by differentiation within each one of these land use types. The disparities are further determined by farmers who cultivate the land (generally in central and southern Guanajuato), and commercial dairy farmers in North-central Guanajuato (McDonald 1991 and 1997).

3 The road to pro-market irrigation reforms: from centralized to decentralized state intervention

3.1 Introduction

This chapter provides a detailed description of the historical and political economic context of the recent irrigation reforms in Mexico. The construction and implementation of the market-oriented reforms in irrigation is approached in the context of the history of the way the Mexican state is organized. As is argued by Long (1988), Long and van der Ploeg (1989) and Vries (1992), programs of planned institutional state intervention are themselves shaped and legitimized by the organization and culture of policy processes, and the planning and policy models that are a result of these processes. These models themselves are the result of the political decisions, struggles and negotiations between the government agencies that are responsible for planning and implementing state programs, their groups of 'recipients' (i.e. electorate) and other organizations, such as political parties, farmer unions and international loan agencies.

Programs like the Mexican IMT and the introduction of water markets do not come on their own, but are generally preceded, accompanied, and followed by other intervention programs that share the same ideological legitimization. This chapter shows how institutional viability of the new arrangements for water management in Mexico should be viewed within the context of a much wider set of centrally planned institutional intervention programs. By doing so, it questions whether IMT and water marketing need a wider set of market-oriented reforms, or the other way around.

3.2 State intervention and economic and political reforms: 1930s-1988

The irrigation reforms of the 1980s and 1990s that are discussed in this book did not come on their own. Rather, they were part of a much wider set of economic, political and constitutional reforms that were implemented since the mid-1980s. Similar to other countries around the globe, in Mexico these reforms emerged as a strong reaction against a long period of extensive state intervention in the market (such as nationalization of private banks and industry) in the 1970s. They were followed by a series of political and economic crises in the 1980s and early 1990s. As is argued by Grindle (1996)[1], these crises opened up an increased space for deliberate efforts to craft new relationships between state and economy and to redefine relationships of power and accountability with society. These reforms form the economic and political context in which the irrigation reforms were developed and implemented. In this section, the road that led to these reforms, as well as the reforms themselves are discussed.

Economic development

The period from 1940 to the mid-1970s is often referred to as the "Mexican miracle" as it is characterized by decades of economic growth along with political stability. Mexico experienced a period of overall economic growth between 1940 and 1970, basically as a result of the land reform program in the 1930s, heavy investments in basic industry and irrigation infrastructure, and a policy of import substitution. From 1934 to 1965, Mexican agricultural production increased by 325 percent. This growth clearly benefited from heavy government investments during the period 1940 to 1955. From 1945 to 1947 these investments were as high as 14 percent of total government expenditures. Despite these investments, there was a slowdown in food production from 1965 to 1979, resulting in a rise in food imports in the 1970s. Not all farmers benefited equally from this growth; as a result of the push for import-substituting industrialization after the early 1940s and the modernization of commercial oriented agriculture, the economic gap between private growers and *ejidatarios* became wider (Thiesenhusen 1996).

By the early 1970s, the first signs of the end of the "miracle" could be observed. While Mexico exported 1.3 million tons of corn during 1965, by the mid-1970s it had become a net importer (Cummings *et al.* 1989), indicating that as far as agriculture was concerned the "miracle" had come to an end. Economists started to warn that the strategy of import substitution, along with extensive subsidies and price control, encouraged inefficiencies in both the industrial and the agricultural sector. During the early 1970s, the populistic response of the Echeverría administration (1970-76) to these emergent economic problems was to further increase the role of government in the economy: subsidies were increased, the number of central government employees grew from 0.4 to 1.3 million between 1969 and 1976, while also the number of state-owned enterprises increased. As a result of these policies and the 1973 oil-crisis, the public sector deficit, foreign debt and inflation rates increased, and the peso became seriously overvalued. As these policies could not be sustained, the government announced a devaluation in 1976 and signed a stabilization agreement with the IMF (Grindle 1996).

The hope in the economy was temporarily re-established in 1978, when Mexico became a major exporter of oil. The economy started to boom again. Revenues from oil were used to dramatically increase public expenditures, which in 1982 reached a rate as high as 22.4 percent of the GDP. In 1982 oil accounted for 77.2 percent of the total exports, inflation reached 58.9 percent, and foreign debts had risen to 86 billion dollars. In the same year, the banking system was nationalized, causing high levels of capital flight and discontent with the political leadership.

The almost full dependency on oil exports, combined with high inflation rates and capital flights made the economy collapse. The economic situation further aggravated when international oil prices began to fall in 1983 and when the resources from oil exports and foreign borrowing had dried up. Under pressure from the IMF, Mexico had to start to rethink its economic policies. Several stabilization plans were introduced during the period 1983 and 1985 under the de la Madrid administration. These plans included the devaluation of the peso, the reduction of public expenditures and control of inflation, the introduction of trade liberalization, and an attempt to reassert government control over exchange rate policies. Yet, inflation rates continued very high, while public investments and foreign debts (over 100 billion dollars in 1986 and 1987) increased. The crisis was further deepened when oil prices dropped to 12 dollars per barrel in 1986, down from 33 dollars in 1981 (*ibid.*).

As the public sector deficit grew, also public expenditures for irrigation had to be sharply reduced. While construction expenditures had risen from an annual average of 16 billion dollars in 1970 to 60 billion in 1980, they declined to 45 billion dollars in 1982 and 1983

(Cummings *et al.* 1989) and had become almost insignificant towards the end of the 1980s (Palacios-Vélez 1994)[2].

Political development

How the different administrations reacted to the economic developments described above can be understood from the way the Mexican state is organized and the kind of political challenges it has faced since the creation of the PRI in 1928. The Institutional Revolutionary Party (PRI) was able to consolidate its hegemonic control over society far into the 1980s. This control was characterized by corporate representation of farmers (primarily through the National Confederation of Campesinos, CNC) and laborers, and by patron-client relationships between economically powerful elite groups and political leaders. Formal and informal links between the government and the PRI created an effective system of patronage and political mobility. Individual and regional interests were incorporated through the distribution of development projects and access to credit, jobs, and other state-controlled resources (Grindle 1996).

Within the agrarian sector, local authority was often in the hands of new local political bosses (called *caciques*) within the *ejidos*. These bosses were empowered by the agrarian land reforms of the 1920s and 1930s and hence politically loyal to the PRI. After the 1930s corporatist and patronage structures effectively served to reproduce the revolutionary policy of "land to the tiller" and at the same time control unrest (Nelson 1997). Throughout the period of the "economic miracle', the government held out the revolutionary promise and the hope of land reform to Mexico's farmers and thus retained its grip on the farmer vote (Foley 1995).

State intervention in agriculture was organized via paternalistic and centralistic regulatory price policies and public investment (such as for irrigation). According to Fox (1995), this type of state intervention did not require an institutional relationship between the federal government and the farmers. Rather, the relationship was mediated by local and regional *caciques*, who were granted relative local autonomy in exchange for delivering PRI votes and political stability.

Subsidized inputs particularly promoted high productivity on modernized private irrigated farms, leaving many small farmers and *ejidatarios* behind. Yet, also these commercial farmers found government prices increasingly unattractive, while small farmers got more and more frustrated by the increasingly limited access to land and low guarantee prices. In 1976, these problems culminated in resistance and mobilization of small farmers. Hence, by the end of the 1970s, both small (generally *ejido*) farmers and large commercial oriented farmers alike started to resist the corporatist and patronage structures and started to mobilize against the regime that kept these structures in place (Foley 1995).

In sum, by the 1970s and the 1980s, political leaders had become uninterested in agrarian reforms, the peasantry had become largely co-opted and controlled by the PRI, and large landowners had become powerful politically and economically as a result of the successful development of commercial agriculture (Grindle 1988, cited in Thiesenhusen 1996). In addition, political instability was fueled by the inability of the López-Portillo (1976-82) and the de la Madrid (1982-88) administrations to deal with the economic crises and accumulating evidence of extensive corruption within the bureaucracy. Furthermore, the hegemony of the PRI was challenged, not only by the emergence of other political parties, but also by new independent regional farmer unions that sought a far more democratic form of internal organization than the PRI-allied CNC. The mobilizations of these unions were no longer centered around the traditional revolutionary PRI slogans, clientelism and patronage, but rather around a range of productivist demands and activities, including better prices, credit, subsidies and commercialization schemes (Foley 1995). For these unions, autonomy from government meant the right to raise these demands independent of the CNC and the PRI, and demand accountability from their leaders (Grindle 1996).

The collapse of the economy together with the increasing dissatisfaction and criticism of government policies, and the lack of participation in political decision making processes, opened the door to fundamentally new economic and political reforms in the late 1980s.

3.3 Pro-market oriented agrarian reforms: 1988 – 1994

The economic and political crisis of the 1980s called for a new style of state intervention in order to restructure economic and institutional relations and to reconfigure the meaning of state-society relationships (Nelson 1997). Three policies that supported this type of reconfiguration are of particular interest for understanding new state-society relationships within the agricultural sector: (1) dismantling, downsizing and (re)privatization of firms, banks and other institutions with major state participation; (2) globalization or internationalization of (agricultural) trade; and (3), constitutional revisions of a series of laws, which fundamentally altered land and water property rights. These policies were already introduced during the initial years of the de la Madrid administration and can be seen as a clear shift away from the highly statist orientation of the previous Echeverría and López Portillo administrations.

Privatization

Radically diminishing the size and scope of state intervention by disbanding state industry, parastatal organizations and marketing boards was seen as an important first step of the market oriented economic reforms. Under pressure from the IMF, privatization started in 1983 with the sale of some small state enterprises, but it considerably gained momentum after 1985. By October 1991, the number of firms with state participation was reduced to 247, down from 1155 in 1982 and 941 in 1985 (Rodriguez 1992). Agricultural investment was particularly hit by the reprivatization of banks and by the restructuring of official rural financial institutions like the National Bank of Rural Credit (BANRURAL). These changes by and large undermined the access of small farmers to credit (Myhre 1996). Similarly, the descaling or cancellation of many public agencies that traditionally assisted the agricultural sector, affected access to crop insurance (through ANAGSA), fertilizers (through FERTIMEX), seed subsidies (through PRONASE), and other services (de Janvry *et al.* 1996).

Liberalization of international agricultural trade

Parallel to this privatization policy, Mexico began also to restructure the nature of state intervention in the economy by gradually dismantling the revolutionary nationalist legacy in favor of increased integration into the international market (Fox 1995). Liberalization and internationalization of markets were particularly established through a process of gradually diminishing regulatory and tariff constraints, which so far had created a large bureaucratic apparatus and had encouraged extensive rent seeking by both private agents and public officials (Grindle 1996). In 1987, Mexico entered the General Agreement on Tariffs and Trade (GATT). Tariff barriers were further reduced and international agricultural was increased with the approval of the North American Free Trade Agreement (NAFTA) between Canada, the United States and Mexico on 1 January 1994, under the presidency of Salinas de Gortari (1988-1994). Holding a PhD in political economy and government from Harvard, Salinas de Gortari was firmly committed to these deregulation policies.

So far, the consequences of the implementation of these trade liberalization programs and agreements for Mexican farmers have shown a mixed record while good documentation on these consequences remain scarce[3]. According to Appendini (1998), the beneficiaries of this "global project" were primarily large private growers with sufficient technological and market know-how to take advantage of opportunities to export to foreign markets. As is noted by de Janvry *et al.* (1995), these programs and agreements would sharply decrease farm level prices of the farm produce. Others predicted the displacement (and migration) of hundreds of thousands of agricultural workers as a consequence of the price fall (Levy and van Wijnbergen 1992). Furthermore, some scholars warn that, as a result of insufficient state support in terms of credit, agricultural investment and extension services, many small farmers will never succeed in participating in the international market, which is controlled by large commercial oriented farmers as well as by multinational agricultural enterprises (Stanford 1996).

Although the de la Madrid administration had made some progress in implementing the above policies, it was noted more for its failure to manage the political and economic challenges and its inability to bring reform (Grindle 1996). When Salinas de Gortari took over office in 1988, few people had confidence in the new president's capacity to fundamentally redefine the relationship between the political institutions and the economy. Much of this doubt was rooted in the fact that he had won a historically low majority of 50.7 percent of the votes[4]. Many of his rivals believed that Salinas de Gortari could only win this election because of electoral fraud, which further reduced the legitimacy of and credibility in the PRI's capacity to adopt and continue the reform process that was started under his predecessor. However, contrary to general expectations, Salinas de Gortari came to be known as the president who effectively pushed reforms and deregulations in virtually all sectors of the economy. Furthermore, by signing NAFTA he gave a big push to liberalized international trade, resulting in increased import prices and import and export activities.

Reforming the countryside: constitutional revisions

Salinas de Gortari firmly believed that his privatization, deregulation and internationalization programs should be accompanied by a series of constitutional 'modernization' reforms. For the country side, probably the most important reforms that Salinas de Gortari introduced, were the revision of Article 27 of the Constitution of 1917 and the issuance of a new Agrarian Law (*Ley Agraria*) in 1992. Article 27 provides the basis for federal legislation to provide land to *ejidatarios*. The key element of the revision of this article is to make it possible to legally sell and rent out *ejido* lands, and hence to end the constitutional obligation of the Mexican government to redistribute state-owned land. In other words, it legally ends the land reform program that had lasted for almost 75 years. The new provisions also allow *ejidatarios* to legally sell, rent, sharecrop, or mortgage their land as collateral for loans. Those who opt not to sell or rent their land can enter into joint ventures or corporations with outside investors, thereby stimulating the opening up of the *ejido* sector to foreign direct investment. The new Agrarian Law establishes the requirements for the formation, membership, and function of these corporations. It also provides for the settlement of land right disputes by decentralized autonomous Agrarian Tribunals (Cornelius and Myhre 1998; Ibarra-Mendívil 1996; Alcalá *et al.* 1996).

Salinas de Gortari was very clear about his objectives to revise land and property rights. On 14 November 1991, in a speech to the twelve organizations of the Permanent Agrarian Congress (CAP), Salinas announced his famous 'ten points to bring liberty and justice for the Mexican countryside'. In this speech, he announced that he would "call a halt to injustice and poverty by ending the land reform program" (i.e. by revising Article 27), and hence alter existing tenure relationships (Salinas de Gortari 1991, cited in Ginzberg 1997). In addition, he argued that the revision would help to capitalize the countryside, open productive options, and juridically protect farmers and common property (Salinas de Gortari 1992, cited in Foley 1995).

Although discussions about the revision had already started in 1989, this sudden announcement took most people by surprise. Also the time between its announcement in November 1991 and its implementation in January 1992 can be considered to be extremely short. Maybe equally surprising, the sudden announcement triggered relatively little resistance and mobilization on the part of the farmer movements and unions. There are five factors that help to understand how Salinas de Gortari and his team were able to implement such dramatic revisions, within such a short period of time, while meeting so little resistance. These factors are characteristic of the way Salinas de Gortari tried to move away from a 'revolutionary' PRI approach towards what he himself called an approach of 'social liberalism'.

The first factor is the *technocratization of politics and policies*. Rather than hiring public officials who had primarily political (i.e. PRI) credentials, Salinas de Gortari recruited a team of highly trained and qualified technocrats who fully supported his neoliberal program, and who at the same time could practice bureaucratic politics. The percentage of his cabinet officials with training in economics or related fields was 59 percent. Many of these officials hold PhDs in economics, commerce or political economy from Yale, Harvard, UCLA, MIT, Princeton or the Mexican university of UNAM (Grindle 1996). Mexico's presidents have extensive powers of appointment, which reaches down to middle-levels in both the government bureaucracy and the PRI. Under Salinas, these powers were even further centralized and personalized. This type of presidential executive powers helped Salinas not only to restructure government in ways that gave added influence to his technocrats, but also to move like-minded people with technical skills to the head of the PRI.

As a result of this technocratization of politics, Salinas was able to effectively change the language of discussion from revolutionary rhetoric to debates about economic modernization, using neoliberal concepts and arguments. Consequently, more and more decisions were based on technical and economic data and arguments. This type of data and arguments convinced Salinas and his team of technocrats that the traditional land tenure system was economically not productive. They were particularly convinced that the production of maize and sorghum by the more than 2 million small producers was economically not viable because these grains could be imported at lower prices. However, the question was how the number of small farmers engaged in the production of these grains could be reduced (Cornelius and Myhre 1998). The group concluded in secret meetings that to them legal reform of land property was the only proper tool to break the deadlock of stagnating and expensive grain production and to end rural misery. The underlying assumption of such a reform was that privatization of *ejido* lands and the legal protection of land property rights would stimulate the establishment of economies of scale (through land consolidation) and induce investment in agriculture. In short, these reforms were seen as the key to recapitalization of the *ejido* sector. The idea of revising Article 27 was born.

The second factor is the *lack of alternative policies*. Opponents of the proposed reform were left with empty hands, as the only known alternative they could bring forward was the existing land distribution system (Grindle 1996). Salinas de Gortari and his team could simply refute this 'alternative' by showing them the economic statistics and data that proved that the land tenure system had resulted in low productivity levels, high degrees of corruption and an impoverished countryside. Or, as the Sub-Secretary of Agrarian Reform (Gustavo Gordillo) in the Salinas de Gortari administration put it: "government regulation of the *ejidos* all too often has been just a screen concealing private accumulation processes" (Gordillo 1992, cited in Cornelius and Myhre 1998)[5]. Gordillo argued that also those state institutions that gave support to the agricultural sector needed to be modernized. According to him, paternalism of the government, which was designed to guarantee social justice in rural Mexico, had gradually evolved into government institutions becoming the protagonist of rural development instead of the producers. This had resulted in bureaucratization, inefficiencies and the obstruction of production (Gordillo 1990, cited in Zaag 1992: 171). Gordillo believed that these processes could be stopped through modernizing rural Mexico. This, according to him, would imply that the central role in rural development should be returned to the farmers, and that government institutions should become flexible.

The third factor is the *lack of unity among the farmer unions*. The president had deliberately decided not to involve the farmer unions and local political leaders in the discussion. By the time the revision of Article 27 was announced, the farmer organizations had only a few weeks to react. A series of articles and reactions (both in favor and against the revisions) were published in national newspapers[6], but these could not turn the tide. The unions and other farmer organizations were hopelessly divided on how to react to the proposed revisions. Initially, the debate that followed the announcement in November 1991 created a high a degree of unity under the farmer movements. However, soon the movement was split in its response, between those groups who rejected the revision, and those who accepted the reform. Many peasant organizations supported the idea of securing property rights over *ejido* resources, but they were less enthusiastic about unconditionally freeing *ejido* land for privatization (Appendini 1998). As is described in detail by Foley (1995) and De Grammont (1996b), the revisions produced consternation not only among *ejidatarios*, but also among the organizations of private growers[7].

The fourth factor is the *international support*. The revision was welcomed and supported by international loan institutions. On 13 December 1991, one month after the announcement, the Secretary of Agriculture submitted a letter to the World Bank. In this letter the government declared that, now that the President and his advisors had shown that they were genuinely committed to make a halt to rural poverty, Mexico was ready to respond to the international request to enter the open economy and to join NAFTA (Alcalá 1996: 59). According to Cornelius and Myhre (1998), the Secretary and his group of like-minded reformers clearly saw the privatization of *ejido* lands and a well defined system of property rights as tools to recapitalize and increase the export of those sectors of agriculture that would be attractive to foreign investors. A few months later Mexico signed the NAFTA agreement.

The fifth factor is the *renewed political support of the PRI*. Any revision of the Constitution would need a two-thirds majority in congress. As Salinas was elected with a very meager victory of just over 50 percent, the reformers were not confident that they would gain such a majority. However, the congressional elections of 1991 were a clear victory for Salinas, which made it easy to get the approval for the reforms from the PRI-dominated congress (Grindle 1996).

3.4 Reforming the agrarian reform: new forms of state intervention

As is noted by Fox (1995), the conventional view is that as a result of Salinas' pro-market and international trade liberalization policies, the Mexican state has also withdrawn its hands from regulating rural markets and land and water property. However, the technocrats clearly recognized some need of price support as a social safety net, particularly for small maize producers. In addition they realized that in order to buffer the political conflicts that were expected in rural areas as a result of the economic reforms, some kind of government intervention was required (Cornelius and Myhre 1998:6).

In order to mitigate the negative impacts of trade liberalization and the withdrawal of subsidies for small farmers, the government directed a wave of resources to the countryside. These resources would also serve to ease the escalating tensions and to hold the political allegiance of particular groups or regions that were pressing demands at a time when traditional resources of public support were depleted. As such, these resources were used as bargaining chips in negotiations with these groups (Appendini 1998). Among the many support programs that were established during these years of transition from highly statist and paternalistic government policies to 'social liberalism', three are of particular interest for this thesis: PRONASOL, PROCAMPO and PROCEDE.

Solidarity program: decentralization and deconcentration

The National Solidarity Program (PRONASOL) was created in late 1988 and directly organized by the office of the presidency (Grindle 1996). Its objective was to make funds available to local communities in order to address the social costs of the pro-market reforms. This was done through a series of sub-programs that distributed resources for projects related to, among others, social community development, small enterprises, credit for small holders (*Crédito a la Palabra*) and infrastructure.

Another aim of the Solidarity program was to stimulate decentralization and democratization by devolving resource allocation decisions to local (user) groups, away from the paternalistic centralization approach of the past. As Fox (1995) notes, Solidarity promised to reform social programs with its commitment to the principles of community participation, public transparency and co-responsibility between government and society. The program became indeed known as a decentralized federal program. In 1994 it transferred 95 percent of its resources to state governments, of which 50 percent was to go to municipal governments (*ibid.*). Although Solidarity funds were actually delivered to the local projects, the projects did not necessarily reach the lower-income citizens, nor did they necessarily prioritize the most pressing serving needs[8]. One of the conclusions that Fox draws is, that the state government continued to play a major role by significantly influencing project choices. The state government retained discretionary power of inter-municipal distribution of funds and virtual monopoly on the technical assistance needed for community development projects of any magnitude[9]. This made it very easy for the state government to condition access to its development program on political subordination.

According to the World Bank (1999), the Solidarity program can be regarded as an example of successfully inducing processes of decentralization and devolution of authority in the countryside. However, the decentralization process in general has been incomplete to the extent that the real responsibilities given to local governments are generic functions but do not include functions specifically targeting rural development. From this point of view, the Bank argues, its should be considered as an extensive deconcentration of services of the Ministry of Agriculture rather than a true decentralization process involving the devolution of functions and powers to local communities. Apart from the devolution of O&M responsibilities to user organizations in large irrigation districts (see chapter 4), the level of devolution to other rural civil society organizations has been rather low. The authority and financing of activities related to rural development planning and the design of strategic intervention programs essentially remained with the federal government, with coordination at the regional level (*ibid.*).

PROCAMPO: developing new accountability relationships

A second measure that the Salinas de Gortari administration took to compensate farmers for loss of income because of trade liberalization, the elimination of input subsidies and the removal of guarantee prices, was PROCAMPO (Direct Rural Support Program). The program was launched in 1993 and gave direct crop subsidies based on acreage rather than on output (via price guarantees), without regard to who owns the land. This meant that farmers on marginal soils and with limited access to irrigation (and hence lower yields) received the same subsidy as more productive farmers. All producers that were engaged in cultivating basic crops could obtain PROCAMPO support, even if their entire crop was not sold on the market but rather directed to household consumption (Appendini 1998), or if they decided not to harvest at all[10]. Although PROCAMPO's contribution to the value of crop production has been significant[11], its overall economic impact is limited as it could not replace the funds lost to the cutbacks in institutional credit. Nor could it effectively stimulate agricultural investment (Myhre 1998).

The program reached millions of farmers that had not benefited under the previous system of price guarantees. However, the patterns of inclusion and exclusion in PROCAMPO were not very clear. Fox (1996) document cases in which PROCAMPO checks were used to pressure voters during the 1994 presidential elections. He also raises questions about the state capacity to develop accountable relationships with millions of farmers. The issuing of PROCAMPO checks required a new agrarian regulatory apparatus, with thousands of agrarian officials. In order to determine who was growing which crop, with how many hectares, and whether PROCAMPO recipients had legal use-rights to the land, the officials had to develop formal relationships with millions of farmers. As such, and contrary to the ideological spirit of Salinas' deregulation and liberalization policies, the state had to penetrate in to the countryside more deeply than it had done before.

Land certificates program: the reproduction of control mechanisms

A third program that required the development of new and intimate state-farmer relationships, was the Ejido Land Rights Certification and Titling Program (PROCEDE), which was needed to make the privatization of *ejido* land under Article 27 work. PROCEDE was inaugurated in 1993 to regularize and map the boundaries of *ejidos* and *ejido* plots and to provide *ejidatarios* with land certificates (Appendini 1998). This also meant that government officials from the newly created *Procuradería Agraria* had to visit *ejidos* and settle land and boundary disputes. State-farmer relationships were further tightened and deepened when PROCEDE certificates were demanded for getting access to other government services, such as for obtaining credit and receiving a PROCAMPO check. Similar to the Solidarity and PROCAMPO programs, these new accountability relationships affected voting practices. As is described by Baitenmann (1998) in the case of the State of Veracruz, by reproducing old clientelistic control mechanisms, field staff from the *Procuradería Agraria* used an arsenal of threats and pressure tactics to force *ejidatarios* to join PROCEDE.

3.5 Irrigation reforms from 1920s - 1989

The political and economic reforms that were discussed above form the context in which institutional reforms within the irrigation sector were established. It is important to realize that the same factors that determined the direction and shape of state intervention in mechanisms of regulation of rural markets and property rights, have also largely influenced the shape and direction of the market-oriented irrigation reforms that are discussed in this thesis. Moreover, for understanding both the implementation strategies of these irrigation reforms, as well as their impact on irrigation performance, one should keep in mind that these reforms were preceded, followed, and accompanied by several other state intervention programs.

Centralizing irrigation management

Small scale irrigation has been practiced in Mexico since pre-historic times (Hunt and Hunt 1976; Enge and Whiteford 1989; Nederlof and van Wayjen 1996). The development of large scale irrigation systems, however, started with the Spanish Conquest and was expanded under the dictatorship of General Porfírio Díaz in the 1880s, who gave out concessions to national and foreign companies to develop irrigated agriculture. State involvement in irrigation development received a legal push with the promulgation of the Water Law (*Ley de Aguas*) of 1910, which followed the Constitution of 1857 that said that all federal waters are public property and for common use. As was noted in the previous section, the Mexican Revolution did not change this. Article 27 of the Constitution of 1917 made it explicit that "land and water property belong to the Nation", but "the Nation has the right to transmit these property rights to individuals, thereby creating private property".

The many political conflicts between the *hacendados* who supported General Porfírio Díaz, and the mainly landless farmers who supported the land reform program, made further agricultural and irrigation development hardly possible in the years after the revolution of the 1910s (Aguilar-Sánchez 1993). Expansion of new hydraulic works only started again when the first Irrigation and Federal Water Law (*Ley sobre Irrigación y Aguas Federales*) was promulgated in 1926. This law foresaw in the establishment of the National Irrigation Commission, whose main mandate was to design and build irrigation districts. However, owing to a lack of sufficient technical expertise, the Commission decided to hire J.C. White Engineering Corp, an American firm, to design large scale irrigation systems (Palacios-Vélez 1994a; Roemer 1997)[12].

The law of 1926 was quickly followed by a series of other water-related laws, such as the first and second National Property Water Laws (*Leyes de Aguas de Propiedad Nacional*) of 1929 and 1934, respectively, and their Rules and Regulations of 1936. One of the particularities of these laws was that they provided for the possibility to form user associations, who could manage government owned irrigation districts. Yet, in practice the management of these districts remained firmly in the central hands of the National Irrigation Commission.

Access to both irrigation water and credit were seen as two of the most important means to keep up which increasing population numbers and food demands. As a result, it is not surprising that, for instance, between 1935 and 1944 the management of ten newly constructed irrigation districts became directly under the supervision of yet another centralized institution, the National Rural Credit Bank (*Banco Nacional de Crédito Agrícola*)[13]. Yet, despite all these bureaucratic incentives and central control, irrigation development could not keep pace with the increase in cultivated land. Furthermore, more and evidence that these new districts were managed in an inefficient way emerged (Palacios-Vélez 1994).

With the objective to dramatically improve the management of the irrigation districts, a new Irrigation Law (*Ley de Riegos*) was promulgated in 1947. At the same time, and as a result of the new law, the National Irrigation Commission was changed into the Ministry of Hydraulic Resources (SRH, *Secretaría de Recursos Hidráulicos*). This Ministry became responsible for the establishment of all integrated water policies and programs, including the operation and maintenance of all government-managed irrigation districts. Although SRH's main mandate was to construct new irrigation districts, the need for better management of these districts was also felt. This resulted in the establishment of a special sub-ministry (the *Secretaría de Agricultura y Ganadería*) under SRH engaged with O&M of irrigation districts. However, owing to coordination problems, this ministry could not manage the districts properly. As a result, in 1951 all O&M responsibilities were re-established with SRH, which further centralized government involvement in irrigation (*ibid.*).

Fully in line with the statist-oriented policies of the Echeverría administration, and in a reaction to stagnating production and increasing food imports (see section 3.2), centralized irrigation development was high on the political agenda during the 1970s as it was seen as the solution to meet ever increasing food demands. In 1975, this resulted in the first National Hydraulic Plan (*Plan Nacional Hidráulico*), which laid out massive development plans for the next 25 years. These plans were going to be supported by the World Bank and the Inter-American Development Bank, and coordinated by the Federal (central) government. For the first time in the Mexican history of centralized irrigation management, the Plan mentioned the role of users in the fields of both cost-recovery and O&M. Yet, it was not made clear how this type of user participation was going to be institutionalized.

The Federal Water Law (*Ley Federal de Aguas*) of January 1972 provided the legal foundation for such type of centralized state coordination in irrigation development, but does not explicitly provide a basis for the above mentioned user participation. The main objective of this new law was to integrate and replace the various existing laws that dealt with the use of national waters and water development, including the irrigation acts mentioned above. The law further limited private initiative in irrigation development, among others by imposing a land ceiling for private growers with plots within irrigation districts, by dramatically reducing the possibility to sell or rent out water rights, and by attempting to further centralize the setting of irrigation fee levels[14].

The Federal Water Law had several institutional implications. First, in 1976 the SRH was merged with the Ministry of Agriculture and Livestock (SAG) into a new Ministry of Agriculture and Hydraulic Resources (*Secretaría de Agricultura y Recursos Hidráulicos*), SARH. As a result of this, the Department which until then had been responsible for managing irrigation districts, and another Department engaged with the development of small farmer managed irrigation systems, were also merged[15]. This meant that the control over all irrigation related issues was concentrated in the hands of one single department with SARH.

The second institutional implication of the Federal Water Law was the establishment of the so called Agricultural Governing Boards of the irrigation districts (*Comités Directivos Agrícolas*). The charter of these boards was to dictate, based on the availability of water, what percentage of land was planted with which crop (Whiteford and Bernal 1996). The most important task of these boards was to approve the annual irrigation plan. Although officially user representatives of the *ejidos* and private growers organization participated in the boards[16], in practice their involvement in decision making processes was virtually nil (Zaag 1992). As Zaag has observed in the case of El Grullo irrigation district, all decisions taken in the boards were planned by local SARH staff and rubber stamped by the regional and central SARH offices. According to Whiteford and Bernal (1996), these boards were highly political organizations. Moreover, as Mares (1980, cited in Zaag 1992) noted, government officials in these boards often acted in collusion with the region's elite through their membership of such boards.

As a consequence of the felt need to reduce government expenditures and to induce efficient use of resources, the then 77 irrigation districts were merged with 150 so called 'rainfed districts' (*Distritos de Temporal*) during the early years of the 1980s. This resulted into the creation of 192 Rural Development Districts (*Distritos de Desarrollo Rural*). The governing boards of these development districts also took over the Agricultural Governing Boards of the irrigation districts. Hence, these new boards were not only engaged with irrigation planning issues, but were also made responsible for coordinating all kinds of other activities related to, for instance, small farmer managed irrigation systems, livestock development and rainfed agricultural. The result of these types of institutional reforms was that even more authority and control were concentrated in the central hands of the SARH.

By the end of the 1980s, farmer groups had experienced that the concentration of so many tasks and control within one central institution had resulted in the bureaucratization and politicization of the access to agricultural resources. Furthermore, several 'water-minded' technocrats within the Ministry of SARH, engaged with the design and coordination of the National Hydraulic Plan, were aware that the institutional concentration of these tasks and control had diverted the political and bureaucratic control over water development resources away from them. As we will see below, these technocrats argued that in order to achieve higher levels of (financial and water use) efficiencies, all water related tasks should be administratively separated from other agricultural government responsibilities. This argument found clear support from President Salinas de Gortari, who saw the creation of efficient and decisive government institutions as an important condition to push his 'administrative modernization' programs[17]. The newly created National Water Commission (CNA) was going to be the first of such 'modern institutions' created by the pro-market administration of Salinas de Gortari (Ramos-Osorio 1999).

The creation of the National Water Commission

The creation of CNA in January 1989 can clearly be regarded as an example of the way Salinas de Gortari established his liberalization, privatization and political modernization reforms. Some of the factors that explained the sudden and seemingly smooth constitutional reform of land use rights (see section 3.2) can also be found in the history of the formation of CNA.

Similar to way he dealt with the land tenure system, also in the discussion on the modernization of the water sector Salinas de Gortari gathered around him a team of like-minded technocrats that supported his policies. Among the most important of these technocrats was González-Villarreal[18]. In the trajectory of modernization of the irrigation bureaucracy, this person assumed a number of important positions. During the period 1975 to 1982 he was the coordinator of the National Hydraulic Plan, which gave him the technical and bureaucratic credentials to deal with the development of the water sector in an integrated way. He earned his political credentials under the de la Madrid administration, where he took the position of Sub-Secretary of Hydraulic Resources during years 1982 to 1988. In this position he was responsible for, among others, the development and management of irrigation districts, and he became known as a dedicated and very well informed professional. During that same time, he also coordinated the PRI meetings that dealt with water related issues. He had known Salinas de Gortari from the time when Salinas de Gortari was campaign coordinator of the presidential election of de la Madrid.

Another person in this group of technocrats was Guerrero-Villalobos, who started as a director general in construction and hydraulic operations under the Echeverría administration. He earned his political credentials and confidence in 1987 and 1988, when he was the PRI coordinator on water issues of Salinas de Gortari's presidential election campaign.

Both persons saw their professional and administrative credentials and their political loyalty rewarded by Salinas de Gortari. González-Villarreal became the first director general of CNA, while Guerrero-Villalobos assumed this position in 1994.

González-Villarreal was among the first who actively discussed his observations on the administrative organization of water related government responsibilities with Salinas de Gortari. According to him, the merger between water resources (SRH) and agriculture (SAG) into SARH had led to a number of problems[19]. First, he argued that the merger had hampered the provision of an effective and efficient water service as the responsibilities of SARH were too fragmented. Second, he argued that under the existing legislation and administration it was not possible to introduce a system of O&M cost-recovery. Third, it was argued that the development of strong policies of integrated management of water required a strong and decisive government institution. Not only were these arguments discussed among the 'water technocrats', they also found support from the World Bank office in Mexico.

González-Villarreal and his group argued for more administrative autonomy and hence the re-establishment of control over water development related issues within a single institution. These technocrats were particularly interested in regaining control over the management of all dams and main infrastructure and the access to all major rehabilitation measures, i.e. the control over the bulk of the resources that go into irrigation through the major international donors (Urban *et al.* 2000). They felt that under the existing arrangement with the SARH, control over access to these resources was too dispersed. In exchange, they were willing to partially hand over control over the management of irrigation districts to newly to be established WUAs. Moreover, the advantage of this arrangement, they argued, would be that cost-recovery from the users and consequently the revenue for the agency would be improved.

Box 3.1 Some responsibilities of CNA

- Propose policies and define and monitor national plans related to hydrological developments;
- Define criteria and guidelines for the integration of government plans and activities in the field of water;
- Coordinate all administrative institutions that deal with water;
- Administer, regulate all national water and hydraulic infrastructure;
- Program, study, construct and manage new hydrological facilities and structures;
- Grant user concessions and register these in a Public Registrar of Water Rights;
- Promote efficient use of all national water;
- Assure and supervise the coordination of all water related programs and assign public funds to carry out these programs;
- Study, propose and execute financial systems that allow the development of water related infrastructure and the provision of water related services.

Source: Article 8, Ley de Aguas Nacionales

The administrative solution to achieving these goals was the establishment of an autonomous 'deconcentrated' entity within the SARH, called the National Water Commission and headed by González-Villarreal. CNA became the sole Mexican authority responsible for design, planning and implementing all water related policies (see box 3.1). In order to give this new administrative entity the legal authority for executing these tasks, the existing Federal Water Law of 1972 had to be revised as well (see section 3.5). In 1994, CNA was administratively transferred from the Ministry of Agriculture to the much smaller Ministry of Environment, Natural Resources and Fishery. However, it continues to be the sole federal authority dealing with water management (Herrera-Toledo 1997).

3.6 Conclusions

The political and economic crisis of the 1980s forced the Mexican government to rethink its centralized and statist oriented intervention policies that had characterized the political economic developments since the 1910s. As a result, since 1982 successive administrations have opted to introduce (re)privatization, deregulation and liberalization of international markets, political democratization, and devolution of the authority to decide on the allocation of resources. These policies were strengthened by constitutional revisions of land use rights.

A combination of factors explain why, under the Salinas de Gortari administration, these changes could be established at such a high pace, while at the same time meeting relatively little resistance. Together these factors characterize the way in Mexico political and economic institutions are organized and as such shape the direction and extent of the political and economic reforms. These factors include: the technocratization of the political discourse; the use of executive presidential powers to break the corporatist alliance between the PRI and the farmer unions; division of farmer organizations along different ideological lines; support from international loan institutions; and congressional and political support for important constitutional revisions.

Rather than pushing the pro-market policies too far, Salinas de Gortari realized that he needed to establish a number of new state programs. These would not only help to make the transition from highly statist and paternalistic interventions towards 'social liberalism', but would also reduce the political unrest and social cost of the agrarian reforms. Contrary to the spirit of the privatization and liberalization policies that were introduced across all sectors in the economy, the new programs did not free rural civil society from the hand of government control and regulation. Rather, they should be seen as new forms of state intervention in which intimate state-society relationships are largely reproduced.

The social liberalism movement also affected the irrigation sector in a big way. Not only were water-minded technocrats within the Ministry of Agriculture advocating the introduction of pro-market mechanisms in the recovery of O&M costs through user organizations, they also opted for the creation of a deconcentrated, administratively autonomous, water institution. As will be demonstrated in the following chapters, these policies of market-oriented water management, user participation and deconcentrated authority dramatically altered user-state relationships, as well as user-user relationships. They have had major impacts on the way irrigation districts are managed under these new arrangements.

This chapter has shown that that the 'introduction' of market-oriented irrigation reforms should be understood in the context of a much wider set of similar reforms that all aimed at totally restructuring the political and economic control over resources. As such, the IMT program and the introduction of water marketing should be seen as two elements of a historical process of political and economic reforms. An important conclusion from this chapter is that the kind of market-oriented constitutional reforms that were envisaged by the Salinas and subsequent administrations do need programs like IMT and the introduction of water markets. These are the kind of policy tools that help the government to achieve its wider political-economic goals, rather than the other way around. In that sense, the process of formulating, implementing, and assessing impacts of IMT and water marketing should not be analyzed on their own, which is commonly done, but rather in the context of other constitutional and market-oriented policy processes.

Another important lessons can be drawn from looking at IMT and water marketing as part of a much more extended policy process in Mexico. This is that these irrigation reforms have essentially been initiated, formulated and implemented by political and economic forces from within the Mexican government. Although international loan agencies have been supportive to these forces, they were not, as is often assumed, the impetus to these reforms.

Notes

1. The description in this section of the political and economic crises in Mexico and the response of the Mexican government to them is largely inspired on the excellent work of Merilee Grindle (1996).
2. Palacios-Vélez (1994a: 90) provides an historical overview of public expenditures in irrigation (for both irrigation districts and small farmer managed irrigation systems) for the eight presidential terms since 1947. Unfortunately, as his data include several assumed expenditures, they are not totally reliable. Yet, the data give a good impression of the magnitude in change in irrigation expenditures as a result of the economic crises. For instance, total expenditures for the four terms since 1971 are about 51 billion pesos (during 1971-76), 90 billion pesos (1977-82), 45 billion pesos (1983-88), and only 10 billion during the period from 1989 to 1992 (all these expenditures are in constant 1979 Mexican pesos).
3. Among the few exceptions are the contributions in an edited volume by Lara-Flores and Chauvet (1996), which document the impact of NAFTA on a number of agricultural sub-sectors including the ones for maize, fruits, horticulture and cotton.
4. Most of the remaining votes went to two opposition parties: the center-right Partido Acción Nacional (PAN) and the center-left Partido de la Revolución Democrática (PRD). After 1988, PAN was able to capture 6 governorships, including the one for the State of Guanajuato. In July 2000, the PAN governor of Guanajuato (Vicente Fox) won the presidential elections. The political agenda of the PAN is very much in line with the neoliberal agenda of the Salinas administration (Grindle 1996) and as such, much of the 1988 vote for the PAN was a protest against the undemocratic organization of the PRI. Officially, the PRD candidate (Cuauhtémoc Cárdenas, the son of the popular former president Lázaro Cárdenas) won 31 percent of the presidential vote in 1988. Democratization, social welfare and a nationalistic foreign policy approach characterized the agenda of the PRD.
5. Within this group of reformers in the Salinas administration, Gordillo was among those who believed that even under a system of privatization of *ejido* land, the *ejido* could still be reconstructed economically as a unit where subsistence farming can be practiced, particularly by 'part-time' farmers whose income, for instance, primarily depend on revenue from migration (Cornelius and Myhre 1998).
6. See Alcalá *et al.* (1996) for an extensive overview of the reactions.
7. For detailed examples on the impact of the neoliberal reforms on the mobilization of farmer organizations and unions, see the contribution in a volume edited by De Grammont (1996a).
8. For examples on the participation of different farmer groups in the Solidarity program see Covarrubias-Patiño (1996).
9. Fox (1995) draws his examples mainly from the southern states of Oaxaca and Chiapas and rightly points out that his results cannot be generalized to other states, mainly because the prior structured of local government, and their relations with state governments, are so different.
10. In several irrigation districts in the North-East of Mexico, some farmers choose to sow a basic crop without harvesting it. Particularly in times of water scarcity, yields in these areas can be

relatively low (for instance 3 ton/ha of maize in Río San Juan irrigation district, compared to almost 6 ton/ha in ARLID). In combination with low market prices, these low yields make the cultivation of crops like maize economically unviable. Yet, some farmers choose to sow maize as it gives them access to PROCAMPO support (personal communication by Ellen Rymshaw).

11. Since 1994, annual PROCAMPO transfers have been equivalent to about 5.4 percent of the agricultural sector GDP (Myhre 1998).
12. Much of this historical overview of Mexican water laws is derived from Palacios-Vélez (1994a) and Roemer (1997).
13. The National Rural Credit Bank's role in supervising the operation of these ten irrigations districts were defined in the Rural Credit Law (*Ley de Crédito Agrícola*) and enforced by the Presidential Decree of 20 December 1935.
14. In 1985 studies were conducted to find out whether it was feasible to establish fixed fee levels for entire regions. Based on the overall water availability, the country was divided into four regions and fee levels for each of these regions were proposes. However, the proposal was not accepted by the Congress.
15. The name of this new Department was *Dirección General de Distritos y Unidades de Riego*.
16. Along with the establishment of the Agricultural Governing Boards, which were engaged with managing large scale irrigation districts, also the so called Rural Development Governing Boards of Irrigation Units (*Comités Directivos de Unidades de Riego para el Desarrollo Rural*) were created for the management of the much smaller 'farmer-managed' irrigation systems. Generally, these smaller systems had their own water user associations. According to Article 77 of the Federal Water law of 1972, representatives of these WUAs were allowed to participate in these boards, along with representatives of a series of government agencies (including the SRH, the Ministry of Agriculture and Livestock, the Federal Electricity Board, and official government banks).
17. The administrative modernization plans were part of the reforms package that was initiated by Salinas de Gortari. These plans aimed at more efficient, more effective and more accountable public decision making at all levels of the government (Fox 1995). Administrative and political decentralization and deconcentration of government institutions were seen as the key condition to achieve these goals. These plans were continued under the administration of Zedillo-Ponce de León (1994-2000) and came to be known as the 'New Federalism' or PROMAP (*Programa de Modernización de la Administración Pública Federal*).
18. This description of the role that González-Villarreal played in the creation of CNA is predominantly taken from Ramos-Osorio (1999).
19. Ramos-Osorio (1999) cite several discussions between González-Villarreal and Salinas de Gortari from minutes from the PRI meetings of the Institute of Political, Economic and Social Studies, held in 1987 and 1988.

4 Implementing new institutional arrangements for water management

4.1 Introduction

In this chapter an account is given of how the new institutional arrangements for local water management in Mexico were formulated and implemented, both at the national level and at the level of the case study in ARLID. It examines the official objectives of the IMT program, the underlying institutional design principles as well as the implementation strategies that were chosen to introduce these new principles. It also shows how constitutional revisions, particularly in the water law, support the implementation of these new arrangements. Furthermore, examples are given on how local irrigation staff and water users have adopted, accommodated and in part transformed these arrangements. In addition to examining the formal design principles, this chapter particularly focuses on those strategies and mechanisms that would eventually help the new institutions to sustain.

4.2 The Mexican IMT program: policy objectives and implementation process

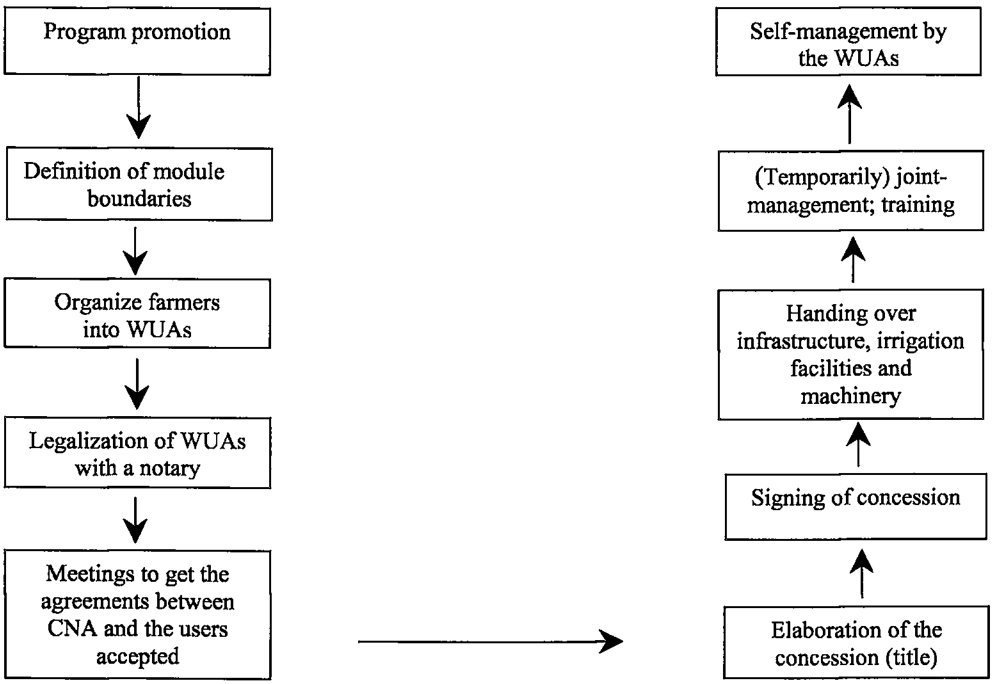
The economic crisis of the 1980s and the consequent introduction of pro-market and liberalization reform programs led to the creation of the National Development Plan for 1989-1994. Under this plan the newly created National Water Commission was given the mandate to develop a National Program for Decentralization of the Irrigation Districts (here called the IMT Program) to establish a market-oriented system of co-responsibility between CNA and the water users.

The reform of the irrigation sector through the introduction of the IMT program completely follows the pro-market approach that the Salinas de Gortari administration established in other sectors of the economy. The main objective of the IMT program was to reduce public expenditure on irrigation O&M by introducing a system of cost-recovery and financial self-sufficiency (Espinosa-de León and Trava-Manzanilla 1992, Trava 1994, Gorriz *et al.* 1996, Johnson 1997 and 1999). Another objective was to transfer O&M responsibilities (including the full recovery of all O&M costs) from CNA to newly established financially autonomous WUAs. The assumption behind greater user involvement in irrigation management was that management by local organizations would better reflect the actual needs and local conditions of the irrigation community. In addition, financial autonomy would give these users an incentive to manage water resources more efficiently than the government. To further induce these greater efficiencies, the program would also provide technical assistance, such as on-farm development initiatives to enhance farm-level productivity and water conservation. Finally, according to Whiteford and Bernal (1996) another reason for transferring responsibilities to users was that the new local management organizations would be more democratic, and as a result, greater political accountability would be built into the management organization (see also section 6.2). This section discusses how these objectives were translated into the different steps that the Mexican government followed to establish the IMT program.

Figure 4.1 illustrates the official steps that had to be followed during the implementation of the IMT program. From this figure it becomes clear that the program followed a mere top-down approach, leaving little room for farmer participation in terms of decision making on the design of the institutional, financial, organizational and legal frameworks and approaches. As will be illustrated in the next section of this chapter, farmers were simply informed about the program objectives and program implementation strategies. During program implementation, real farmer participation was limited to the election of their representatives to the assemblies of the to be established WUAs, attending training programs, and signing the concessions.

While underemphasizing the diversity in the ways the program has been implemented and adopted, international organizations have advocated the Mexican IMT program as "*the* transfer model" to other countries such as Turkey and India (Andhra Pradesh), apparently due to the program's scale and speed of implementation. By May 1999, 3.16 million hectares had been transferred to 419 WUAs, representing 93 percent of the area served by the 81 irrigation districts in the country (CNA 1999).

Figure 4.1 The official implementation steps of the irrigation management transfer program



Source: CNA (1994)

Foreign visitors of international agencies, banks and foreign irrigation agencies often mention the 'Mexican IMT model', thereby explicitly referring to the scale and speed of the program implementation process (e.g. Mishra 1995, Gorriz and Groenfeldt 1996 and Ujjankop 1995). However, if one unpacks this 'model', other characteristics than scale and speed become more important as they help to link the content and process of IMT implementation with the viability of the new arrangements. They also show the nature of IMT within the local Mexican organization of political and agrarian structures. This makes it easier to understand why the Mexican 'model', if any exists, cannot be regarded as a blueprint for countries with other socio-economic and political conditions and histories. The characteristics that make the Mexican IMT model unique are:

Wider package of reforms
As was demonstrated in chapter 3, IMT did not come on its own but rather followed and was part of a wider set of similar market-oriented reforms, as a result of which the provision of many agricultural services had already been privatized. Consequently, farmers realized that also the O&M services, which were traditionally provided by CNA, would soon cease to exist, leaving them without any irrigation service unless they would start organizing these services themselves. To most farmers the concept of transfer was completely new and many user delegates were hardly aware of what their new roles would comprise (Whiteford and Bernal 1996) or what the financial implications of these would be for them. On the other hand, farmers had experienced that the quality of service provided before transfer had declined. CNA succeeded in convincing farmers that WUAs could provide a better O&M service at lower costs.

Political commitment to reduce government staff
Implementation of the IMT process could be introduced at a high pace because of the firm political commitment at the presidential level, not only to create an autonomous water institution (see section 3.5), but also to use this institution to introduce market mechanisms in irrigation management and to reduce public investments in O&M. An effective way of reducing public costs, is to make public agency staff redundant. As noted above, by weakening and marginalizing the role of the PRI and unions, Salinas de Gortari was able to make the political system far less corporatist in nature than before. This made it relatively easy to reduce the number of government employees and, more importantly, to by-pass to a great extent their labor unions.

From 1990 to 1994, 42 percent of the 7,808 CNA personnel involved in irrigation O&M were retired or released. In addition, another 2,382 staff were supposed to be made redundant, of whom 2,326 were members of the union (CNA 1994)[1]. Most of these retired or reduced staff used to work at the field level (ditch tenders and other technical staff), but considerable reductions were also made with the CNA district and regional offices. In some cases, former CNA staff were rehired by the WUAs, but there was no obligation to do so. In other cases, CNA made use of a retirement program or could transfer personnel to other departments or government agencies. Finally, the remaining staff made redundant had to look for other employment opportunities.

Constitutional framework
The Mexican government clearly understood that the IMT program could only be introduced after a thorough revision of the water law (Palacios-Vélez 1994b; Rosegrant and Schleyer 1996), which would follow similar market-oriented modifications as the revisions to Article 27 and the Agrarian Act (see section 3.2). As will be discussed in detail below, in 1992 a new National Water Law was enacted, which combines public ownership with private management of national water and irrigation facilities. The act provides for:

- the government being the sole authority to retain ownership of national water resources as well as all infrastructure and irrigation facilities;
- the formation of WUAs as legally recognized non-profit civil associations (*asociaciones civiles*) to whom CNA can grant user concessions for a period of up to 50 years (but generally 20 years). These concessions give WUAs the right not only to use national water resources and manage irrigation facilities, but also to buy and sell water either within the agriculture sector or with other sectors in the economy;
- the definition of the obligations of WUAs to operate and maintain the system in accordance with the District Regulations and Instructions of O&M and administration of the module. In addition, the Law stipulates that WUAs are responsible for fee collection and that these fees should cover the full O&M and administration costs of the entire system.
- the creation of a hydraulic committee at the level of the district, in which representatives of all WUAs, CNA and the State of Guanajuato decide on issues related to seasonal planning, water trading between WUAs and access to externally funded system improvement programs.
- the registration of water rights (i.e. concessions) in a Public Registry of Water Rights (REPDA) in order to ensure legal certainty of these rights. The legal concessions ('titles') are deposited with a public notary.

Hydraulic boundaries
The program was built around the idea of two organization levels: the district and the modules. Each module is managed by a WUA. The boundaries of the these modules are based upon hydraulic considerations: water delivery to the area should be easy and efficient to accomplish and, where possible, fit within existing irrigation sections (Trava 1994, cited in Johnson 1997a). In order to have an economically viable management size with relatively low fixed overhead costs, the sizes of the module areas are relatively large, ranging in size from 1,500 hectares (e.g. Corralejo module in ARLID) to 50,000 hectares (e.g. in Bajo Río Bravo irrigation district), each managed by an individual WUA. Formal irrigation management organizations below these module levels do not exist.

Existing institutional agrarian structure
The program was developed on an already existing strong institutional and ideological base: the *ejidos* and the organizations of private growers, along which most of the agrarian production was organized. WUAs are constituted as civil associations and are comprised of elected user representatives to the general assembly. From the assembly an executive board is elected, who is charged with the supervision of a hired team of technical and administrative staff headed by a general manager (see chapter 6 for more details). Water users are members rather than stakeholders of the association.

It was decided that the general assemblies of the new WUAs should also be organized around the lines of *ejidos* and private growers, with representatives from both groups of farmers. Each *ejido* within the command area of the WUA could elect one representative (plus a replacement) to the assembly of the WUA. In addition, each municipality within the governing area of the WUA could appoint one farmer (plus a replacement) to represent the private growers.

The election of user representatives along existing institutional lines made it logistically and politically easy for government officials to visit these organizations and promote the transfer program to farmers. Furthermore, by embarking on these existing organizations and their internal power relationships, delegates of both *ejidatarios* and private growers—who normally are organized through their cooperatives and growers' unions (Foley 1995)— could be elected following the already existing procedures and patronage-oriented practices of electing delegates from within these organizations. As will be demonstrated in the case of ARLID, this sometimes resulted in the election of existing leaders, who used their new position in the assembly or board of the WUA to further strengthen their own economic and political networks (see section 6.6). Yet, irrespective of the political opportunistic and pragmatic choice to organize WUAs along existing lines of the agrarian structure, the IMT program was certainly ambitious in its attempt to bring two groups that differ so much socio-economically and politically together into one management organization.

Financial autonomy

As will be further demonstrated in chapter 7, WUAs are charged with fully recovering the cost of O&M at all system levels to achieve hundred percent financial self-sufficiency. Except for a negotiated percentage of the revenue from fees that the WUA has to pay to CNA for O&M of the dams, head works and the main canal system, all income can be used by the WUA. As such, the WUA is financially autonomous. Similarly, costs associated to O&M activities executed by CNA staff from the district offices are also to be paid out of irrigation fees. However, in practice some CNA staff at the district offices continue to be paid by CNA central office in Mexico City. As actual O&M costs differ from district to district, both the mechanism and levels of fee settings differ from place to place and may even vary between individual WUAs within the same district[2].

Arrangements for co-management

The introduction of the IMT program did not result in a complete replacement of the existing management agency (CNA) by new management entities (the WUAs), but rather was built around a framework of co-management between the two. IMT is implemented in two stages. In the first stage, WUAs will assume responsibilities for managing the irrigation district below the level of the main canal, while CNA retains the responsibility for managing the dams, head-works and main systems. An important strategy during this stage was that CNA agreed to work in a collaborative mode for a fixed period of six months from the time of transfer so that the new WUAs could gain experience with managing the secondary system before they where left on their own, both financially and managerially.

During the second stage of IMT, WUAs would federate themselves into Limited Responsibility Societies (LRSs) and take over responsibilities for O&M, administration and financing of the main system (canal and drains) as well, while CNA continues to have control over management of head-works and dams[3]. During both stages CNA would have monitoring, regulatory, training and advisory roles.

Political support from large farmers

CNA clearly decided to first transfer the larger irrigation districts in the north-west of Mexico to show that IMT was workable[4]. In these districts many large private producers would politically support this kind of neoliberal reforms. These farmers felt that by taking over responsibilities for O&M from the government, they would get an opportunity to better control the rehabilitation, modernization and efficient use of the irrigation facilities, which were needed to further expand their export oriented businesses (Gutiérrez 1998).

Low program cost

The organization of WUAs and training of agency staff and farmers come with a cost. However, the institutional development costs are a relatively small fraction of the World Bank's Irrigation and Drainage Sector program loan to Mexico, under which the IMT program falls: 1.9 percent (or 24 million US dollars) of the approximately 1.3 billion dollars. These costs equal to approximately 8 US$ per hectare (Meinzen-Dick *et al.* 1995)[5]. As to the farmers: CNA granted concessions to the WUAs to use its machinery and equipment to maintain the canals, which meant that (at least initially) WUAs were not confronted with high capital costs.

Training and policy promotion
The Mexican Institute of Water Technology (IMTA) started an extensive training program (financed by CNA) to leaders and technical staff of the WUAs. These programs focused on O&M and financial and administrative management (including the usage of computer packages) of the modules as well as on the general idea behind IMT. Other training programs were aimed at improving the technical skills of remaining CNA staff. Between 1992 and 1994 a total number of 5,214 participants attended these training programs, of which 68 percent were WUA staff and leaders, and 32 percent were CNA technical staff (Rendon *et al.* 1996). In addition, with the objective to promote IMT and to convince farmers to support the program, CNA ran an extensive mass media campaign prepared by communication specialists[6], along with universities and industry (Meinzen-Dick *et al.* 1995).

4.3 Supportive constitutional revisions: the new water law

Colby (1988) and Perry *et al.* (1997) see the existence of clearly defined water use rights or entitlements of all users under all levels of resource availability as one of the major preconditions for the establishment of cost-recovery through WUAs and the introduction of market forces into the allocation of water. The bases for current water rights in Mexico are laid down in the National Water Law (*Ley de Aguas Nacionales*) of 1992.

The law clearly follows and supports the kind of economic and political reforms in agricultural pricing and market policies that were discussed in section 3.3. In fact, it is crucial to the entire nature and existence of the IMT program as it gives central authority to the newly created CNA to coordinate and establish these policies. The revision of Article 27 of the Constitution of 1917 and the Agrarian Law thoroughly redefined land property rights, and also helped the government to phase out economic and legal obstacles to transferring property rights, and stimulate commercialization and commoditization of (*ejido*) land and national waters. In order to tune the exploitation of national waters and the use of federal irrigation infrastructure with these liberalization and market-oriented policies, CNA, the Ministry of Agriculture and Hydraulic Resources (SARH) and several other ministries and departments appointed a great number of economists, lawyers and environmentalists to evaluate the Federal Water Law of 1972 and to propose a new water law (Roemer 1997; Ramos-Osorio 1999). After a process of discussion and negotiation at the levels of the Cabinet, political parties, the House of Representatives (*Cámara de Diputados*) and CNA, the new law was passed without considerable changes in December 1992, less than a year after the revision of Article 27[7]. In comparison with the Federal Water Law of 1972, the new law provides for several arrangements that seek to facilitate, among others:

- users to create their own financial autonomous water user associations (WUAs) and participate in decisions and investments. This implied that new WUAs had to be created, to whom CNA could grant titles of water concessions and permits to use irrigation infrastructure (CNA 1996; Whiteford and Bernal 1996; Svendsen *et al.* 1997);
- users to assume responsibility for O&M activities;

- users to assume responsibility for O&M cost recovery and to financially contribute to the physical improvement of the infrastructure (Roemer 1997);
- the granting of water use rights (concessions) and rights to make use of irrigation infrastructure and facilities;
- the provision of certainty in user rights by creating a Public Registry of Water Rights (Roemer 1997; Ibarra-Mendívil 1996; Bray 1996);
- the possibility to transmit and market water rights between users within the same basin or between those who make use of the same aquifer (DOF 1992).

What do these revisions mean for the definition of water rights? As far as surface water is concerned, Mexico does not have a tradition in what Sampath (1992) classifies as riparian rights and prior rights. Instead, it follows an administered system of public allocation of rights. Generally, these rights are defined in terms of a proportion or share of flow or storage. Historically there is a clear difference between Mexican property rights of water and concessions (or usufruct rights). This concept of separating water property rights from use concessions was introduced during the Spanish period (Easter and Hearne 1995; Roemer 1997) and was re-affirmed in Article 27 of the Constitution of 1917. Nowadays, property rights for water are exclusively held by CNA, but CNA can grant concessions to individual users and WUAs. This means that under the new law, the allocation of water rights largely continues to follow an administered system, but it allows, within certain limitations, the marketing of concessions.

The National Water Law and its Regulations provide for CNA to grant three types of concessions that are relevant to the rights and obligations of WUAs and individual users in ARLID:

1. a concession to a corporate body for the use of national waters for agricultural purposes[8]. In the case of ARLID this means that concessions can be issued to WUAs[9].
2. a concession or permit to a corporate body or WUA to use or manage irrigation infrastructure[10]. If the federal government has participated in the financing, construction and O&M of the district, CNA has to hand over O&M to the users[11], organized in a WUA and following the bylaws of this organization[12].
3. a concession to an individual user for the use of national waters for agricultural purposes. This means that, in theory, concessions could be granted to individual water users for the use of surface water within each of the modules and to individual well owners within the district for the use of groundwater.

Once issued, these concessions have to be recorded in the Public Registry of Water Rights (REPDA), maintained by CNA and in theory open to the public[13]. Registration of concessions allows CNA and the hydraulic committee of the district to control whether actual volumes drawn do not exceed concessioned volumes. Furthermore, registration should give grantees legal certainty over their rights to use the water. Under certain conditions and regulations, CNA can authorize transfer of rights or concessions within a given basin or aquifer through a simple notice of change of the title holder and registration of this in REPDA. Concessions can be issued for periods ranging from 5 to 50 years and are renewable[14]. By granting them concessions, WUAs legally assume O&M responsibilities, which are monitored by CNA. These responsibilities include:

- carry out the O&M works necessary for the exploitation and use of the water;
- satisfy the requirements for efficient use of the water and ensure its reuse;

- develop and follow bylaws which include regulations with regard to (among others): decision making on distribution of water among members of the WUA, the form in which individual rights of members are guaranteed, the form of system O&M and investment in infrastructure, the forms of O&M cost recovery, and procedures for dealing with complaints and sanctions;
- fully recover O&M costs from the water users as well as to amortize the cost for capital investment related to construction and rehabilitation of irrigation facilities from the users[15]. WUAs are required to pay to CNA a certain percentage of the revenues from fee collection in order to pay for CNA services related to O&M of the dams, headworks and main canal system. The fee has to be presented to CNA for approval;
- prepare seasonal O&M budgets based on expected revenue from cost-recovery. Prepare monthly financial statements that show to what extent planned activities have been executed. These budgets and statements have to be sent to CNA for monitoring and recommendations for improvements;
- distribute the water among the WUAs according to operational rules and regulations that are set out by a hydraulic committee. And, distribute water among individual users following the operational rules and regulations set out by the particular WUA.

An important peculiarity of the law lies in the definition of consumptive use and return flows that determine which fraction of the concession is tradable (Rosegrant *et al.* 1995; Rosegrant and Gazmuri 1996). Unlike in for instance California and Colorado, the tradable proportion in a district like ARLID is not limited to consumptive use but rather is the full share including return flows. The law does not provide for third-party rights to return flows, which means that in effect these return flows, if any, are made available to downstream users at no charge. According to Cummings and Nercissiantz (1992) this reduces transaction costs to water trade. On the other hand, Rosegrant *et al.* (1995) caution that this system does not protect third parties against adverse impacts from water trades.

O&M rules under the new law

Following Ostrom (1990 and 1992) and Tang (1992), three layers of rules that cumulatively affect the management of Mexican irrigation districts can be distinguished. First, constitutional-choice rules determine who is eligible to participate in irrigation management, and who can be excluded as a user. They also determine the rights, ownership, authority and obligations of each institution involved in irrigation management. Changes in constitutional-choice rules automatically affect the definition of the second layer of rules, i.e. the collective-choice rules. Collective-choice rules are used by irrigation agencies, WUAs and sometimes other external agencies in making the policies for water management at the district level. These rules determine the general principles for allocating and distributing water between and to a lesser extent within modules. These rules indirectly affect the lowest layer of rules, i.e. the operational rules. Operational rules are used by WUAs, their technical staff and individual members to decide on day-to-day management decisions, including irrigation scheduling and distribution of water, canal maintenance, monitoring and evaluation procedures, modes of sanctioning and enforcement. Ostrom (1992) also argues that it is useful to distinguish between formal (or official) rules set by for instance legislatures, courts and other regulatory agencies, and informal rules set by informal collective-choice arenas such as gathering of users and private associations. In many cases one can find an interaction, if not co-existence, between these two orders of rules, which together determine the actual operational rules-in-use[16].

In the case of post-transfer Mexican irrigation districts rules and principles for O&M are founded at two levels. First, constitutional rules exist in the form of the National Water Law of 1992 discussed above. The act regulates the formal ownership and use of national waters and defines the rights and obligations of all water users with respect to capture, preservation, allocation, system O&M, registration of water rights, construction and rehabilitation of systems, and cost-recovery. Second, collective-choice rules are defined in two documents. The first document is the *O&M manual* (attached to the concession), which regulates the modes of water appropriation, allocation and distribution at the level of the entire district, monitoring of maintenance activities, and administration and cost-recovery (see below). The second document is the *bylaws* of the individual WUA, which regulates the mechanisms of user representation, conflict resolution and rights and obligation of the general assembly, the oversight committee and the executive board (see below).

As was discussed in section 1.3, O&M rules are one reflection (or manifestation) of an institutional policy. As these policies are an outcome of a political process of negotiation, modification and reproduction over institutional design principles, also these O&M rules should be seen as an outcome of such processes, rather than a set of formal and static norms that everybody follows they way they are supposed to. This will be further demonstrated in chapters 5 to 7.

4.4 Post-transfer institutional arrangements in ARLID

ACTORS INVOLVED

Five main groups of actors are involved in post-transfer institutional arrangement for managing ARLID: CNA, the WUAs, the Hydraulic Committee, the Limited Responsibility Society, and the individual users.

CNA

Prior to management transfer in 1992, the irrigation district was entirely managed by the CNA and its predecessors. The CNA employed heads of the irrigation units (now called modules) and ditch tenders who were responsible for daily O&M. Farmers had to go to the CNA offices to pay their fees. After transfer, these units were transferred to the WUAs. WUAs were made responsible for O&M of the district below the main canal, while officially CNA's role now is restricted to management of the four dams, headworks, and main canals[17]. The CNA district office is located in the town of Celaya and is headed by a chief engineer, who is also responsible for the management of the much smaller neighboring district of La Begoña.

Presently, CNA shares responsibilities for the operation and maintenance of the district with the newly created WUAs. Even so, CNA continues to be responsible for the overall management of the district and it plays important monitoring, regulatory, training, and advisory roles (see also box 3.1). Similar to the pre-transfer organization of the CNA district office, the chief engineer is assisted by a chief of operation and a chief of maintenance, as well as by several other technical and administrative staff. Also, the CNA district office continues to have zone or unit offices within the district, with staff responsible for daily O&M of the main canals and headworks.

WUAs

Each WUA is comprised of four managerial and institutional layers: the general assembly, the oversight committee, the executive board and the group of technical staff. Whereas the first three groups is comprised of water user members who have assumed non-paid positions within the WUA, the technical staff are paid professionals who are directly hired and controlled by the executive board of the WUA.

The general assembly elects representatives of both the *ejido* sector and the group of private growers. Following the bylaws of the WUAs in ARLID, each *ejido* within the service area of the WUA sends one representative plus an alternate to the assembly, whereas each municipality can also send one person to represent the sector of private growers. *Ejido* representatives are elected by the *ejido* assembly of which all *ejidatarios* are member. The *ejido* assembly is headed by a commissioner (*comisariado*) who presides the executive committee of the *ejido*. This committee plays a key role in helping *ejidatarios* to get access to the package of official support associated with *ejido* property. This package included crucial government services like preferential credit through BANRURAL, tax advantages, access to subsidized inputs and water and rights to common lands for grazing and pasture (Goldring 1996a). Being key persons in the interface between government services and *ejidatarios* often give the *comisariado* as well as the other members of the executive *ejido* committee prestige and political clout which they can use for accumulating social, economic and political power (Goldring 1996b). As a result, also the 'election' of *ejido* representatives to the assemblies of the WUAs is often controlled by the *comisariado* and other powerful *ejido* members, which justifies a certain level of skepticism about the level representation and democracy within the general assembly of the WUA (see chapter 6 for examples).

The main rights and obligations of a general assembly include:

- to elect the executive board and the oversight committee;
- to approve the seasonal operation and maintenance programs;
- to approve the annual budget;
- to approve the level of the proposed irrigation service fee.

Box 4.1 Some rights and obligations of the executive board of a WUA

- Administer and direct the affairs and resources
- Agree, sign, amend and renew contracts
- Acquire immovable and movable property needed
- Represent the WUA before the authorities
- Oversee all matters related to administrative and technical staff in order to exceed the budget
- Carry out resolutions adopted by the general assembly
- Monitor O&M and administration in accordance with the authorized agricultural planning
- Forward to the CNA for its information and approval the O&M budgets
- Issue calls for tenders and official correspondence
- Submit a detailed financial statement to the general assembly at least annually.

Source: Gorriz et al. 1996: 26

The general assembly elects from their members an oversight committee, which is comprised of farmer inspectors from the groups of *ejidatarios* and private growers as well as from the CNA district office and the state government. The oversight committee's main task is to inspect the accounting records, assets, inventory and reconciliation of bank accounts of the WUA (Gorriz *et al.* 1996). The general assembly's most important task is to elect and control the executive board of the WUA.

The board is comprised of a president, a secretary, a treasurer and their deputies. According to the bylaws (which each WUA in ARLID has formulated), every three years the entire board has to be replaced, and re-election of board members for another three years is not allowed. Also, every three years the office of the president of the board has to alternate between the groups of *ejidatarios* and private growers.

The duties of the executive board are summarized in box 4.1. The general assembly of the WUA meets several times per year[18]. The board calls meetings, particularly to discuss issues related to the annual irrigation plan, fee setting, finances, and maintenance and rehabilitation programs. Often these meetings are also used to exchange information about market prices of inputs and produce, problems with pests and diseases, and other relevant agricultural information. Occasionally experts from CNA, other public agencies or commercial companies are invited to give short courses or presentations to the members of the assembly on a wide range of subjects, ranging from water use efficiencies to the applications of a new variety.

The positions in the general assembly, oversight committee and executive board are honorary and unpaid. WUAs employ their own general managers (*gerentes*), ditch tenders (*canaleros*) and maintenance and administrative staff, paid out of the fees which the associations collect from its members. This group of technical and administrative staff is accountable to and is controlled by the board. Together, the board and the technical staff are responsible for delivering a number of O&M and administration services to the members of the WUAs. These services are summarized in table 4.1.

Table 4.1 O&M service provision from WUA to water users

Type of service	Description
System operation	• negotiate seasonal dam releases and irrigation schedule in HC • preparation of seasonal irrigation schedule • delivery of irrigation at the right place, the right time and sufficient for the hectares that the user has paid a turn for • monitoring of operations • water theft prevention and conflict resolution between farmers • technical advise on how to use water more efficiently • channeling complaints and requests via HC to CNA
System maintenance	• preparation of seasonal maintenance plan • cleaning of secondary canals and drains • maintenance and repair of structures and service roads • monitoring of cleaning of farm ditches • channeling complaints and request via HC to CNA • negotiate better O&M service provided by CNA (for dams, headworks and main canal)
System improvements	• minor system improvements • information on externally funded system improvement programs • facilitate access to externally funded farm improvement programs
Administration	• preparation and presentation of O&M budgets • setting and negotiating of fee levels in HC • administration of fee collection • inform users about actual fee levels • maintaining and updating the list of users • administration of farmers' cropping patterns

Hydraulic Committee

Also in 1992, a hydraulic committee was formed at the district level. By law, each district should create such a committee, which is comprised of representatives of CNA, the presidents of the WUAs and the State (i.e. the Secretary of Agriculture). One of the most important obligations of this committee is to formulate the O&M rules and regulations of the district and monitor whether those who have been given user concessions follow these rules. Under these rules, the hydraulic committee also has to develop and approve the seasonal operation and maintenance programs (see chapter 5). These approvals need the signature of all committee members. For ARLID this implies that WUAs hold 11 votes, whereas CNA only holds one vote. However, in addition to carrying the signature of the 11 presidents and the CNA chief engineer of the district, all seasonal irrigation plans are generally also signed by the CNA State manager and his deputy, as well as by the State secretary of Agriculture and two other officials from SAGAR. The tasks of the hydraulic committee are summarized in box 4.2. Hydraulic committee meetings are chaired by the chief engineer of the district. Occasionally CNA officials from the State, regional or even central offices participate in the meetings of the committee to discuss issues that go beyond the boundaries of the district. Examples of such issues include management of multi-purpose dams, basinwide allocation of water, or access to State or federal funds that are channeled through CNA offices at the State, regional or central levels.

Box 4.2 Some obligations of the hydraulic committee at the district level

- Formulate the O&M rules of the district and present these to the CNA for approval
- Call committee meetings and distribute the minutes with all decisions to the users
- Monitor the annual irrigation and maintenance plans
- Conduct studies and implement programs related to better use of water, soils and infrastructure
- Monitor the cost-recovery program
- Promote training programs and technical assistance provided by the CNA

Source: Article 99 of the 1994 regulations to the National Waters Act of 1992.

Limited Responsibility Society

A fourth and more recent group of actors that are involved in the management of irrigation district are the Limited Responsibility Societies (LRSs). During the second stage of irrigation management transfer, LRSs have taken over from CNA actual O&M as well as financial responsibilities for the main canal system. The LRS federates all WUAs within the district and is comprised of the WUAs' presidents. The LRS hires technical staff such as a general manager, heads of operation and maintenance, ditch tenders for daily O&M of the main canals as well as administrative staff.

Individual users

All users that have land within the command area of the irrigation district and are registered within the list of users (*padrón de usuarios*) held by both the WUAs and CNA, are members of the WUA. Unlike similar participatory irrigation reform programs in for instance South Asia, the Mexican IMT program does not aim to maximize direct participation in O&M of all users but involves farmers through their representatives on the general assembly. Although formal direct participation in decision making processes does not take place, individual users can have indirect control over O&M related decisions by channeling their complaints and suggestions to the board and the general assembly via their representatives. Individual users do also approach board members directly to air their problems or ideas. The most common way used by individual members to have influence over daily and weekly O&M schedules and practices is to approach the ditch tenders or general manager of the WUA directly.

In general, individual users have two obligations: follow the O&M rules and regulations that are set out by the district and the WUA, and fully pay the cost related to the O&M service that is provided by the WUA and CNA. The O&M rules and regulations say, for instance, that all farmers need to clean their field ditches (or tertiary canals) prior to paying and receiving the first irrigation. In return, farmers have the right to receive the irrigation turn they have requested and paid for, as well as to be kept informed by their representatives about the decisions made by the board and the general assembly.

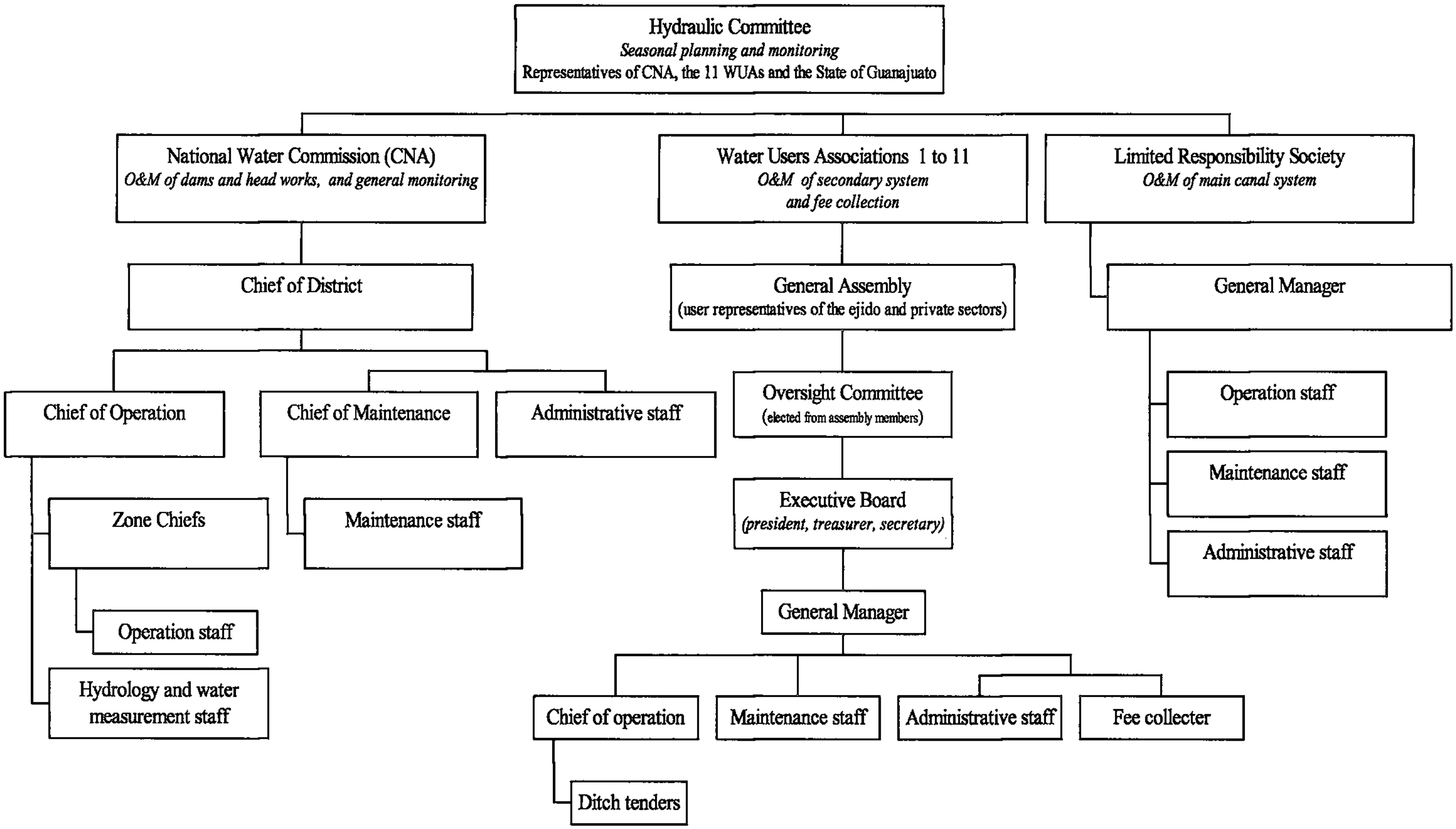
INSTITUTIONAL RELATIONSHIPS

Figure 4.2 shows the organizational set-up of the district after transfer. The figure clearly shows that, in theory, CNA and the WUAs are equal partners who are both responsible for managing O&M at different system levels. It also shows the central role of the hydraulic committee in having the agency and the WUAs together decide on issues related to planning the irrigation season.

Figure 4.3 shows the most important relationships between CNA and the users involved in O&M of the system during the pre-transfer period. Similarly, figure 4.4 shows the relationships between the four organizations (CNA, the hydraulic committee, the WUAs and the LRS) and the users since the introduction of IMT in 1992. Each of these relationships will be discussed in detail in the chapters that follow, but some general characteristics are briefly discussed here, basically to illustrate the kind of complex institutional transformation the organization of O&M has undergone. The institutional relationships between CNA and the users can be described by the four mechanisms that are studied in order to unpack the new institutional relationships (see section 1.3).

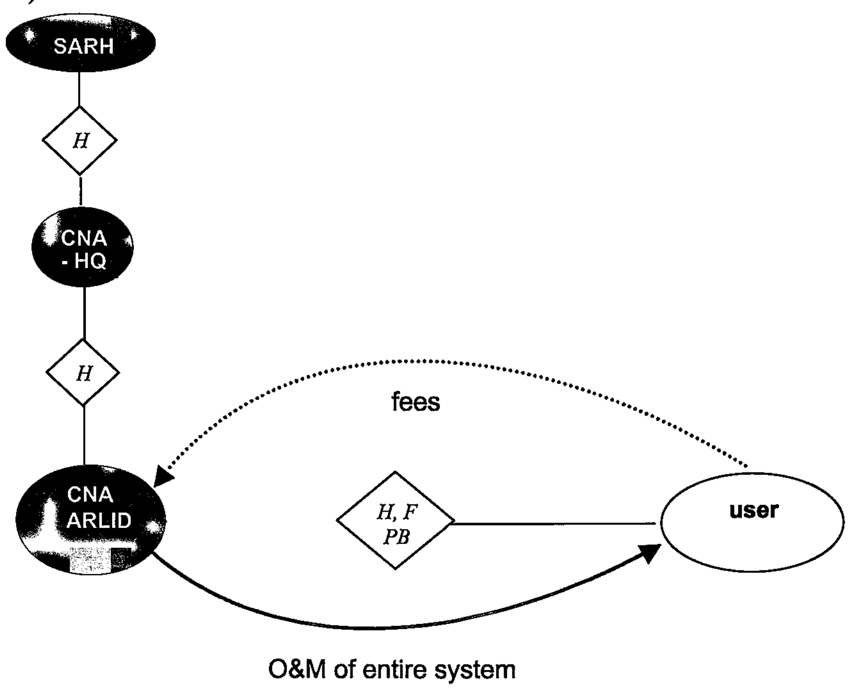
Relationships between different actors and groups are generally determined by more than one of these mechanisms. In addition to these mechanisms, the figures also show the most important O&M services delivered by each managing organization as well as the kind of payment that others have to make to receive these services and as such describe the accountability mechanisms between the actors. Although the figures highlight the delivery of O&M services in return for fee payment, other accountability relationships also exist. Examples of these are, delivery of improved maintenance services in return for political support, or illicit delivery of water in return for bribes (chapter 7). However, for reasons of clarity, these accountability mechanisms are not shown in both figures. For the same reason, external actors that influence these mechanisms (such as local politicians and other government agencies) are also not shown in the figures but their roles and relationships are discussed in the relevant chapters that follow.

Figure 4.2 The organizational structure of ARLID after transfer



Before transfer, O&M at all system levels was bureaucratically managed by agency staff from the CNA district office. This means that relationships between the agency and the water users were primarily administrative (based on instructions on how to follow bureaucratically set irrigation schedules) and financial. Farmers were hardly involved in decision making processes related to developing and executing O&M plans. In return for the provision of O&M services, farmers had to pay the agency an irrigation fee. However, as will be demonstrated in chapter 7, cost recovery rates were very low resulting in financial self-sufficiency rates as low as 15 percent during the early 1980s. An important reason that contributed to these low cost recovery rates, were the poor O&M service provided by the agency. As a consequence of these low rates, the agency found it even more difficult to improve the service. As is described in detail by Zaag (1992), who studied irrigation management practices during the pre-transfer period in another irrigation district, ditch tenders hired by the irrigation bureaucracy formed the day-to-day linkage between the users and the agency.

Figure 4.3 The most important relationships between CNA and users prior to IMT (1989-1992)



Relationships:

H = hierarchical (administrative directives, authorization, bureaucratic control)

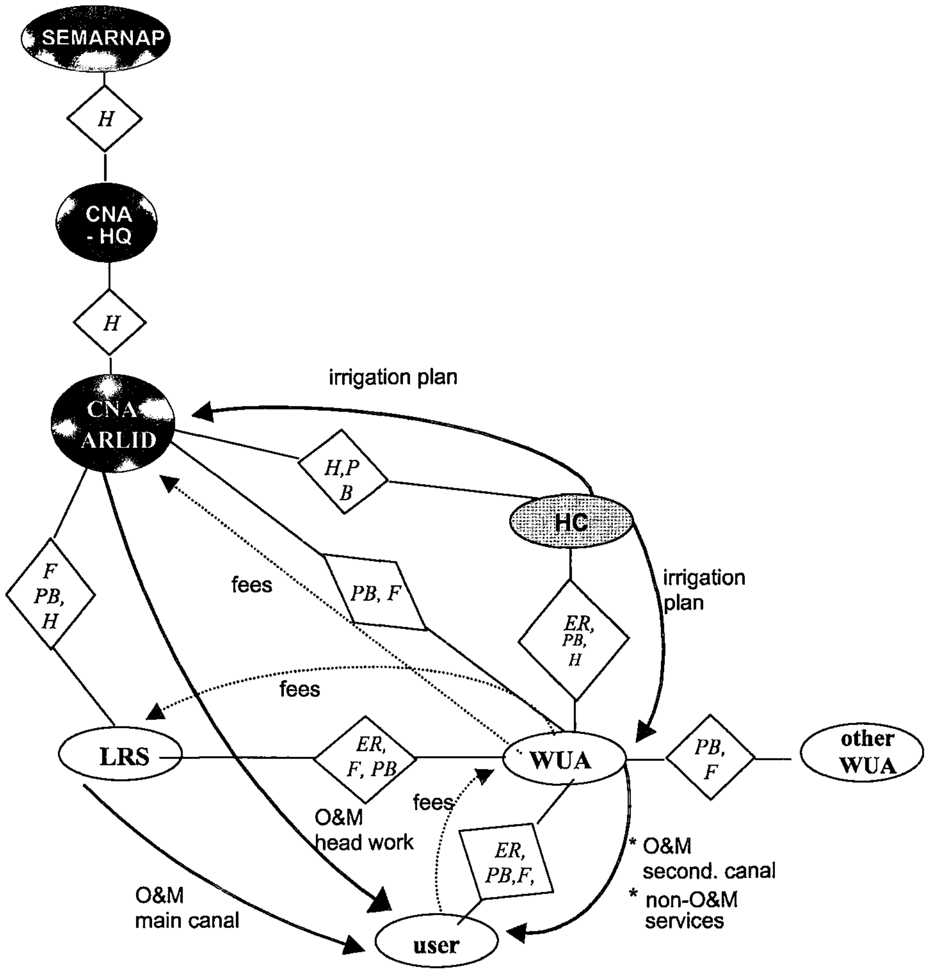
F = financial (fee payment, rent-seeking, bribes)

PB = political bargaining (negotiation, lobbying, political and moral persuasion, pulling votes)

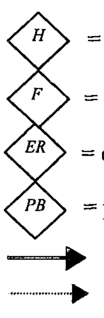
→ flow of service

⇢ flow of payment

Figure 4.4 The most important relationships between irrigation management organizations and users after IMT



relationships:



= hierarchical (administrative directives, authorization, bureaucratic control)

= financial (fee payment, rent-seeking, bribes)

= electoral / representation (elections, agreements, solidarity)

= political bargaining (negotiation, lobbying, political and moral persuasion, pulling votes)

flow of service

flow of payment

As real 'frontline workers' these ditch tenders had to maintain good working relationships with both their employer and the users. Generally, this meant that ditch tenders tended to be more accountable to the users, with whom they had daily contact, than to the agency from whom they receive a salary irrespective of the quality of their work performance. In addition to these weak mechanisms of administrative and financial accountability, relationships between users and lower agency staff at the field level were further characterized by high levels of rent-seeking, bribing and favoritism (see chapter 6).

The post-transfer accountability relationships are discussed in detail in the three chapters that follow, but a quick comparison between figures 4.3 and 4.4 immediately points to a number of major changes in the way O&M is now organized. The first obvious difference is the dramatic increase in the number of formal organizations within the district involved in managing O&M. Three new organizations produce the link between the agency and the users: the WUAs[19], the hydraulic committee and the LRS. As will be demonstrated in the chapters that follow, ditch tenders (who are now employed by the WUAs) continue to be important 'middlemen' between the users and the management organizations. Yet, users can now find more easily direct ways to the new management organizations, of whom they are members and to whose assemblies they directly elect user representatives.

Another major difference between the two figures is the change in payment flows. Users now pay their fees directly to the WUAs, who in their turn pay a percentage of their revenue to CNA (and later also the LRS). This means that CNA has now become directly dependent on the WUAs for their income.

A third observation that can be made by simply comparing the two figures, is that in addition to the three sets of relationships that already existed before management transfer was introduced, another set of relationships has become important: electoral. This implies that under the current management arrangements, relationships between users and managers are now, at least partially, determined by mechanisms of user representation, solidarity and democratization as well (see chapter 6).

One important aspect that cannot be shown in both figures, is that several groups of actors are comprised of persons that are also member of other groups. The most obvious example is that of the presidents of the 11 WUAs, who do not only lead their own associations, but also represent these associations in both the hydraulic committee and the LRS. Similarly, the CNA chief engineer of the district is responsible for managing the dams and main infrastructure and also chairs the meeting of the hydraulic committee. This situation could imply that in some cases these actors might have to defend conflicting interests. This will become clear, for instance, in the case of negotiating the volumes and prices of water that is traded between the WUAs. As leader of a WUA that wants to sell water, the president needs to negotiate the highest water price possible (see chapter 8). At the same time, however, he is also member of the LRS, whose success in replacing CNA in main system management is built on a high level of solidarity among the eleven presidents of which the LRS is comprised. This required level of solidarity might conflict with demanding a high water price from fellow WUAs that desperately need water but cannot afford to pay high market prices. Finally, the same president is member of the hydraulic committee, which has to guarantee that water marketing does not negatively affect the access to water by all WUAs.

4.5 Implementation of irrigation reforms in ARLID

POLICY IMPLEMENTATION PROCESS

The IMT process at ARLID started in 1992, with CNA officials paying visits to the 281 *ejidos* in the district. More than 470 promotion meetings were held with farmers to convince them of the assumed benefits of the IMT program and the need to raise water fee levels (Gorriz and Groenfeldt 1995).

During the second half of 1992, each *ejido* within the module area had to elect its delegates to the general assemblies of the WUAs. Subsequently, these delegates elected their boards. Irrigation fee levels were established for each WUA, using a methodology designed by CNA based on the volume that each WUA is buying. The percentage of total fee collection to be paid to CNA was negotiated (see chapter 7). By November 1992, all eleven WUAs had officially assumed responsibilities for fee collection and O&M of the infrastructure below the main canals. From June 1992 to December 1994, CNA provided 18 training courses (table 4.2). These courses were mainly directed at the technical staff of the new WUAs and focused on the concept of IMT, system O&M, and seasonal planning. By November 1992, the new WUAs started hiring their own staff, but until mid-1993 CNA helped the WUAs to manage the distributary canals and those below them.

In 1992, concessions permitting WUAs to use the infrastructure were signed between the WUAs and CNA. As will be further discussed in chapter 8, by law, these usufructuary rights should be accompanied by volumetric water concessions. In the case of ARLID, these volumetric concessions are based on the average volume of water of 880 Mm^3/year (see table 2.1) available in the four reservoirs at the start of the agricultural year for the period 1949-94. Each WUA is entitled to a share of this volume proportional to the area of the module under canal irrigation, provided that the volume is available at the start of the season. By law, these volumes should be registered in REPDA at CNA. However, by April 1997, although signed by CNA, these volumetric concessions had not been passed on to the register.

CNA, through its training and research institute IMTA, provided many training programs to leaders, farmer representatives and staff of the new WUAs as well as to remaining CNA staff. In the first two years after transfer 331 persons participated in these courses (table 4.2). Later, other government agencies such as the ministry of agriculture, universities and international institutes like IWMI provided free short technical training programs or organized workshops in which experiences and problems related to IMT were discussed. More recently, the national association of water users association (ANUR) has created the National Center for the Transfer of Irrigation and Drainage Technology (CENATRYD) with funding by the WUAs, CNA, and the Spanish International Cooperation Agency. This center receives technical support from IMTA and will provide continuing training to ANUR's own staff, CNA staff, and technical and administrative staff from the WUAs (De León-Mojarro *et al.* 1999). Occasionally WUAs themselves hire experts to help them out with technical problems, particularly in the field of installation and use of computer software for financial administration systems.

Table 4.2 Training courses for technical staff and leaders of the WUAs in ARLID, as part of the IMT process (1992-1994)

Year	Month	Title	Participants
1992	June	Regional course on irrigation management transfer	1
	August	Seminar to promote and initiate irrigation management transfer of irrigation districts	1
	September	Course on transfer, for the CNA heads of irrigation units	8
		October and November 1992: IMT	
	November	Regional course on system operation	2
	December	Management course, for leaders of WUAs	37
1993	February	Professional practice course on operation of the secondary canal system in Abasolo, Huanímaro and Corralejo	34
	March	Professional practice course on operation of the secondary canal system in Salvatierra and Acámbaro	28
	May	Professional practice course on operation of the secondary canal system in Jaral, Valle and Cortazar	32
	July	Professional practice course on operation of the secondary canal system in Irapuato, Salamanca and La Purísima	21
	August	Course on the design of irrigation plans, for WUAs	42
	October	Course on water distribution	85
	November	Diploma in drainage and salinity control	1
	November	Workshop on technical improvements in canal irrigation	2
1994	February	Course on efficient use of water and energy	30
	February	Workshop on aero-mapping (AU2) of irrigation districts	1
	September	Diploma in the planning of the improvement of production in irrigation districts	1
	October	Course on AU2 in Windows	2
	December	Workshop on technical improvements in canal irrigation	3
Total			331

Source: CNA district office, Celaya.

THE ESTABLISHMENT OF WUAS AND THE LRS

Being used to paternalistic agencies and centrally controlled agricultural development programs, the sudden message that farmers now had to assume management and financial responsibilities for operating national water resources and their associated infrastructure came as a surprise to most water users in ARLID. All farmers had experienced a deterioration in the provision of O&M services over the last two decades and were concerned about the viability of their irrigation resource. But few farmers would have thought that the government would transfer the control over water resources and irrigation facilities so easily into the hands of the users. Similarly, as a result of the neoliberal reforms all farmers had faced a dramatic reduction in all kinds of agricultural support services, such as credit programs and subsidized inputs. But few would have imagined that the neoliberal thinking would imply that most CNA staff in the district were going to be made redundant and that farmers themselves were being made responsible not only for controlling the management of large parts of the system but for financing O&M services as well. Hence, the idea that CNA would transfer much of its control over valuable resources to the farmers was completely new to most of the farmers and they found it hard to respond swiftly to it in a more or less organized way.

Irrespective of the massive promotion and training campaigns, elected WUA leaders, user representatives and common water users alike reported that they had no idea what the exact implications of the management transfer would be. However, the campaigns were certainly successful in getting two messages across: that the IMT program would definitely be implemented, with all its managerial and financial consequences for the farmers; and, that farmers were given the opportunity to gain full control over cost-recovery and hence to use this income to considerably improve the quality of O&M. Particularly the latter message was welcomed by farmers that actively sought to become involved in the new WUAs, either out of a genuine belief that the provision of O&M could be improved and be delivered at a lower cost to the farmers, or out of personal and opportunistic financial and political motivations to have a greater stake in the control over large amounts of funds and resources, or both.

Initially, many farmers were doubtful and reluctant to accept the program. One of the reasons for this was that they were afraid that, given their large ideological and sometimes economic differences, private growers and *ejidatarios* could never cooperate in the same management organization. Many *ejidatarios* feared that private growers would assume most of the control over resources and decision making processes. Yet another group of farmers believed that the control over irrigation resources should maintain with paternalistic state agencies in order to avoid conflicts between politically and economically divided groups of water users. Although these farmers initially resisted the IMT program, they soon came to realize that the implementation of the program was a fact and that there was not going to be a way back to traditional government controlled management.

In ARLID water users never succeeded in effectively mobilizing their resistance, as many farmers realized that openly opposing CNA could have a negative impact on their personal access to government assistance. Even though CNA's control over canal irrigation was going to be reduced, farmers knew that in the future they still would have to deal with the agency. For instance, at the time of management transfer (and as a result of the new National Water Law), CNA had also started the process of updating and recording concessions for the use of groundwater. Many farmers knew that they still needed CNA to get their groundwater concessions recorded in REPDA and thereby safeguarding their rights to use groundwater. Similarly, even in the early stages of the transfer program, it became clear that CNA would continue to be the agency through which all kinds of funds for government and externally financed system improvement programs would be channeled. Hence, farmers were afraid that open resistance to CNA would jeopardize their future access to these programs.

Two examples from Cortazar illustrate how the newly elected WUA leaders came to know about the program and how they got involved in managing the WUA. The first example shows the experience of the first president of Cortazar WUA, an *ejidatario*. This person lives in one of the 35 *ejidos* that are located within the governing module area of the WUA. Although he comes from a well known and influential family, he and his family never played important roles in wider regional social and political networks. His farther used to occupy 43 hectares of *ejido* land, which were divided between his sons after he died. When the new president assumed the position as the first president of Cortazar WUA, he owned 8 hectares of land. Virtually all of this land was irrigated by private deep tubewells. Although his father never made it to the *comisariado* (head) of the *ejido* assembly, as the assembly member responsible for organizing access to national credit programs for *ejidos*, he certainly had an influential and well respected position within his *ejido*.

His son, who was in its early thirties when the IMT program was started, first learned about transfer when CNA officials called a meeting. In this meeting water users were simply told that farmers had to take over O&M tasks and become responsible for fee collection as well. They were also told that this would result in better O&M and lower fees at the same time. During this meeting few farmers argued against the program. According to the new president, farmers were used to be informed about new government programs and activities in this way and to even sign in on government programs without knowing what they meant. During this same meeting, CNA officials also told the farmers to appoint representatives from each *ejido* as well as from the group of private growers. Out of these groups, 10 candidates had to be nominated as new leaders of the WUA board. During the meeting farmers were also told that the first president should be elected from the group of *ejidatarios* "as they occupy the majority of land". To the president's own surprise, his name showed up several times during the election.

Although he felt he was too young, inexperienced and certainly too ignorant about the transfer, he said that he accepted the position as first president of the new WUA as it would provide him opportunities to gain some management experience and above all to expand his social network. According to him, it took him and his fellow leaders quite some time to fully realize the financial and legal implications of this new management arrangement between CNA and the association. As they had no idea about the actual cost of managing the system, they simply accepted the 'negotiated' high percentage of almost 27 percent of the total fee collection that the WUA had to pay to CNA; which they later regretted. On the other hand, the president is very positive about the way CNA helped them to get started with the new WUA and to manage the system. He was impressed with CNA when the agency offered them the keys of the heavy machinery, even though much of the machinery was in total disrepair.

The story of the first treasurer (and later president during the second administration) of the WUA draws a similar picture of the transfer process in Cortazar. Like the *ejidatario* that became the first president, the treasurer first learnt about the IMT program in the meeting that was called by CNA. Being a large export-oriented private grower, with 25 years of farming experience in the United States, he is a well known and respected person within the entire district. He cultivates more than 500 hectares of land, not only in Cortazar but also in other module areas and even in other States. In addition, he owns a bull farm, with more than 300 bulls, and he is a leading person in one of the producers cooperative in the city of Salamanca. When CNA told them to nominate candidates to represent the group of private growers in the new WUA, he was elected unanimously. Other private growers thought he was the ideal candidate because of his extensive business oriented experience, management skills and important networks. Furthermore, initially hardly any other private grower was interested in the IMT program (which is geared at managing canal water) as for irrigation most of them rely on their own private deep tubewells. So there were simply not enough candidates that were interested in representing the group of private growers within the new association.

Although he was used to administer financial and commercial matters, he noted that also he lacked the experience of managing an irrigation system. When he started as a treasurer he found it difficult to assess the actual costs associated with operating and maintaining canals and other irrigation facilities. Which, according to him, is the reason why initially he also accepted the agreement to transfer 27 percent of revenue from their fee collection to CNA. Only after having managed the system for two or three years he started to realize that this percentage did not reflect the actual cost of managing the main system and the district headworks. At this point he started to openly discuss the possibility of taking over O&M responsibilities for managing the main canal from CNA as well.

The creation of the LRS

Unlike the establishment of the WUAs, the creation of the LRS in 1997 was a process which was greatly determined by the water users themselves. Creation of LRSs was already planned to happen under the second phase of the IMT program but in the case of ARLID, leaders of most WUAs played a very active role themselves. Only WUAs that pay a relatively low percentage of their income to CNA initially resisted to the idea of federating the WUAs into a LRS, as they were afraid that this would increase their financial contribution to managing the main system. Yet, the majority of the WUAs liked the idea of a LRS for five reasons:

1. As noted by the first treasurer of Cortazar WUA, after a few years of management experience the WUAs got a better feel for the actual costs related to managing a system and they realized that it could be done at much lower costs than what they were paying CNA. This idea was supported by the National Association of Water Users (ANUR), whose number one priority at that time was to try to reduce the overall financial contribution of WUAs to CNA[20].
2. Although WUAs were transferring large amounts of their income to CNA, they felt that they did not receive the kind of O&M service they had paid for. WUAs were particularly concerned by the lack of maintenance in the main canals and in fact had started to clean some sections of those canals themselves (see chapter 9).
3. Irrespective of the large reductions in CNA staff already made, leaders and technical staff of WUAs felt that CNA was still employing too many redundant staff, particularly in the CNA field (or unit) offices. They felt that their financial contributions to CNA only served to keep this staff in their positions.
4. Particularly leaders from Cortazar and Valle felt that once they had created a LRS, it would be easier to get access to all kinds of externally funded system improvement programs. More importantly, they had experienced that so far they had not had any control over the cost and quality of the works as they were not involved for instance in selecting the companies to whom the contracts were granted.
5. Leaders from business oriented WUAs like Cortazar, Valle, Jaral and Salamanca felt that once the LRS was created it would be easier to also establish sideline companies that deal with the bulk marketing of seeds and agro-chemicals and to construct a storehouse for their own produce.

During the course of 1996, the idea of creating a LRS was heavily discussed, not only in meetings of the hydraulic committee but also at regional and national seminars and workshops on irrigation related issues. The idea was further openly supported by the then Secretary of Agriculture to the State of Guanajuato (who runs a large commercial farm in Cortazar module) as well as by the then Governor of Guanajuato, a member of the center-right opposition Partido Acción Nacional (PAN) and advocate of neoliberal agrarian reforms[21]. The idea also received a positive response from both the CNA State office of Guanajuato and the head of the district in Celaya. Although the latter person would lose most of his staff (see below) as a result of this development, he accepted it as part of the official IMT program strategy and never argued against it in public.

The most important discussion held, not only between the LRS and CNA but also among the individual WUAs, was the level and distribution of financial contribution by WUAs to both the LRS itself and CNA. As to the height of the contribution: it became clear that CNA would receive much less as it would only continue to be responsible for managing the headworks and dams. Furthermore, unlike the existing arrangement between CNA and the WUAs in which the percentage of contribution differed from WUAs to WUAs[22], leaders now argued that all WUAs equally benefit from O&M of the district head works and hence would pay an equal percentage of their fee collection to CNA. This percentage was negotiated at 9.5 percent, down from for instance 28 percent in the case of Valle and 11 percent in the case of Salvatierra.

In addition to having to contribute to CNA's costs of managing the headworks, the WUAs also had to pay the LRS for managing the main canals[23]. Those leaders that had actively advocated and initiated the creation of the LRS argued that all WUAs would have to pay an equal percentage of their revenue to the LRS. However, as this would imply that some WUAs would see their total contribution be reduced by half and others would have to accept a 100 percent increase, it was decided to initially differentiate between the WUAs. All WUAs have started to pay the LRS the difference between the 9.5 percent for CNA and their previous overall contribution to CNA. In that sense, the creation of the LRS has become cost neutral for all WUAs. However, the main target of the LRS is to use this income more effectively by considerably increasing the quality of O&M services at the level of the main canals.

4.6 Conclusions

With the introduction of the IMT program in the early years of the 1990s, the Mexican government started a very ambitious policy reform program, aiming at a rather dramatic change in the institutional set-up of irrigation management in Mexico. This program has been applauded worldwide, mainly because of its high pace of implementation and the fact that more than 90 percent of the irrigated area under agency management has now been transferred to newly created local user associations. As a result, by the end of 1998 new WUAs were established in 77 of the 81 large-scale irrigation districts in the country (Ramos-Valdés *et al.* 1999).

Irrespective of the effectiveness and the viability of these reforms, it is worth summarizing the conditions that made the implementation of the new WUAs for the provision of irrigation services possible on such a large scale in a relatively short period of less than 10 years:

- it was part of a much wider set of similar neoliberal policy reforms;
- it received the political commitment at the highest policy level to reduce redundant agency staff;
- it was accompanied with a new water law, that defined property rights over water and provided the new service organizations with clear rights and responsibilities;
- it was built around clearly defined boundaries;
- it was developed on already existing strong institutional and ideological basis for user representation in the new organizations;
- it was clear about its financial targets: total cost recovery from the users as well as financial autonomy of the service organizations;
- it was clear about the extent and content of arrangements of co-management during the transition phase from agency management to user management;
- it received the political support from large groups of economical powerful farmers;
- it was established at a relatively low cost;
- it was made possible through extensive promotion and training campaigns.

The above constitutional revisions and implementation strategies have certainly supported the adoption of IMT on part of the local users. On the other hand, one has to realize that the water users were left without a choice. The government was firmly committed to reducing its role in the provision of irrigation services. Furthermore, the government succeeded in convincing large groups of farmers that users themselves could probably do a better O&M job than the government, at a lower cost. This made users realize that there was not going to be a way back. This in part explains the relatively low level of farmer resistance to these reforms. However, as will be demonstrated in the following chapters, of equal importance has been the fact that the supportive attitude chosen by CNA to implement IMT in the way as it was described in this chapter. They provided the kind of credibility and institutional flexibility to jointly start the process of creating mechanisms of accountability. It will be demonstrated that these mechanisms are important to make the newly introduced institutional design principles work, rather than the implementation of the principles itself.

Notes

1. Unfortunately, I do not have post-1994 staff numbers for all districts. See table 6.4 in chapter 6, for changes in staff numbers in ARLID.
2. The most commonly found way of fee setting is a fee per hectare per irrigation turn, irrespective of the crop that a farmer grows. However, differentiation of fees per crop also exist. Generally farmers pay per irrigation delivery (normally with planned water depths per turn; hence indirectly a volumetric payment per hectare). However, in some districts farmers pay a seasonal flat fee, irrespective whether they receive water at all or the number of deliveries.
3. So far, Limited Responsibility Societies have been created in nine of the eighty irrigation districts, including ALRID in February 1997.
4. The first districts that were transferred were Culiacán-Humaya (1990-92), Río Mayo (1991), Río Fuerte (1992) and Río Yaqui (1991-92) in the North-east and Delicias (1991-92) in the North (CNA 1994).
5. In comparison, institutional development costs of the participatory irrigation programs in the Philippines totaled US$ 25 per hectare, or 3 percent of the construction costs (Meinzen-Dick *et al.* 1995).
6. Meinzen-Dick *et al.* (1995:13) mention that these campaigns were coordinated by communication specialists from FAO. However, as far as I know CNA and FAO never came to an agreement on this and consequently the promotion campaigns were coordinated by IMTA. For these promotion campaigns IMTA produced a number of videos (of which several scenes were shot in ARLID) on the preliminary results of the IMT program.
7. Among the few issues that were actually discussed in the House of Representatives, was to what extent the State could allow private initiative in the construction and use of government infrastructural facilities. However, the consensus of these discussions seemed to be that the time of paternalistic State control over irrigation facilities was over, and that a thorough revision of the existing water law would help to tune irrigation development policies to other process of liberalization and privatization (Ramos-Osorio 1999).
8. Ley de Aguas Nacionales, article 50-I.
9. In legal terminology, WUAs are referred to as Civil Associations. In order to exempt civil associations that operate and maintain irrigation systems from paying income taxes over their fee collection, the Value Added Tax Law (*Ley del Impuesto Sobre la Renta*) had to be modified (Palacios-Vélez 1994).
10. Ley de Aguas Nacionales, article 50-II.
11. Ley de Aguas Nacionales, articles 64 and 65.
12. Ley de Aguas Nacionales, article 51.
13. Ley de Aguas Nacionales, articles 30 and 31.
14. Ley de Aguas Nacionales, article 24.

15. The National Water Law is subject to a number of laws that regulate federal property rights. These laws include the Contribution to Improvements of Public Works for Federal Hydraulic Infrastructure Law (*Ley de Contribuciones de Mejoras para Obras Públicas de Infraestructura Hidráulica Federal*) and the Federal Rights Law (*Ley de Derechos Federales*) (Roemer 1997).
16. The same concept of co-existence between legal construction of State and other formal legislative law and customary, often community based, people's law is dealt with in-depth in the legal pluralism literature (for theoretical overviews of this literature, see von Benda-Beckmann 1992 and von Benda-Beckmann *et al.* 1998; for the application of the concept of interaction between relevant legal frameworks in irrigation management, see de Jong 1989 and Spiertz 1992). A somewhat different piece of literature on legal pluralism in water management is chapter 6 in Maass and Anderson (1978). Rather than showing how state and people's law co-exist, they provide a fascinating case how the new system of prior appropriation derogated the generally accepted common law.
17. In February 1997 the LRS was created, which federates the 11 WUAs of ARLID. As the operation of the LRS became only effective in early 1998, its performance is not described in this thesis.
18. According to their bylaws, the general assemblies should meet at least once every two months.
19. For reason of clarity, in Figure 4.4 only two instead of 11 WUAs are included. This is only to emphasize that relationships also exist between two or more WUAs.
20. The National Association of Water Users (*Associación Nacional de Usuarios de Riego*, ANUR) was initiated in 1994 as a result of the First International Seminar on Transfer of Irrigation Districts (held in Cd. Obregón) and federates all Mexican WUAs. The association's objectives include the promotion of and gaining access to system improvement projects, training, studies, legal and financial assistance for all WUAs and LRSs. In that sense it works in close collaboration with CNA and IMTA, but it certainly also has it own policy agenda. Reducing the financial contributions of WUAs to CNA ranks very high on this agenda. Other issues for discussion and negotiation that are promoted by ANUR include the share between WUAs and the government for system improvement and rehabilitation works and the creation of a nation wide contingency fund to help WUAs that are affected by sudden droughts (and hence have no income from irrigation fee revenues).
21. See also note 4, chapter 3.
22. CNA's argument to differentiate in the percentages of total fee collection that WUAs have to pay to the agency, is that WUAs do not make equal use of the main systems. WUAs like Salvatierra that hardly make use of the main system infrastructure would contribute less than a WUA like Cortazar, which is served by 72 kilometers of main canal. Although this argument was accepted by the WUAs when they signed the concessions in 1992, by comparing percentages and length of main canals they later found out that their was not a clear correlation between the two. This made them very suspicious about the level and fairness of contribution they had to pay.
23. The LRS had to hire its own technical and administrative staff. However, due to severe droughts dams remained closed during 1997-98 the winter season, which was going to be the first season of self-management by the LRS. As a result, except for hiring a general manager (a former CNA engineer) and a head of operations, the hiring of other staff was postponed until the 1998 summer season. By that time all field activities for this study had already ended and no further observations on the actual performance of the LRS could be made.

5 Formal arrangements and practices of operation and maintenance

5.1 Introduction

This chapter provides a detailed analysis of the official post-transfer arrangements for O&M in ARLID, the actual irrigation practices, and outputs of these practices in terms of relative water supply, equity and land and water productivity[1]. The aim of this chapter is to assess how irrigation managers (from both the irrigation agency and the WUAs) and users cope with the new arrangement for allocating, distributing and using water. It shows how and why the practices of coping with these arrangements sometimes differ from the institutional design principles. An important argument that can be made here is that eventually viability of institutional arrangements for O&M is more influenced by the way local irrigation managers and users jointly choose their strategies to work with these arrangements, rather than by following the design principles of these arrangements. It helps managers and users to jointly create operational accountability.

A second aim of this chapter is to provide a detailed analysis of how local irrigation managers and water users use their water in the context of both relative water scarcity (see chapter 2) and the market-oriented aim of policy makers to motivate farmers to maximize the economic outputs per unit of water and land. The latter has become particularly relevant as more and more state subsidies that support the production of 'low value' food crops have been dismantled (see chapter 3).

5.2 Institutional design principles for water management

FORMAL WATER ALLOCATION, DISTRIBUTION, AND SCHEDULING PRINCIPLES

Between modules

In ARLID, water allocation between modules is based on three principles, defined in the O&M manual. First, pre-seasonal allocation takes place at the beginning of each agricultural year (November). CNA determines the water availability in the four reservoirs serving the district and present these results to the hydraulic committee. Following the O&M manual, each module is concessioned a percentage of the available volume in the reservoirs. These concessions are in proportion to areas with surface water rights in each module, and are irrespective of the actual area irrigated, or the crops grown. The actually yearly concessioned volumes should be delivered at the intake of each module and hence do not include main canal conveyance losses between the dam and the module intake. The concessions are given in table 5.1.

Table 5.1 Concessions (in percentage of available dam storage) of ten modules in ARLID

Head-end modules		Middle-reach modules[1]		Tail-end modules	
Acámbaro	8.4%	Cortazar	17.5%	Abasolo and	
Salvatierra	16.4%	Salamanca	15.0%	Corralejo[2]	14.2%
Jaral	6.2%	Irapuato	5.9%	Huanímaro	3.7%
Valle	12.6%				

Notes: [1] Purísima could also be regarded as middle-reach module, but as it has its own dam it is excluded here. [2] Abasolo and Corralejo share the same intake and hence are taken together.

Based on these concessions and the water availability at the start of the agricultural year, the hydraulic committee makes the annual plan of how much volume will be allocated to each module. These planned volumes can differ slightly from the concessioned percentage as every year these volumes are adjusted for under-usage or over-usage of water by the WUA in the previous year. Furthermore, as will be discussed in chapter 8, water can be traded between WUAs. If this occurs at the start of the agricultural year, these traded volumes can be included in the plan.

Second, normally the full command area of each module can be irrigated. However, in times of water scarcity, the total area to be irrigated is determined by negotiation between CNA and the WUAs in the hydraulic committee. This varies from module to module and is basically determined by physical characteristics of the module, the patterns of land distribution, experiences with past cropping patterns, and farmer's crop preferences. For example, in years of water scarcity a module with an average land holding of 8 hectares might decide to restrict irrigation to a maximum of 5 hectares per user (irrespective of the total holding a farmer has), whereas a module with an average holding of 4 hectares might decide to limit irrigation to a maximum of 2.5 hectares per user. Such restrictions were made in the 1996-97 agricultural year, when for instance irrigation in Salvatierra was restricted to 2.5 hectares per user, whereas in Cortazar the restriction was 5 hectares. The restriction was decided upon by the individual general assemblies of each WUA and approved by the hydraulic committee at the start of that particular agricultural year. Enforcement of area restriction is not the only cause for not irrigating the entire command area. Farmers can also deliberately decide to irrigate less land than they are entitled to.

Third, the hydraulic committee also decides on the number of irrigation turns that can be delivered to each module, the start and the end of each irrigation period, and whether irrigation will be provided during both winter and summer seasons. Generally, this decision counts for all modules as CNA is reluctant to open the dams to deliver water to only a few modules as this would mean considerable conveyance losses in the main system. In years of normal water availability, four irrigation turns per user can be delivered during the dry winter season. Farmers can even receive a fifth turn at the end of the dry winter season if there is sufficient water left for the following wet season. Also, under normal conditions of water availability, two irrigation turns are delivered at the start of the summer season in April or May. However, deviations from this principle occur, normally in combination with area restrictions. For example, also for the agricultural year of 1996-97, the hydraulic committee decided to restrict deliveries to no more than 4 irrigations during the winter season and only one turn at the start of the summer rainy season up and above area restrictions[2].

The WUAs (and previously CNA) make suggestions but do not enforce the cultivation of particular crops. Farmers can cultivate whatever crop they like to grow provided that the growing stages coincide with the general seasonal irrigation schedule, which normally has one or two closing weeks of each distributary canal between the subsequent turns (see below). In addition, many farmers have access to groundwater (either through ownership of a private well, or though rental of water from private or public wells, or both), which makes it possible for those farmers to grow crops that require more flexible irrigation scheduling. This explains the high diversity in cropping patterns described in chapter 9. Occasionally one can observe posters in the offices of the WUAs that advise (but do not prohibit) farmers not to grow a particular crop. However, in those cases this is always related to the occurrence of pests or diseases, or to expected low market prices for the produce.

Within modules

The method of water control within the modules can be classified as arranged demand, with restrictions on the number and duration of deliveries. In-seasonal allocation rules within modules are based on four principles. First, a farmer cannot receive more turns than the maximum number of irrigations allocated to the module. Exceptions are made for farmers who grow crops like beans that require more frequent irrigation turns, but only if this extra irrigation falls within an irrigation period determined by the third allocation rule mentioned above. Second, each farmer can grow any crop he or she wants to grow. Third, farmers cannot request water for more than the area registered in their names. In case the hydraulic committee decides that less than the full command of the module can be irrigated, the WUA decides on the maximum area that can be irrigated by a farmer. Finally, the maximum volume of water a farmer can receive is determined by the WUA, based on a theoretical or planned water depth per irrigation. Generally, the WUA does not distinguish between water requirements of different crops, but plans with delivering flat water depths across its farmers, irrespective of the crops these farmers grow.

Scheduling

Based on the total number of turns requested and the planned water depth, the WUA calculates the total volume of water requested for the week. The weekly requests are communicated to CNA for scheduling deliveries to the modules. Everyday CNA and WUA staff check at the module intake whether requested volumes are actually delivered. Water distribution between the secondary canals or laterals within a module is based on the same arranged scheduling. For each canal the total volume requested is calculated, and gates are set accordingly. Unlike what is practiced at the head intake point of the module, volumes that enter the secondary canals are not measured, but are estimated and reported by ditch tenders based on their experiences and strategies (see section 5.5).

OPERATIONAL TARGETS AND MONITORING

Explicit management targets do not exist for ARLID. However, my own interpretation of the system operation manual, interviews with system managers and daily observations of irrigation management practices reveal that CNA and the WUAs share a consensus about meeting the following six management targets:

- WUAs get the seasonal volume of water they have been allocated at the start of the agricultural year;
- WUAs do not irrigate an area that exceeds the planned area;
- WUAs receive the weekly scheduled volume of water they have requested for at the start of each week;
- farmers receive the number of turns they are entitled to, have requested, and have paid for;

- farmers receive sufficient water to irrigate the area that they are entitled to irrigate;
- O&M costs should be fully recovered from the farmers.

System managers of both CNA and the WUAs use several techniques to monitor whether these targets are met, at field, module, and district levels.

At the field level, ditch tenders report daily to their WUA how many farmers did receive water, for how much area, and for which crop. At the end of each day, ditch tenders meet at the module office to check whether their reports correspond with the weekly schedule. An estimate of the volumes delivered to each farmer is also reported. These reports are aggregated for the entire module, and are sent to the CNA district office weekly.

At the module level, daily measurements are taken at the head of the main canal, as well as at a small number of other hydrological control points. Daily reports mention both planned and actual volumes. They carry signatures of both the CNA official responsible for deliveries to (a group of) modules and of a technical staff member of the WUA. This is generally the head of ditch tenders or sometimes the general module manager. A weekly report that totals daily volumes is sent to the CNA district office.

At the district level, CNA aggregates the reported volumes, irrigated areas and crops, and produces monthly reports, which are presented and discussed at the hydraulic committee meeting. Furthermore, as farmers have to pay prior to each irrigation turn they receive, WUAs are able to keep good track of the total amount of fees paid by farmers. At the end of each season, the WUAs report their total fee collection to CNA. As the seasonal plan defines the total area to be irrigated as well as the number of turns to be delivered, it is easy to calculate the total planned fee collection, and to monitor whether actual collection follows planned collection.

It is the legal obligation[3] of the CNA to collect information from the WUAs that detail the irrigation operation, maintenance and financial plans and their budgets as well as the monthly progress of these plans and budgets in terms of area cropped, the cropping pattern, the volumes actually delivered and the average yields per crop[4]. CNA has handed out standard formats to the WUAs, which they can use for their progress reports. Although some WUAs have made slight modifications to these formats, all associations continue to use them. It is the task of the CNA chiefs of operation and maintenance (district level) to see that all WUAs submit their reports in time. At the start of the season, each district office has to send to CNA headquarters in Mexico City the O&M and financial targets for the entire agricultural year. At the end of the season, the district office aggregates all information obtained from the WUAs plus their own information on main system and dam management and produce seasonal reports which they need to send to CNA headquarters. Subsequently, CNA headquarters closely monitors whether at the district level operational, maintenance and financial targets were met.

Although the described activities should be sufficient to monitor daily, weekly, monthly, and seasonal performance relative to the six targets mentioned above, a few practices limit this. First, ditch tenders' reports form the basis for most of the data reported to both the modules and the CNA district office. As will be demonstrated in the following section, these flow estimates are often inaccurate and unreliable. Second, monitoring of daily and weekly water deliveries are based on aggregated field reports. Rather than making real measurements at the canal level (except for the head of the main canal), conveyance and distribution efficiency rates are applied to these aggregated field level volumes to obtain 'gross' volumes at canal intakes. However, it is not clear where these efficiencies rates are derived from. Although CNA and others periodically measure canal losses, this is normally only done for isolated studies in a very small number of canals. As a consequence it is not clear how close these efficiency and loss rates are to real values, nor to what extent historical changes in efficiencies that result from canal improvements or deterioration are accounted for[5]. Even though all WUAs use computers, aggregation of field-level data takes much time. As a consequence, the production of weekly, monthly, and seasonal reports takes a long time, and these reports hardly serve as decision support tools to take immediate managerial action when needed.

5.3 Arrangements for system maintenance

Compared to problems related to system operations, the decision making process of maintenance planning, budgeting and priority setting receive very little attention in the literature of Mexican irrigation. Documentation of examples that show the impact of management transfer on maintenance practices and results are even more scarce [6]. This lack of attention is not justified by the importance of maintenance to the WUAs, who also had to take over responsibility for maintaining secondary canals and drains with their structures.

As will be demonstrated in chapter 9, approximately 60 percent of the entire O&M budget is supposed to be spent on system maintenance activities. However, both before and after transfer neither CNA nor the WUAs use a well tested and standardized methodology of irrigation asset management[7]. Yet, CNA wants all WUAs to follow this "60 percent rule".

Before management transfer

Before management transfer, all maintenance was done by the CNA in Celaya. Before management transfer, most maintenance was done at the level of the main system, dams and other headworks, resulting in a neglect of the secondary canals and particularly of the drains. Maintenance activities at these levels were executed by the maintenance department of the CNA office. They were organized around a cluster of irrigation units (similar to the present modules) rather than for each individual unit within the district. This facilitated the movement of heavy machinery within this cluster of units as to the urgency of maintenance requirements within a relatively large geographical area[8]. Farmers were only responsible for cleaning their field ditches. This cleaning had to be finished before the start of the first irrigation turn.

CNA followed a top-down approach in developing their maintenance program. Maintenance priority setting was mainly based on the judgments of the head of the maintenance department, rather than on a methodology that identified the hydraulic importance of a structure or canal stretch, their structural and functional conditions and the consequent effects of deterioration on hydraulic and agricultural performance. Although the head of maintenance was accountable to the district's chief engineer, he was virtually the only person to decide on the annual and day-to-day maintenance programs and the priority setting within these programs. For the development of the maintenance program he used three sets of information.

First, he evaluated the maintenance program of the previous year. This gave him an idea of both the kind of routine activities that had to take place and the kind of works that could not be done in the previous year and should be included in the present year's program. Second, he made an estimate of the O&M budget that he might receive from CNA central office in Mexico City. By experience he knew that the budget that he had submitted to Mexico City (which is based on real needs) would be less than the actual funds he would receive. This indicates the strong influence and control the central office maintained. The submitted maintenance budget was calculated using standard cost units for each maintenance item, per m^3, canal surface or canal length. Third, to be able to make these calculation in addition to the routine activities the information from field officers on the need for any additional urgent (non-routine) maintenance activity that to his judgment had to take place was crucial. He clearly considered the suggestions provided by the head of the irrigation units within the district, who in turn received information from the CNA-employed ditch tenders.

These field officers needed to report daily to the head of the maintenance department on any kind of necessary maintenance work as well as on the progress of the works that were executed. In some cases the ditch tenders received complaints and suggestions from farmers. Because of both the difference in political and social status between the farmers and the CNA engineers in Celaya and the long distances farmers had to travel to the CNA office in Celaya, few water users went directly to see the district chief or head of the maintenance department. As a result, farmers' complaints or suggestions about maintenance requirements always had to travel the bureaucratic route via the ditch tenders and heads of irrigation units and were filtered accordingly. Whether the ditch tender regarded a farmer complaint to be relevant or justified to be reported depended a lot on the economic and political position of this farmer and on his relationship with the ditch tender. Interviews with farmers revealed that there was a lot of 'favoritism' on the side of the CNA technical staff, favoring private growers and large landowners.

One of the most important consequences of the kind of neglect of maintenance from the part of the CNA (particularly at lower system levels) was that farmers had completely lost their confidence in CNA as being a reliable organization that can solve their maintenance problems. As a result, farmers were forced to solve the most critical problems themselves. There are numerous reports from farmers who claim that they did most of the desilting of the secondary canals themselves, sometimes in organized small work parties (*faenas*) with fellow *ejidatarios* along the same canal or even neighboring *ejidos*, but often individually as well. In most of these cases farmers had not even tried to have CNA involved as experience had taught that attempts to get access to for instance heavy CNA machinery generally remained fruitless. Whereas farmers were actively involved in desilting and weeding of the secondary canal systems, the drains generally remained untouched. Consequently, some of the drains in ARLID had not been cleaned for more than 15 years, causing problems of water logging in for instance parts of Salvatierra module.

The poor performance of maintenance by CNA provoked another important reaction. Among the most important reasons why farmers accepted the conditions for management transfer so easily (see chapter 4), was that many users saw management transfer as a way out of the maintenance trap. Although they did not have hands-on experience with developing maintenance programs and budgets, they simply suspected that farmers themselves could do a much better maintenance job than CNA.

During management transfer

CNA and the WUAs agreed to work in a collaborative mode for at least 6 months from the time of transfer so that the new WUAs could gain experience with maintenance before they were left on their own. One of the preconditions for transfer was that CNA should grant concessions to the WUAs to use almost all of its heavy machinery, such as draglines and hydraulic excavators. In total, 25 pieces of equipment (including some relatively new pieces), with a total estimated value of 1.7 million US dollars, have been transferred to the WUAs in ARLID. However, some of this machinery was in severe disrepair and WUAs felt that maintenance of this machinery would cost them more than buying new equipment. As a consequence, during the period December 1992 to July 1995, the WUAs bought 29 pieces of heavy machinery. These were paid for out of fees collected from the users. In addition, three

WUAs received new equipment, such as trucks and laser equipment for land leveling, as part of a World Bank assisted program for on-farm water management improvement (PRODEP). This brings the total of number of heavy machinery currently used by the WUAs to approximately 60. However, the distribution of these among the WUAs are rather unequal: Cortazar has about 10 machines whereas La Purísima only has one excavator. Consequently, some WUAs need to borrow machinery from others. So far, WUAs have not asked high rental prices when they rent out their machinery to other association (and occasionally to CNA as well). The borrower only covers the operational expenses (fuel, and sometimes an operator) and do not contribute to the depreciation costs. On the other hand, those who borrow machinery are totally dependent on the availability of the machinery, which particularly is very limited during the two months before the start of the season when all WUAs maintain their irrigation networks.

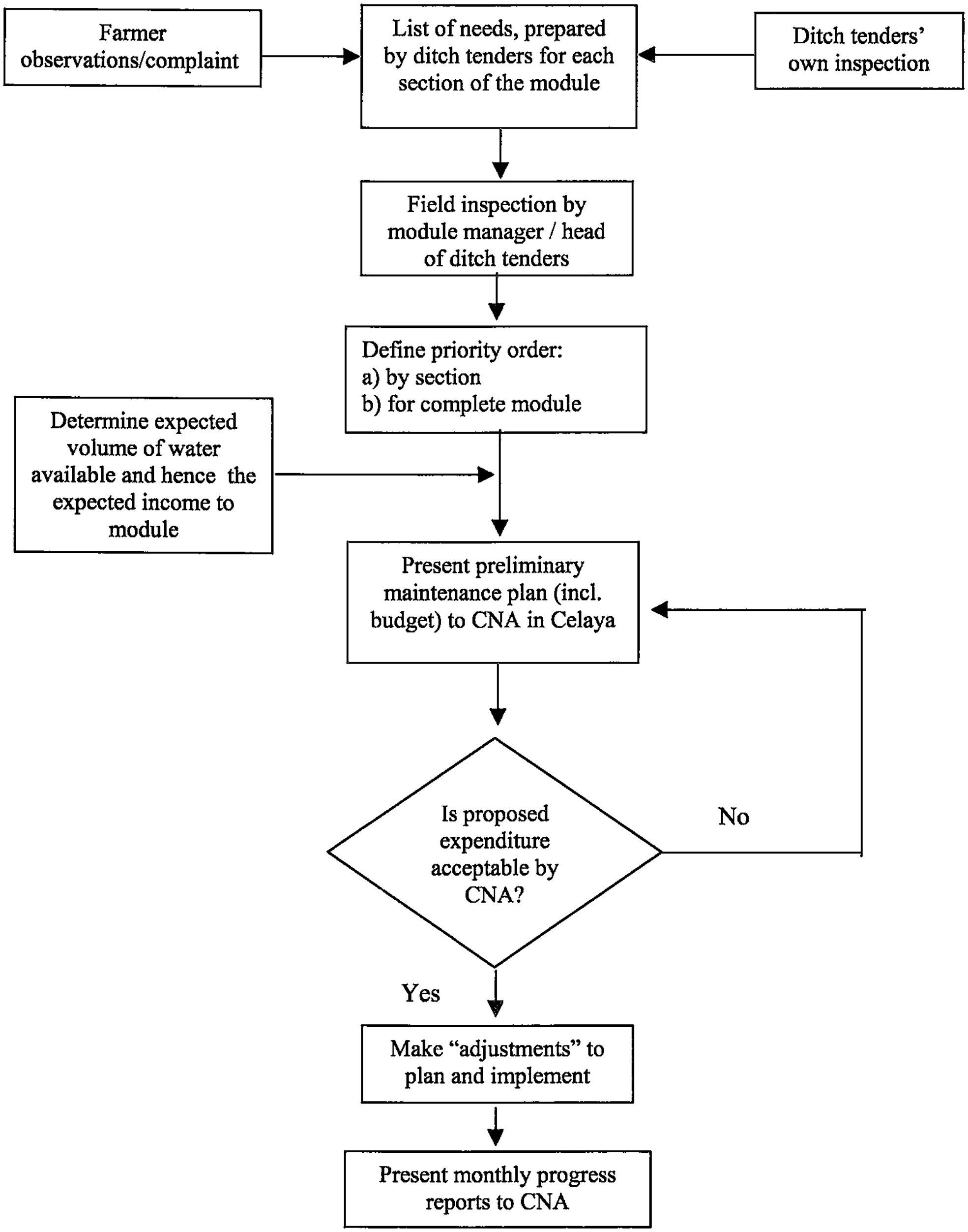
After management transfer

Since transfer, the WUAs have been responsible for maintenance of the entire secondary system (distributary canals, drains and structures). Each WUA has employed specialized maintenance staff, who are directly controlled by the general managers of these associations. Normally, the general manager develops the maintenance program for the entire year, including the budget, in October. At the start of the season this plan has first to be approved by the general assembly of the association. The proposed maintenance programs rarely provoke critical questions from the farmer representatives to the assembly. Although the WUAs are financially responsible for all maintenance, once the assembly has approved the program, WUAs still have to submit their maintenance budgets, as well as the monthly progress reports (of planned and actually executed maintenance activities) and the associated financial statements to the CNA office in Celaya for comments and approval.

The district chief engineer and his head of the maintenance department make a personal judgment on whether the proposed activities are relevant and whether they can be executed within the proposed budget. If necessary they recommend some modification to the planned activities. However, interviews with managers and leaders of all eleven WUAs showed that in practice CNA accepts the proposals without providing any comments. Furthermore, CNA has employed three technicians who should run the canals of all modules and check whether the proposed activities have actually been executed. However, I never came across these people in the field and also the WUAs report that such field inspections by CNA do not take place. On the other hand, the district chief and his heads of maintenance and operations do make frequent field trips to the module areas to attend all kinds of requests from the WUAs as well as to check whether contract works along the main canals take place in a proper way. During these trips they also make general observations on the condition of the infrastructure that is maintained by the WUAs. However, they do not systematically keep records of these observations.

As to approving the maintenance budget, CNA also sees whether approximately 60 percent of the expected income from fee collection is proposed to be spent on maintenance. However, as is demonstrated below, actual expenditures deviate considerably from the planned budget. Although CNA can easily monitor these actual expenditures by means of the monthly progress reports that the WUAs need to submit, they hardly do so. It was observed that their only concern with the progress reports is that these are submitted in time. Once submitted, they are not used to advise WUAs on how to better set priorities and execute the maintenance activities.

Figure 5.1 The post-transfer maintenance planning cycle



Source: IWMI-HR Wallingford training workshop on priority setting in maintenance, Irapuato, May 1998.

After four to five years of experience with executing maintenance programs, some WUAs started to realize that they should use a better system to set priorities for the kind of maintenance works that have to take place within the given and often limited budget[9]. So far, all WUAs have basically followed the same method of ad hoc maintenance, which they inherited from CNA. However, as is shown in figure 5.1 there are differences.

The main difference now is that the administrative lines between those who make fields observations on maintenance needs, and those who are responsible for carrying out maintenance works, are much shorter. Each ditch tender now makes his own list with maintenance needs. This list is based on his own observations as well as on complaints and reports he receives from farmers. Every week, during a meeting with his colleagues, the ditch tender submits this list to the general manager of the WUA. This manager prepares a program based on priorities set for each section within the module as well as for the entire module. The way these priorities are set do not differ from the way the CNA head of the maintenance department used to do it before IMT.

Another major difference between pre- and post-transfer maintenance procedures is, that after transfer users visit the office more frequently to report maintenance problems directly to the WUA's manager or to board members. As a result, priority setting is currently more influenced by mechanisms of favoritism, particularly in those cases where farmers maintain good personal relationships with the president and the general manager of the WUA.

5.4 Actual water allocation between modules

In the previous section, the official arrangement for water allocations and distribution between and within the modules were described. In the chapters that follow, several accounts will be given on how these arrangements have changed historically as a consequence of irrigation management transfer, the new water law and the development of water trading between WUAs. However, in order to better understand how in practice water is allocated, distributed and used under the current arrangements and water availability, some detailed examples of daily water use practices in pre-selected canals and fields in Cortazar and Salvatierra are given in this section. The basis of this analysis are the twice daily flow measurements and observations during the 1995-96 winter season and 1996 summer season[10]. The examples compare actual flow measurements and operational targets with reported and planned values by the WUAs and hence follow the evaluation approach which uses the internal operations indicators as explained in section 1.6

Similar to others years since management transfer, also the 1995-96 agricultural year started with a meeting of the hydraulic committee. In this meeting a first assessment of actual dam storage was presented by CNA to the other members of the committee. In November 1995, the gross storage in the four reservoirs supplying the district was 1,118 Mm^3, of which approximately 742 Mm^3 were assigned to irrigation[11]. This gross storage was the seventh lowest level recorded but yet slightly above the average of the series of 15 years reported in chapter 9 while the volume assigned to irrigation was 73 Mm^3 less than the 30 years annual average of 815 Mm^3/year available for the district. The hydraulic committee decided that this volume was sufficient to supply five irrigation turns to each farmer: four for irrigation of winter wheat, and a single irrigation for summer sorghum. As this suggestion followed the usual pattern (i.e. no crop or area restrictions were enforced), all WUAs agreed to it.

Based on the available storage, the WUAs were given a volumetric concession for the entire year following the percentages given in table 5.1. Once the volumes were determined, they were published in the local newspapers by means of a statement signed by CNA, the Secretary of Agriculture of the State of Guanajuato, as well as by the presidents of all eleven WUAs. Irrigation of the winter crop started in the second week of December 1995. To assess whether at the end of the season the WUAs and CNA were able to follow this plan, a comparison is made between concessioned volumes and actually supplied volumes during both the winter and the summer season of that year (table 5.2).

Table 5.2 The distribution of concessioned, planned and actual volumes between the modules of ARLID for the agricultural year 1995-96

	1	2	3	4	5	6	7	8	9
Module	Water concession (% of total water)	Planned volume (Mm^3)	Actual volume supplied to irrigated area Winter (mm)	Summer (mm)	Total (mm)	Total (Mm^3)	as % of total actual supply	Actual / Planned %	Actual/ Concess. %
Head									
Acámbaro	8	67.8	1895	168	2063	62.9	8	93	97
Salvatierra	16	125.7	1846	310	2156	145.9	19	116	115
Jaral	6	43.3	1239	267	1506	49.7	6	115	103
Valle	13	99.2	865	259	1124	90.1	12	91	91
Middle									
Cortazar	17	133.3	1013	291	1304	132.9	17	100	98
Salamanca	15	90.1	794	212	1006	95.2	12	106	82
Irapuato	6	44.8	1065	282	1347	47.1	6	105	103
Tail									
Abasolo and Corralejo	14	111.2	na	na	na	118.3	15	106	108
Huanímaro	4	26.4	na	na	na	30.5	4	116	107
Total	100	741.8				772.5	100		
Average			1245	256	1501			105	101
CV			451	49	446			9	10

Note: na = not available as precise data on actually irrigated area could not be obtained.

The average annual irrigation application was 1,500 mm/year; however, the recorded irrigation depths in the winter season show a marked variation between the modules, with for instance 1,895 mm/year of irrigation per hectare actually cropped in Acámbaro and only 794 mm/year in Salamanca. The explanation for this variation is that once the total volumes assigned to each module are determined, the WUAs can decide individually how they want use the water. A WUA can either try to irrigate its entire command by allowing each farmer to irrigate all of his land within the module area, or it can aim at reducing the total area actually irrigated by applying higher water depths on each hectare that is irrigated. WUAs of modules with higher apparent water depths opted to crop a reduced area, resulting in lower irrigation intensities for the winter season, ranging from 42 percent in Acámbaro to 91 percent in Valle.

Despite the differences in irrigation application strategies, overall the actual water volume supplied closely matched the concessioned and planned volumes, though actual deliveries exceeded the allocated volumes by 5 percent. There is some evidence of variations in water allocations between modules (CV=10%). However, as will be explained in chapter 8, this is the result of water trading rather than of poor allocation. As examples in chapter 8 will show, the key to equitable water allocation between the WUAs is the performance of the hydraulic committee and the way it succeeds in monitoring actual allocation relative to planned allocation.

5.5 Actual water distribution and use in selected canals and fields

DISCREPANCIES BETWEEN ACTUAL SUPPLIES AND PLANNED & REPORTED SUPPLIES

One way to internally assess the performance level of the WUAs is to measure whether actual irrigation supplies meet their own planned supplies (see section 1.6 on internal performance assessment). As discussed above, water deliveries are scheduled around planned water depths (at plot level), which are subsequently converted to planned weekly deliveries at the levels of the distributaries and main canals.

At the level of the selected canals and laterals in Cortazar and Salvatierra, actual water supplies were obtained by the daily flow measurements that were taken for this study. Figures 5.2 and 5.3 analyze the weekly supplies for each lateral monitored in Cortazar. The cycles observed in the graphs correspond to individual irrigation turns provided by the WUA. Planned and reported values show a very high correlation. The reason for this is the way the ditch tenders report water distribution. Although the WUAs use planned water depths to calculate the volumetric demand and distribution for each week and each secondary canal, actual distribution is not based on volumetric measurements.

At the level of the secondary canals and fields, ditch tenders estimate but do not measure flows. Although each delivery should provide a uniform, planned irrigation depth to each farmer who requested and paid an irrigation, the ditch tender fixes the time needed to fully irrigate one hectare. The duration of supply is determined by the ditch tender's experience and the relationship with the individual water users rather than by planned water depths. Ditch tenders only roughly report the time farmers receive water. The ditch tender's main concern is to report the area a farmer had requested and paid an irrigation for, rather than the actual volume supplied. Using the planned water depth, he calculates the theoretical discharge (m^3/s), and records these in his daily irrigation reports to the WUAs.

For the two selected secondary canals, measured values are almost consistently higher than planned values. Furthermore, planned and reported values supplies show a very high correlation. For secondary canal A (figure 5.2) the ditch tender reported weekly supplies that were on average as close as 97 percent of planned values, whereas the supplies actually measured for this study were 2.7 times higher than the planned and reported ones. This can be explained through a combination of poor control at the intakes of the laterals, the ditch tender's particular position as the cousin of the WUA's president (see chapter 6), and failure to adjust gate settings after the conditions of the infrastructure had changed as a result of intra-season maintenance, as was the case in week 7 of distributary canal A (figure 5.2).

Figure 5.2 Planned, measured, and reported volumes of distributary canal A in Cortazar module, during winter and summer seasons of 1995–96

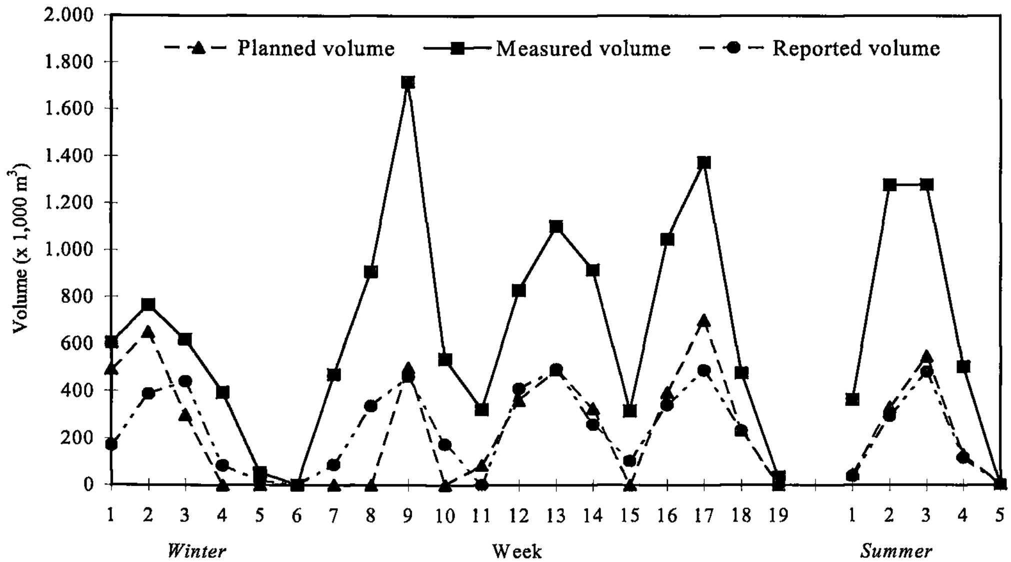


Figure 5.3 Planned, measured, and reported volumes of distributary canal B in Cortazar module, during winter and summer seasons of 1995–96

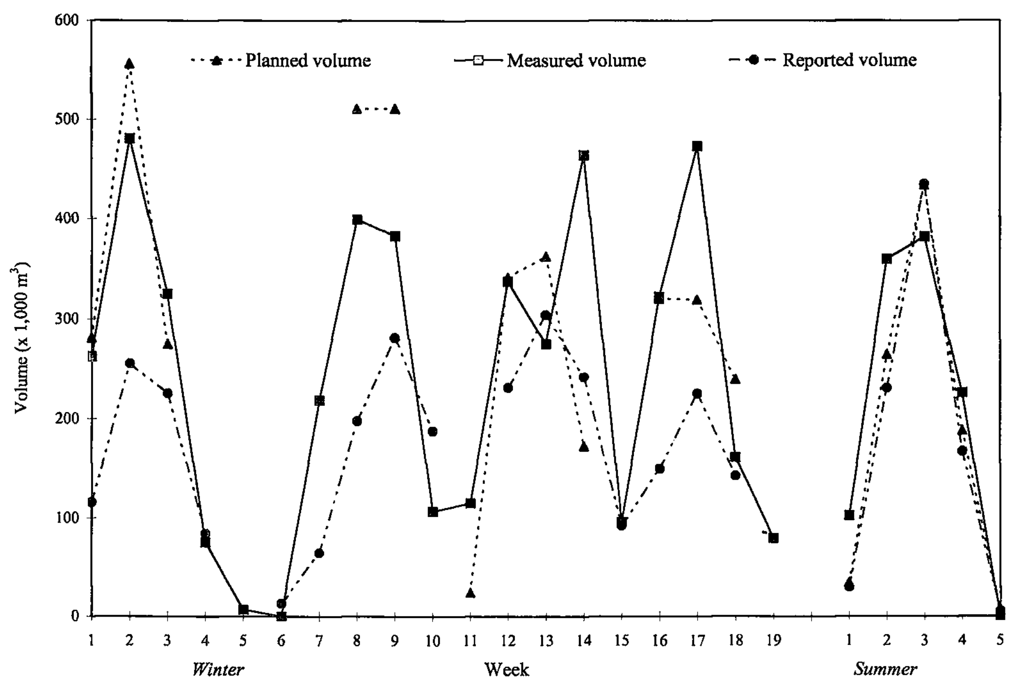


Figure 5.4 Planned, measured, and reported volumes of the Gugorrones main canal, in Salvatierra module, during the winter and summer seasons of 1995–96

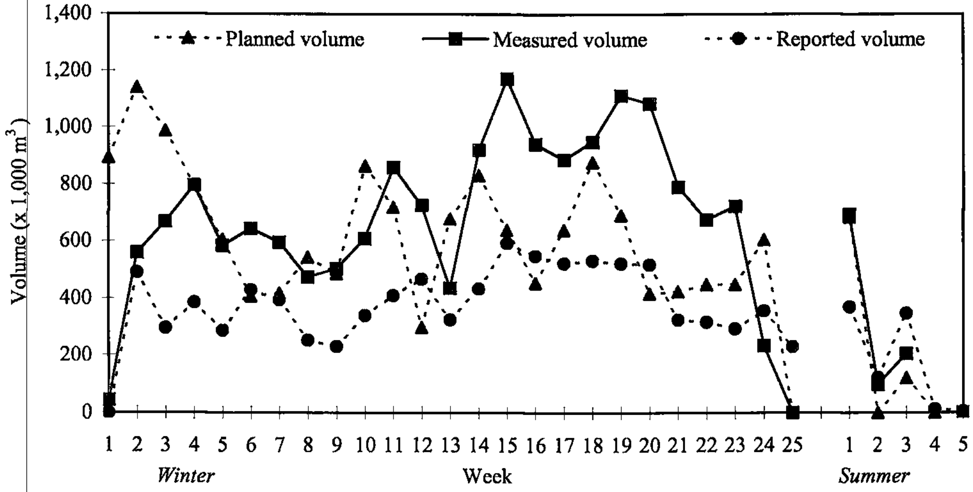


Figure 5.4 shows the weekly supplies for the selected main canal in Salvatierra module. Unlike the examples from Cortazar, the results from Salvatierra show more consistency between what was measured and what the WUA had planned to deliver. This suggests better water control at the intake point. However, close analysis of the daily reports shows that most ditch tenders in Salvatierra are aware of the scheduled discharge at the intakes of the six main canals and did report accordingly[12]. Moreover, because of the short distances of the main canals in Salvatierra ditch tenders can frequently visit the intake point and check and report the actual delivery at the intakes of these main canals. The large difference between reported and measured values is caused by the practice of most ditch tenders to calculate reported volumes at the field level, whereas actual supplies are measured at the canal intakes. Therefore, reported volumes do not include conveyance losses in the main canal.

PLANNED AND ACTUAL CROP WATER DEMANDS

With respect to the water demand, table 5.3 compares the planned water requirements for the winter season of both modules with the theoretical crop water requirements obtained through CROPWAT. The requirements planned by the WUAs incorporate the perceived canal losses at each level of the system. For Cortazar, the ratio of the CROPWAT to the field-level values corresponds to the planned application efficiency, in this case 70 percent. The ratio between field and secondary canal values constitutes the distribution efficiency planned by the WUA, in this case 85 percent. Finally, the ratio between secondary and main canal values corresponds to the planned conveyance efficiency, in this case 80 percent. Thus, the system has an overall planned distribution efficiency of 48 percent (0.7*0.85*0.8), which is considerably higher than the overall system efficiency rate of 32 percent measured by both Palacios-Vélez and Exebio-García (1992) and Peña-Peña and Herrera-Ponce (1999)[13], or the 27.6 percent reported by Tenango-Zitlalapa and Hernández-Saucedo (1994). These low irrigation efficiency rates for ARLID can be considered typical of most Mexican irrigation districts (Palacios-Vélez and Exebio-García 1992; Palacios-Vélez 1994b). Although CNA claims to base these planned efficiency rates on actual measurements, no evidence was found that these measurements actual took place at several strategic points in the system and at fixed time intervals during the cropping season. Moreover, official CNA records on conveyance efficiencies suggest that these rates have not changed for a number of years, even though canal maintenance practices have changed considerably as a result of management transfer (see chapter 9). Yet, when making their irrigation plans and schedules both CNA and the WUAs use these assumed efficiency rates as if they were actual rates.

Because of the irrigation network configuration of Salvatierra module there are no secondary canals as such. Two reasons explain the difference in the theoretical crop water requirements between Cortazar and Salvatierra: the difference in evaporation (Appendix 3) as a result of altitude and humidity differences, and the considerable difference in planting dates.

An important observation from table 5.3 is that both WUAs do not differentiate on crop water requirements for different crops. Irrigation scheduling and planning are based on the main crop, in this case wheat. This practice results in excess calculation of irrigation requirements, especially in Salvatierra with its diversified cropping pattern, which during the 1995-96 winter season comprised 68 percent wheat, 22 percent beans, and 10 percent vegetables.

Table 5.3 Calculated (CROPWAT) and planned water requirements in the Cortazar and Salvatierra modules, in winter 1995–96 (mm/season)

Crop	CROPWAT	Planned Requirements by the Module (mm/season)		
	requirements (mm)	Field	Secondary canal	Main canal
Cortazar module				
Aconchi wheat	607	775	930	1175
Salamanca wheat	523	775	930	1175
Onion	477	775	930	1175
Barley	466	775	930	1175
Tomato	493	775	930	1175
Vegetables	310	775	930	1175
Salvatierra module		Field		Main canal
Aconchi wheat	580	850		1350
Salamanca' wheat	505	850		1350
Tomato	508	850		1350
Onion	477	850		1350
Chillies	470	850		1350
Chickpea	460	850		1350
Barley	409	850		1350
Beans	303	850		1350
Vegetables	280	850		1350

MANAGING IRRIGATION WATER WITH HIGH SAFETY MARGINS

The Relative Water Supply (RWS, see section 1.6 and Appendix 4) indicator was used to compare actual water use with planned and reported use. Three different RWS values were measured, using different supplies in the numerator of the indicator (table 5.4). *Actual RWS,* was calculated using actual water supplies obtained from flow measurements by CNA and the WUAs at the intakes of all modules; *planned RWS,* using planned water supplies obtained from administrative records from both CNA and the WUAs; and *reported RWS,* using recorded volumes by ditch tenders. In the case of the private wells, two different RWS values are calculated: actual RWS, using actual pumped volumes; and reported RWS, using pumped volumes as recorded by ditch tenders.

The first conclusion that can be derived from table 5.4 is that at the module intake level the actual RWS winter value for Cortazar is slightly lower than the average value of 2.4 for the entire district, whereas the value for Salvatierra is more than twice as high, suggesting concentration of water on that area that is actually irrigated, resulting in a low irrigation intensity for the winter season of 50 percent compared to 81 percent for Cortazar.

A second conclusion from table 5.4 is that in Salvatierra actual and planned RWS values match relatively well at the module (i.e. intake) level. Also, at the module intake actual RWS values are only slightly higher than reported values. This again suggests that the management succeeds in closely following the irrigation plan. However, this correlation is closely related to the fact that ditch tenders are familiar with daily planned flow levels at the intake of the Gugurrones canal and generally report those volumes as being the actual ones. At the field level high discrepancies were found between actual and reported values (table 5.5). There are several reasons that explain this. First, because of the high number of farmers and a high degree of land fragmentation[14], ditch tenders of Salvatierra WUA have many problems in obtaining adequate information on the crops farmers actually grow, causing severe problems with seasonal and weekly irrigation scheduling as well as with reporting actual deliveries at the field level. Second, Salvatierra is the only module where winter and summer crops are mixed. As a result, there is an overlap in cropping patterns, which makes scheduling and delivering a very complicated activity. Rather than trying to deliver water closely to the actual irrigation requirement of each distributary canal, ditch tenders choose to deliver an amount of water with a high margin of safety (which explains the high RWS values reported below).

Third, and related to the previous point, Salvatierra has a very diverse cropping pattern. Although the WUA schedules water delivery as if all crop were the main crop (wheat and sorghum for the winter and summer sub-seasons, respectively), many farmers grow crops that need less water albeit more frequent irrigation turns. Ditch tenders are supposed to give farmers only the number of irrigations that correspond with the main crop, but in practice they try to adjust the schedule in such a way that it meets the irrigation requirement of a particular farmer. There are two ways in which this is done. The first way of accommodating to the farmers' real irrigation demand (both in terms of irrigation depth and frequency of deliveries) is to change a farmer's official winter turn for an extra turn in the summer, or to deliver less water per turn, yet more frequently. The other way is to bribe the ditch tender in turn for an extra irrigation delivery. With the high water depths delivered to the farmers, this can be done without depriving other users too much of their requirements (see the next section on equity). These arrangements are always made between the individual farmer and the ditch tender. However, for reasons explained in the previous section of this chapter, the ditch tender is particularly concerned about reporting closely to programmed values. As a consequence, he has to modify the extra-official deliveries in his daily reports.

Table 5.4 Actual over planned and reported RWS values in ARLID and the Cortazar and Salvatierra modules, in winter 1995–96, and summer 1996

Season	RWS type	Entire district	Cortazar module	Salvatierra module	ratio	Entire district	Cortazar module	Salva-tierra module
				Surface irrigation				
Winter 1995-96	Actual	2.4	2.1	4.4	A / P:	96%	87%	133%
	Planned	2.5	2.4	3.3				
	Reported	1.6	1.5	2.0	A / R:	151%	137%	218%
Summer 1996	Actual	1.9	1.9	2.0	A / P:	90%	92%	93%
	Planned	2.1	2.0	2.1				
	Reported	2.0	1.8	2.3	A / R:	98%	105%	84%
				Private wells				
Winter 1995-96	Actual	2.1	2.1	2.1	A / R:	118%	107%	--
	Reported	1.8	2.0	not reported				
Summer 1996	Actual	2.2	2.2	2.3				
	Reported	1.3	2.2	not reported	A / R:	172%	100%	--

Note: A / P means actual (measured) RWS values over planned values; A / R means actual RWS values over reported values.

A fourth reason why ditch tenders in Salvatierra have difficulties in actually measuring and reporting real deliveries at the field level, is that in most canals surface water is mixed with pumped water from both private and public deep tubewells (see below). This makes it difficult to assess how much water actually flows to each plot.

Table 5.5 shows that during the winter season, the actual RWS value is much higher than the reported one. Part of the reason for this is that actual values are measured at the intake of the modules while reported values are estimated at the field level.

The observations on table 5.5 are supported by the data obtained from own flow measurements at the field level. Actual, planned, and reported RWS values of selected fields in the two modules were calculated. In the case of Cortazar, the values show little variation between the different fields observed, and are in line with those obtained for higher levels of the system. Values for Salvatierra are consistently higher than those for Cortazar. They also show more variation, corroborating higher water availability. The last three columns again highlight the high correlation between planned and reported values.

Table 5.6 provides similar information for the summer season in Cortazar. For the same reason as explained above, the summer season values show a high difference between fields irrigated with surface water and those irrigated with wells: an average of 1.8 for the former and 2.4 for the latter. For Salvatierra, only actual values were available. The average value of the actual RWS of fields irrigated by canals is 2.3, while the average value for fields irrigated by wells is 2.4.

It can be concluded that the irrigation district operated during the winter 1995–96 and the summer 1996 seasons under conditions of relatively abundant water availability. It was possible for the managers to supply the crop water requirements with a good margin of safety. This is indicated by the high RWS values at different system levels. Generally, RWS values in Salvatierra exceed the district's average levels while values in Cortazar are slightly below this average.

Furthermore, RWS values obtained at all levels suggest that well users use more water per hectare than those using canal water. The reasons for this are a relatively low pumping cost as a consequence of subsidized energy tariff (see chapter 7) and the attempt to avoid risks by not waiting until the rains have started. Finally, crop water requirements are calculated on the basis of a single main crop, normally a relatively high water-consuming one in order to be on the 'safe' side. Particularly in Salvatierra, where farmers grow relatively more crops that require less water, this has led to over-calculation of irrigation depths and consequently to the high RWS values observed.

Table 5.5 Actual, planned, and reported RWS values in selected fields in the Cortazar and Salvatierra modules, in winter 1995–96

Cortazar Field #	Irrigation source	Measured water depth (mm)	Reported water depth (mm)	1 RWS-Act	2 RWS-Plan	3 RWS-Rep	4 1/2 (%)	5 1/3 (%)	6 2/3 (%)
1	Surface	834	728	1.7	1.6	1.5	106	113	107
2	Surface	832	794	1.7	1.6	1.6	106	106	100
3	Surface	898	803	1.6	1.4	1.4	114	114	100
4	Surface	961	813	1.9	1.6	1.7	119	112	94
5	Surface	825	760	1.7	1.6	1.6	106	106	100
6	Surface	844	801	1.7	1.6	1.6	106	106	100
7	Surface	931	797	1.9	1.6	1.6	119	119	100
8	Surface	1122	781	2.2	1.6	1.6	138	138	100
9	Surface	1040	781	1.8	1.4	1.4	129	129	100
10	Surface	1057	828	1.8	1.4	1.5	129	120	93
11	Surface	1177	795	2.3	1.6	1.6	144	144	100
12	Public well	994	762	2.0	1.6	1.6	125	125	100
13	Private well	958	-	1.7	1.4	-	121		
14	Private well	861	-	1.5	1.4	-	107		
15	Private well	971	-	2.0	1.6	-	125		
Average		954	787	1.8	1.5	1.6	120	119	100
Salvatierra Field #	**Irrigation source**	**Measured water depth (mm)**	**Reported water depth (mm)**	**1 RWS-Act**	**2 RWS-Plan**	**3 RWS-Rep**	**4 1/2 (%)**	**5 1/3 (%)**	**6 2/3 (%)**
1	Private well	1151	-	2.1	1.6	-	131		
2	Private well	1007	-	2.0	1.7	-	118		
3	Surface	843	915	1.7	1.7	1.8	100	94	94
4	Private well	1110	0	2.2	1.7	-	129		
5	Surface	732	846	3.1	3.5	3.5	89	89	100
6	Surface	1173	1296	2.3	1.7	2.6	135	88	65
7	Surface	858	0	2.3	2.3	0	100		
Average		982	611	2.2	2.0	2.0	108	90	87

Note: RWS-Act = actual (measured) relative water supply; RWS-Plan = planned relative water supply (by the WUA); RWS-Rep = reported relative water supply (derived from the ditch tenders' daily reports).

Table 5.6 Actual, planned, and reported RWS values in selected fields in the Cortazar module, in summer 1996

field #	Irrigation source	Measured water depth (mm)	Reported water depth (mm)	1 RWS-Act	2 RWS-Plan	3 RWS-Rep	4 1 / 2 (%)	5 1 / 3 (%)	6 2 / 3 (%)
1	Surface	274	0	1.9	1.8	1.3	102	138	135
2	Surface	225	196	1.8	1.8	1.7	97	103	106
3	Surface	269	232	1.8	1.8	1.8	102	104	102
4	Surface	491	253	2.3	1.8	1.8	125	124	100
5	Surface	210	228	1.7	1.8	1.8	96	98	102
6	Surface	260	231	1.8	1.8	1.8	101	103	102
7	Surface	208	229	1.7	1.8	1.8	96	98	102
8	Surface	253	229	1.8	1.8	1.8	100	103	102
9	Surface	253	231	1.8	1.8	1.8	100	102	102
Average	Surface	271	203	1.8	1.8	1.7	102	108	106
10	Well	599	204	2.5	1.8	1.7	136	143	105
11	Well	438	216	2.2	1.8	1.7	119	124	104
12	Well	595	207	2.4	1.8	1.7	135	142	105
13	Well	620	289	2.5	1.8	1.9	138	133	96
14	Well	757	216	2.7	1.8	1.7	152	158	104
15	Well	719	248	2.7	1.8	1.8	148	148	100
16	Well	633	215	2.5	1.8	1.7	139	145	104
17	Well	628	216	2.5	1.8	1.7	139	144	104
18	Well	456	216	2.2	1.8	1.7	121	126	104
19	Well	693	278	2.6	1.8	1.9	145	141	97
20	Well	690	216	2.0	1.4	1.4	145	150	104
Average	Wells	621	229	2.4	1.8	1.7	138	141	102
Overall average		454	214	2.2	1.8	1.7	121	125	104

Note: RWS-Act = actual (measured) relative water supply; RWS-Plan = planned relative water supply (by the WUA); RWS-Rep = reported relative water supply (derived from the ditch tenders' daily reports).

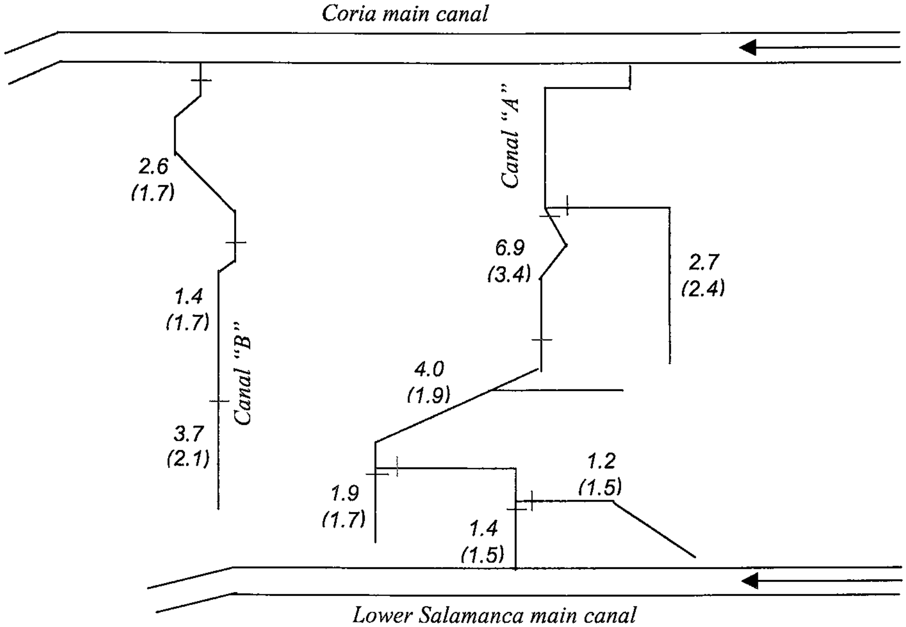
5.6 Equity and differentiated access to irrigation water

EQUITY AND SPATIAL DISTRIBUTION OF RWS: WHO LOSES?

RWS values obtained at the head of the different reaches within the selected distributary canals were also used as an indicator of spatial distribution of water. These values are shown in figures 5.5 and 5.6. The tail-end of secondary canal B in Cortazar received more water during the winter season than the head-end or the middle reaches. For all distributary sections, RWS values exceeded 1.0. This means that actual water delivery always exceeded planned deliveries. Because of the good condition of the lateral, farmers in middle and head-end reaches never have difficulties with taking in water to their fields. As a consequence, excess water is carried to the tail-end, which explains the high RWS value. Lateral A is much longer and suffers from physical problems, inducing the typical head-tail difference. Yet, also in this case tail-end farmers still receive sufficient water to meet crop demand. The explanation of the high RWS value of 6.9 is that canal losses in this reach are very high as the canal runs very close along the river in very coarse soils, causing high levels of seepage.

The summer values follow the same pattern as during the winter. Unlike the head-end area, which is dominated by large landholdings of private growers, control of water distribution in the tail-end is difficult because of the large number of small fields that are cultivated by *ejidatarios*. In general, summer RWS values are much lower, and show more spatial uniformity as all farmers get equal rainfall and only one irrigation is supplied.

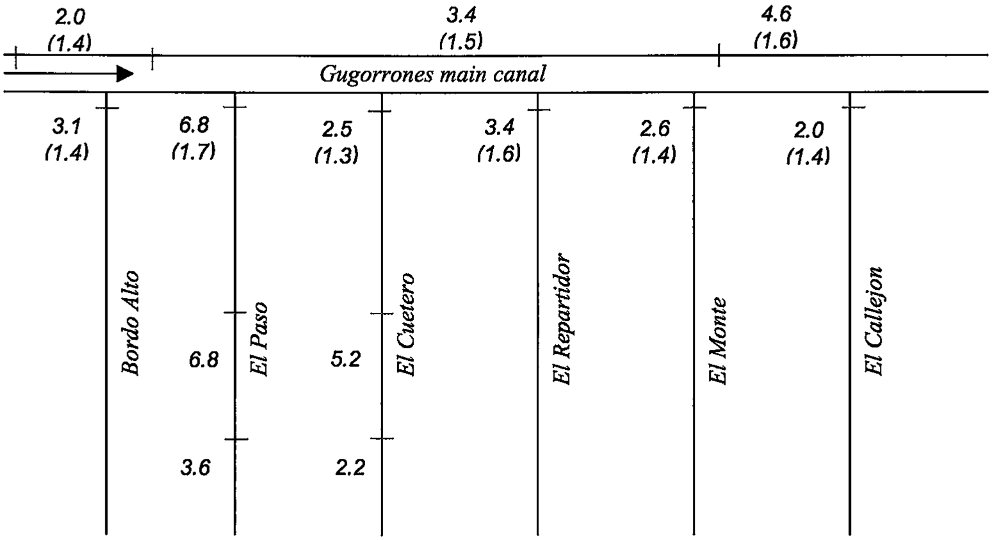
Figure 5.5 Spatial distribution of RWS values across different sections in selected distributary canals in Cortazar module



Note: values within parentheses are RWS values for the 1996 summer season, while the other values are 1995-96 winter values.

Figure 5.6 shows the distribution of RWS values for the selected canal in Salvatierra module. Also in this canal, all sections received sufficient water to meet crop requirements. However, water control in the Gugorrones main canal and its secondary canals is difficult because of severe disrepair of the infrastructure, the large number of farmers, and the relatively small plots. Three public deep tubewells pump directly in the canal network, which further complicates water management. Furthermore, daily observations and measurements at the control points, selected wells, and fields show that many private well owners also illicitly irrigate with canal water, particularly by mixing groundwater and canal water as explained above. Although RWS values generally exceed 1.0, there is no uniform distribution of RWS values along the selected main canal and distributary canals.

Figure 5.6 Spatial distribution of RWS values in the Gugorrones main canal and its laterals, in the Salvatierra module



Note: values within parentheses are RWS values for the 1996 summer season, while the other values are 1995-96 winter values.

A general observation on these results is that although water distribution between and within secondary canals can be highly uneven, an important characteristic of water management within the selected areas is that no farmer suffers from water shortages. There are five reasons that explain this. First, as was demonstrated with tables 5.5 and 5.6, at the field level ditch tenders generally allocate sufficient water to irrigate a farmer's crop as they feel committed to supply sufficient water to the *area* a farmer has paid an irrigation turn for, rather than allocating water on a strictly *volumetric* basis.

Second, in an arranged schedule controlled system like ARLID, where farmers pay for each irrigation turn, users make sure that they receive the water they have requested and paid for. They do this by making the WUA financially accountable for the way they distribute the water (see chapter 7). Given the relatively high levels of water availability, ditch tenders can easily meet these requests without having to control the system in a very strict way. Furthermore, the group of farmers along a particular secondary canal who can irrigate at the same day is restricted and hardly ever exceeds ten farmers. This makes controlling water distribution relatively easy.

Third, as a major feature of the arranged schedule controlled system, farmers know when they are to receive the turn they have paid for. Normally, those farmers that were told they could irrigate on a particular day try to meet the ditch tender. Generally this happens early in the morning at main canal where the ditch tender sets the gate to take water into the secondary canal. As farmers know that the time they can irrigate their fields is not unlimited (although generally they can irrigate as long as they want), they try to prevent that other farmers illicitly take water during their turn. If a farmer observes that the water level to his field falls, he runs the canal upstream until he has found the cause. He tries to solve it on the spot, with or without the help of the ditch tender. As will be demonstrated in chapter 7, this does not mean that illicitly taking water by private well owners and larger farmers who can bribe the ditch tender, does not occur.

Fourth, there is no clear head-tail bias in holding sizes. Large and small holdings are scattered from head to tail-end. Likewise, *ejidatarios* and private growers are distributed unevenly along the distributaries. The only exception to this is secondary canal B in Cortazar. Here, two private growers (brothers) cultivate most of the area in the head-end section. However, these growers possess and use their own private wells and consequently make no use of canal water.

Fifth, with RWS values generally above 1.5, guaranteeing access to water is not a major problem to farmers, irrespective the location of their fields. This reduces the need to illicitly take water. However, it does not entirely eliminate the practice of water stealing, with or without the involvement of the ditch tender.

PREFERENTIAL ACCESS TO WATER BY LARGE FARMERS AND WELL USERS

According to Montgomery (1983), in general Mexican private growers are given preferential access to water by the ditch tenders, basically as the result of bribing and other forms of political maneuvering. However, results from volumetric measurements in the limited set of 20 parcels selected for this study, do not point in the same direction. For instance, during the 1995-96 winter season the actual applied water depth on fields irrigated by *ejidatarios* averages 948 mm, whereas private growers received an average of 972 mm. Also in terms of actual over reported RWS there is no bias towards one of the groups of water users: *ejidatarios* received 17 percent more than reported while private growers received 16 percent more than reported by the ditch tenders. These observations do no necessarily mean that preferential water distribution does not occur. Preferential distribution is more related to well owners, who according to the bylaws of the WUAs do not have a right to canal water if they have access to groundwater. However, in practice it frequently occurs that these well owners take canal water without having paid the official fee for it. As in general private growers own more wells than *ejidatarios* (table 2.2), preferential water distribution to users of wells will favor private growers more than *ejidatarios*.

There are four modes of appropriation of canal water by well users. First, through direct stealing, i.e. without the ditch tender's or leaders' permission. For reasons explained above, the magnitude of water theft is relatively low. During the time of our field observations and measurements, we came across a number of cases where well owners had appropriated some canal water, basically to supplement own pumping. However, we never came across cases where well users were continuously stealing water, i.e. for every irrigation turn that the crop required.

Second, with permission from the ditch tender, the technical manager of the WUA, or from one or more of the WUA leaders, canal water is obtained through bribing. The most common practice observed is that well owners bribe ditch tenders to give them one or more irrigation turns. Generally this happens when well owners seek to supplement their well water with canal water, normally at the start of the irrigation season when there is a peak crop requirement. In some cases, when farmers cultivate several plots, it is possible that one plot is officially registered with a well while for other plots they have a right to use canal water. Several times it has been observed that these farmers pay a water right for only a portion of the fields with canal water rights, while for the remaining part (including sometimes the fields irrigated by wells) water is bought directly (and of course illicitly) from the ditch tender.

Many farmers also reported that sometimes general managers of WUAs (often with consent of the leaders) hand out bogus receipts of payment, which a farmer can show to the ditch tender and receive water for. Although farmers and even ditch tenders from several WUAs confirmed this, as far as has been observed, only in Cortazar this resulted in the general managers to be fired[15]. These practices involving general managers and leaders of WUAs are almost always related to forms of nepotism along the lines of family, political or *ejido* relationships between the manager or leader and the farmer. As will be illustrated in chapter 6, in some WUAs these forms of nepotism and political accountability severely undermined the WUA's credibility towards the users and could eventually jeopardize the institutional viability of the association.

Finally, sometimes leaders of WUAs also use their political and economic positions to gain better access to water themselves. Several water users reported that in some cases there is a preferential distribution of canal water to leaders of WUAs, even if officially they have no right to use canal water such as in case they have their own wells. When asked, only one leader confirmed that (before management transfer) he had frequently bribed former CNA ditch tenders to irrigate major parts of his fields despite the fact that he could have pumped water from his own well. In all these cases ditch tenders did not include these supplies in their daily reports to the WUA[16].

Third, with permission from ditch tenders and other WUA staff, canal water is given to farmers with wells that have a very low pumping capacity. According to the bylaws of the WUAs, farmers who own wells with very low pumping capacities can request and buy canal water. This was for instance the case with field 14 in Cortazar (table 5.5). This field of 8 hectares is located in the middle reach of distributary canal B and is owned by a private grower. The farmer owns a 6 inch pump, with a measured discharge capacity of only 18 liters per second[17]. As this discharge is far too low to irrigate the entire 8 hectares, the farmer requested the ditch tender to supplement groundwater with canal water. In similar cases, the WUA allows farmers with low capacity wells to use canal water, provided that they pay the normal fee. However, in this case the deal was made between the ditch tender and the farmer. As a consequence the farmer received four full irrigation turns from the canal, in addition to his own groundwater. As can be seen from table 5.5, the ditch tender did not report these turns, nor did the farmer pay the official fee to the WUA.

The fourth mode of appropriation of canal water by well owners is the most common one. Here, canal water and groundwater are mixed within the open canal system and a disproportionate amount of canal water is let into the farmers' fields. This deserves further explanation and illustration. In most cases of farmers who use wells, water is pumped directly into the field. However, particularly when the pump serves several plots, or when water is sold to other farmers (chapter 8), the canal infrastructure has to be used to transport the water. Water is pumped into the canal and taken into the field, which sometimes is located more than a thousand meters from the well. These fields can be located downstream of the well, but cases in which fields are located upstream of the well do also exist. In these latter cases water in the canal can be temporally checked in order to raise its level. However, in most cases groundwater is simply mixed with canal water and the farmer takes into the field as much water as he needs.

Comparative measurements of both pump discharges and water intakes at the field level, show that in most cases farmers take more (mixed) water from the canal than the discharge capacity of the pump that they use. These practices do not only occur in the case of private wells, but are even more common in the case of the public wells managed by the WUA. This has a historical reason. Originally these public wells were constructed by CNA to supplement canal water in times of water scarcity. They were built along main distributaries or (in the case of Salvatierra) along main canals. When in 1992 CNA handed over O&M responsibilities to the WUAs, also these wells were transferred. However, rather than using them as a supplemental source to canal water, compact areas were assigned to each of these wells. These compact areas range in size from approximately 20 hectares to 60 hectares and average 43 hectares per well. Farmers with land within these compact areas were supposed to only use the water pumped from this wells, for which they had to pay the WUA a fee (see chapter 6). Yet, to be able to transport water to these compact areas, users of public wells have to make use of the canal infrastructure. As a result, groundwater and canal water are mixed. Measurements show that at the field level public deep tubewell users take more water than the maximum discharge capacity of the pump.

NIGHT IRRIGATION

All the above observations on how farmers and ditch tenders distribute water and deal with other farmers illicitly taking water were made during daytime. Although the five arguments provided above suggest that there is no reason to illicitly take water at night, it is still possible that water stealing or water movements other than those scheduled occur. Chambers (1988) was and continues to be right when he stated that canal irrigation at night is a real blind spot[18].

In order to observe deviations between authorized (or planned) and actual water levels and gate settings at night, a data logger was installed at three different locations along the selected distributary canals in Cortazar[19]. For each of these points the fluctuations in water levels were plotted every 30 minutes (see Appendices 6.1 to 6.3) in order to show differences between day and night. Generally, the ditch tender sets the gates every morning between 6.00 a.m. and 9.00 a.m. and again in the afternoon between 5.00 p.m. and 8.00 p.m. Most of the changes in the three graphs of Appendix 6 are the result of these authorized gate settings and the subsequent changes in water levels. By analyzing the fluctuations in water levels in between these planned changes, one gets an idea of the frequency of unplanned changes in water levels. These changes can have several causes. First, when a farmer has finished irrigating his fields, he will close the pipe outlet even if he has not used the entire entitled irrigation time. As a result the water level in the distributary will rise slightly. Second, the ditch tender sets the gate according to the number of hectares that are scheduled to receive water during a particular day. Any additional area irrigated will cause an unexpected fall in the water level.

Table 5.7 provides the analyses of fluctuations of water levels during day-time and night-time. Several observations can be made from this table. First, there is no significant difference between the average (over the entire period of observations) between day-time and night-time water levels. This suggests that during the night no additional area is irrigated. Second, there is no significant difference in the CV of water levels between day-time and night-time observations. This also suggests that the frequency of gate manipulations during the day and at night are similar. The only exception to this is the observation in the tail-end reach of distributary B, which produce CV values of 56 percent during the day and 71 percent during the night. However, as only a few farmers receive irrigation in this area, opening and closing of the gate in this part of the distributary occurs by definition less frequently.

Finally, the number of unexpected changes in water level were counted during day and night, respectively[20]. In general, given the long period of observations, few unexpected changes in water level were recorded. This suggests that farmers generally respect their irrigation turns and do not take water outside these turns. Furthermore, the frequency of unexpected changes during the night follows the pattern of changes during the day. Only in the tail-end area of distributary canal B, a relative high number of unexpected changes can be observed during night time. However, five out of seven times this is caused by farmers closing their pipe outlets. The only clearly observed example of water theft during the night was on 4 February 1997, in the tail-end area of distributary B. The previous night around 8.00 p.m. the ditch tender had closed a upstream gate, which caused a drop in the water level from 0.40 meter to approximately 0.10 meter at midnight. However, a farmer in this area opened a upstream gate to release more water and the water level raised to 0.55 meter at 3.00 a.m. At 7.00 a.m. he closed the gate, which made the water level fall to 0.10 meter. At 9.30 a.m. the ditch tender came by to set the gate and start the official irrigation schedule for that day.

Table 5.7 Day-time and night-time fluctuations of water level in the selected distributary canals, Cortazar module, winter season 1996-97

	Head-end reach, distributary B		Middle reach, distributary A		Tail-end reach, distributary B	
	day[1]	night[2]	day	night	day	night
Observation period during winter season 1997	Feb 28– March 7		March 12– March 28		Jan 31– Feb 7	
Average water level (m)[3]	0.57	0.56	0.63	0.64	0.30	0.32
CV of water level (%)	26	29	31	30	56	71
Number of unexpected changes in water level between gate settings	1x higher 1x lower	2x higher 2x lower	6x higher 8x lower	3x lower	4x higher 5x lower	5x higher 2x lower

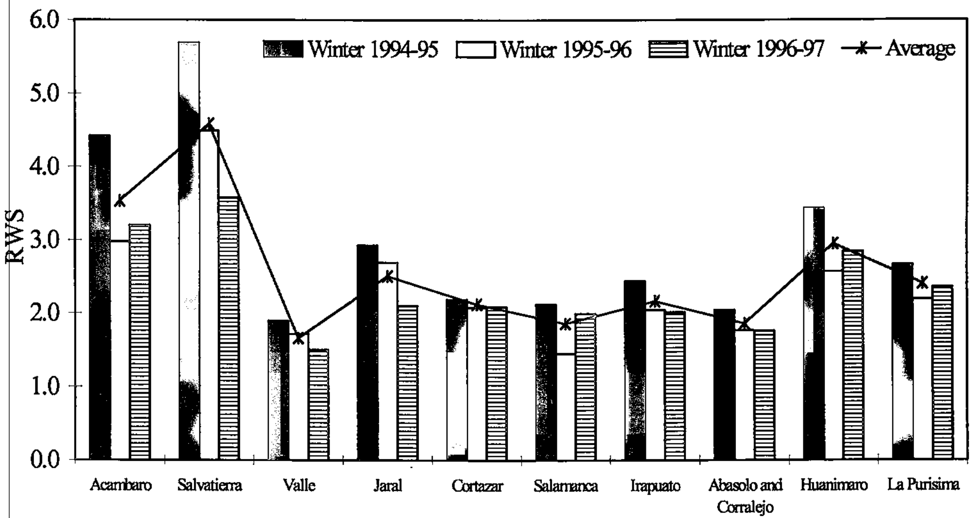
Notes: [1] day-time observations from 6.00 to 18.00 hours. [2] night-time observations from 18.00 to 6.00 hours. [3] these are the averages of all recordings with a 30 minutes time-interval during the entire observation period.

5.7 Comparison across WUAs: pursuing land or water productivity?

This section explores the strategies that farmers chose to maximize the economic output per unit of land or water. The reason for this is that one of the assumptions of market-oriented irrigation policies is that these policies will provide incentives to farmers to maximize their economic output. One way of looking at these strategies is to observe whether there are differences in the ways farmers from different WUAs cope with this issue. As all WUAs in ARLID operate under a similar model and conditions of market-oriented irrigation management, one could assume that they equally deal with this issue of economic maximization. This section will test this assumption and analyze what to farmers is more important: maximizing outputs per unit of land, per unit of water, or both?

The results presented in the previous section only show the situation for one year and within two modules. In order to see whether these results are representative for other years and other modules as well, RWS values were also compared across the 11 modules within the same irrigation district for the three post-transfer years from 1994 to 1997. Figure 5.7 shows the RWS values for three successive winter seasons, plus the average of these values per module. The results indicate that there is a clear difference between the modules. The average value of three years of the 11 modules is a RWS value of 2.6. Yet, as is demonstrated in the figure, especially Acámbaro and Salvatierra modules produce much higher averages (3.5 and 4.6, respectively), whereas Valle has a RWS value of only 1.7. The rest of the modules have values that range from 1.9 to 2.9. The high value of Acámbaro can be explained by the fact that owing to climate conditions the crops require less irrigation services (three instead of four or five). Yet, it receives its full proportional allocation. As a consequence, it can use this allocation to apply higher water depths per irrigation turn resulting in higher RWS values. The reasons that explain the high RWS values in Salvatierra were already discussed above.

Figure 5.7 Average RWS values for the modules of ARLID, winter seasons 1994-97

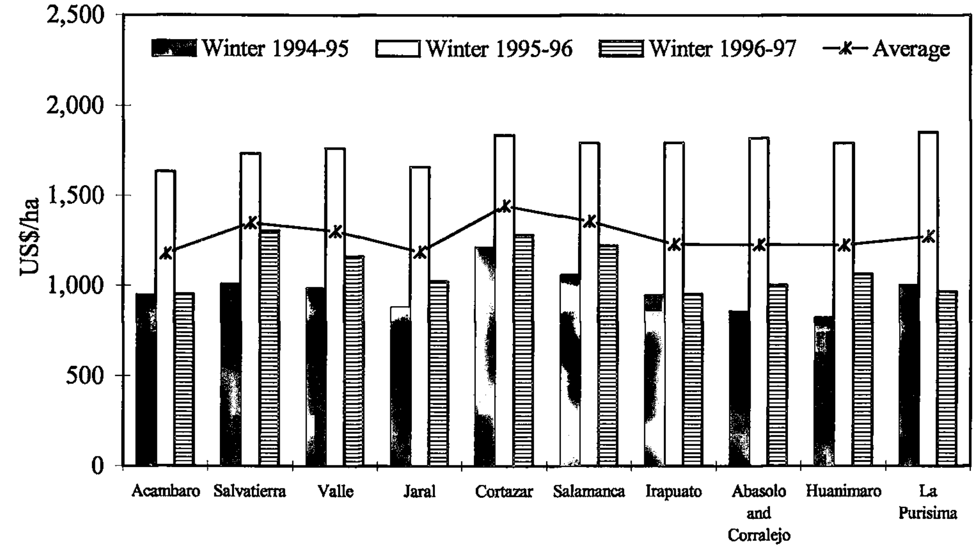


This comparison across 11 modules for a period of three years clearly suggests that users apply an irrigation regime that points to high levels of water use. This is surprising given the fact that the average irrigation intensity for these three years is only 71 percent during the winter season (and less than 140 percent for the entire agricultural year, with two crops). If the overall seasonal surface water availability is limited, then why are farmers applying so much water per hectare cropped if water is so limited? And why do they not opt to increase the irrigated area by applying less water per hectare cropped? The answers to these questions may be found in the comparison between water and land productivity. For this comparison, crop yields (ton/ha), standardized gross value of production (SGVP) per unit of water supplied and consumed, and the SGVP per irrigated cropped area and command are measured for the 11 modules during three winter seasons (for definitions see Appendix 4)[21].

Comparison across the 11 modules shows that although actual wheat yields ranged from 5.5 ton/ha to 7.0 ton/ha in the three years after management transfer, equivalent wheat yields ranged from 5.2 ton/ha in Huanímaro (1994-95) to 7.6 ton/ha in Salvatierra (1996-97). This high equivalent yield in Salvatierra is explained by the fact that during the 1996-97 winter season 21 percent or the irrigated area was cropped with beans, which produce high wheat equivalents because of their high market price. Both actual and equivalent yield levels are high compared to other irrigation district in Mexico (Palacios-Vélez 1994a) and nearby small scale irrigation systems in the State of Guanajuato (Dayton-Johnson 1997).

Figure 5.8 shows little difference in SGVP per hectare cropped. The average value is US$ 1,279 per hectare, while the CV is only 6.3 percent. This suggests that the modules are able to receive approximately the same return to land, irrespective of their cropping pattern and their high differences in water availability. There is no correlation between the RWS values and the productivity of the modules: the correlation coefficients between these values are -0.13, -0.50 and -0.11 for 1994-95, 1995-96 and 1996-97, respectively.

Figure 5.8 Standardized gross value of production (SGVP) per hectare cropped for the modules of ARLID, winter seasons 1994 to 1997



Another observation from figure 5.8 is the high difference in values between three years that are reported. The average values for these years are 973 US$/ha, 1,769 US$/ha and 1,095 US$/ha. These difference can be attributed to the change in world market price for wheat in those years: 159 US$/ton in 1994-95, 262 US$/ton in 1995-96 and 173 US$/ton in 1996-97[22]. Although yields are considered to be high, the low prices farmers receive for their wheat crop explains why returns to land cropped are not among the highest of the systems studied by IWMI (Molden *et al.* 1998; Sakthivadivel *et al.* 1999).

Returns to unit of command are again considerably lower than returns to land cropped and vary widely between the modules. The average return is US$ 869 per hectare command, while the coefficient of variation is 26 percent. The lowest average values over three years are for Acámbaro module (434 US$/ha) and Salvatierra module (586 US$/ha) while Valle module has the highest return with 1,165 US$/ha.

Figure 5.9 shows the output per unit of irrigation water supplied. The graph shows the high range in values, with no clear bias to the location of the module. The average value is 0.12 US$/m^3, while the coefficient of variation is 25 percent.

Finally, figure 5.10 shows the output per unit of water consumed. Similar to the output per unit of water supplied (figure 5.9), there is relatively little difference (CV is 10%) in output per unit of water consumed between the modules. The only clear exception is again Salvatierra module, which has a much higher output per unit of water consumed as a result of its high percentage of high value crops like beans and vegetables.

Figure 5.9 Standardized gross value of production (SGVP) per m³ of water supplied to the modules of ARLID, winter seasons 1994 to 1997

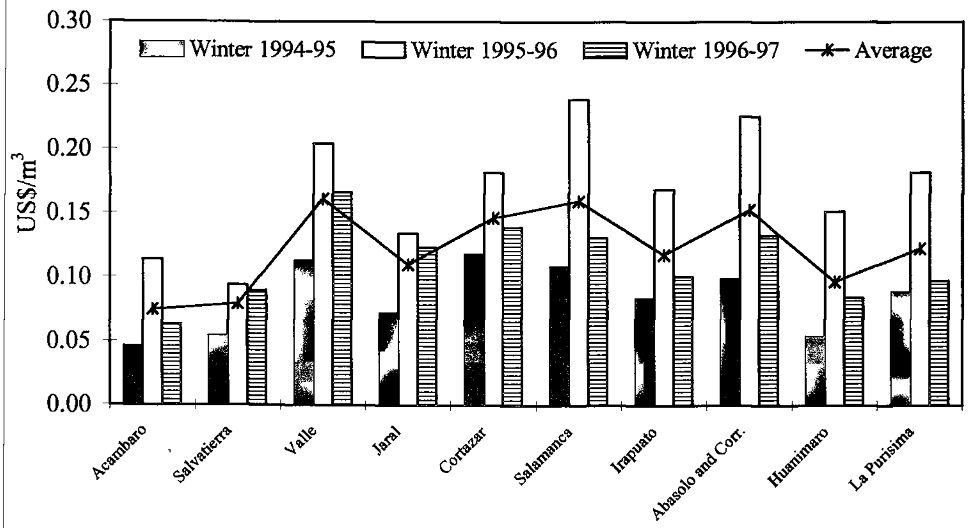
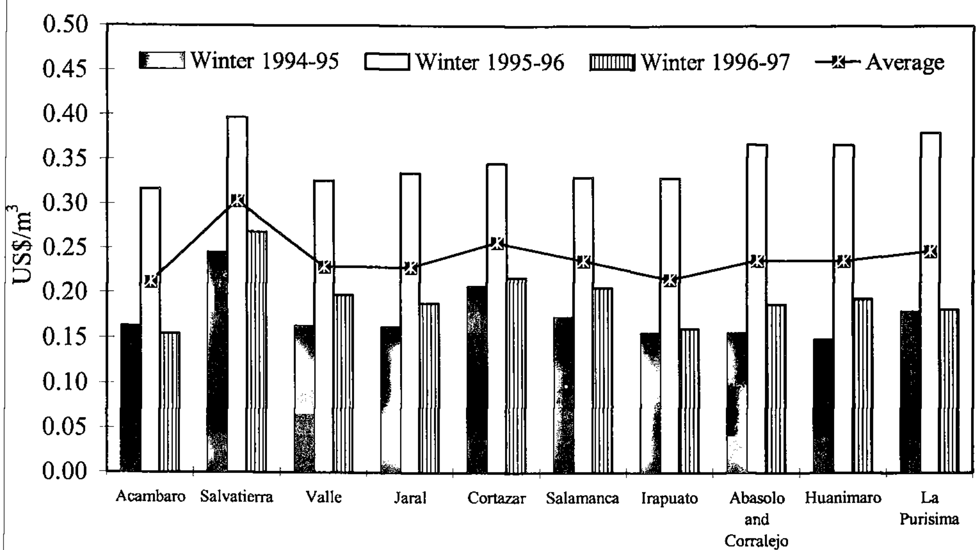


Figure 5.10 Standardized gross value of production (SGVP) per m³ of water consumed to the modules of ARLID, winter seasons 1994 to 1997



Comparison of returns to land and water across modules shows that returns to land cropped are relatively high, with low coefficients of variations. On the other hand, returns to unit of command area are generally very low, with high coefficients of variations. Similarly, while returns to consumed water are high with low coefficients of variation, returns to water supplied are low with high coefficients of variation. This demonstrates that irrespective of what the water availability situation of each module is, system managers and farmers try to maximize their returns to land cropped, resulting in high returns to a unit of water consumed. Rather than trying to spread water more thinly over a larger area and increase the depleted fraction of the water supplied, users chose to apply more water to the area that is actually cropped resulting in high RWS values and low returns to water supplied. In theory this means that farmers could crop more land by applying less water per hectare irrigated and hence increasing their productivity of the water supplied.

The comparison also shows that although RWS values vary considerably between the modules (figure 5.7), their returns to land cropped are approximately the same. This suggest that those modules with the highest RWS values could reduce the volume of water per hectare irrigated without affecting the returns to land. This would particularly be the case for Salvatierra and Acámbaro modules, which have very high RWS values, low returns to water supplied, and because of low cropping intensities very low returns to unit of command. Given the fact that Salvatierra has the highest return to unit of water consumed, it shows that the module has high potential to considerably increase its output per water supplied.

The general conclusion that can be drawn from the cases presented above is that although water is the limiting factor in ARLID, the irrigation management strategy chosen by users of the district is to maximize returns per unit of land cropped, rather than increasing returns per unit of water allocated to their fields. This results in relatively high returns to land cropped and water consumed, but very low returns to unit of command and water supplied. On the average, the volume of water applied to each hectare of land cropped is almost twice as high as the required demand for crop evapotranspiration.

5.8 Conclusions

One of the aims of this chapter was to analyze how local irrigation managers and farmers practice irrigation management under the current arrangements for O&M. The observations made in this chapter can be summarized as follows.

Actual allocation of irrigation water between the modules closely matched the concessioned and assigned allocation (see chapter 8 for a more detailed analysis). This suggests that at the start of the season, WUAs know how much water will be delivered to them. Establishment of a hydraulic committee at the district level, in which all WUAs participate, has given the WUAs an effective means to monitor the actual supplies against the concessioned and assigned volumes.

The hydraulic committee decides on the dates of the opening and closing of the dams. Farmers schedule their irrigation around these days. These irrigation periods are long enough to provide for flexible scheduling within these periods. This is certainly the case under the arranged scheduling arrangement in ARLID in which farmers request and pay for an irrigation service to be provided on a certain day.

The irrigation district operated during the winter 1995–96 and the summer 1996 seasons under conditions of relatively abundant water availability. It was possible for the managers to supply the crop water requirements with a good margin of safety, as indicated by the high values of RWS at different system levels. Generally, RWS values in Salvatierra are much above the district average levels, while values in Cortazar are slightly below them. Also, on-field flow measurements point to high adequacy of water at the field level. However, the way irrigation deliveries are reported by ditch tenders blurs this high adequacy in official reports. Generally, ditch tenders underreport the volumes allocated to farmers. Furthermore, reported volumes are roughly calculated or even calculated using the planned water depth as a reference. As these reported volumes are the basis of the monitoring of water management from the field up to the district level, this practice has considerable consequences for the quality of the performance monitoring done by CNA and the WUAs.

Crop water requirements are calculated on the basis of a single main crop, normally a relatively high water-consuming one in order to be on the 'safe' side. This leads to over-calculation of irrigation depths, especially in Salvatierra where farmers grow relatively more crops that require less water. This has translated into the high RWS values observed.

RWS values obtained at all levels suggest that well users use more water per hectare than those using canal water. The reasons for this are a relatively low pumping cost as a consequence of subsidized energy tariff (see section 7.4) as well as the attempt to avoid risks by not waiting until the rains have started.

As a result of high actual RWS values, spatial distribution of RWS values along selected canals is not a major concern to farmers. Daily measurements at selected canal and field levels, indicate that all farmers receive sufficient water to meet crop requirements. While some variation in spatial distribution exists, there is no bias to user location (head-middle-tail) within the irrigation network. The reason for this is that farmers closely monitor that they receive the irrigation service they have requested and paid for. At on-farm level, personal interactions between users and ditch tenders play a significant role since this determines both flow size and number of hours that a particular plot may get water.

Finally, standardized gross values of production per unit of irrigation supplied or to the water consumed are relatively new concepts and there is a dearth of information that would allow comparison. Some preliminary values have been obtained by IWMI for other systems worldwide and indicate that, generally, values found in ARLID are high, especially for crops irrigated under wells (Molden *et al.* 1998 and Sakthivadivel *et al.* 1999).

CONFLICTS IN OPERATIONAL ACCOUNTABILITY

In section 1.3, a distinction was made between mechanisms of operational, financial and political accountability. These three forms of accountability play a role in the way water is actually distributed between the beneficiaries of the services provided by CNA and the WUAs. The above examples of water distribution in selected canals and to selected fields provide detailed information on the mechanisms of operational accountability in water distribution. Examples of political and financial accountability mechanisms are given in chapters 6 and 7, respectively. Although the latter two cannot be separated from operational accountability, analysis of operational accountability shows that water managers at different system levels are concerned about different ways of being accountable to their constituencies. This has sometimes led to conflicting operational accountability mechanisms.

The direct access to the WUAs' representatives is the major advantage of the new institutional arrangement compared to the situation before IMT. In case of irregularities that farmers want to have solved, they can now more directly approach the irrigation managers, who like themselves are water users. If they do not want to approach the board members directly they can and do contact their delegates who will bring their matter to be discussed in the general assembly. The WUA is directly accountable to them and its members have the power to 'vote out' the board and elect a new one in case of irregularities - as has already happened in one occasion in the Irapuato WUA (see section 6.3).

Whereas the accountability mechanisms for O&M at the 'lower level', especially between the farmers and their organizations (WUAs, SRL) are clearly established and function well (see Urban *et al.* 2000 and the chapters that follow), several possible weaknesses regarding the accountability mechanisms at the 'higher level' can be identified. The rules defining the relationship between CNA and the users' organizations obviously leave some scope for flexibility in the distribution of the management roles between CNA and the WUAs. In the case of ARLID this flexibility is used by the CNA to grant a large degree of 'freedom' to the users organizations in the O&M of their irrigation systems and to reduce CNA's formal supervising role to a minimum. Up to the present this has worked well, partly due to the close personal and professional links between CNA and the user representatives, such as influential private farmers who reside in the district.

According to the water law the hydraulic committee defines the "rules of the game" for the district in the district regulations. These regulations, however, have to be approved by CNA. In the case of coincidence of opinions and interests – as in ARLID – this works smoothly. However, how will this work in situations of conflicting interests? What if in cases of water shortage (and consequently shortage of funds for maintenance) the interests of the individual parties differ? How will CNA react, if the WUAs decide to allocate significantly less than 60% of their income (as presently proposed by CNA and done by the WUAs) to maintenance? Will CNA continue to let the hydraulic committee take the respective decisions or will it resume its role as supervising and finally decisive entity and take on a conflicting position towards the users? Potentially there is the danger of conflicting interests: whereas CNA has to safeguard its assets that they concessioned to the users (irrigation infrastructure, rural roads), the WUAs might pursue slightly different primary objectives (concentration on maintenance issues that are directly relevant for production goals). Let us explore some of these questions.

The examples presented in this chapter show that, so far, the CNA and the hydraulic committee have been accountable to the WUAs. Their main concern is that water is strictly distributed proportional to the service areas with rights to canal water that each of the WUAs within the district has. Furthermore, the CNA district office is mainly concerned to meet the operational targets of irrigated area and cost-recovery. They are accountable to the CNA headquarters for producing seasonal reports that show that the district performs according these administratively set targets. This accountability has a trickle-down effect via the WUAs to the ditch tenders. The WUAs' main concern is that a farmer receives irrigation water and that he does not irrigate more than the planned area, irrespective of the crop he grows, the soil type of his farm, or how much water is actually supplied to his plot. As a result, as long as the WUAs receive sufficient water to meet the water requirement of irrigated crops in the fields that farmers have paid an irrigation turn for, WUAs do not always check whether CNA actually delivers the volumes requested.

Also, ditch tenders generally record the calculated (i.e. planned) rather than the actual flow in their daily irrigation reports. Strategically this practice satisfies the two groups the ditch tenders are accountable to. Farmers are satisfied when they receive all the water they need and have paid for (per hectare), while the management and leadership of the WUAs are satisfied when the daily reports reflect the operational targets. As a consequence of these two practices, there are large differences between the volumes planned, reported and what was actually measured in the system. This system of accountability based on making daily reports that reflect planned rather than actual performance at all management levels shows that ditch tenders tend to *administer* rather than *manage* water distribution. One of the end-results of these accountability mechanisms is that water is distributed in a 'safe' way, i.e. with levels of water supply that satisfies all end-users. This is reflected in the relatively high values of

RWS. It was possible for both CNA and the WUAs to supply the crop water requirements with a good margin of safety.

EVALUATING IRRIGATION PRACTICES USING AN INTEGRATED BASIN APPROACH

The above O&M strategies and accountability mechanisms have helped to reproduce existing practices and arrangements of water management, resulting in relative high levels of water use. This is in contrast with the idea that the new institutional arrangements would encourage managers and farmers to use water more efficiently. Yet, the problem with qualifying this reproduction as being right or wrong lies with the problematic concept of 'efficiency'. Whether the above practices of high water use per unit of land cropped within ARLID should be evaluated as being right or wrong depends on the reasons behind this strategy and whether users have options to manage their water differently. Among the most important internal factors and processes that explain the present management strategy are: the poor physical conditions of the infrastructure (particularly in Salvatierra); high land fragmentation; and scheduling and distributing water to meet water requirements of the main crop rather than real crop requirements. However, the most important incentive to not wanting to change irrigation practices and arrangements, is that irrigation managers pursue planned area rather than actual volumetric needs as *the* management objective. This raises the question which options do local irrigation managers and farmers prefer to change these practices?

The first option that users have, is to adhere to the current situation as it guarantees them high returns to every hectare that they are allowed to crop. At the field level this option results in low consumed fractions of supplied water. A second option is probably the most conventional one and is often advocated by irrigation engineers: attempting to improve water use efficiencies at all system levels resulting in increased returns to water supplied to the fields. The above examples provide several opportunities for technical and managerial recommendations, which include to increase field application efficiencies through field leveling and reduce conveyance efficiencies (for instance by lining canals and improving structures). This would allow the WUAs to spread water more thinly. Similarly, several WUAs could better match planned and scheduled water distribution with real crop requirements, resulting in lower RWS. Furthermore, WUA staff could be trained to distribute water according to the principle of management by volume instead of management by area targets.

In the case of ARLID, the water that is saved if this approach is followed could be used in three different ways. First, it could be used to expand the area actually cropped within the module areas, resulting in higher returns per hectare of command. Second, it could be saved for a supplementary irrigation service during the summer season. However, as rainfall generally meets crop requirements in the summer, this strategy would not increase returns per land and water. A third way, and one that is now being followed by WUAs like Valle, is to sell some of their annual volumetric allocation to other WUAs (see chapter 8).

A third option would be to allocate less water to the district and to allow more water to be used by users downstream of ARLID. As mentioned in the description of the district, 44 percent of the water available for the nine districts in the basin is allocated to ARLID, while it only has 33 percent of the area covered by these districts. This indicates that the allocation is relatively high and that other districts receive less water per unit of command than ARLID.

Technically it possible to introduce the second and third option. Yet, one has to be cautious to recommend either one of these on the basis of the data presented above. Keller *et al*. (1996), Molden (1997) and Solomon and Burt (1999) argue that the above classical thinking on irrigation efficiencies can lead to erroneous conclusions and serious mismanagement of scarce water resources. The main argument they use is that the classical efficiency approach ignores the potential beneficial reuse of irrigation return flows. Translated to the context of ARLID, they would argue that although farmers fail to increase the returns to the water supplied, it does not necessarily mean that the non-consumed (or non-depleted) fraction of that water cannot be reused and generate new returns elsewhere for other beneficial (Molden 1997) or reasonable (Solomon and Burt 1999) uses[23].

Whether the high RWS values and consequently low returns to supplied water can be justified given the fact that other users in the basin receive relatively less water, depends on how return flows from irrigation can be used both within and outside the district. Thirty-one percent of the command area in ARLID is served by wells, which pump water from three different aquifers. Each of these aquifers are already over-exploited resulting in an annual fall of the static water table from two to five meters per year (Muñóz 1996), approaching depths in the range of 100 to 200 meters[24]. Although the direct hydrological relationships between irrigation in ARLID and recharge of these aquifers are not fully clear, one could hypothesize that any attempt to increase the consumed factor of the water that is used for surface irrigation through rehabilitation and modernization programs would jeopardize groundwater recharge, which could result in making groundwater inaccessible to generate any additional returns. Scott and Garcés-Restrepo (1999) assess the impact of three alternative scenarios of surface irrigation management on static water levels in the middle reach of the Río Lerma basin through the application of a simple conjunctive surface-groundwater model that accounts for groundwater recharge from surface irrigation. They show that, contrary to conventional thinking, decreasing the surface RWS by 10 percent was simulated to result in an extra average decline of 0.91 m/year *in addition* to a historical average static water level decline of 2.12 m/year for the 1982-98 period. Increasing the RWS by 10 percent (equivalent to increasing reservoir releases by 25 percent) was simulated to reduce average decline to 1.21 m/year (down from an average of 2.12 m/year). These results indicate that the sustainability of groundwater trends are highly sensitive to the surface water management practices.

Similarly, prior to concluding that water use practices at ARLID have to be shifted to producing higher outputs per unit of water applied within the district, it is necessary to first develop a better understanding if and how outflows of the district are used more downstream in the basin. ARLID is located in the upper reach of the basin. Reducing outflows of ARLID would have an effect on the volume of water available to downstream users and consequently on the return to water that these users can produce.

Notes

1. Parts of this chapter are drawn from Kloezen and Garcés-Restrepo (1998a and 1999b) and Kloezen (1998).
2. For the agricultural year 1997-98 it was decided to not irrigate at all during the winter season and to provide only one turn for the 1998 summer season. This decision was the result of exceptional low rainfall in central Mexico during the summer and autumn of 1997 and the consequently low storage of all major dams. As this decision not to irrigate at all during the winter season falls beyond the timeframe of this study, it is not further discussed here.
3. Article 99 of the Regulations (*reglamentos*) to the 1992 National Waters Act. The document that stipulates the O&M rules of the district, says that WUAs are obliged to inform CNA about the annual irrigation plans (including acreage irrigated and cropping pattern) as well as about the maintenance and administrative plans with their respective budgets. It is not clear in what way CNA can sanction those WUAs who do not meet these obligations.

4. Ditch tenders have to report yield levels obtained by farmers. Rather than checking actual yields of (or sample of) all their farmers, they ask a few farmers in each section of the module to report on their yields. As farmers generally sell all their produce to nearby commercial enterprises, these reported yields can easily be cross-checked. Comparison between yields reported by other ditch tenders in the same module, and by commercial enterprises, agricultural banks and local departments of the ministry of agriculture show a high level of consistency.
5. Although both CNA and the WUAs in ARLID produce 'exact' efficiency rates (up to two decimals), no one could explain how these values were obtained. Tenango and Hernandez (1994) give a number of efficiency rates for ARLID for the years 1985-1990, but unfortunately they do not explain how these were obtained.
6. Among the few exceptions of literature that report on canal maintenance in Mexico are Sijbrandij (1989) Zaag (1992) and Sijbrandij and Zaag (1993), who studied farmers' involvement in maintenance in the Autlán-El Grullo irrigation district in Jalisco. Most of the (gray) literature on maintenance in Mexico focus on measures for aquatic weed control (see for instance the several contributions by IMTA in Palacios-Vélez *et al.* 1996). Studies explicitly looking at the impact of IMT on canal maintenance programs include: Vermillion and Garcés-Restrepo (1996 and 1998) on Colombia; Svendsen and Nott (1997a and 1997b), Scheumann and Valletin (1997) and Scheumann (1998) on Turkey; Oorthuizen and Kloezen (1995) on the Philippines. Studies that looked at the impact of participatory management on the maintenance of pump systems include Wester *et al.* (1995) on Senegal; and Johnson and Reiss (1993) on Indonesia.
7. Unlike in irrigation, Integrated Asset Management Systems are commonly used in other fields related to infrastructure, such as roads maintenance. Asset management planning deals with the identification and inventory of assets and quantifies their condition and their performance both in terms of the individual asset and the overall system (Rumsey and Harris 1990, cited in Burton *et al.* 1996). The only two papers on the application of this approach in the field of irrigation that I came across are Ferguson *et al.* (1993) on maintenance planning in the Yanco irrigation district in New South Wales (Australia) and Burton *et al.* (1996) on irrigation investment planning in Indonesia.
8. The drawback of this 'cluster approach' for this study is that, unlike the present WUAs, CNA did not keep their maintenance records at the level of the individual irrigation unit or module level but were kept at the level of these clusters. This made a before-after comparison of actual costs and volumes of maintenance executed at the level of the modules impossible.
9. During the last phase of the field research on which this thesis reports, IWMI in collaboration with HR-Wallingford and the Irapuato WUA started an action-research project on priority setting in maintenance program planning. The project followed and modified the software-driven methodology on condition assessment procedures for irrigation infrastructure, developed by HR-Wallingford (see Cornish and Skutsch 1997, and Cornish 1998). As this project was started after completion of the field work for this thesis, results of this project are not discussed here. The final results of this project are published by IWMI (Wester *et al.* 2001). MARLIN draws heavily on Integrated Asset Management Planning theory described in note 7.
10. Appendix 5 provides some contextual data on cropping intensities, cropping patterns, production levels, water use and climate for the particular year reported here. Production values in this appendix are already in 'equivalent' yields, following the measurement procedure defined in Appendix 4.
11. For reasons explained above, dam storage data for La Purísima are excluded from this analysis.
12. Unlike for instance Cortazar, Salvatierra does not have one or two large main canals but 6 smaller ones. The design discharges do not exceed 3 m^3/s (compared to almost 30 m^3/s in the case of the Coria main canal in Cortazar) and the canals are much shorter.
13. Peña-Peña and Herrera-Ponce (1999) measured an overall system efficiency of 31.8 percent, comprising of a conveyance efficiency of 76 percent for the main and secondary canals, an on-farm conveyance efficiency of 71 percent, and a field application efficiency of 59 percent.
14. Salvatierra has 25 percent of all the users within the district, while it occupies 14 percent of the district area.

15. According to this manager, the official reason why he had resigned was that he was given another job with the Ministry of Agriculture in the State of Guanajuato. However, after a few months he was re-hired by the WUA, but this time as the supervisor of the other ditch tenders, which is one position below his previous assignment. The reason why he was re-hired is that this person, more than any of the other technical staff, was very familiar with the module area as he had previously worked in the same area as a CNA employee (see also chapter 7).
16. Of the selected fields in which water measurements were taken (tables 5.5 and 5.6), in one case supply of canal water was not reported by the ditch tender (table 5.5, Salvatierra field 7). However, this is the result of problems with updating the list of actual users rather than an example of illicit appropriation of water. The part of the Salvatierra command area where this field is located has recently been extended, but plots have not been mapped and given proper numbers yet, which makes it difficult for the ditch tender to report water deliveries.
17. Normally in this part of the command area (with pumping depths of 50 to 100 meters) discharges of 6 inch pumps range from 35 to 50 liters per second.
18. After Chambers (1988) drew attention for studying night irrigation, few papers have emerged on this subject. An exception is a section in the MSc thesis by Bolding (1992), who describes an example of a night control by a Work Inspector in the Tungabhadra Left Bank Canal, India. Also for the case of Mexico, documents on night irrigation could not be found. Probably the most important reason that explain this is that the combination of robbery, use of weapons, and high alcohol intake can make the experience of field visits at night a very unpleasant one (and the reason why I did not even attempt to survey at night).
19. A Starlog System data logger (model 6301B AUE, software version 3.032, November 1995) was used to record the water level with an interval of 30 seconds. Subsequently, the 30 minutes averages were downloaded as a spreadsheet file and plotted to the three graphs in Appendix 6.
20. Changes that are due to planned re-setting of the gate have been excluded from this calculation. Also, only water level changes of more than 10 percent were considered.
21. For definitions plus examples see also Kloezen and Garcés-Restrepo 1998a; Molden *et al.* 1998; Sakthivadivel *et al.* 1999.
22. These and all other values in figures 5.8 to 5.10 are based on actual (current) World Market Prices for wheat.
23. Molden (1997) distinguishes between beneficial and non-beneficial uses. Beneficial uses include water depletion for consumptive uses and process depletion for beneficial consumptive uses. Non-beneficial uses include non-depleted uses like outflows to the sea. Solomon and Burt (1997) introduce the parameter '*irrigation sagacity*'. In addition to the *beneficial uses* identified by Molden, irrigation sagacity also considers *reasonable uses*, i.e. those uses that may not contribute to agronomic production, but are nonetheless justified under certain particular circumstances such as water used to maintain a salt-balance or for other environmental protection reasons.
24. Chávez (1998, cited in Scott and Garcés-Restrepo 1999) reports depths of 500 to 1,000 meters in the Salamanca area.

6 Mechanisms of political accountability in local water management

6.1 Introduction

This chapter deals with political accountability mechanisms that influence the administrative performance of the new WUAs[1]. It looks at the socio-economic and political relationships between leaders and staff of WUAs with the members of these associations[2]. The level and extent of political accountability in WUAs is shaped by the means that users have to monitor and control the decisions taken by their leaders and management. The extent to which users actually can monitor and control decision making is determined by the way they are represented in the general assemblies and boards of their WUAs. Section 6.2 discusses how user representation is formally (*de jure*) defined in the bylaws that were drafted by CNA during the early stages of IMT implementation. In addition, it shows how *de facto* these users are represented and to what extent they can and do monitor and control the decisions that are taken by their leaders.

In section 1.3 it was argued that accountability is a process in which mechanisms of monitoring and controlling management performance of leaders and staff are created and earned. In section 6.3 a detailed account is given of two strategies that leaders of WUAs in ARLID have developed in order to maintain and expand their control over decision making processes within their WUAs: 1) they try to make use of their political power to become re-elected as a WUA leader; 2) they use their position as WUA leader to further expand the economic and political networks, on which the existence of WUAs more and more depend. Examples are given on how users try to counter-balance this to ensure accountability rather than despotism.

In section 6.4 some examples are given on how the above mechanisms of maintaining political control are weakened by the employment policies of the WUAs and by the role CNA plays in conflict resolution, particularly in the case of conflicts between users and leaders.

6.2 User control over decision making processes

REPRESENTATION IN GENERAL ASSEMBLIES

Individual membership of WUAs, and the water rights attributed to this membership, is regulated through Articles 51, 52 and 67 of the 1994 National Waters Law. All private growers and *ejidatarios* that own or occupy land within the command area of the WUA are members of this organization provided that their names appear in the list of users (*padrón de usuarios*) which has to be maintained by the WUA (i.e. the official concession holder). This list of users is a legal document, annexed to the concession title signed between the WUA and CNA, and has to be recorded in REPDA.

One of the major challenges that all new WUAs faced when they started was to update the user lists. In some cases the list had not been updated for more than 25 years. Yet, for demographic reasons, and as the result of the illicit practice of selling and renting out *ejido* land before modification of Article 27 in 1992, there was a large discrepancy between the officially registered users, and users who actually owned or occupied the land. Although all WUAs have started the process of updating their lists[3], by 1998 none of them had finished doing so.

Only farmers whose names appear in the list of users can be elected as representatives to the general assembly of a WUA. According to Whiteford and Bernal (1996), one objective of the IMT program was to create greater political accountability by introducing a system of democratic representation of *ejidatarios* and private growers in the general assemblies of the WUAs. Historically, these two categories of farmers belonged to different farmer unions, processing cooperatives organizations, often competing for control over agrarian production, access to credit and others means of production whose distribution were controlled by the State. The IMT program was certainly ambitious in respect to the fact that it officially tried to bring these two user categories together in a management organization (see section 4.2).

From a democratic point of view, the IMT experience would be a success if both categories would have equitable representation in the management of the module. The conceptual problem that arises here is the definition of equity[4]. The official definition of equity is clearly defined in the bylaws of each WUA. 'Equitable' representation of the users in the general assembly is defined as 'one *ejido*, one vote for *ejidatarios*' and 'one municipality, one vote for private growers'. For all WUAs in ARLID this means that *ejidatarios* far outnumber private growers as there are many more *ejidos* within the district or module area than municipalities. Also if one uses other means of measuring representation, it is clear that *ejidatarios* are relatively over-represented in the general assemblies. In the case of Cortazar, for instance, this implies that the general assembly comprises 70 *ejidatarios* (35 *ejidos*, each with one representative and one replacement) and 14 private growers, totaling 84 members. In the case of Salvatierra, 8 private growers compete with 88 *ejidatarios* (44 *ejidos*) in the same assembly. In Cortazar these numbers equate to one *ejidatario* representative for 31 *ejidatario* members, or for every 140 hectares of *ejido* land, compared to one private grower representative for 71 private growers and for every 876 hectares of private land. In comparison, in Salvatierra one *ejidatario* member represents 58 *ejidatarios* (or 154 hectares of *ejido* land) and one private grower represents 122 private growers (or 292 hectares of private land). On the other hand, one has to note that particularly in Salvatierra private growers have relatively more access to groundwater and hence have less interest in the managing canal water.

Formal representation in the general assembly does not necessarily mean that all members have similar control or influence over decision making processes during the meetings. Observations of several assembly meetings in various WUAs show that generally little discussion takes place. In most cases the meetings are used to *inform* farmer representatives about the irrigation and maintenance programs, the current market prices, changes in fee levels, expected problems with diseases, the existence of externally funded system improvement programs and other government programs, and on how individual users can try to get access to these programs, *et cetera*[5]. Discussions, if any, are generally held between board members and only a handful of farmers. Real discussions only take place during the presentation of the yearly financial statements, when farmers generally ask for clarifications (see chapter 7), or during times of conflicts over the (re-) election of board members (box 6.1) or modifications of the bylaws (box 6.2).

It is difficult to assess why most assembly members remain silent during the meetings. However, studies on formal farmer organizations in Mexico suggest several possible reasons that might explain the lack of actual contribution to discussion in general assembly meetings. A first reason is related to the social, political, economic and ideological differentiation and power relationships between generally well-trained and outspoken board members, and common farmer representatives (Zaag 1992). This is particularly the case if the latter group belongs to the category of *ejidatarios* and the former to the group of private growers. Many farmers are reluctant to disagree with leaders, on whom they often are dependent economically, politically or socially. Female representatives often remain silent during official assembly meetings. They have experienced that in a culture dominated by prevailing stereotypical ideas about the gender division of labor, it is hard for female WUA members to be listened to[6].

Probably the most plausible explanation of why user representatives hardly ever participate actively in decision making processes in meetings, is that negotiation over access and control over resources as well as problem resolution normally takes place in more informal arenas rather than in formal settings like assembly meetings. WUA issues are heavily discussed in other social-political networks and during all kind of occasions where groups of farmers meet. These include gatherings at farmer cooperatives or farmer unions, *ejido* meetings, political party meetings and social happenings like weddings and festivals. Also, WUA issues are normally heavily discussed at the entrance of the WUA office prior to the official meetings, when all farmers are waiting for the board members to arrive. It is mainly during these 'waiting sessions' that representatives exchange ideas and arguments and decide on which decisions they would support and which they would reject. As soon as the meetings have started, most farmers prefer to leave the presentation of 'their' arguments to one or two outspoken and generally higher educated and economically and politically more powerful farmers who feel less reluctant to argue with board members in public meetings.

LEADERSHIP AND CONTROL OVER DECISION MAKING PROCESSES

The second component of the official definition of equal farmer representation stipulated by the bylaws of the WUA is that leadership should alternate every three years when elections of board members are held. Officially a leader cannot be re-elected into the same position.

The general popular assumption among observers of the IMT process is that within a few years private growers would have assumed all leader positions and as a result would have taken *de facto* control over irrigation management in the districts. Table 6.1 provides some information on how the leadership positions were formally distributed between *ejidatarios* and private growers at the start of the second administration in 1996. Of the 12 presidents (11 WUAs and the LRS), six belonged to the group of *ejidatarios* and six to the group of private growers. Hence, given their lower number in the district, presidents that belong to the category of private growers are relatively over-represented. If one looks at all leader positions (including the secretaries and treasurers), the distribution of *ejidatarios* and private growers within the boards better reflect the actual distribution of users within the district. In order to better understand the significance of these numbers for the desired democratization process (Whiteford and Bernal 1996), three remarks have to be made here.

First, the *de jure* distribution of leader positions does not necessarily reflect the *de facto* control over decision making power within a WUA. For instance, in some WUAs leaders other than the president control major decisions. During its first administration (1993-1996), the board of Cortazar WUA was presided over by an *ejidatario*, but it was clear that all decisions were actually controlled by the treasurer of the association. This treasurer was a large and business-minded private grower, maintaining good relationships with regional and national politicians.

The second remark is that all three leaders of the LRS are private growers. As it is expected that the LRS will become more and more important for the management of the district, it is clear that private growers have more control over decision making processes, resources and external support programs related to this management. The LRS' ambition to expand its mandate to providing agricultural support services other than O&M can also be understood within this context. All three leaders run large export-oriented farms and maintain extensive contacts and networks with agricultural enterprises and regional and national politicians.

A final remark that has to be made in connection to table 6.1 is in line with the first remark. Actual control over power within the WUAs is best illustrated by the way and the extent to which leader positions are mobilized within the association, particularly over the three administration terms since the creation of the WUAs in 1993. Before this is further discussed in detail in the next section of this chapter, it is useful to first discuss to what extent common water users are aware of who their leaders are and what they do.

Table 6.1 Distribution of leader positions between *ejidatarios* and private growers during the second administration (1996 - 1999)

	President		Secretary		Treasurer		Total	
WUA	*ejidatario*	private grower	*ejidatario*	private grower	*ejidatario*	private grower	*ejidatarios*	private growers
LRS (federation)		1		1		1	0	3
Acámbaro	1		1		1		3	0
Salvatierra	1		1			1	2	1
Jaral	1		1			1	2	1
Valle		1		1	1		1	2
Cortazar		1	1		1		2	1
Salamanca		1	1		1		2	1
Irapuato	1			1	1		2	1
Abasolo	1		1			1	2	1
Corralejo		1	1		1		2	1
Huanímaro		1		1	1		1	2
La Purísima	1		1			1	2	1
total	6	6	8	4	7	5	21	15
%	50	50	67	33	58	42	58	42

Lack of communication between users and their leaders and representatives has been a common complaint put forward by many users. Although 90 percent of the 125 farmers that were surveyed for this study said they knew that O&M responsibilities had been transferred from the government to the WUAs[7], only 63 percent of these farmers knew who the president of their association was. On the other hand, 80 percent knew who their representative was to the general assembly of the WUA (table 6.2). The table also shows that private growers are generally better aware of who their president is than *ejidatarios*. At the same time, less private growers knew by whom they were represented. This is explained by the fact that large private growers normally prefer to deal directly with the president of the WUA, particularly if the latter is a private grower himself whom he frequently meets in producer confederations and cooperatives. For *ejidatarios* it is easier to first approach the representatives from his own *ejido*, with whom he generally has daily contact.

Table 6.2 Percentage of farmers surveyed (n-=125) who know who the WUA president and their own representative to the general assembly are

	Knows the president		Knows his representative	
	yes	no	Yes	no
Ejidatarios (n=90)	60	40	87	13
Private growers (n=35)	71	29	62	38
All farmers (n=125)	63	37	80	20

Answers to survey questions on how leaders and delegates are actually elected present a less rosy picture of the democratization process (table 6.3). Approximately 70 percent of both *ejidatarios* and private growers have no idea of how board members are elected. This shows how little control they have over these elections. *Ejidatarios* are better aware of how their delegates are elected as elections take place in the meetings of the *ejido* assembly. These meetings generally show a high turnout as many other issues are being discussed and decided upon (several in connection with other neoliberal reforms, such as the PROCEDE program and the sale of *ejido* land).

Table 6.3 Percentage of farmers surveyed (n-=125) who know how the board of leaders and their own representative to the general assembly are elected

	Knows how the board is elected		Knows how own representative is elected	
	yes	no	Yes	no
Ejidatarios (n=90)	34	66	64	36
Private growers (n=35)	30	70	35	65
All farmers (n=125)	33	67	43	43

In addition to the lack of knowledge of these official election procedures, farmers are even more concerned about the lack of information on what has actually been discussed in the meetings of the general assembly. Although minutes of assembly meetings are sent to all representatives, they hardly ever reach the water users. Numerous farmers complain that they were never informed by their leaders and representatives on issues like the start of the irrigation season, irrigation schedules, the maintenance program, training activities and changes in fee levels. Most farmers have to find out about decisions on these issues by experience or via word by mouth.

Whiteford and Bernal (1996) report that 40 percent of the *ejidatarios* whom they interviewed were not pleased with their WUA leaders, while 78 percent of the private growers said they were pleased. According to them, these figures clearly show which group controlled the WUA leadership. However, it is doubtful whether the level of satisfaction of each of the two categories is a good indication of who actually controls leadership. Although the above discussion on leadership in ARLID points to relatively higher control over decision making processes by private growers, an almost equally high percentage of farmers surveyed said they have confidence in e.g. the way leaders manage the WUA financially (see also table 7.1). This indicates that water users do not automatically link their (dis)satisfaction with the leadership to the fact whether the leader belongs to the same user category. When asked what according to them is the main reason why leaders wanted to be elected on the board of the WUA, only 8 percent of the *ejidatarios* and 13 percent of the private growers said that they believed that these leaders primarily wanted to use their position for their own financial and political benefits. All other farmers said that, according to them, the leaders' main concern was to improve the O&M of the district.

6.3 Strategies to maintain political accountability

Strategy 1: remobilization of WUA leaders

To most leaders, getting elected as a leader of one of the new WUAs is an effective way of establishing and reproducing their socio-economic and political relationships with water users. As such, becoming a leader of a WUAs is seen as an effective way of gaining more control over decision making processes within the organization of agricultural production.

As was noted in section 6.2, the change or remobilization of leader positions with every new administration period of three years is a good indication of who actually controls management decisions. Officially, leaders cannot be re-elected into the same position. Yet, a common strategy followed by leaders who try to maintain control over WUA management is to get re-elected into another position. As is illustrated in box 6.1, a WUA president succeeded in getting re-elected in the same position through buying votes and loyalty from technical staff and farmers as well as through political manipulation of members of the general assembly. In other cases (such as Cortazar), leaders were re-elected into other board positions because members of the general assembly had positive experiences with those leaders and did not want to lose their access to important political and commercial networks and their capacity to manage the WUA in effective and financially sound ways.

Figure 6.1 shows how leaders and some managers are mobilized in four WUAs since the start of their creation in 1992. All initials in bold indicate that leaders were elected more than once, generally into different positions. The sequence in their positions is indicated by arrows. All other leaders, (whose initials are not given), were elected only once and have stopped to play an active role in the board once their terms were over. The figure allows for several interesting observations.

The first observation is that even by glancing at the figure, it becomes clear that some WUAs have more bold initials and arrows than others, indicating a higher activity of mobilization of leadership and management positions. Salvatierra has clearly the highest frequency of re-mobilization and re-election of leaders. As is illustrated in box 6.1, this is clearly the result of the WUA president trying to maintain control over the association. At the start of every new administration, La Purísima WUA seems to completely replace its leaders. In the cases of Cortazar and Irapuato WUAs, one or two leaders are re-elected into new positions. In two of these cases, members of the over-seeing committee were re-elected as board members, particularly as they had gained experience with WUA matters as well as confidence with the other users.

A second observation is that Salvatierra has had two mid-term elections and Irapuato had one election before the official term of the sitting leaders was ended. In the case of Salvatierra this was the result of ongoing political struggles within the association and consequently the farmers' dissatisfaction with their leaders. In some cases treasurers and secretaries had to step down as they had lost their fights with the president of Salvatierra WUA.

Figure 6.1 Mobilization of WUA leaders and general managers across positions, and within and across governing terms, in four WUAs during three terms of administration, 1992-1999

WUA	Position	1st term (late 1992- early 1996) user category		2nd term (early 1996- early 1999) user category		3rd term (early 1999 onwards) user category
Salvatierra	president	**AAA** (ejid.)		**AAA** (ejid.)		**CCC** (ejid.)
	secretary	ejidatario	**DDD** (ejid.)	**DDD** (ejid.)	private grower	DLE (ejid.)
	treasurer	ELE (priv. grower)	**BBB** (priv. grower)	**BBB** (priv. grower)		priv. grower
	overseer	**EEE** (priv. grower)		**EEE** (priv. grower) and **FFF**(ejid.)		ejidatario
	manager (paid)	*ARG*	*PLP*	*PLP*	***FFF*** ***CCC***	***CCC** and GF*
Cortazar	president	ejidatario		**JJJ** (priv. grower)		**KKK** (ejid.)
	secretary	ejidatario		ejidatario		ejidatario
	treasurer	**JJJ** (priv. grower)		ejidatario		private grower
	overseer	ejidatario		**KKK**(ejid.)		ejidatario
	manager (paid)	*MVM*		*GPH*	*SO*	*SO*
Irapuato	president	private grower		ejidatario	ejidatario	ejidatario
	secretary	**LLL** (priv. grower)		**MMM** (ejid.)		ejidatario
	treasurer	ejidatario		**LLL** (priv. grower)	private grower	private grower
	overseer	**MMM** (ejid.)		private grower		ejidatario
	manager (paid)	*JBF*		*RSH*	*EA*	*EA*
La Purísima	president	private grower	private grower	ejidatario		ejidatario
	secretary	ejidatario		ejidatario		ejidatario
	treasurer	ejidatario		ejidatario		private grower
	overseer	ejidatario		ejidatario		ejidatario
	manager (paid)	*EA*		*EA*	*RSH*	*RSH*

Notes: Initials in bold are leaders that were elected more than once. All the other leaders (both *ejidatarios* and private growers) were elected only once. Initials in italics are general managers who are hired by the WUA (and hence do not represent any of the two user categories).

Box 6.1 Political conflicts around the re-election of a WUA president: an example from Salvatierra

According to the bylaws of each WUA in ARLID, every three year the position of president of the user association should alternate between the categories of private growers and *ejidatarios*. The first elected president of the Salvatierra WUA was an *ejidatario*. Unlike most other *ejidatarios*, this person was from a well-to-do family. Furthermore, the family had gained quite some political leverage in the town of Salvatierra, which is demonstrated by the fact that the brother of the WUA president was the mayor of the city of Salvatierra.

By the end of 1995, the president had come to the end of his term and farmers had started talking about electing a new president. Many farmers welcomed the idea to elect a new leader as the present person could apparently not solve the many O&M problems associated with the poor condition of infrastructure, land fragmentation, crop diversity and extremely high number of farmers that had to be served (see chapter 5). Furthermore, under his administration the WUA had received quite some negative publicity as a result of financial mismanagement, and corruption (see chapter 7). Finally, many farmers were fed up with the high turnover and re-mobilization of positions within the board of the WUA as well as with the frequent changes of technical staff, including the general manager (see figure 6.1). This was believed to be the result of internal political conflicts and favoritism. The start of a new administration would provide a good opportunity for a new beginning, with new leaders. However, irrespective of the bylaws, the president refused to step down. What followed was a high level political battle between two different factions within the WUA, who both tried to 'gain votes' by manipulating election meetings as well as individual users and technical staff.

Mid October 1995: The first open demonstration against the re-election of the president took place. A group of about 10 user representatives to the general assembly of the WUA accused the president and the treasurer of financial mismanagement (see chapter 7) and of using their positions for strengthening their own interests. In addition, the president was accused of "giving loans to himself" (*autopréstamos*). This group also warned that they would strongly oppose the re-election of the president.

Mid November 1995: Knowing the tense political situation in the WUA of Salvatierra, the State manager of CNA Guanajuato sent a letter to all 44 *ejidos* within the module area, saying that these *ejidos* should send their representatives to the election of the new general assembly. This new assembly should elect from their members the new board of leaders. CNA suggested that none of the present leaders nor any of the technical staff that worked for the WUA should attend this meeting. CNA also proposed to send an observer to the meeting (without the right to vote).

13 December 1995: The new assembly has to vote for a new board, including a new president. The planned meeting had to start at 9.00 a.m., but more than 30 opponents of the WUA president did not allow him to attend the meeting. They also rejected the idea to allow the brother of the president (who is the mayor of Salvatierra) to attend the meeting as an observer. For this reason, representatives that supported the re-election of the president left the meeting and as a consequence there was no quorum. An official observer from the State of Guanajuato suggested to not only allow the thirty representatives that opposed the president, but also to invite their replacements to attend the meeting. According to the bylaws this is possible and it would guarantee sufficient quorum. However, some of the farmers entered the meeting without being able to present the official legal documents that show that they were officially registered as users and hence eligible representatives to the assembly. This made the observers from both CNA and the State of Guanajuato leave the meeting around noon and it helped the supporters of the acting WUA president to postpone the meeting. The next day, CNA officially announced in the local press the reasons why the meeting was cancelled and informed users that a new meeting would be called for January

16 December 1995: A new meeting was called by the opponents of the acting president. However, this president did not show up and three new board members and their replacements were elected.

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18 December 1995: More than 50 farmers came to the WUA office to officially install the new board. The problem, however, was that the acting president did not show up to hand over both his position and the keys to the office. The office remained closed and nobody could enter the building until a public notary would have made an inventory of the assets that belonged to the WUA. During the days that followed, supporters of the acting president started arguing that the election of the new board did not have a legal basis as most of the farmers that attended the meeting were replacements to the official representatives. Moreover, it was argued that election could not have taken place without the presence of observers from CNA and the State of Guanajuato.

In the three weeks that followed, the tension between the two factions increased, resulting into clashes between technical staff that remained loyal to the acting president and those who supported the unofficially elected new president. The latter group is led by engineer CCC (see figure 6.1), who would play an important role later on. However, his group lost more and more political clout as supporters of the new president felt threatened by the acting president, who in the mean time had mobilized quite some political support from his PRI friends, including his own brother (the mayor) and the head of PRI-tied farmers' union CNC. Initially, when the WUA was established in 1992, CCC supported the acting president but he totally disagreed with the president's attempt to be re-elected. Moreover, he became more and more concerned with the lack of technical expertise of some of the staff that were hired by the president.

8 January 1996: A new official meeting was called, observed by the head of CNA Guanajuato, the Secretary of Agriculture of the State of Guanajuato and the mayor of Salvatierra. Although one third of the farmers voted against the acting president, with 51 votes the president was re-elected. Farmer CCC that had led the group against the president was elected as vice-president. According to some representatives and technical staff, the election of CCC as a vice-president was the results of negotiations that had taken place between these two persons during the weeks that followed the meeting of December 16. As soon as the voting results were clear, 30 farmers left the meeting without waiting until the head of CNA Guanajuato had officially taken notice of these results.

24 February 1996: A special meeting was called to present the annual financial statement for 1994-95 to the assembly. During that meeting a group of farmers, including the new vice-president CCC, handed out a 'list of observations" which showed a high number of incidents and accusations of financial mismanagement and corruption (see chapter 7). This further weakened the position of the president and he had to give in on a number of changes in his technical staff, some of whom were hired merely because they were politically loyal to the president. Also the *ejidatario* member of the overseeing committee that controls the board had signed this list of accusations. Later on he was hired as the new general manager of the WUA .

In other cases, water users from the opposition factions forced the president to accept their candidate to become the vice-president of the WUA (not indicated in the figure), to compensate for the re-election of the president. In order to further compensate for his re-election, later on the president had to hire this opposition candidate (with the initials CCC) as the general manager of the WUA, paying him a very competitive salary. During his time as opposition candidate for the presidency, as vice-president and as general manager, respectively, this CCC had gained sufficient political support from both technical staff and the users to be elected as the president of the third administration and at the same time assume the (paid) position of general manager.

In the case of Irapuato, the general assembly forced the president and the treasurer to step down one year before the end of the second administration. The main reasons for this were the discovery of unjustified cheque payments, and the assembly's and technical staff's general dissatisfaction with the president's attitude of favoritism and nepotism. Also in the case of La Purísima, nepotism caused severe political unrest among both members of the general assembly and technical staff, which were not resolved when field activities for this study came to an end.

A third observation on figure 6.1 is that also general managers are replaced quite frequently. In some cases, general managers are replaced because they themselves found better job opportunities. In other cases they were replaced because of their disappointing performance, or because of a salary request that could not be met. Also, in WUAs like Salvatierra, the position of general manager had become a political one. Since 1992, Salvatierra has had five general managers, of whom three during the second term of administration. All these general managers were hired due to political reasons, either because the person was politically closely related to the president, or because he was pushed forward by the opposition faction within the association as kind of exchange money for the re-election of the president. The Salvatierra case is also an example of how former (unpaid) leader positions are manipulated into (paid) management or staff positions. One of the complaints brought forward by several farmers and ditch tenders was that general managers hired by the president in Salvatierra were paid excessively high salaries[8].

A final observation on figure 6.1 is that only in the case of Cortazar, the position of president was alternated between private growers and *ejidatarios*. In Irapuato and La Purísima *ejidatario* presidents were replaced by other *ejidatarios* during the election of the third administration while in Salvatierra all presidents so far have been *ejidatarios*.

Strategy 2: expanding socio-economic and political networks

Although the traditional CNA-users patron-client relationships are weakened, they are being replaced by new networks of leaders of WUAs, users, private international seed and agro-chemical companies and local and state politicians. These actors play a role in setting the market prices for agricultural inputs, electricity and crop produce and it has become clear that many WUAs want to increase their stake in these networks. WUAs have become both powerful instruments and actors in the political and the economic arenas of negotiation. This makes the position of leader of a WUA a very desired one. To most leaders, becoming a president of a WUA brings an opportunity of further expanding their already existing networks, rather than starting one. Almost all leaders are elected mainly because they already possess several (sometimes up to 20!) positions in all kinds of local organizations like production cooperatives, unions, *ejidos* or political parties. Yet, one can see a clear distinction between how these leaders use their new position within the WUAs to further expand their own networks. At the risk of over-generalizing and simplifying, WUAs and their leaders can be classified by two types of organizations.

The first type is the heavily politicized WUA, in which local party and *ejido* politics determine decision making processes and resource distribution, including water distribution. As is illustrated with the example in box 6.1, leaders of this type of WUAs use their positions mainly as spring boards for their personal political ambitions by linking into all kinds of local political networks and often by using funds of WUAs to buy votes and loyalty, or by offering (relatives of) political friends well paid staff positions within the WUA.

The second type of WUA is politicized in a different way. Rather than building networks around local (municipality, *ejidos*, etc) political networks, leaders of this group of WUAs are more market-oriented. Decision making and resource distribution are determined by cost efficiency and the aim to commercialize agriculture. An important strategy followed to accomplish this aim is through networking in order to gain access to (inter)national commercial agricultural enterprises, farmer cooperations, farmer unions and higher-level (regional, national) politicians and as a result obtain better prices. Generally, these leaders have gained considerable experience with commercial and often export-oriented farming and run large farms themselves. As a result, they do not need the WUA for their own direct financial benefit. Interviews with this type of leaders and their staff as well as daily observations on how they handle WUA affairs, clearly indicate that they often invest considerable amounts of their own money and time. They also keep a very strict and transparent system of financial administration in order to avoid any possible accusation on rent-seeking attitudes[9]. Yet, although these leaders claim to invest in these networks mainly for the benefit of the WUAs, their own farming activities will of course also benefit from expanding these networks as it guarantees them first hand access to, for instance, lower prices for agro-chemical inputs and participation in externally funded system improvement projects.

Examples of these business oriented leaders are the presidents of WUAs like Cortazar and Valle. These two leaders also played major roles in the establishment of the LRS, which aims at more cost-effective and quality-wise better management of the main canal than used to be the case under CNA management. They also promote the idea of creating commercial trade companies parallel to a group of interested WUAs[10]. The idea here is that these companies would help to reduce the cost of agricultural inputs to farmers by buying these inputs in bulk and selling them to the members of the WUAs that make part of these companies. Similarly, they would aim at receiving better prices for their products by storing their produce in new store houses run by these companies.

Probably more important than possessing the position of president of a WUA, is the presidents' membership of the hydraulic committee. Membership of the hydraulic committee provides these presidents with real opportunities to expand their socio-economic and political networks. They can use their official relationship with CNA and other state representatives not only to gain access to resources from all kinds of externally funded system improvement programs, but also to actual decision making on how these resources are distributed. By sitting on the hydraulic committee, presidents of WUAs do not only have more direct access to resources that are channeled through CNA (like the funds of most system improvement programs) but also to powerful regional and national politicians. Leaders of Cortazar and Valle paid regular visits to the Secretary of Agriculture of the State of Guanajuato as well as to the governor of Guanajuato[11]. This was to discuss the establishment of the LRS, to try to increase the level of crop subsidies, or to negotiate the percentage that users and WUAs had to contribute to system improvement programs that were paid by and via the government (see section 9.5 for an overview of these programs).

For WUA leaders one way of expanding their socio-economic and (often political) networks is by trying to become involved in the provision of services that are not necessarily related to improving water management. Most WUAs in ARLID have now started to assume responsibilities for providing non-irrigation related services to their users which before the neo-liberal reforms used to be delivered by State agencies (see sections 3.2 and 3.3). Table 6.4 gives an overview of the types of non-irrigation services that WUAs currently provide to their members.

WUAs do not only fulfill their regular tasks related to O&M, administration, fee collection and system improvements, but have also become active in providing and facilitating access to information and training on these aspects of system management. In addition, they play an active and important role as mediators between users and CNA. Particularly as members of the hydraulic committee they are in the position to channel complaints and suggestions for improvements to CNA. Furthermore, they negotiate with CNA the seasonal fee levels and irrigation plans and try to reach agreements on these, which in the short run are favorable for their users[12].

The provision of non-irrigation services is very diverse in its nature. In the cases of legal assistance, the service is largely limited to providing and updating information on water rights. Similarly, most WUAs provide users with or facilitate access to information on current market prices, seeds and new agricultural methods. Occasionally, WUAs themselves provide training and technical assistance on irrigation methods; in other cases they organize workshops in which experiences with running system improvement programs and IMT are discussed. However, all these training programs and workshops primarily focus on the user representatives to the general assembly as well as to the associations technical staff, thereby excluding common water users.

Table 6.4 Provision of non-irrigation services by WUAs to water users in ARLID

Type of service	Description
Legal	• up-dating WUA bylaws and define user representation • maintaining and updating list of members (and hence define those who have legal access to water) • monitor water user concessions of the WUA • inform users about REPDA • inform users on how to get a concession for private wells • hire a lawyer for conflict resolution
Agricultural extension	• advise users on what crop they can best grow (given market, water availability and expected diseases) • inform users about current market prices, seed varieties, new agro-chemical products, etc • organize information meetings with enterprises that sell agro-chemical products and seeds
Provision of inputs	• provision of seeds and agro-chemical inputs (through parallel organization)
Agricultural finance	• try to negotiate better prices or subsidies for agricultural produce (with State and federal government agencies) • if requested, advise private well users on current market prices for traded water • inform users about credit programs of banks and government • provide individual informal credit in order to help users to get access to system improvement programs (very rarely) • hand-out statements on actual cropping patterns of individual users, which they can use to get access to PROCAMP crop-subsidies
Training and technical assistance	• organize own small training programs on water use (for user representatives) • co-organize workshops to discuss current problems and impacts of IMT • facilitate access to training programs organized by CNA, IMTA, SAGAR and others (on water use, minimal and zero tillage, etc) • inform individual users on methods for fertigation • rent out equipment and staff for laser leveling of individual plots

Some leaders of WUAs are trying to further improve both the economic position of their water users and their own positions by filling institutional voids in the provision of support services, which were a result of the dismantling of previous state services. With support from their economic and political networks, these leaders proved to be able to increasingly control the provision of agricultural support services other than O&M. Two examples illustrate this.

The first example is the provision of agricultural inputs. With the dismantling of state subsidies for agro-chemical inputs and seeds and with the abolishment of state controlled credit institutions, farmers have been left in an institutional vacuum as far as access to cheap productive resources are concerned. As is noted by Appendini (1996), the new set of institutions such as the productive programs of Programa Nacional de Solidaridad (PRONASOL) and PROCAMPO do not fill this vacuum. As a result, farmers are faced with a significant increase in costs. In addition, with the restructuring of rural credit institutions, only the financially solvent farmers have retained access to credit, which has accelerated social and economic differentiation (*ibid.*; Myhre 1996; de Janvry *et al.* 1996). Although by law civil non-profit organizations like WUAs cannot be involved in the trading and distribution of agricultural inputs, some user associations in ARLID have started to respond to these price increases by creating parallel organization that help users to have access to better prices. Jaral, Irapuato, Corralejo, Valle, Cortazar, Salamanca and Abasolo have already started to sell agro-chemicals and seeds at lower bulk prices. So far, Valle WUA has been most progressive in this respect by serving approximately one thousand users, not only with inputs but also by renting out to farmers equipment for laser leveling of irrigation fields. Jaral and Corralejo follow with approximately hundred farmers that they each served in 1996. Although these numbers are still relatively low, it shows the intention of the WUAs to have a greater stake in facilitating access to better prices and services. As was noted in chapter 4, this intention was one of the driving forces of WUA leaders for wanting to establish the LRS. Although none of the WUAs have yet started to construct their own storehouses for grains, several associations play with the idea to bulk store the produce of their members and establish contracts with commercial enterprises to sell the produce at favorable market prices.

The second example of WUA's attempts to gain control over agrarian production is their offer to facilitate farmers' access to PROCAMPO acreage based crop subsidies (see section 3.4). To have access to PROCAMPO subsidies, farmers need to prove how many hectares of grains they have actually sown. As all WUAs keep close records of fee payments (and hence of the hectares irrigated), they can easily provide users with written statements on a farmer's cropping pattern. All WUAs in ARLID have started to hand out these statements free of charge[13]. The WUAs spend quite some time on administrative handling (for checking the cropping patterns and making computer print outs), but they claim they do this for farmers' benefits only. Also, they say they 'sell' this service to improve and maintain good relationships with their water users. Yet, this service also benefits the WUAs directly in two ways.

First, some WUAs like Cortazar have put conditions on handing out the statements. Farmers will only receive the written statement on current, and if needed previous, cropping patterns if they have settled all their outstanding irrigation fees (if any). In this way the association has created an effective means to better control and guarantee its own revenue from irrigation. As the income from PROCAMPO (which is approximately 400 pesos per hectare, depending on the crop) generally exceeds the dues, farmers accept this condition and pressure on the part of the WUA.

Second, historically the allocation of crop subsidies are characterized by a high extent of vote catching from the rural poor. Several studies on the effectiveness of PROCAMPO point toward an continuation of this tradition. For instance, Barta (1996) states that during the election year of 1994, PROCAMPO was transformed into an overt rural vote-catcher[14]. By giving WUAs control over farmers' access to PROCAMPO aid, the potential for political clientism has also been created within the associations.

6.4 Mechanisms that weaken political accountability

Having dealt with some mechanisms that helped leaders to maintain control over decision making and political accountability, below an analysis is given on how political accountability can be weakened by employment strategies and conflict resolution, respectively. A third way of counter-balancing the negative effects of political accountability, is by linking control over decision-making within the WUA more closely to financial accountability. This issue will be further dealt with in chapter 7.

Counter productive employment strategies

A direct consequence of management transfer is the change in staffing, as all the staff responsible for managing canals—the distributary canals and those below—are now directly hired by the WUAs. Staff responsible for main system and dam management continue to be hired by CNA in Celaya. In general, the managers of the WUAs are responsible for daily O&M, although they receive guidelines from the board of delegates. In ARLID, WUAs were very reluctant to hire ditch tenders and other technical staff who had been made redundant by CNA as a result of IMT. The respondents mentioned four reasons that explain this:

- WUAs wanted to reduce the number of technical staff to become more cost-effective. Whereas CNA generally assigned one ditch tender per module section (approximately 500 ha), most WUAs decided to hire only one ditch tender for every two sections. In all cases, the increase in service area is compensated by having ditch tenders make use of motor bikes or small trucks to run the canals;
- Under CNA, the agency had difficulties in controlling the performance of ditch tenders, often resulting in poor delivery of O&M services and rent-seeking behavior. WUAs made a strong case for not having to re-hire these staff;
- WUAs wanted to hire their 'own people,' which in some cases led to hiring relatively young ditch tenders, who were well-trained but who lacked experience. In other cases this strategy led to favoritism and nepotism, and hiring of poorly trained relatives or other persons who were socially and politically closely related to the leaders of the WUA (for an example, see box 6.1)
- The positions of CNA staff used to be heavily protected by labor unions that were closely controlled by the ruling PRI party. This made it difficult to lay off staff that had proved to perform poorly or to ask field staff to work during off-duty hours in cases of emergency or during work peaks in the irrigation season. In order to avoid these problems, WUAs only wanted to hire staff that (in the words of a WUA leader) were "not union minded" (*sindicalista*).

Table 6.5 shows that in ARLID CNA staff levels were reduced from 273 in 1992 to 116 in 1996, a reduction of almost 60 percent. This means a considerable saving for the government. The remaining 116 CNA staff are responsible for the dams and the two main canals only. During the time of this study, CNA was still staffing its unit offices within the district, leading to hiring a large number of staff that were basically doing nothing. For instance, in 1996 CNA was still hiring 12 staff for its field office in Cortazar. This is a very high number, given the fact that the main duty of this staff was to deliver water to the Antonio Coria main canal in accordance with the weekly delivery schedules and to check whether the gates along this canal were properly set (see chapter 5). Frequent visits to this office showed that most staff tried to kill their time by sitting behind their empty desks, reading their newspapers.

Table 6.5 Staff levels before and after transfer in the Alto Río Lerma irrigation district

	before IMT (8/1992)	after IMT (8/1996)		
	CNA	CNA	WUAs	Total
Governance (hired heads and managers)	4	3	11	14
Operation	155	70	94	164
Maintenance	81	19	46	65
Administration	30	15	41	56
Monitoring and evaluation	3	2	0	2
Other	0	7	0	7
Total	273	116	192	308
Canal irrigation area (ha)	85,118			85,118
Area per staff member (ha)	312			276

This relatively large number of remaining CNA personnel explains why total staff numbers (CNA plus WUAs) have increased by 13 percent after transfer. Especially the WUAs feel that an unspecified percentage of these CNA staff are residual personnel that for political and labor-union-related reasons remain within the agency with no specific tasks. As was noted earlier, this has been one of the major reasons why the WUAs wanted to create the LRS. As a consequence, it is expected that soon CNA's staff in the district will be further reduced to 30 persons or less, down from 273 staff in 1992, and 116 staff in 1996.

Although most WUAs succeeded in considerably reducing salary costs by hiring fewer but generally highly motivated and well trained staff, they introduced several new employment policies that often proved to be counter productive. The most problematic policy that is followed by all WUAs is to hire most technical staff only on a temporary basis. Particularly ditch tenders are only hired during the two irrigation sub-seasons, i.e. from early December until the end of May. In addition, they are often told to take a compulsory and unpaid "rest" (*descanso*) in between the two sub-season. Similarly, when irrigation activities are reduced as a result of droughts they can be told to leave without notice. This policy has proved to be problematic in two ways. First, it is difficult to keep staff motivated without providing them a certain level of security that they can remain within the job. Many ditch tenders are continuously looking for more permanent job opportunities, even if these jobs pay less. Secondly, and as a consequence of the previous point, all WUAs suffer from high staff turnover resulting in farmers complaining about having to frequently work with inexperienced new staff that are not familiar with the area. In addition, the WUAs have to continuously invest in training new staff and supervising them.

Another problematic policy that is followed by some WUAs is to have the ditch tenders pay for transport costs associated with running the canals. In these cases ditch tenders have to use their own motorbikes and have to pay for fuel out of their own pockets. Generally their base salary is a bit higher compared to those ditch tenders that work for WUAs that do pay for all transport costs. But naturally ditch tenders try to save on transport costs by running the canals less frequently or by not traveling to remote tail-end areas. In other cases, ditch tenders and other staff are compensated through a complex system of gratifications. As this system is far from transparent, it leaves plenty of room for rent-seeking attitudes and favoritism. In some WUAs this has resulted in excessively high salaries for "befriended" staff (see table 7.5 in the next chapter) and unrest among staff.

CNA's role in conflict resolution between leaders and users

The second way in which the reproduction of political accountability is challenged is by putting pressure on the leadership by both users and CNA. An effective way for users to challenge their leaders is by explicitly asking CNA to mediate in conflict resolution.

The conventional view is that IMT has led to Mexican government withdrawal from controlling water management. Although officially the role of the CNA below the main canals has ceased to exist, from daily field observations and press reports it is learned that the agency continues to play a role in setting the fee levels (chapter 7), in developing and monitoring seasonal irrigation and maintenance plans (chapter 5), as well as in channeling access to externally funded system improvement programs (chapter 9). Another important role that CNA continues to play is as a mediator in conflict resolution within the WUAs.

Before discussing CNA's role in solving problems within WUAs, a brief overview of mechanisms of conflict resolution at other levels within the district are briefly presented below. The first level where conflicts might take place is between individual farmers. Most irrigation related conflicts between farmers deal with irrigation plot boundaries and stealing of water by others during the official irrigation turn of a farmer. In most cases these conflicts are resolved between the concerned parties. Occasionally ditch tenders, general managers or leaders of the WUAs, and even CNA officials, are asked to mediate. In other cases local *caciques* (moral, social or political leaders) or presidents of *ejido* assemblies might intervene. Severe conflicts over plot boundaries are rarely taken to State courts given the high financial and social costs involved.

A second type of conflicts occur between individual users and CNA or WUAs. These conflicts generally deal with defaulting on fee payment or on cleaning requirements[15], with stealing water, or with damaging irrigation facilities by the water user. In all these cases leaders and general managers from WUAs and sometimes CNA officials first talk directly to the farmer to try to solve the problem. Generally these management organizations can refer to the WUA's bylaws and O&M regulations to show the farmer his rights and obligations as a member of the WUA. In some cases CNA and WUAs seek the help of local political or moral leaders to convince the farmer about his responsibilities. As neither CNA nor the WUAs have legal powers to directly impose fines on defaulters[16], help from other federal, state or municipality authorities can be sought as well, but this has rarely taken place. For extremely difficult cases, WUAs in ARLID have started to hire a lawyer jointly. The role of this lawyer is not so much to defend the associations in court but rather to mediate between the user and the WUA by explaining to both parties what according to the bylaws and O&M regulations of the WUAs the rights and responsibilities are.

Conflicts between users and CNA or WUA staff and leaders can also start if users feel that they are disfavored by CNA or the WUAs. Conflicts over rent-seeking attitudes of ditch tenders or other WUA and agency staff are still quite common. Similarly, farmers sometimes have conflicts with ditch tenders over untimely or inadequate delivery of irrigation services. Under former CNA management it was hard to solve these problems as field staff were hardly made accountable to higher agency staff. Moreover, their positions were heavily protected by labor unions. Although, these type of conflicts between users and staff continue to take place, effective control by the WUA board and representatives of the general assembly, as well as the WUAs' loose labor policies, make it much easier to lay off staff who have proved to perform poorly or that are corrupt (see the examples in box 6.1)

In ARLID real conflicts between WUAs and CNA have not occurred during the time of this study. However, examples from other districts in Mexico show how difficult it is for WUAs to take CNA to court if they feel that they do not receive their irrigation concessions or other irrigation services that they have a legal right to[17]. Instead of going through the politically difficult trajectory of taking the agency to court, WUAs from the La Begoña irrigation district (which like ARLID is also managed by the CNA district office in Celaya) have frequently taken over the CNA district office in Celaya to express their dissatisfaction, for instance with the irrigation plan or imposed restrictions to release water from the dam during the drought period in 1997-98[18]. In ARLID, these kind of disagreements over, for instance, the fee levels, the irrigation plan, priority setting in CNA's maintenance program, or the allocation of funds from external programs, are openly discussed during the meetings of the hydraulic committee[19] and other public gatherings like workshops and seminars. Unlike in La Begoña, these disagreements have never led to conflicts that required external mediation by courts nor to be solved through pressure mechanisms such as strikes or taking over of the local CNA office.

Box 6.2 Contested bylaws: an example from Salvatierra WUA

By the end of 1996, the board of Salvatierra WUA decided to change its bylaws, amongst others to allow for 16 instead of 8 private growers representatives in the general assembly. The group that disagreed with the president's general policy and particularly with his attempt to be re-elected (see box 6.1) saw the modifications of the bylaws as a nice opportunity to gain more power over decision making processes within the WUA by changing the system of representation. Their suggestion was to have the *ejidos* represented in proportion to the size of their *ejidos*. In this way larger *ejidos* would have more representatives than smaller *ejidos*. This would be in contrast with the current system in which, irrespective of its size, each *ejido* has one representative (plus one replacement).

The first meeting to discuss these modifications was cancelled because of the lack of a quorum of 50 percent. Ten days later, the president suddenly called for a second meeting. Although only 35 percent of the assembly members could attend, the president decided to continue with the meeting. However, the issue of representation was hardly discussed. The main reason was that the person who was heading the group of farmers that supported the idea of representation proportional to the size of the *ejido* could not attend. It soon appeared that the mayor of Salvatierra town (who is the brother of the WUA president) had called this person away from the meeting. As a town councilor of the PRD opposition party he could be called to meetings by the mayor. Some farmers said that this action was clearly orchestrated by the president of the WUA. Although he was replaced by someone else to be the spokesman during the WUA meeting, the WUA president simply did away with the arguments by saying that the group of farmers that seek to change the system of representation, should submit their arguments on paper. He did not allow the issue to be further discussed during the meeting and a decision on it was never taken.

Whereas disagreements *between* WUAs and CNA could always be solved through discussion and negotiation, conflicts between factions *within* individual WUAs frequently demand mediation *by* CNA. As was noted in chapter 4, conflict resolution within WUAs is officially regulated through both the bylaws and the O&M regulations of the WUA and the district[20]. Yet, not all conflicts can be solved by simply following these laws and regulations. First, the daily interpretation and local transformation of these laws and regulations leave plenty of room for conflicts to be unsolved. Second, in some cases factions or individual users within the WUA explicitly ask CNA, and sometimes other external people, to mediate in conflicts, even if the rules for conflict resolution are clearly enough defined to solve problems within the organizational boundaries of the WUAs themselves. In general, three types of conflicts were observed for which mediation by CNA was sought.

The first type of conflicts deals with the election of leaders. As the example in box 6.1 showed, the official regulation that leaders cannot be re-elected can be easily lifted under political pressure and manipulation. Although CNA decided to step in between the two factions that were fighting for the presidency of the WUA, it could only observe and report on the meetings. Its role was limited to checking whether the election were held with sufficient quorum, and whether those farmers that wanted to vote had been actually been elected as user representatives and as such were also registered in the user list of the WUA. However, as an external observer, CNA officials could not prevent the president from being re-elected.

The second type of conflicts that needed mediation by CNA deals with contesting the meaning of user representative to the general assembly. The example in box 6.2 shows that in some WUAs farmers try to gain more control over decision making processes in the general assembly by changing the definition of user representative. Rather than electing one user representative per *ejido*, proportional representation according to the *ejido* size (in terms of hectares, number of *ejido* members, or both) is favored by some farmers. The example also shows how easy it is for the ruling WUA leader to manipulate the decision on user representation in his favor by using his political networks to push his opponent out. Also in this example CNA officials, as well as a lawyer, were invited to attend the meetings that dealt with the intended modification of the bylaws, but their roles were marginalized to answering technical and legal oriented questions.

A third type of conflicts within WUAs deals with farmer's dissatisfaction with the leadership of the WUA. Several causes of farmers' dissatisfaction have already been discussed in this chapter and include financial mismanagement and corruption, nepotism and other forms of favoritism on the part of the president. In the case of Irapuato, representatives of the general assembly were able to vote the president and the treasurer out. When these two persons refused to step down, other leaders and farmers that had pushed the replacement of the two board members called upon the CNA head of the district to mediate. Although this CNA official did not have the authority to force new elections, his moral position as a State representative helped to replace the entire board.

6.5 Conclusions

Members of the new WUAs consider equity in user representation in the general assemblies to be crucial for the legitimization and proper functioning of these associations. A popular assumption on the Mexican IMT program is that powerful private growers will *de facto* take control over decision making processes. The results from ARLID do not fully support this assumption. *De jure*, *ejidatarios* still posses approximately 60 percent of all leader positions. This is clearly the result of the way the new institutional arrangements for irrigation management were implemented: building on an already existing strong institutional organization of user groups (*ejidos* and organizations for private growers) and the definition of bylaws of the WUAs that foresee in user representation of both groups. However, there are clear signals that *de facto* private growers control powerful decision making entities such as the LRS.

One of the strengths of the Mexican IMT program is that it allows for local modifications of the policy implementation strategies, including the way user representation is organized. However, at the same time this could also be one of its weaknesses, because it allows for ample political manipulation of decision making arrangements by politically powerful leaders.

Some WUAs have started to argue that user representation to the general assemblies should be organized differently. However, the arguments and strategies used by leaders and user representatives who advocate these modifications are not very transparent and could lead to over-representation of economically and politically powerful farmers, at the cost of other users.

A major weakness of the current arrangement of user representation to the general assemblies of local service organizations, is the almost non-existent flow of information to the other recipients of irrigation and non-irrigation services. Common (non-representative or leader) users are hardly aware of both the decision making and election processes. Nor are they adequately informed about the results of these processes. As a consequence, users complain about the lack of information on the content and timing of irrigation service delivery. As a result, it is difficult for the constituencies of the user representatives to make these representatives accountable for the way user concerns and ideas are being brought forward in the meetings and decision making processes. In practice, this implies that "user participation" in decision making over the provision of services does not go beyond the members of the executive boards, general assemblies, LRS and the hydraulic committee.

Another concern of the current arrangements of user representation is that clear mechanisms that help to prevent the re-election of leaders do not exist; not even if these leaders have used their positions for personal financial and political gains. Although the bylaws of the WUAs mention that leaders cannot be re-elected, remobilization of leaders to other or even the same positions do frequently occur. Mechanisms of favoritism, nepotism and political or moral persuasion of user representatives and even technical staff make it very difficult for common users to make these leaders step down. On the other hand, there also exist some positive mechanisms that help users who disagree with these policies of re-mobilization and re-election of leaders to signal out their dissatisfaction. The most powerful of these mechanisms is the paying of service fees, which will be discussed in the next chapter. Although it is very difficult for users to fully default on paying service fees, users have been successful in forcing leaders to change their staffing policy (i.e. practices of favoritism and nepotism) by simply refusing to except an increase in the level of service fees.

Finally, there exists a genuine concern on the part of the Mexican irrigation bureaucracy that the involvement of WUAs in the provision of non-irrigation services might shift their attention away from delivering adequate O&M services, as some leaders will find the provision of this type of services more lucrative, both financially and politically. Although so far field observations in ARLID have not supported these concerns, it is important to closely monitor whether indeed the provision of non-O&M services by WUAs does not negatively affect their main responsibility, i.e. the provision of irrigation services.

Notes

1. Parts of this chapter are drawn from Kloezen (2000).
2. Mechanisms of political accountability also exist at levels beyond the boundaries of WUA–user relationships. Examples of these include accountability between local CNA staff and CNA staff at higher levels of the irrigation bureaucracy; or between higher CNA bureaucratic levels and regional or national politicians. Although I am fully aware of the importance of these higher levels of political accountability mechanisms for the understanding of construction and reproduction of irrigation institutions, these were beyond the scope of this study (see section 1.7).
3. In some cases this process was facilitated by the Ejido Land Rights Certification Program (PROCEDE) which aimed at formalizing the tenure of former ejido land in order to better

regulate the privatization of *ejido* land (Article 27 of the Constitution) under the coordination of the Agrarian Attorney General's office (*Procuraduría Agraria*). PROCEDE initially won support from the farmers as it would legitimate already existing practices of selling and renting *ejido* land and improve access to credit and other agricultural support services (Goldring 1996b). However, its execution was heavily delayed, partially because of disputes over land boundaries and farmers' resistance to fully privatize *ejido* land (Nuijten 1995). In addition, overburdened field staff from the *Procuraduría Agraria* have used an arsenal of threats and pressure tactics to force *ejidatarios* to vote to join PROCEDE, which further stimulated farmers' resistance to become officially registered (Baitenmann 1998). As a result, PROCEDE has helped little to speed up the updating of lists of water users.

4. For the many definitions and conceptions of equity in the context of irrigation management, reference is made to contributions in Boelens and Dávila (1998).
5. Occasionally, outsiders are invited to present new products like seeds or agro-chemicals, to provide short training programs or to present results of ongoing studies or other activities within the module area.
6. For case studies on female participation in the context of irrigated agriculture in Mexico see Brunt (1992), Villareal (1994), Monsalvo-Velázquez (1997), Ahlers (1999) and Vera-Delgado (1999). In addition to not being listened to once they are elected to the general assembly, a more structural problem for the involvement of female users in WUAs, is that very few women are legally recognized as property owners and hence are not considered to be eligible for membership of the WUA. In order to become a member of the WUA (and hence to be potentially elected as a representative) one has to be a legal land owner. In general, less than 20 percent of all land titles are registered in the name of women. As a result, the number of women that are elected are user representatives in the general assemblies of WUAs is insignificant. Ahlers (1999) reports that in the case of the Lagunera irrigation district, only 2 percent of all user representatives are women. Moreover, from this group most women are widows, who generally informally transfer their right to exert their membership to male relatives such as their sons (Vera-Delgado 1999). Although most women lack formal membership of WUAs, one has to be careful to conclude that women have no influence on decision making processes related to access to and control over irrigation. As is observed by Zwarteveen (1997), as backstage actors women are sometimes involved in WUA matters in non-formal ways.
7. Several people to whom I mentioned this high percentage of farmers' awareness that the WUAs are now managing the system were skeptical as they assumed that few farmers would have know that CNA has transferred responsibilities to the new WUAs. But the explanation is simple: in ARLID all farmers have to come to the WUA office to pay their fees prior to receiving any water. All WUAs in ARLID have done a very good job in showing the world who they are, generally by painting the name "Civil Association of Agricultural Producers of Water Users Association so or so") in big letters on the walls and gates of their offices. This is hard to miss for anyone who visits these offices for the first time. Also inside the offices, poster presentations of assembly meetings and social gatherings, pictures of proud farmer leaders, paintings and slogans make anyone who enters the office aware of the fact that the place is run by a farmer association rather than by a government agency. Finally, the receipt of the fee payment clearly mentions that the fee has been paid to a WUA. Of course, the fact that virtually all farmers know that responsibilities for O&M (including fee collection) has been assumed by their own user association does not necessarily imply that they also know how the WUA functions or what their institutional and financial relationships are with government agencies.
8. For instance, a general manager in Salvatierra was paid almost twice the salary of a general manager in Cortazar WUA and only slightly less than the CNA head (Chief Engineer) of the district.
9. I have several first hand experiences with this. For instance, the board of Cortazar WUA had offered me free office space in the building of the association (which they had bought out of their own resources). The only condition to this generous offer, put forward by the then treasurer and later president, was that they would keep close track on all phone calls (which was easy as the bills were specified per call) and use of their photocopying machine. They insisted in presenting

me with an official bill for this every month. When I offered to leave them my furniture, motor bikes and some other items as a kind of payment, the president again insisted that we should specify these items in an official letter from the institute. When asked about this unexpected high level of administrative accuracy, the president explained that rumor had that some members of the general assembly farmers thought that I was paying him under the table. These, and many other incidences, show the effort this president took to be regarded as clean as possible. He also explained that for him (being a well to do large farmer) these kinds of petty payments, if any, would not be worth the loss in social status.

10. Due to favorable tax regulations for WUAs (which are considered as non-profit civil associations), the Mexican law does not allow WUAs to become involved in profit-making activities. As a consequence, any kind of commercial trading that favor the members of the WUAs should be done by parallel organizations that are officially independent from the WUAs.
11. In July 2000, this governor was elected at the first PAN president of Mexico (see also chapter 3, note 4).
12. This, of course, does not necessarily mean that the outcome of these negotiations are favorable for the overall viability of system management. For instance, as will be demonstrated in chapter 7, the WUAs concurred with the farmers' wish to negotiate in the hydraulic committee a stabilization of fee levels. As a result, however, none of the WUAs were able to keep up with annual inflation rates, which have put these associations in financial jeopardy.
13. Some WUAs ask 1 or 2 Mexican pesos for administrative handling and photo copies.
14. According to Barta (1996), about 3.5 million rural families received PROCAMPO money from the PRI government on the eve of the elections.
15. Before the start of the irrigation season, all users are obliged to clean the field ditches adjacent to all plots that they plan to irrigate. If done so, the farmer receives a chit from the ditch tender which mentions that the farmer has sufficiently cleaned his ditches. Only after receiving this chit the farmer can pay his fee prior to receiving his first irrigation turn.
16. In case of unauthorized appropriation of water (for instance by illegal wells), damage to irrigation facilities and defaulting on fee payment or ditch cleaning, CNA has to make an official report and in some cases can also cut off the farmer from water supply by closing the well or canal structures. Fines can be made in the name of CNA, but CNA has to call on the help from other authorities to actually impose the fine (Articles 119 to 123 of the National Waters Law of 1992). WUAs lack any of these powers.
17. See for instance the case mentioned in chapter 7, in which users from the Bajo Río San Juan irrigation district in Taumalipas State are accusing CNA for depriving them of irrigation water from the Cuchillo dam in favor of water supply to a powerful industrialist in the City of Monterrey.
18. Compared to ARLID, the relatively small irrigation district of La Begoña has shown many conflicts, not only between the four WUAs and CNA, but above all between the WUAs within the district. As far as I could judge from a distance (through local press reports and infrequent visits to some WUAs in this district), many of the conflicts between WUAs are rooted in several clashes between different political factions within the district. As a result, these WUAs could not come to agreements on their irrigation plans, for which they often (to my personal judgment, improperly) blamed the CNA district office in Celaya.
19. See section 8.3 for an example of such a discussion on water trading between WUAs.
20. The obligation to define O&M regulations at the levels of both the district and the WUA are clearly stipulated in the National Waters Law of 1992 (Articles 50 and 66) and its 1994 Regulations (Articles 90, 91 and 101).

7 Creating financial accountability and self-sufficiency

7.1 Introduction

One of the main objectives of the Mexican IMT program was to establish financially sound mechanisms of cost-recovery and self-sufficiency. Advocates of neo-liberal financial-institutional reforms propose the introduction of quasi-market incentives into the management of large-scale irrigation systems (e.g. Repetto 1986; Uphoff *et al.* 1991; World Bank 1993; Rosegrant *et al.* 1995; Briscoe 1996; Saleth and Dinar 1999). Two concepts are central in the reasoning behind these policies: financial autonomy and financial accountability (see section 1.3). In this chapter an analysis is made of the financial viability of the post-transfer institutional arrangements for irrigation management[1]. This is done by giving detailed accounts of practices and mechanisms of financial accountability, transparency, autonomy and rent-seeking. Furthermore, the chapter provides a detailed analysis of the impact of irrigation management transfer on both the financial self-sufficiency of the WUAs and the change in cost of water to farmers.

7.2 Mechanisms of financial accountability

PAYMENT OF IRRIGATION SERVICE FEES

Both before and after management transfer, farmers were supposed to settle their fees prior to receiving their irrigation turn. Before transfer, farmers had to go to the CNA Unit offices to pay their irrigation fees. Interviews with CNA officials and farmers indicate that many farmers did not pay their fees for several reasons, including: the long distances that farmers had to travel to these offices; the long hours farmers had to wait in line to pay their fees; the extra unofficial transaction costs (bribes) farmers had to pay to the fee collectors; the practice of bribing the ditch tenders directly rather than paying the official fee; and, the lack of legal power that CNA had to sanction defaulters.

After transfer, farmers pay the WUAs directly. Only 2 percent of the farmers surveyed said that payment has become more difficult after transfer. Forty percent reported that the process of paying has become much less cumbersome after transfer. The most important reasons for this, mentioned by farmers are the following.

Shorter distances to travel, because of the establishment of more offices where farmers can make their payments. Many farmers complained that before transfer they had to travel much longer distances to make their payments to CNA[2]. CNA used to have only a few offices within the district. Several farmers recalled that they never knew to which of the CNA offices they were supposed to go. A private farmer from Cortazar mentioned that he first was supposed to travel to Irapuato to make his payments, then the office was changed to Salamanca, subsequently to Cortazar, and finally again to Salamanca. Also, many farmers remembered that frequently they had to get up between 3.00 a.m. and 5.00 a.m. to be sure to be at the office in time. Although these offices generally opened at 8.00 a.m. (until 1.00 p.m.), farmers made sure that they were at the office at 7.00 a.m. (and in some cases even at 5.00 a.m.) to join the queue. Farmers mentioned that this was necessary as only a fixed number of farmers per day could make their payments. If you arrived too late, you had to come back the next day and start the same procedure all over again.

At present, all eleven WUAs have their own offices where farmers can go to pay their dues[3]. Farmer can come at any time they like during office hours, which is generally between 8.00 a.m. and 4.00 p.m. As soon as a farmer knows when he wants to receive his irrigation turn, he can come to the office and pay for it.

Improved service delivery by and reduction in unauthorized payments made to administrative staff who collect the fees. Compared to the situation prior to transfer, farmers now report that they are more satisfied with the professional and personal attitude of the WUAs' fee collectors. Whereas farmers say that they had to regularly pay the CNA fee collectors a bribe (in addition to the official fee), they now say that current administrative staff of the WUAs do not ask for these extra-official payments. The three main reasons that explain the difference in attitudes between former CNA staff and current administrative staff that is hired by the WUAs are that: 1) WUA staff are hired and directly controlled by the users themselves, which stimulates better quality of the services that they deliver; 2) most administrative staff are well trained and have a good professional record; 3) as discussed below, all WUAs have started using computers, which helped to increase administrative efficiency, transparency and flexibility in fee payments.

FINANCIAL AUDITING AND TRANSPARENCY

By assuming O&M responsibilities, WUAs also took over full responsibility for financial management. According to the O&M manual (which is a legal document attached to the concession title), any user association has to implement two mechanisms that help to control financial management. First, every year the WUAs should submit their O&M budgets to CNA. Although CNA does not posses the authority to reject the proposed budget, it does provide WUAs with strict guidelines and formats for developing these budgets[4]. The most important guideline they give is that the WUAs should allocate 60 percent of their total budgets to maintenance, 25 percent to operations and 15 percent to administrative expenses (salaries included). From observations and interviews it was learned that most WUAs strictly follow these guidelines. But as will be demonstrated below, actual expenditures differ considerably from these planned allocations, without CNA taking measures to check this. Another requisite towards CNA is, that each month the WUAs should submit statements of their actual expenditures. In theory, this should provide CNA with information to check on the financial management of the WUAs. However, in reality this kind of control hardly takes place.

A second financial control mechanism is the internal auditing, done first by the board of the WUA, and subsequently by the general assembly. Leaders and managers of all 11 WUAs indicated that this is more important than the external auditing done by CNA. In practice, almost weekly the president and the treasurer of the WUA check the accounts and payments made. In the case of Cortazar, for instance, every week the president asks the administrative staff to make print-outs of all the expenses and income of that particular week. Major expenses always need the authorization and signature from the president and sometimes also from the treasurer. Although the president from Cortazar WUA visits the office only a couple of hours a week, technical and administrative staff have almost hourly telephone contact with him to discuss expenditures.

The president and other board members are in turn controlled by the general assembly of farmer representatives. In theory they have the authority to turn down budget proposals. However, observations of assembly meetings learned that few farmers question these proposals and even fewer farmers provide suggestions for modifications. Similarly, at the end of the agricultural year, the board presents an overview of the total income and expenditures. However, assemblies of most WUAs take these statements for granted and only ask for some minor clarifications. As such, the assembly does not serve as a real check and balance mechanism but rather as an instrument to have the budgets formally approved[5]. Only in a few cases (like in Salvatierra in 1996 and in Irapuato in 1998) it was observed that several user representatives had serious doubts about the expenditures made. They questioned in public the general financial policy followed by the leaders. Some serious charges against the leadership of these WUAs were made. Some of these complaints even made it to the local press and included[6]:

- general misuse of WUA funds for personal benefits;
- unjustified check payments;
- lack of proper tax declarations;
- lack of transparency on various staff allowances and gratifications such as payments for over time, good performance and vacations;
- lack of control on special loan schemes for staff;
- lack of a complete inventory of assets owned by the WUA.

These kind of accusations have invited several types of action and reaction on the part of the user representatives. In the cases observed in Salvatierra and Irapuato, user representatives asked higher CNA officials to step in as mediators in the conflict. In most cases the CNA head engineer for ARLID had been invited as an observer to the meetings in which these complaints were discussed. In other cases, also the CNA representative of the State of Guanajuato and even the Secretary of Agriculture in Guanajuato had to intervene and settle the conflict between those who supported the financial policy of the leaders and those who disagreed. However, in all cases the final decision was taken by the general assembly by means of vote. As was demonstrated in chapter 6, these votes are highly manipulated by political factions within the assembly. In the case of Salvatierra the result was that the president was re-elected, whereas in Irapuato the president had to step down.

Another strategy that is followed by all WUAs is, that they decided to ask for an annual financial audit by external independent auditors. Also, WUAs have started to use computers, which dramatically facilitated the administrative and financial management by the associations. This has largely helped to increase the financial transparency of the WUAs. At any moment administrative staff of the WUAs can produce financial statements which show all the income and expenditure. Similarly, when farmers come to pay their fees, the staff that collects the fee as well as the farmer immediately see to how many irrigation turns the farmer is still entitled to, for many hectares, for which crops[7], for how many turns he has already paid, and consequently what his total dues to be settled are. At the same time, the farmer receives a computer print-out of the receipt which shows when the farmer is due to receive his water and for which plots. The farmer needs to show this receipt to the ditch tender in the

Box 7.1 Controlling bribing practices: three examples

1. A common strategy of WUAs to control ditch tenders' bribing practices, is to frequently shift them to other sections of the module. In this way, WUAs try to prevent ditch tenders to establish close personal relationships with their users. During several occasions, it was observed that ditch tenders were shifted after users had complained about malpractices of the ditch tender, including asking for high bribes. In one occasion the ditch tender was the cousin of the former president of the WUA. This president was a well respected person and lived in the same module section where the ditch tender worked. Although farmers had complained about the ditch tender before, it was difficult to fire the man as long as his uncle was still in charge as a president. When a new president took office, the ditch tender still kept his job, but only until it was reported that he had had a fight with one of the farmers. The new president immediately took this as an opportunity to fire the ditch tender, and to hire someone who had no personal connections with farmers and leaders in the area where he had to run the canals.

2. In another module, farmers complained heavily about the bribing practices of the supervisor of a group of six ditch tenders. Besides being a supervisor, he was also working as a common ditch tender, serving one of the module's section. Because of his excessive bribing practices, farmer representatives wanted the WUA leadership to fire this ditch tender cum supervisor. However, rather than firing the person (who had frequently shown his loyalty to the WUA's president), the board decided to take away his position as a supervisor as well as to shift him to another canal, where he had not yet established personal relationships with water users.

3. Ditch tenders are not the only technical staff who take bribes. In one case, the president of a WUA came to know that the general managers of the module had illicitly handed out bogus receipts of fee payments to some befriended farmers. Farmers need to show these receipts to ditch tenders as a proof of payment. By using these bogus receipts farmers can receive an irrigation turn without having paid for one. As a reaction, the board took immediate action and fired the manager. Officially the manager had accepted a job offer outside the irrigation district, but everybody knew the reason why he had left. By letting the manager go, the board made a clear signal to the rest of the technical staff, indicating that they did not accept any rent-seeking practice. Yet, as the manager was the most experienced person in the module (who had worked with CNA for a long time in the same area), the WUA felt that they needed his skills and experience and requested him to come back. However, rather than re-offering him his former position as a manager, he could only return as a supervisor of the ditch tenders. He gratefully accepted this offer (showing that his other 'job offer' was not as serious as he wanted everyone to believe). By offering him this lower position, the board could still signal out that it does not accept any malpractices. This became ever more evident as the new manager was a well trained but very junior person, being half of the former manager's age (but yet his superior).

field as an evidence that he has paid his irrigation turn.

The use of computers was initiated by the WUAs themselves. Most WUAs hired private ICT-consultants, who developed and installed the required software. Some WUAs received computer training from CNA, but most associations sent their administrative staff to private courses. The WUAs use software not only for their financial administration and to keep record on fee payments, but also for maintaining information on irrigation plans, delivery schedules, cropping patterns and user registration.

These transparency mechanisms have positively affected farmers' confidence in the financial management of their WUAs. Table 7.1 shows that 56 percent of the respondents of the farmer survey says to have confidence in how the WUA is managed financially, whereas 23 percent report not to have any confidence in how financial resources are managed. Answers to questions on financial management considerably vary across the four WUAs where the survey was held and confirm the above observations on lack of financial transparency in Salvatierra. Of all farmers surveyed in Salvatierra, only 13 percent said to have confidence in the financial management of the WUA, whereas 55 percent says not to trust how the association deals with financial matters. In comparison, 72 percent of the respondents in Cortazar, 89 percent in Valle and 67 percent of the farmers surveyed in Huanímaro responded as having confidence in their WUA's financial management.

Table 7.1 Farmers confidence in the financial management of their WUAs

	Ejidatarios (n=90)	Private growers (n=35)	All (n=125)
Farmer has confidence	57	56	56
Farmer has no confidence	24	18	23
Don't know	11	21	14
No answer	8	6	7

CONTROLLING RENT-SEEKING PRACTICES IN WATER DISTRIBUTION

Financial accountability and transparency are largely determined by the extent to which practices of bribing irrigation staff are controlled. In irrigation it is important to distinguish between three forms of bribery at the local (i.e. irrigation district and below) level[8]. The first form of bribery is a mechanism *to control access to water*, which manifests itself in patterns of water distribution that deviate from formal and planned patterns.

A second form of bribery deals with mechanisms of *appropriation of large sums of money*. This kind of bribery normally manifests itself in design, rehabilitation and sometimes maintenance of irrigation infrastructure, in which often lucrative contracts are involved.

The third form of bribery is related to getting *access and control over political power*. This type of bribing generally manifests itself in for instance WUA leaders manipulating water users to re-elect them. Also, sometimes it takes bribes to buy higher agency staff, politicians and other political influential persons that help leaders as well as the WUAs to get better access to all kinds of O&M and non-O&M services. This chapter only deals with the first form of bribing, i.e. the one in which bribing is used to try to structure water distribution practices[9]. Like in most other gravity irrigation systems in the world, farmers in ARLID occasionally make extra-official payments to ditch tenders and other technical staff in return for better services in irrigation deliveries.

Both before and after management transfer, one can find three clearly distinct institutionalized types of practices of bribing ditch tenders. Whereas the first type of practice has hardly any impact on the patterns of water distribution, the second and third modes have. The first, and most common, practice is to pay ditch tenders a small tip. All farmers can report on cases in which, in addition to the official irrigation service fee, small amounts are paid to have for instance a little more than the entitled area irrigated, or to have irrigation supplied at different times than programmed[10]. These payments basically serve to establish and maintain the relationships between farmers and ditch tenders. They also help to better accommodate the official irrigation schedule to the individual needs of farmers in terms of timeliness of deliveries. Farmers themselves hardly regard these payments as bribes (*mordidas*), but prefer to talk about tips (*propinas*)[11]. These payments are generally not more than the price of a cool drink and hardly ever exceed 50 pesos (US$ 3.00). Although these payments are important to massage local relationships between users and irrigation staff, they do not influence common mechanisms of water delivery as described in chapter 5; water distribution in the observed canals is predominately determined by the official irrigation schedule and the practice of delivering the amount of water that is required by the farmer to irrigate the area that he has paid a water right for. The kind of bribing discussed here stimulates minor deviations from these schedules[12], but does not deprive other farmers from their official irrigation turns[13].

The second mode of bribing in connection to water distribution is less common but does have an impact on access to water by other farmers. In all four modules where farmers were interviewed on rent-seeking attitudes of ditch-tenders and other technical irrigation staff[14], farmers reported on cases of private well owners (who are not entitled to use canal water) bribing ditch tenders to supply canal water to fields irrigated with wells. This would save the well owner considerable pumping costs. As these private well owners are often large land holders, the amount of extra land to be irrigated is considerable and therefore generally influence the availability of water for those farmers who are officially entitled to receive canal water. One of the present leaders of a WUA admitted that when the system was still managed by CNA he frequently bribed CNA ditch tenders to supply canal water to him with which he could irrigate more than one hundred hectares of his land. As these lands were officially registered as being fed by his private wells, he was not entitled to receive canal water. Yet, every season he paid the ditch tender thousands of pesos to receive this water. He also admitted that he never bothered to come to the CNA office to pay his dues for his lands under canal irrigation but instead preferred to pay the CNA ditch tender directly. As large volumes of water are involved here, it is almost impossible to also supply the scheduled volumes to those farmers that have a (paid) right to canal water, even with RWS values as high as 2.0 at the level of the distributary and tertiary canals (see chapter 5).

Whereas the 'tipping' mode of bribing only involves a farmer and a ditch-tender, in the second mode of bribing also other technical staff can be involved. The last example in box 7.1 illustrates that farmers sometimes can bribe the general manager of the WUA to illicitly hand out irrigation receipts to them. In other cases it was observed that both the ditch tender responsible for a certain section of the module and the supervisor of all ditch tenders within one module were involved in these practices.

The third type of bribing practices that influence water distribution is much more indirect and hence more difficult to observe. It refers to the examples provided in chapter 6 on how WUA leaders manipulate and 'buy' farmers loyalty as a means to strengthen their positions within the association. As the example in the previous chapter shows, some leaders use their technical field staff (particularly ditch tenders and the chief of ditch tenders) to gain votes from the user representatives to the general assembly for their re-election. It has been observed that some of the ditch tenders who were afraid of losing their jobs showed their loyalty to these leaders, even though they disagreed with the irrigation policy followed by the leaders. The only mechanism a ditch tender has to buy these votes from the user representatives, is to favor them and their constituencies with more water. Again, these practices are difficult to observe and their impacts on water distribution are even more difficult to measure. But numerous farmer reports in Salvatierra clearly indicate that this kind of political bribery has influenced practices of favoritism in water distribution. Whereas in the first two types of practices of direct bribing in water distribution both parties have the opportunity to stay away from them, this third type is characterized by a high level of extortion, where the leaders are able to force ditch tenders and users to express their political 'loyalty' to them. In return for their loyalty ditch tenders can keep their jobs and users are not deprived of an irrigation service.

How have these bribing practices changed as a result of management transfer? Sixty-nine percent of the farmers surveyed reported that the practice of bribing the ditch tenders in return for better irrigation delivery services has been reduced as a result of transfer. The reason for this is, that in comparison with the situation prior to transfer, distances between users and system managers are much shorter, which give users, their representatives and leaders more opportunities to control ditch tenders (see the examples in box 7.1). Two years of process monitoring and participatory observation in Cortazar and Salvatierra WUAs revealed that particularly in the case of Cortazar farmers come to the WUA office to complain about rent-seeking attitudes of ditch tenders. Before transfer, farmers knew that CNA ditch tenders could hardly be fired as they were backed up both by their agency and their unions. Moreover, for reasons explained above, individual farmers were very reluctant to go directly to the CNA office in Celaya and complain to engineers whom they hardly knew.

After transfer, ditch tenders are directly hired by the WUAs and controlled by the leaders and the assembly of the users. As many farmers know their representatives to the general assembly of the WUA (and in some cases also the president of the association) it is less difficult to complain about rent-seeking attitudes of ditch tenders. This has often resulted in ditch tenders being fired by the WUA leaders or being moved to other sections of the module. Also, the high turnover of ditch tenders and their frequent rotation over different sections within the module area help prevent the creation of patron-client relationships between ditch tenders and users. However, this does not mean that rent-seeking behavior has ceased to exist. Thirty percent of the farmers report that they continue to pay small tips to ditch tenders. At the same time, interviews with many farmers clearly indicate that practices of favoring large private growers with wells has dramatically been reduced. In addition to the accountability reason mentioned above, another important reason that explain why several of these large growers have ceased to bribe ditch tenders is that they themselves often have key positions in the new WUAs and feel that they should be a good example to their own constituencies. As was discussed in chapter 6, by becoming leaders of WUAs these farmers can gain personally, in terms of receiving social and political prestige, of getting access to new networks, and in some cases even of personal financial benefits. These leaders will not take the risk of losing their positions by paying relatively small sums of money to the staff they themselves hired.

7.3 Financial self-sufficiency and autonomy

A major reason why farmers agreed to take on O&M responsibilities was that this would give them direct control over the revenue from fee collection. The new WUA leadership realized that to sustain the system, the first challenge was to improve the fee collection rate and to try to at least maintain the level of the irrigation fee per hectare as was established by CNA during the years preceding management transfer. Collecting fees themselves became interesting for these WUAs as they would receive full control over their income, which meant a high degree of financial autonomy. Although CNA provided advice on how to allocate the income of the WUAs to the different line items of the associations' budgets, the agency was not able to have full control on how the WUAs would spend their income. As a consequence, as will be demonstrated in this section, WUAs were able to considerably deviate from the proposed budget allocations, which sometimes resulted in spending the money more closely to actual needs but in other cases resulted in utter misuse of WUA funds.

Also, CNA and the hydraulic committee can advise on what they perceive are sustainable fee levels, but the final decision on these levels is with the individual WUAs. This does not imply that CNA will unconditionally accept the fee level proposed by the hydraulic committee. The first reason why they are interested in preventing a decrease in the fee is that by law they should monitor whether the WUAs manage the infrastructure in a financially viable way. This implies that the WUAs have to collect sufficient fees to at least cover actual O&M expenses.

The second reason why CAN is interested in at least maintaining fee levels (and guaranteeing financial self-sufficiency) is that recurrent O&M cost for the dams and the main system needs to be paid out of the fee collection by the WUAs as well[15]. At the start of the management transfer process, CNA determined which percentage of the total fee collection by the WUA had to be paid to the CNA district office. Interviews with leaders of the WUAs revealed that the associations were hardly involved in setting the level of these percentages. The percentages vary from module to module and range from approximately 11 percent of total collection in the case of Salvatierra to approximately 28 percent in the case of Valle. According to CNA, these differences reflect the relative use a module makes of the dams (which is of course equal for all WUAs) and main system infrastructure. Salvatierra, which has no main canals that are managed by CNA, would therefore pay a much lower percentage than for instance Cortazar, which uses more than 70 km of main canal. Yet, the differences cannot completely be correlated to the proportional use of main infrastructure. Some WUAs (and particularly Valle) started to realize that they were proportionally paying much more than others, which stimulated a discussion among the members of the hydraulic committee to change these percentages.

In the beginning of the transfer process CNA wanted the WUAs to daily transfer the percentages of the daily fee collection to the CNA bank account in Celaya. Later, after WUAs had protested about the unacceptable administrative costs and work load that this implied, this rule was relaxed to weekly payments.

Table 7.2 shows the development of the fee per hectare that a farmer pays every time the irrigation service is delivered, before and after transfer. To prepare farmers to paying fees that better reflect the actual O&M cost, two years before transfer, CNA increased the charge by approximately 400 percent. This explains the sudden increase observed in figure 7.1. After transfer the WUAs did not succeed in keeping pace with inflation rates, which explains the drop from approximately US$17 per hectare of irrigation services in 1993 to about US$8 in 1996[16]. Interviews with managers and leaders of several WUAs and CNA staff revealed that the actual fee levels are less than half of what they feel they should levy to manage the modules at optimum level. But they also realized that few farmers and their representatives would approve an increase. Although irrigation fees constitute less than 5 percent of the total production cost (see next section), farmers argued that they cannot carry yet another financial burden in addition to the high prices for agricultural inputs, which have increased considerably as a result of the agricultural price policies. Every season the hydraulic committee proposed an increase. However, for three years, until the summer of 1996, farmers were able to resist this.

Figure 7.1 shows a similar decline in fees paid by farmers after correction for inflation. The fee dropped in terms of total cost per hectare per season, as well as a percentage of standardized gross value of production (SGVP, see below and Appendix 4 for a definition).

Figure 7.1 Seasonal irrigation fee (July 1994 US$) per hectare and as percentage of SGVP, ARLID winter seasons 1982-1997

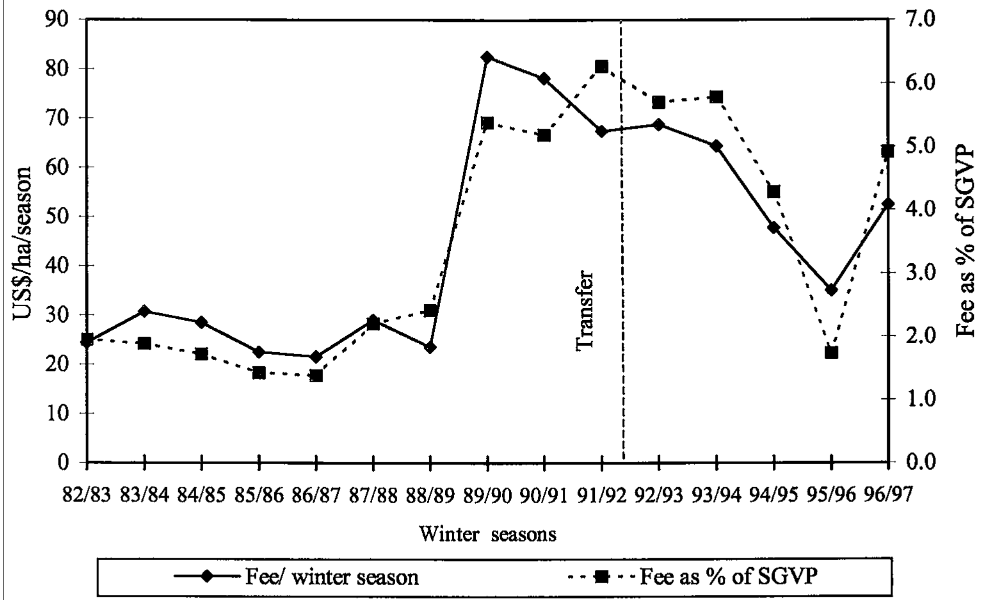


Figure 7.2 Fee revenue (July 1994 US$) and average annual collection rate, ARLID 1992-1996

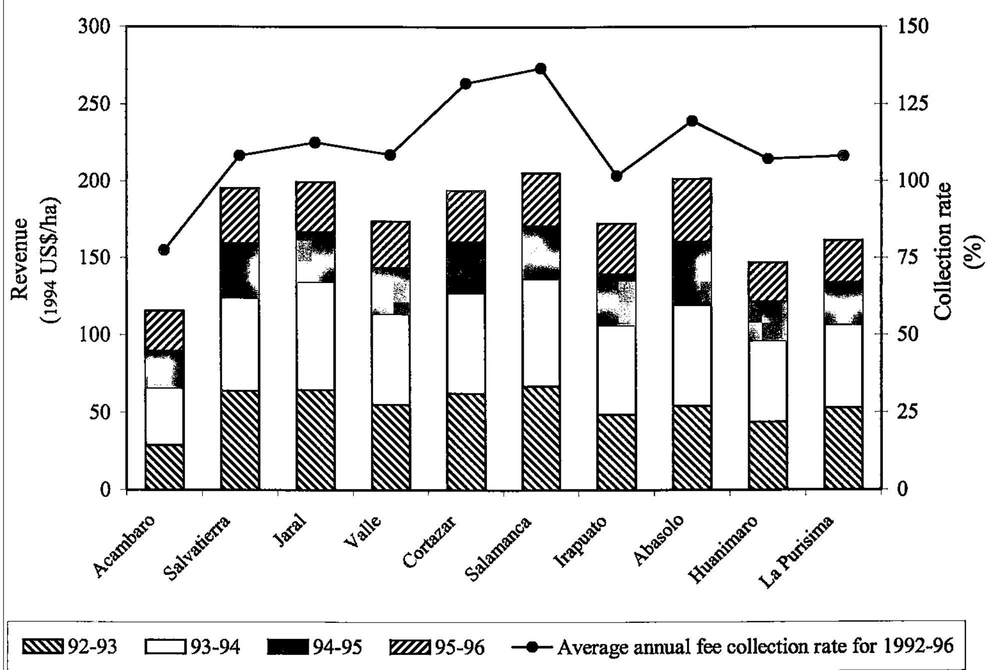


Table 7.2 Historical development of the irrigation fee for canal irrigation in ARLID

Year	Season	Fee (Nominal pesos/ha per irrigation turn)	Fee (1994 US$/ha per irrigation turn)	Fee per irrigation turn in terms of kg/ha of produce equivalent: Sorghum	Wheat
1983	winter	0.3	6.10		23
	summer	0.7	10.00	54	
1984	winter	0.7	7.69		28
	summer	0.7	6.00	24	
1985	winter	1.0	7.14		27
	summer	1.0	5.39	26	
1986	winter	1.4	5.63		23
	summer	1.4	3.64	19	
1987	winter	3.0	5.39		20
	summer	3.0	2.18	19	
1988	winter	10.0	7.26		30
	summer	10.0	6.60	34	
1989	winter	9.6	5.90		24
	summer	9.6	5.35	28	
1990	winter	42.0	20.64		76
	summer	42.0	18.48	127	
1991	winter	49.6	19.56		76
	summer	49.6	18.14	113	
1992	winter	49.6	16.86		81
	summer	49.6	16.16	127	
1993	winter	55.8	17.22		93
	summer	55.8	16.58	151	
1994	winter	55.8	16.10		93
	summer	55.8	15.62	140	
1995	winter	55.8	11.96		67
	summer	55.8	10.52	60	
1996	winter	55.8	8.77		29
	summer	64.0	9.30	74	
1997	winter	100.0	13.1		83

Irrespective of the recent erosion of the per hectare-irrigation fee, for reasons explained above, the WUAs succeeded in dramatically increasing the overall collection rate. Table 7.3 shows the development of both the self-sufficiency (actual collection over actual expenditure)[17] and the fee collection (actual collection over planned collection) rates. Clearly, one of the major impacts of management transfer in ARLID is the enormous improvement in self-sufficiency: from about 50 percent in the 3 years preceding transfer to over 120 percent in the post-transfer years. Data on planned fee collection for the pre-transfer period are not available, but data for the 4 years that follow transfer show an average collection rate of 120 percent[18].

Table 7.3 Change in self-sufficiency and fee collection rate, ARLID 1989-1996 (in nominal pesos and constant July 1994 US dollars)

	1	2	3	4	5	6	7	8	9	10	11
	Actual O&M expenditure			Planned fee collection			Actual fee collection			Self-Sufficiency	Fee collection rate
	Pesos	Pesos/ha	July 1994 US$/ha	Pesos	Pesos/ha	July 1994 US$/ha	Pesos	Pesos/ha	July 1994 US$/ha	% (7/1)	% (7/4)
1989	6,633,603	79	44	na	na	na	3,305,590	39	22	50	na
1990	8,433,104	100	44	na	na	na	3,545,013	42	19	42	na
1991	12,664,518	151	55	na	na	na	7,440,000	88	32	59	na
1992	14,107,094	168	55	na	na	na	na	na	na	na	na
1993	12,514,641	149	44	13,018,285	155	46	16,086,021	191	57	129	124
1994	14,669,207	174	49	16,066,900	191	53	18,280,700	217	61	125	114
1995	15,758,926	187	35	13,958,243	166	31	17,164,590	204	38	109	123
1996	15,596,666	185	26	16,300,483	194	28	19,876,120	236	34	127	122

Note: na = not available.

Table 7.4 Per hectare O&M expenditure and income (real pesos) and distribution of categories, Salvatierra and Cortazar WUAs, 1993-1996

	Salvatierra WUA					Cortazar WUA				
Expenditures	1993	1994	1995	1996	Total	1993	1994	1995	1996	Total
Total O&M cost (pesos/ha)	221	225	211	250	908	165	250	228	330	973
System maintenance (%)	43	44	35	31	38	17	20	23	19	20
System operation (%)	19	17	23	22	20	11	18	17	13	15
Administration (%)	14	15	17	17	16	16	15	14	14	15
O&M of official wells (%)	12	11	10	16	12	13	14	15	26	18
Depreciation of heavy machinery (%)	0	1	1	3	1	7	6	5	8	7
Fee payment to CNA (%)	12	10	11	11	11	33	24	25	19	24
Others (%)	1	1	4	1	2	3	3	0	1	2
Income										
Total income (pesos/ ha)	202	202	269	244	917	247	271	277	287	1,083
Irrigation fees (%)	100	100	72	96	90	97	97	89	93	94
Rent of machinery (%)	0	0	22	0	7	0	0	0	0	0
Bank interest and others (%)	0	0	6	4	3	3	3	11	7	6
Self-sufficiency										
Income – Expenditure (pesos/ha)	-19	-23	58	-6	9	82	21	49	-43	110

Note: US$1.00 (July 1994) = Pesos 3.5.

Figure 7.2 shows the difference between WUAs in revenue mobilized per hectare from irrigation fees. These revenues range from US$116 to US$205 per hectare for 4 years, with an average of US$182 per hectare (in constant 1994 dollars). The Acámbaro module, because of its higher elevation and cooler climate, gets by with the provision of one less irrigation service and consequently collects less revenue from the fee. The figure also shows the historical decline in fee revenue as a consequence of the economic crisis that followed the December 1994 devaluation of the peso. Finally, the figure shows that most WUAs succeeded in maintaining a fee collection rate above 100 percent[19].

COPING WITH INFLATION AND DROUGHT: FINANCIAL VIABILITY IN JEOPARDY

Table 7.4 shows an example of how two WUAs have allocated their financial resources. A first observation is that these actual allocations considerably deviate from the budgeted allocations proposed by CNA. The proposed allocations of 60 percent to maintenance, 25 percent to operations and 15 percent to administration is not followed at all. This suggests that the obligatory submission of planned budgets to CNA is merely an administrative exercise. It also suggests that CNA has *de facto* no control over the WUAs' expenditures. This is supported by the opinion of the management of the 11 WUAs. When asked, they all admitted that CNA only plays a minor advisory role in this respect. As a result, all WUAs reported that they see it as a waste of time to strictly follow the rule set out in the O&M manual to submit yearly to CNA the proposed budget allocations and to submit monthly statements of actual expenses.

Another observation is that in both WUAs real O&M expenditures have increased, particularly in Cortazar. This is mainly the consequence of high investments in rehabilitating the module's public deep tubewells (which are managed by the WUA) and the increase in energy costs for operating these wells[20]. Particularly in its first year of operation, Cortazar succeeded in keeping its costs low while achieving high revenue from fee collection. As a consequence, the WUA immediately bought its own heavy machinery. The WUA succeeded in maintaining this situation until 1996, when expenditures started exceeding the income of the association.

From its creation in 1992 onwards, Salvatierra WUA has always had difficulties with balancing its income and expenditures, resulting in a total positive balance of only 9 pesos/ha over 4 years. Three reasons explain this fragile situation. First, Salvatierra has a large number of farmers with relatively small landholdings (see Appendix 1). This makes it necessary to employ a larger number of ditch tenders, increasing the overall salary costs. Second, much of the module's infrastructure is in disrepair, resulting in relatively higher maintenance costs (see table 7.4 and chapter 9). And third, the WUA is known for its internal political problems (see chapter 6), resulting in "favoritism" and nepotism in the WUA's staff employment policy and relatively high salary costs for administrative staff. Table 7.5 shows that in 1996 salary costs of administrative staff had increased to 30 percent of total salary costs, whereas the cost for operation staff (such as ditch tenders) had declined from approximately 60 percent in the two years after the association was started to less than 25 percent in 1996. The WUA was able to achieve this enormous reduction in the cost of ditch tenders by paying them less compensation and gratifications. However, most of this reduction was caused by the association's policy to only hire ditch tenders on temporary positions. As a result ditch tenders could be fired at end of each sub-season and sometimes even during the season. This policy caused a lot of unrest among the ditch tenders and many of them decided to look out for more secure and permanent positions, inducing a high turnover of field staff.

Many farmers in Salvatierra increasingly started to complain about this situation as they felt that the service that they received had considerably deteriorated as a result of the association's staff policy. For reasons already explained in chapter 6, they were not successful in replacing the leadership and hence had to look for other means to try to make the leaders more accountable. The most effective way they used to achieve this was to simply refuse to accept the proposed rise in irrigation fees from 56 pesos per hectare and irrigation delivery in 1996 to 100 pesos in 1997, unless the leaders of the WUA would show a real commitment to both reduce salary costs and improve maintenance. Farmers were particularly concerned about the high costs of (what they perceived) unnecessary administrative staff, which they believed was the result of hiring too many friends of the president. Completely defaulting on fee payment would have been difficult to practice as in an arranged demand system like ARLID defaulters can be easily deprived of irrigation deliveries[21]. However, by refusing to pay the fee increment farmers could signal their dissatisfaction with the leaders' salary policy and poor maintenance performance[22]. As Salvatierra was the only WUA in the hydraulic committee that could not convince its members to accept the higher fee, it received high attention in the local press, which in addition put considerable moral pressure on the WUA's leadership.

Table 7.5 The distribution of staff salary costs over administration, maintenance and system operation (as % of total salary cost per WUA)

	Cortazar WUA			Salvatierra WUA		
	Admin.	Maintenance	Operation	Admin.	Maintenance	Operation
1993	17	16	66	12	24	64
1994	9	20	71	10	31	59
1995	6	28	66	15	32	53
1996	12	26	63	30	47	23

The two examples of how WUAs manage their finances show that, over the first four years of their operations, the WUAs could maintain financial self-sufficiency. However, in 1996 even a business-oriented WUA like Cortazar started to have difficulties maintaining its financial viability. All WUAs acknowledge that this situation could jeopardize their financial sustainability. By the end of 1996, all eleven WUAs started to rethink their financial situations, which resulted in two strategies. First, the WUAs decided to increase the fee to US$11 per hectare of irrigation services for the 1996-97 winter season. Although farmers again protested against such an increase, in one of the hydraulic committee meetings the WUAs decided that they should collectively be firm in their decision in order to be able to sustain themselves financially. Second, WUAs have pushed CNA to transfer O&M responsibilities for the main system to them. This resulted in the establishment of the LRS in February 1997 and a reduction in the average percentage of the fee paid to CNA, from 25 percent to 9.5 percent of the total fees collected.

As is demonstrated in table 7.4, a major weakness in the financial management systems of the 11 WUAs in ARLID is that the associations rely almost entirely on irrigation fees for their revenue. Moreover, fee revenue is totally dependent on the availability of water, as farmers are charged per number of irrigation services provided. This means that in dry years WUAs will not have sufficient income to maintain their regular staff or even keep their offices open. None of the 11 WUAs in ARLID maintain a contingency fund that could help them to overcome any kind of financial shortfall or to have a financial reserve for emergency repairs. When asked why such a fund was not kept, leaders of WUAs mentioned two reasons. First, annual inflation rates of more than 50 percent are not an incentive to save money.

Second, building a contingency fund is only possible by charging a flat fee on top of the fee per number of irrigation services provided. The current agreement between the WUAs and CNA says that the WUAs have to pay CNA a fixed percentage over all the fees they collect, including any extra fee. For this reason, WUAs are reluctant to charge a fee other than the per hectare of irrigation services fee.

The lack of a contingency fund caused many problems during the 1997-98 winter season, when the income of the WUAs was almost nil as a result of drought. As the dams were still empty at the start of the winter season, the hydraulic committee had to decide that no irrigation at all could be provided. Normally farmers receive four or five irrigation turns during the winter, which means that 80 percent of the WUAs' income has to come from fee collection during the winter. Because of the drought none of the WUAs had any income and hence had to make most of their staff redundant. Some WUAs decided to keep only one or two ditch tenders (out of 8 in for instance Cortazar), basically to operate the module's public deep tubewells and to monitor cropping patterns under private wells. Other WUAs, like Salvatierra, even had to close their offices as they could not pay their telephone and electricity bills. Only the WUA of Valle was able to keep all its ditch tenders and other technical staff as the WUA started to rent out their land leveling equipment to the users, for which they had trained their staff. This kept most of the staff working, in addition to raising some income out of the leveling service they provided.

7.4 The cost of water to farmers

The concern that the cost of water will rise with the privatization of management runs through all dimensions of farmers' concern about change (Whiteford and Bernal 1996). Many participants in the international debate argue that the cost of private irrigation management (paid by farmers in the form of irrigation service fees) would be an excessive high financial burden to many small farmers. Although in general it is clear that fees have increased (table 7.3), the cost of water as to the total value out of production or as a share of the total cost of production continue to be low in ARLID. Figure 7.1 indicates that the cost of irrigation to farmers has declined from almost 6 percent of the SGVP in the year of transfer to 2 percent in 1996. In 1997 this percentage increased again to 5 percent as a result of both a nominal increase from 56 pesos to 100 pesos per hectare per delivery (see table 7.2) and a drop in the SGVP for wheat from US$2,022/ha in 1996 to US$1,069/ha in 1997[23] (see also chapter 9).

Table 7.6 shows that a farmer's average net income is approximately 75 percent of the SGVP. Post-transfer data on the cost of water in relation to other production cost do not exist[24], but the table shows that in Cortazar after transfer the average cost of the water service as a percentage of total cost of production is only 6.3 percent[25]. Furthermore, in all cases the cost of water is less than 3 percent of the gross agricultural income. Salvatierra shows similar results: the cost of the water service is around 8.2 percent of the total cost of production or less than 3 percent of the gross agricultural income.

Compared to the winter season, SGVP values for the summer season are much lower, especially for surface irrigated fields in Salvatierra. The average net income as a ratio of the SGVP ranges from 53 percent to 74 percent. Owing to problems with weeds, Salvatierra farmers have higher expenses on hired labor and machinery.

Table 7.6 Average cost of irrigation tariff and pumping relative to agricultural costs and income for selected fields in Cortazar and Salvatierra modules, winter 1995-96 and summer 1996

	Cropped area	Production cost (US$/ha)					SGVP and NVP (US$/ha)				Cost of water tariff or pumping as % of:		
	(ha)	Hired labor	Inputs	Machinery	Fee or Pumping	Total Cost	Ton/ha	FG Price/mt	SGVP	NVP	Total Costs	SGVP	NVP
						Winter							
Cortazar													
All (n=15)	4.9	40	295	161	33	530	7.2	253	1,821	1,290	6.3	1.8	2.6
Surface n=11)	4.5	47	296	165	34	542	7.1	255	1,814	1,272	6.3	1.9	2.7
Wells (n=4)	5.8	22	294	151	31	499	7.4	248	1,838	1,339	6.3	1.7	2.3
Salvatierra													
All (n=6)	3.0	38	189	154	34	415	6.3	284	1,795	1,381	8.2	1.9	2.5
Surface (n=3)	2.3	47	188	146	35	415	4.1	330	1,341	926	8.4	2.6	3.8
Wells (n=3)	3.7	29	190	162	33	415	8.6	262	2,250	1,835	8.1	1.5	1.8
						Summer							
Cortazar													
All (n=20)	5.0	24	204	75	37	340	9.1	133	1,210	871	10.8	3.0	4.2
Surface (n=8)	4.0	19	204	69	9	301	9.1	128	1,168	866	3.1	0.8	1.1
Wells (n=12)	5.8	28	204	79	55	365	9.0	137	1,230	865	15.1	4.5	6.4
Salvatierra													
All (n=13)	2.4	91	267	154	22	534	9.1	135	1,228	694	4.2	1.8	3.2
Surface (n=3)	2.3	70	256	99	9	435	6.2	149	923	488	2.1	1.0	1.9
Wells (n=10)	2.5	97	270	173	24	564	10.1	130	1,315	751	4.3	1.8	3.2

Note: FG Price = farm gate price; SGVP = standardized gross value of production; NVP = Net value of production

Table 7.7 Cost and energy use of selected private and public deep tubewells in the Cortazar and Salvatierra modules

	Winter season 1995-96					Summer Season 1996				
	Water use m^3/ha	Energy use m^3/kWh	Energy cost US$/1,000 kWh	Pumping cost US$/ha	Pumping cost US$/1,000 m^3	Water use m^3/ha	Energy use m^3/kWh	Energy cost US$/1,000 kWh	Pumping cost US$/ha	Pumping cost US$/1,000 m^3
Private wells Cortazar (n=10)	9,460	6.5	16.88	24.57	2.60	6,210	7.5	22.08	18.28	2.94
Public wells Cortazar (n=20)	6,160	6.0	16.88	17.33	2.81	11,460	7.0	22.08	36.15	3.15
Private wells Salvatierra (n=10)	10,893	6.6	16.88	27.86	2.56	4,079	5.1	22.08	17.69	4.34
Public wells Salvatierra (n= 21)	9,400	5.0	16.88	31.73	3.38	5,497	4.0	22.08	30.34	5.52
Average	8,978	6.0	16.88	25.37	2.84	6,812	5.9	22.08	25.62	3.99

Similar to the winter season, the cost of water against total production cost is equally low in the summer season. The only exception is the cost of water for those Cortazar farmers who use water from wells. This is explained by the fact that three of the farmers sampled, who used to irrigate with canal water during the winter season, decided to buy water from well owners for their summer crop. These farmers paid up to US$85/ha for their water, compared to an average energy cost of US$18/ha (table 7.7).

Although other inputs and services (like electricity supply) have increased considerably as the result of the liberalization reforms, the cost of water remained relatively low. Yet, 62 percent of the farmers (or 63 percent of the *ejidatarios* and 58 percent of the private growers) report that they think that the cost of irrigation water is higher after transfer.

Several farmers remembered that they had to pay an additional maintenance fee at the time when the system was still managed by CNA. Also under the current WUA management farmers sometimes have to pay a fee in addition to the regular fee per hectare per irrigation delivery. For instance, at the end of the 1995-96 winter season, Salvatierra WUA tried to levy an additional charge of approximately US$5 to cover its high maintenance costs. However, they had difficulties collecting the additional fee as they had no mechanism to force farmers to pay this fee. Only ten of the forty farmers surveyed in this module actually paid the additional maintenance fee.

7.5 Conclusions

There are clearly some first signals that point to financial arrangements that might jeopardize the existence of the WUAs in ARLID, despite the positive results in cost-recovery so far. There are several reasons to be concerned about the financial viability of the financial arrangements for providing irrigation and other services.

First, the WUAs' inability to cope with annual inflation rates. Levels of irrigation fees are not automatically indexed for inflation, but instead are determined by negotiations between members of the hydraulic committee, the general assemblies and recipients of the services. Second, the income of the WUAs almost entirely depends on their revenue from irrigation service fees, which in turn depend on the availability of water. During periods of severe drought (as was the case in 1997-98), WUAs do not have income and have to let go their staff. None of the WUAs maintain contingency funds, from which they can continue to pay their staff and maintain their offices open during times of unexpected drops in revenue. Third, staff policies and staff salaries are highly determined by factors related to nepotism and favoritism. Moreover, staff can be made redundant at any time. This has highly frustrated most technical staff, who as a consequence look out for more secure job opportunities. As result, most WUAs are faced with the necessity to continuously train newly hired staff.

These factors seriously challenge the viability of the WUAs. Yet, other factors explain how most associations in ARLID were able to establish financial systems that helped them to survive during the difficult initial years of their existence.

Probably the most important financial component of the management transfer policy is that the WUAs could become financially autonomous. Although a certain percentage of the revenue from service fees had to be transferred to CNA to cover O&M costs associated with the management of the dams, headworks and main canals, the remaining revenue could stay within the WUAs. This has created a great feeling of financial responsibility among the leaders, representatives and users alike, and has provided users a mechanism to make the WUAs financially accountable

Improved financial transparency also helped the WUAs to become accountable financially. Financial transparency of revenue and expenses associated with the provision of irrigation services, was greatly improved as a result of the introduction of computers as well as of hiring well trained professional administrative staff. Furthermore, all WUAs have started to hire external auditors to check their books. Although financial malpractices on the part of leaders have not disappeared as a result of these changes, they were certainly reduced.

The common practice of bribing technical staff and sometimes leaders has not come to an end after the new financial arrangements were established, but it has clearly been reduced. The most important factor that explains this, is that technical staff is now directly hired by the service organization. Moreover, the new organizations were not forced to take over former agency staff with records of poor performance and rent-seeking attitudes. As a result, it has become easier to make the association accountable and as a consequence to make corrupt staff redundant. In addition, recipients of irrigation services have experienced that is had become easier to report malpractice of technical staff directly to the user representatives or leaders, and they have noticed several times that their complaints actually resulted in staff replacements.

Notes

1. Parts of this chapter are drawn from Kloezen (2000) and Kloezen *et al.* (1997).
2. For reason of clarity, the 'CNA' acronym is used here. However, it would have been more correct to use 'SARH/CNA' as most farmer reports on practices of cost recovery, financial management and bribing refer to the period before 1989 when the system was still managed by the SARH. Although CNA has been in charge since 1989 (first for the management of the entire system and since 1993 for main canal and dam management only), most farmers still mix CNA and SARH. Many farmers just talk about *Recursos* (Resources, i.e. the Ministry of Hydraulic Resources) when they refer to the irrigation agency in charge. Some other common terminology used by farmers to refer to the irrigation agency are: *Secretaria* (i.e. Department or Ministry), or *'Los que venden el agua'* ('Those who sell the water'). The latter terminology could also refer to the WUAs.
3. Because of its size and its spread-out layout, Cortazar WUA has even two offices where farmers can make their payments: in the town of Cortazar and another small office in Salamanca.
4. The O&M manual that is attached to the concession title dictates the methodology that the WUAs have to follow to determine the fee per hectare per irrigation delivery. This method first calculates the cost per m^3 of water by dividing the total volume of available water per module with the total *required* O&M budget for these modules. Subsequently, it converts this into a cost per hectare by including the total planned water depth for that particular year. However, as is discussed in this chapter, the level of *required* budgets are hard to define and even more difficult to actually get approved by the assemblies of the WUAs. As a result, WUAs first calculate how many hectares they can irrigate and how many irrigation turns they can deliver given the volume of water available at the start of the season, and subsequently multiply these with the fee level (per hectare per irrigation delivery) that they feel they can collect. This gives them the total target budget.
5. Every WUA has a oversight committee (which comprises members of the general assembly) that control and audit the board of directors. However, I never observed any major activity by these committees.
6. See for instance: *La Tribuna* (January 11, March 11 and 15, 1996), *El Sol del Bajío* (17 December 1995) and *A.M.* (9 January 1996).
7. The number of irrigation turns a farmer is entitled to is determined by the seasonal irrigation plan. The information on how many hectares a farmer is entitled to irrigate is derived from the list of registered water users (or WUA members). All WUAs are now in the process of updating this list.

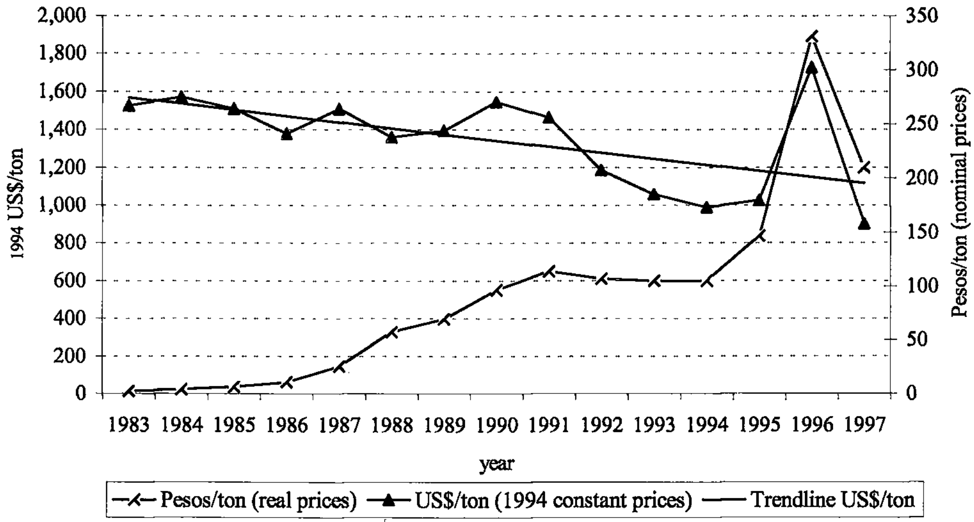
8. Mooij (1992) provides a classification of three forms of corruption and bribery, which can be followed to describe bribing practices in irrigation as well. In the first form bribes are used to speed up or improve services that were supposed to be delivered anyway. Generally both parties involved are more or less equal in the sense that both can decide to refrain from bribing. In the second form, the person that should deliver the service is able to impose his or her will on the other. This form is often referred to as coercion or blackmail. Finally, a third form of bribing practices is related to misappropriation of money or commodities (food, building materials, etc).
9. Rent seeking in practices other than water distribution also occurs, particularly in the fields of system maintenance and rehabilitation, where often external contractors are hired. Also in ARLID there are many rumors that bribing plays an important role in the granting of system improvement contracts. Examples of these include the granting of contracts under the "Efficient Use of Water and Electricity Program". Under this program private contractors are hired to upgrade existing pumps and to install small buried pipe systems. However, I have never had the opportunity to eye-witness these rent seeking practices myself, nor was I able to collect evidential empirical data that support these rumors. Trying to observe these practices outside the field of water distribution would have implied that I had to use rather different research methods (like following bureaucrats, private contractors, middlemen, politicians and their networks) than the ones I used to observe daily irrigation practices in the field (see section 1.7).
10. This particularly happens when farmers grow crops that need more frequent deliveries than the number of required deliveries for wheat, maize and sorghum (which are the main crops). For instance, beans generally take 5 to7 irrigation deliveries instead of the 4 deliveries planned by the WUA. In many occasions farmers try to make deals with ditch tenders to increase the number of deliveries, albeit with less water per delivery. The ditch tender generally only reports the official 4 deliveries that the farmer has paid for. In other cases, and particularly in Salvatierra, farmers negotiate with the ditch tender to "transfer" one of the four official deliveries of the winter season to the summer season, when normally only one deliver is officially scheduled (and paid for). Whether a ditch tender seeks to receive a bribe for these services depends a lot on the personal relationship between the farmer and the ditch tender. Also in some modules these practices are more common and tolerated by the WUA leadership. This is for instance the case in Salvatierra where the high percentage of non-standard crops and a high level of land fragmentation stimulate deviations between the official irrigation schedule and actual deliveries.
11. The Mexican Spanish translation of a bribe is *una mordida*, which literally means 'a bite'.
12. One could hypothesize that these local patterns of accommodations positively influence distribution and application efficiencies as irrigation supplied closer to the irrigation needs of the farmer. Particularly in the case of beans and vegetables (which require less irrigation but more frequent deliveries) the deviations from the planned schedule might result in situations where supplied volumes better met crop water requirements. Unfortunately I do not have sufficient data to support this hypothesis. The reason why I want to make this point here is, that often it is believed that deviations from official plans and schedules are an indication of poor irrigation performance. Yet, this argument disregards the fact that planned targets themselves can be poorly (i.e. unrealistic) defined and hardly ever reflect the irrigation requirements at the very micro level, such as the sub-distributaries in Salvatierra.
13. The practice of bribing and corruption in water distribution is a popular subject for discussion among many irrigation engineers, irrigation policy makers and scholars who study water management (see for instance Repetto 1986). However, few researchers have studied and reported these practices in a systemized manner. Among the exceptions are Wade (1982 and 1988) and Ramamurthy (1995), who argue that bribery and corruption have become institutionalized and structuring mechanisms of getting access to canal water in many irrigation systems in South India. Also Mollinga's (1998) observations in a similar irrigation system in Karnataka confirm that bribes and corruption largely control the patterns of irrigation management, particularly when maintenance and construction are involved. However, unlike Wade and Ramamurthy, Mollinga

argues that farmers' bribing of Irrigation Department staff has hardly functioned as a mechanism to control water distribution within the canals. Mollinga's main conclusion in this respect is that water control is much more a political contestation of resource use, in which (political accountability) relationships between rich water users and politicians are more important than (financial or bribing) relationships between users and agency staff. Oorthuizen (1998) arrives at the same conclusions in his study on main system management in the Philippines. For accounts on bribing practices in irrigated agriculture in the Pakistani Punjab see Merrey (1983: 443-449).

14. These four modules are: Salvatierra, Cortazar, Valle and Huanímaro.
15. In ARLID, salaries of CNA district staff (located in Celaya) continue to be paid out of central funds. This means that payments to the CNA district office by the WUAs only cover operational costs such as materials, transport, casual laborers and administrative costs to run the CNA district office. I heard that in some other districts, also CNA district staff is paid out of the fee collection, but I was not in the position to verify this. Also important in this respect is to know that all payments from WUAs to the CNA district office remain with CNA in the same district. Examples from other countries show that in many cases fee collected are first transferred to the general state treasurer, thereby delinking the level of collection and the actual use of this collection by and for the managers and users of the particular system were the fees were collected. See Small and Carruthers (1991) for general theory on mechanisms of cost-recovery and financial autonomy in irrigation. For case studies, see for instance Kloezen 1995 and 1996 on financing participatory irrigation and lack of financial autonomy in Sri Lanka; and Svendsen (1993) and Oorthuizen and Kloezen (1995) on the impact of financial autonomy policies on irrigation performance in the Philippines.
16. In actual peso terms the fee level remained the same during this period.
17. The actual O&M expenditures after 1992 do not include the cost of the staff still employed by CNA as these are all paid out of federal funds rather than out of the fees collected from farmers.
18. The planned fee collection is based on the planned acreage to be irrigated and the planned number of irrigations for a particular year, multiplied with the current per ha-irrigation tariff. Hence the collection rate does not necessarily reflect the required sum needed to manage the district optimally. Under this methodology any change in the number of irrigations actually delivered changes the collection rate.
19. This was possible because WUAs often could deliver more irrigation turns over and above the amount upon which the planned collection target was based.
20. Since the early 1990s, the Government of Mexico has been phasing out subsidies on energy.
21. Cutting off defaulters from irrigation supply is much more difficult in supply driven systems (like most Asian paddy systems, ref. Mollinga 1998) where water is supplied more or less continuously to all canals and fields and where stealing of water is more institutionalized than in arranged demand type of systems like ARLID where water is delivered to individual farmers at pre-arranged times.
22. This situation can be compared by the Taiwan case described by Moore (1989). Moore challenges what he calls the myth that hired technical staff of water user associations are obliged to perform well as their salaries depend financially on the willingness of users to pay for the level of service they receive from the associations. According to Moore, (at least in Taiwan) the facts run directly contrary to the myth, as the actual mechanisms for controlling management are more political and less democratic. Yet, Moore agrees that to some degree fee payment is used to stimulate managerial performance. Rather than complete defaulting on fee payments, Taiwanese farmers express their dissatisfaction with the service they receive by delaying the payment. For the associations, speed in fee collection is seen as one element in the formal grading system which directly affect salary increments and promotion.
23. Mexican farm gate prices for basic food commodities like wheat and maize closely follow the trends in world market prices. Hence farmers are very vulnerable to frequent fluctuations in these world market prices. Furthermore, for most Mexican farmers farm gate prices have declined

dramatically since the 1980s, basically as a result of NAFTA and other trade liberalization (De Janvry *et al.* 1995 and De Janvry *et al.* 1996), leading to expected displacement from agriculture (Calva 1991; Levy and van Wijnbergen 1992; Robinson *et al.* 1991, all cited in De Janvry *et al.* 1995). The graph below illustrates the fluctuation in wheat prices for farmers in ARLID. Real wheat prices were exceptionally high at 1,890 pesos/ton (or US$302/ton at constant 1994 dollars), but dropped to 1,200 pesos/ton (or US$158/ton, at constant 1994 dollars) in 1997. Finally, the trendline clearly points to a decline in constant farm gate prices between 1983 and 1997.

Fluctuations in farm gate prices for wheat in ARLID, 1983-1997



24. I made several attempts to collect reliable time series data on the cost of production in the years preceding management transfer. However, detailed information that separate production costs for canal irrigation from production costs under well irrigation, or that separate production in ARLID from other forms of irrigation in the region can not be found. The only source of available information on costs of production of farmers in ARLID could be found in the local offices of FIRA (*Fideicomisio Instituido en Relación a la Agricultura*, a trust fund for agriculture constituted by five government funds for agriculture which rediscounts loans of farmers' credit unions on a subsidized basis). But as FIRA mainly aims at credit worthy large farmers, the costs of production of these farmers (who are often engaged in intensive export oriented production) was regarded not be representative of costs made by all farmers, including the small ones. For more information on the performance of FIRA and other credit programs see Covarrubias-Patiño 1996, Myhre 1996, Mackinlay and de la Fuente 1996, and Myhre 1998).
25. The cost of water, related to wells includes both energy cost for pumping and seasonal maintenance, but excludes capital costs.

8 "Getting the prices right?": tradable water rights and water marketing

8.1 Introduction

In this chapter the focus of analysis is shifted from IMT towards another market-oriented reform in the Mexican irrigation sector: the introduction of tradable water use rights and water marketing[1]. The chapter assesses how the new arrangement of providing WUAs with clear use concessions have affected the practice of water trading, both between individual water users and between WUAs. By doing so, the examples given in this chapter challenge the notion (popular among new-institutional economists and many policy makers) that water is used in a more optimal way if it is valued as an economic good.

This chapter fills some of the empirical void on experiences with water marketing in Mexico. This is done by presenting a case on water trading between newly created WUAs in ARLID. Although water trades of both ground and canal water between individual farmers have occurred even before the Mexican National Water Law was implemented in 1992, as far as could be observed, bulk trading of water between WUAs have only started after the law came into force and only occurs in a very limited number of districts. This chapter demonstrates how tradable water rights to WUAs are defined and what the practice is of water trading in this district. It evaluates to what extent the practice of water trading between the eleven WUAs in ARLID follow the assumptions on water markets as discussed in section 1.4.

8.2 Water use concessions in ARLID

WATER USE CONCESSIONS TO WUAS

Perry *et al.* (1997), Colby (1988) and others see the existence of clearly defined water rights as one of the major preconditions for the introduction of market forces into the allocation of water. The National Water Law of 1992 and its 1994 Regulations clearly seek to define concessions for the use of national waters and State owned irrigation infrastructure, as well as their registration in REPDA (see chapter 4). Yet, introduction of new legislation does not necessarily mean that in practice these use rights are established and that registration takes place. To what extent have new water rights been introduced to the WUAs in ARLID?

In 1992, at the time of irrigation management transfer, all eleven WUAs signed legal documents that gave them the status of civil associations as well as concessions that allowed them to use both water and infrastructure[2]. In ARLID each WUA has been entitled with a concession for a period of 20 years. These concessions are renewable. The most important annex to the concessions is a manual that describes regulations for O&M as well as for budgeting, cost recovery and financial administration[3].

The concessions that were signed by the WUAs do not mention a fixed volume to which the association has a right, nor do they refer to REPDA. Instead, the concession follows the principle of pre-seasonal allocation of water between the WUAs. As explained in chapter 4, in this principle CNA is obliged to determine the volume available to the WUA at the start of each agricultural year. Subsequently, the hydraulic committee allocates the available storage proportional to the area under surface irrigation that is managed by the WUA. Hence, in ARLID volumetric concessions are effectively defined as a proportion of available storage. As a consequence, the volume that a WUA is entitled to varies from year to year. Generally the volume allocated at the start of the agricultural year holds for the entire year (i.e. for both winter and summer seasons).

The hydraulic committee closely monitors whether the actual supply to a WUA does not exceed the allocated volume. In case a WUA is able to save water (i.e. using less than the allocated volume), the water can be used in three ways. First, in theory the WUA could save and 'store' non-used water for the next year. In practice this never happens as storing water in the reservoir would imply major evaporation and percolation losses and consequently would considerably reduce the net volume that can be used next year. Second, and most common in ARLID, is to adjust the irrigation plan for the summer season. At the end of the winter season (when approximately 75% of all water that had been concessioned for the entire year has been used), WUAs know how much water they have left for the one or two irrigation turns during the summer season. In case a WUA has used less water during the winter season than planned, 'saved' water can be used to either increase the number of irrigation turns during the summer, or increase the area to be irrigated, or both. Third, and most interesting for this chapter, allocated water that has not been used can be traded to other WUAs.

At the end of the agricultural year, and before the start of the new winter season, the hydraulic committee examines which WUAs have exceeded their volumes. In these cases, the new proportional shares are reduced with the volumes exceeded in the previous year. Occasionally an additional volume is made available during the season. Although one would expect that the same principle of proportional allocation would be applied during the season, the examples in the next section of this chapter shows that rights to make use of this extra water can be negotiated, which shows that water rights related to in-season allocation are less clear.

WATER USE CONCESSIONS TO INDIVIDUAL WATER USERS

The individual rights of the users of canal water within irrigation districts are not clearly defined, neither in the law and its regulations nor in the concession documents of the WUAs. Each farmer within the irrigation district area who is officially registered in the list with users of a WUA is entitled to receive a share of the volume that has been allocated to the WUA of which the farmer is a member[4]. Water use rights of individual users are subject to the decisions taken by the hydraulic committee concerning the number of irrigation turns and the area to be irrigated[5]. Once the WUA has received the volume in bulk, it should distribute the water among its users according to the annual irrigation plan made by the WUA. Following this plan, the WUA should deliver to the users the volume in accordance with the planned and required volume and time of delivery (see also section 5.4). Although the law stipulates that each WUA should define its own procedures on how to prioritize canal water distribution in times of water scarcity, none of the WUAs in ARLID ever finalized the formulation of these procedures, although several attempts were made to pass drafts of the internal operational rules and regulations through the assemblies of the WUAs (see chapters 4 and 6).

If one follows the WUAs' operational target to supply a flat water depth to all users (irrespective of the crop they grow), one could argue that farmers are entitled to fixed volumetric rights. However, as was demonstrated in chapter 5, farmers receive varying volumes of water as in daily practice a water right is defined as the right to receive sufficient water (within the predetermined number of irrigations).

Water rights to users of tubewells are more clearly defined than individual rights to canal water. In theory, each tubewell should have been concessioned with a maximum annual volume that may be drawn from the well. This volume is based on both the area served by the well and the assumed cropping pattern. However, in practice there are two problems that limit the implementation of these rights. First, issuing and recording concessions to the 16,500 registered tubewells in the State of Guanajuato (Guerrero-Reynoso 1998) is a time consuming process[6]. Second, once the concessions have issued, monitoring whether well users do exceed the concessioned volumes does not take place as a result of lack of staff within CNA. As a consequence, it is common practice to irrigate larger areas than authorized, which contributes to the alarming rate of over exploitation of the aquifers (see chapter 9).

REGISTRATION OF CONCESSIONS

According to the law, once they have been granted concessions of water use should be registered in REPDA. As usage of canal water is only concessioned to WUAs, individual users of canal water are not registered in REPDA. The REPDA manual that describes the procedures and formats for registration of rights to WUAs mentions that an "average annual volume" has to be recorded in the concession. Although an officially signed concession did not yet exist in 1997, the CNA district management for ARLID had prepared a draft concession, which mentions an annual average volume of 831.5 Mm^3/year (or 761.5 Mm^3/year when La Purísima module -which has its own reservoir- and Pastor Ortíz are excluded). Yet, it remains unclear what kind of water right the district can attach to these average volumes[7].

Registration of user concessions is seen as one of the most important preconditions to secure water rights. Yet, interviews with CNA staff responsible for REPDA in early 1997 showed that none of the concessions to the WUAs had officially been recorded yet[8]. Furthermore, in general WUAs are poorly informed as well as confused about their rights and concessions. Interviews with leaders and managers of the 11 WUAs in ARLID showed that only three WUAs have an idea about the existence and general function of REPDA. Four WUAs know that in ARLID concessions are defined in terms of proportional share of available water in the reservoirs. Four other WUAs have no idea how their concessions are defined. One WUA believes that a concession is the average of the water available over the last five years while one WUA thinks it is the volume that they received last year. Only one WUA referred in general terms to the relationship between a concession and the actual dam storage.

As far as registration of concessions to individual tubewells is concerned, an official of the CNA office in Celaya estimated that less than 25 percent of the existing private wells had officially been concessioned and registered in REPDA. This leaves the majority of well owners without official entitlements.

These results show how poorly informed WUAs and individual users are about their water rights and the function of REPDA. Whereas WUAs still have some secure rights, lack of registration and poor information severely weakens the actual rights of individual users. Participation in water markets is limited to those who actually know what their rights concerning water trading are. Many farmers (and WUAs, see Ahlers *et al.* 1998) still believe that trading of water and water rights is an illegal practice. Generally only larger farmers who take part in various political networks and with sufficient political clout are informed about the latest legislative reforms. This creates unequal negotiation positions between for instance smaller farmers who wish to rent out some of their land and water to neighboring large farmers.

CONCESSIONS VERSUS ACTUAL DELIVERIES TO WUAS

Comparison between pre-seasonal proportional allocations (which define the concessions) and total actually delivered volumes during the season provides an indication on how effective concessions to WUAs have been implemented in ARLID.

Table 8.1 Comparison between allocation and the actual supply to each WUA, ARLID 1992-97

	1	2	3	4	5	6	7	8
WUA	Allocation	Actual supply to each WUA as % of total supply						Average actual /
	% of total Water available	92-93 %	93-94 %	94-95 %	95-96 %	96-97 %	Average %	Allocation 7/1 (%)
Acámbaro	8.4	6.6	6.3	6.3	6.6	7.7	6.7	80
Salvatierra	16.4	19.2	16.5	17.4	19.3	16.2	17.7	108
Jaral	6.2	5.5	6.7	6.0	6.6	7.0	6.4	103
Valle	12.6	9.8	10.1	11.8	11.9	11.5	11.0	87
Cortazar	17.5	17.7	17.4	16.8	17.6	16.7	17.2	96
Salamanca	15.0	16.4	15.6	14.5	12.0	14.4	14.6	97
Irapuato	5.9	4.3	5.1	5.7	6.2	6.3	5.5	93
Abasolo and Corralejo	14.2	17.5	17.5	17.4	15.7	15.8	16.8	118
Huanímaro	3.7	3.0	4.7	4.2	4.0	4.5	4.1	111
Total[1]	100	100	100	100	100	100	100	CV = 14 %

Note [1]: the corresponding volumes for these years are 929 Mm^3 (1992-93), 974 Mm^3 (1993-94); 871 Mm^3 (1994-95); 755 Mm^3 (1996-96); 675 Mm^3/ (1996-97). The average total supply of these four years is 828 Mm^3/year.

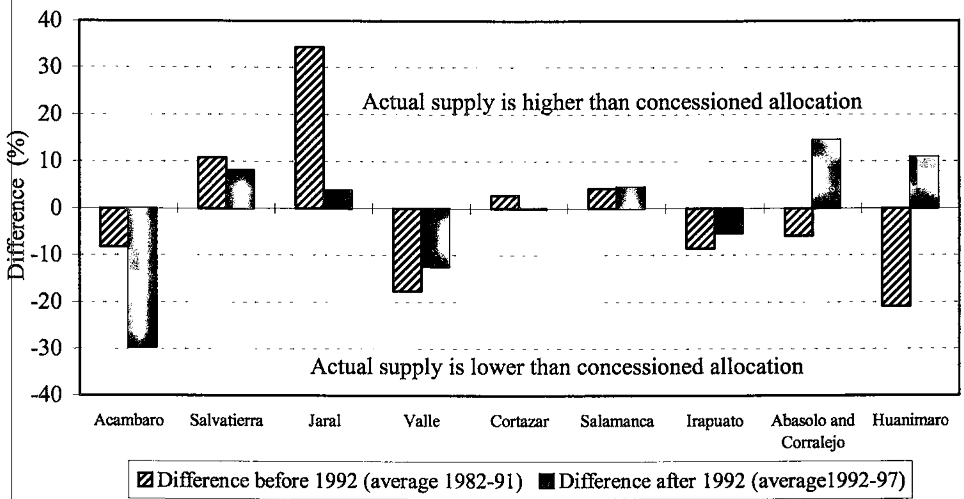
Table 8.1 shows the difference between the concessioned allocation (which is defined as a percentage of total available storage, column 1) and the actual deliveries during the agricultural seasons 1992-93 to 1996-97 as a percentage of total deliveries to the district (columns 3 to 7). The highest difference between concessioned and actual deliveries is found in the case of Acámbaro WUA, who received 20 percent less than is proportional water right.

This is not the result of poor allocation by CNA but rather of its climate conditions, which make that Acámbaro requires less irrigation. Yet, it is entitled to its proportional share of available dam storage. As a consequence it can sell some of its concession to other WUAs. All the other modules stay within a 18 percent difference. As will be demonstrated below, some of this difference is due to the fact that WUAs sell parts of their rights to other WUAs.

Proportional allocation between WUAs is not new to ARLID and was introduced decades before the new water law came into practice. Analyses of figure 8.1 shows that proportional allocation of available storage has slightly improved after 1992, when the new law facilitated the establishment of WUAs who assumed major roles in monitoring actual over concessioned deliveries. In the ten years before 1992, two modules stayed within the 5 percent difference; after 1992, this number increased to four modules. Before 1992, two modules showed a difference of more than 20 percent, while in the period 1992-1997 only one module showed more than 20 percent difference. Before 1992, the CV of the average differences was 16 percent while after 1992 this value reduced to 14 percent.

The period since the introduction of the new water law might be too short to draw conclusions on improvements in water allocation between WUAs, but analysis of the five years since the law suggests that CNA and the WUAs have succeeded in closely following the allocation rule. This is mainly the result of the fact that the WUAs use the hydraulic committee to frequently monitor actual distribution between WUAs against planned and concessioned allocation.

Figure 8.1 The difference between allocation and actual supply, before and after 1992



THE NEED TO BETTER DEFINE WATER RIGHTS

Lack of secure water rights is often seen as the most important factor to hamper the development of water markets (Rosegrant and Binswanger 1994; Kemper 2001). Preliminary results of studies in ARLID and other Mexican district under various drought, tenure and cropping regimes show that under the new water law of 1992 entitlements of individual users continue to be poorly defined[9], and that water trades between farmers have had a long history and were hardly affected by the new law. While property rights for land have been clear and fixed since the amendment of Article 27 of the constitution, surface water rights are only specified at the level of the WUAs. All farmers that are officially registered as a land user within the irrigation district have water rights. Yet, individual water users of canal water depend for their water rights on the allocation decisions taken by the hydraulic committee as well as on the internal operational procedures developed by each WUA. A major problem is that, so far, none of the WUAs in ARLID has developed the procedures. Consequently, rules that define how water should be allocated during times of water scarcity do not exist.

Although rights for well owners are more clearly defined in the concession to each well, few concessions have been actually issued, which leaves most well owners without clear rights. Furthermore, monitoring of existing concessions to well owners hardly takes place.

Whereas individual water rights remain unclear, the new law is clearer on concessions to WUAs. This has facilitated water trade between WUAs in ARLID and it has provided these WUAs to be more actively involved in monitoring their annual concessions. Actual allocations closely follow these concessions as a result of the strong monitoring role that the WUAs play in the district's hydraulic committee. Having a hydraulic committee does not necessarily mean that WUAs play their decision making and monitoring role effectively. ARLID is known for the strong leadership of the majority of WUAs, which (among other examples) is demonstrated by the willingness of the WUAs to create the Limited Responsibility Society. This kind of leadership plays a crucial role in defining the relationship between CNA and the WUAs, particularly when both parties of interest meet in the hydraulic committee.

In years of relative water abundance, the current way of defining the concessions appears to be effective. However, examples from other districts show that under conditions of severe drought or increasing competition between irrigation and industrial usage legal entitlements do not sufficiently guarantee that WUAs receive their proportional share. Johnson (1997) reports on a case in the state of Nuevo Leon where the city of Monterrey has diverted irrigation water to another dam to serve the needs of the city's powerful industrialists. Yet, these WUAs have legal concessions, as well as a 1952 agreement signed by the President stating that the water belongs to the irrigation district. Similar situations could happen in ARLID as well if CNA does not carefully discuss with the WUAs its plan to transfer 10 Mm^3/year from La Purísima dam to the historical town of Guanajuato, which desperately needs more water to meet its higher water demand from the tourist sector. Discussing and implementing such plans are only possible if concessions are more clearly defined and more effectively registered in REPDA.

8.3 Water trades between WUAs

OPPORTUNITIES FOR TRADING WATER

In theory, trading of parts of the water concessions to WUAs can occur at different moments of the year. First, trading could take place at the start of the season, when all WUAs know in principle how much water they have available to be used during the entire agricultural year. As discussed before, this volume is a proportional share of available storage at the start of the season in October or early November. If from experience, or from the first indication of farmers on how much area they want to irrigate, it appears that the WUA does not need the entire volume concessioned, it already could decide to sell some of its water to other WUAs. This could be the case with for instance Acámbaro module, who owing to more favorable climate conditions, generally needs less water than the other WUAs and yet receives its full proportional share. As a result, occasionally it is able to trade out some water (see below). So far, none of the WUAs has ever traded out water before the start of the seasons. There are two reasons that explain this: a) it is difficult to assess the exact irrigation requirement at the start of the season, as WUAs do not know how much area farmers will actually grow and rain could be less than anticipated. A WUA does not want to take the risk to not be able to fulfill its irrigation commitments to its own users; and b) at the start of the season its is not clear which WUAs are interested in buying water.

The second opportunity for trading water could be during the season. Although this could happen at any time during the season, the examples below show that water trading between WUAs only takes place at the end of the winter season, when the cropping pattern for the following summer season (which generally has only one or two irrigation turns) is defined. At the end of the winter season, a WUA knows whether actual total deliveries follow the planned deliveries and hence whether they have sufficient water for the last irrigation turn of the winter season or for the first turn of the summer season, or whether they will be short on water. The implication of the economic argument made in section 1.4, would be that trading water in between the summer season and winter season would increase the price of water because of higher opportunity costs at this time of the season (when water is felt to be scarce by some WUAs as failing to irrigate might mean a total crop failure) compared to the start of the season (when water is still abundant). Furthermore, for those WUAs who want to sell water, non-traded water is not a lost commodity (with the consequent low opportunity cost) as this water can be used to expand the irrigated area in the summer season, or to increase the number of irrigation turns during the summer, or both.

NEGOTIATING WATER TRADES

In order to understand the practice of water marketing between WUAs in ARLID, it is important to distinguish between trading of concessions for the entire duration of that concession, and trading (or renting) of a fraction of the concession for a period much shorter than the duration of the concession. In ARLID, so far only the latter type of trading has occurred[10].

The first incident of water trading between WUAs took place at the start of the 1995 summer season. In that year, Acámbaro sold water to Cortazar, Salvatierra and Huanímaro (table 8.2). Leaders of Salvatierra WUA complained that they wanted to buy the entire available volume from Acámbaro but that CNA intervened by arguing that also other prospective buyers should be given the opportunity to buy water from Acámbaro.

The total volume of these trades was 22 Mm^3. In 1995, prices were entirely negotiated between the WUAs involved in the transaction, with --according to the WUAs themselves-- CNA only having to approve and register the transaction. Two WUAs indicated that CNA also helped to prevent that WUAs would sell their water for "excessively high prices", but they did not indicate what they perceived was a reasonable price. Interviews with managers of the WUAs indicated that Cortazar paid a much lower price for the water than Salvatierra and Huanímaro because of higher opportunity costs to transport the water from Acámbaro to Salvatierra and Huanímaro (see also page 178).

Table 8.2 Water trading between WUAs in ARLID: volumes and prices

Season	Seller	Buyer	Volume (Mm^3)	Bought as % of total used[1]	Price US$ / 1,000 m^3
Summer 1995	Acámbaro	Cortazar	10.0	25%	0.40
	Acámbaro	Salvatierra	10.0	21%	0.93
	Acámbaro	Huanímaro	2.0	23%	0.93
Summer 1996	Acámbaro	Salvatierra	8.0	36%	2.00
Summer 1997	Acámbaro	Abasolo	3.0	19%	3.44
	Acámbaro	Huanímaro	2.0	86%	3.44
	Valle	Salamanca	3.5	18%	3.50
	Valle	Abasolo	1.0	6%	3.44
	Jaral	Salamanca	0.45	2%	3.50

Note [1]: This is the share of the volume bought to the total volume used by the buying WUA for that particular summer season .

The second occasion of water trades between WUAs occurred in 1996. In the irrigation plan for the 1995-96 agricultural season, four irrigation turns for the winter and one irrigation for the summer season were programmed. However, by the end of the 1996 winter season, some WUAs had fully used their assigned volume for the entire year and hence tried to buy water to be able to, at least, deliver water to those farmers who had already paid for their summer irrigation. Salvatierra, Cortazar, Valle and Huanímaro were among the WUAs that showed interest in buying water. Acámbaro and Salamanca indicated that they wanted to sell water. Yet, the only WUA that actually bought water was Salvatierra, who paid US$ 2.00/1,000 m^3 (table 8.2). This is twice the price the WUA paid in 1995. According to the WUAs and CNA, this price reflects better the O&M cost related to transporting the water to the users. Valle wanted to buy 10 Mm^3 from Salamanca, but thought that the price of US$1.07/1,000 m^3 was too high. Also Cortazar desperately wanted to buy water in order to be able to irrigate the 100 hectares that farmers had already paid an irrigation turn for. It had already started to negotiate buying water from private well owners (against pump operation cost) when rains set on and the necessity to buy water declined. Because of these rains, also Huanímaro did not have to buy water.

Negotiations on water transactions for the summer 1997 season started in May. At that time the new LRS, which federates the 11 WUAs, had been created. This appeared to be important for the way negotiations on water allocation and trading between individual WUAs took place. First, the hydraulic committee, in which all WUAs and the new LRS participate, played a major role in discussing the volumes and prices of the transactions. Second, some WUAs used what they called "the required solidarity among the members of the LRS" as an argument, both to try to get access to the water that was going to be sold and to try to reduce the price. These two observations are illustrated by the negotiation that took place in the hydraulic committee meeting of May 1997.

The objective of this meeting was to decide on how an additional volume of 42 Mm^3 had to be allocated between the WUAs. Because of unexpected heavy rains in March and April of 1997, the reservoirs had filled up considerably and CNA decided to assign an extra volume to the district. This volume was additional to the assigned volume of 640 Mm^3 for the 1996-97 irrigation season. At that time, the WUAs had already used 546.2 Mm^3 for the winter season, which meant that 93.8 Mm^3 of total assigned volume could still be used for the summer season (column 1, table 8.3). With the additional 42 Mm^3 the WUAs had a total availability of 134.8 Mm^3 of water for the summer season.

The question, however, was how to allocate the additional volume. This appeared to be a problem as the WUAs of Salvatierra, Valle, Jaral and Cortazar had made an enormous effort to enforce their farmers and staff to strictly follow the irrigation plan with its area restrictions. Consequently, as is demonstrated in column 2 of table 8.3, these WUAs had 'saved' 20 to 26 percent of their total annual assignment for the summer season. On the other hand, Abasolo and Huanímaro were less successful in following their own irrigation restrictions and, with one more irrigation turn committed, had already exceeded their entire annual volume. Three of the four WUAs of the first group (Valle, Cortazar and Salvatierra) argued that they should be rewarded for the fact that they succeeded in forcing their water user members to strictly follow the irrigation plan to save water, and therefore should have the first right to the additional volume. The second group accepted the argument that they failed to strictly follow the irrigation plan, but argued that now with the new LRS users have to declare their solidarity with each other and therefore allow all WUAs to have equal access to the additional volume. By means of paying a fine for their slack management, they offered to pay a higher price for the water. This plea for solidarity was particularly addressed to the presidents of Valle and Cortazar (who are both among the group of WUAs that saved water) as they had just been elected as the president and treasurer of the LRS.

As is dictated by the water law, CNA also participated in the meeting. However, it was observed that the negotiation took place among the WUAs themselves, particularly between the two groups mentioned above. Three CNA representatives were present in the meeting: (1) the chief engineer of the district, who hardly played a role during the meeting and did not argue against or in favor of any of the WUAs; (2), the district's head of operation, who presented the current information on dam storage, volumes supplied to each WUA so far as well as three different options or scenarios for allocating the extra water; and (3), the assistant manager in charge of CNA Guanajuato, who played the most active role by trying to moderate the discussion and separate arguments for and against the three options presented below.

Columns 3, 4 and 5 of table 8.3 show the three different options for assigning the extra water between the WUAs that were discussed during the meeting. In the first option, the additional volume is allocated strictly proportional between the WUAs (following the percentages given in column 1, table 8.1). Although neither the water law nor the district's own operation rules define the principles of in-season allocation of additional water, this option would strictly follow the pre-seasonal allocation (and concession) principle. Those WUAs that had already exceeded their assigned annual volume would receive their proportional share of the additional volume, minus the volume that they had already exceeded. This would imply that Abasolo would receive less than it needed and Huanímaro would not receive any water at all.

The second option looks strictly at the planned irrigation requirement for the summer season of each WUAs and allocates the additional volume in such a way that all WUAs would have enough water to meet these requirements. This would mean that those WUAs who had saved water (as was planned in the annual irrigation plan) for their summer crop would not receive water at all, and that those who had not followed the irrigation plan (and even exceeded it) would receive most of the additional volume. The third option closely follows the first option, but also re-allocates the volume that was deducted from those WUAs who had exceeded their annual volume.

In was clear that Salvatierra, Valle, Cortazar, and to a lesser extent Jaral, could not accept the second option as, according to their arguments, their users would not accept to be punished for the fact that they strictly followed the irrigation plan with its restricted areas.

The discussion on these three options took several hours. Although the presidents of Valle, Cortazar and Salvatierra clearly argued for the first option, they did not want to play it too hard as all three were also key members of the board of the new LRS (the president, treasurer and secretary, respectively). Not only did these long discussions annoy the presidents of the WUAs, but the CNA representatives as well. When the discussion seemed to have reached a deadlock, the CNA assistant manager in charge proposed to close the meeting so that the WUAs could further deliberate on the allocation of the additional volume among themselves. At this point of the discussion CNA had nothing to lose as it had already shown its good-will towards the users by allocating an additional volume of water. However, presidents from both groups strongly objected to this idea and argued that CNA, being a member of the hydraulic committee, should share the responsibility for the final decision of the meeting.

After five hours of negotiation, the majority of the WUAs chose the third option, as that would make full use of the additional volume as well as satisfy both groups. Yet, those WUAs who received little or no water at all felt that they could not leave the meeting without having acquired some water for their users. At this point, CNA suggested that those WUAs who had saved water could consider whether they would sell some of this water to WUAs who needed more water. Acámbaro, Salvatierra, Jaral, Valle and Cortazar decided that they were able to sell the volumes mentioned in column 6 of table 8.3. Column 7 shows which WUAs were interested in buying water. Although interested, Huanímaro could not buy water as it had already exceeded its annual concession by eight percent. Also, as it is a small module at the tail-end of the district, it was considered that any potential volume the WUA could buy would be so small that it would not even reach the farmers because of conveyance losses along its way to the module.

There was very little discussion on the price of the additional volume assigned by CNA, nor on the price of the extra water that the WUAs would re-allocate or sell among each other. CNA suggested that the WUAs would pay US\$0.26/1,000 m^3. Those WUAs who sell some of the additional water would be paid the same price. As this price was so low compared to prices paid in previous years (table 8.2), it was regarded as a symbolic price and none of the WUAs found it worth discussing.

Shortly after the allocation of the extra water had been decided upon, the WUAs again started to negotiate water trades. Acámbaro, Valle and Jaral sold water. As table 8.2 shows, Abasolo, Huanímaro and Salamanca bought water. Again, the hydraulic committee meeting was the arena where negotiations took place. This time the negotiation concentrated more on the price of the traded volume. Unlike 1995, and to a lesser extent 1996, WUAs that could sell water now argued that the price should better reflect the opportunity cost of carrying the water to the users. Or in other words, the price should better reflect the income that a WUA would receive if it had sold the same volume of water to its individual users. However, the question that was discussed was whether the price should reflect the cost of water to farmers of the WUAs that sells or that of the farmers of the WUA that buys the water.

Table 8.3 Negotiated allocation of an extra volume and agreed plan for water sales at the start of the 1997 summer season

WUA	1	2	3	4	5	6	7	8
	Volume left over for summer		Extra volume assigned by CNA			Volume to be sold by WUA	Volume that WUA can buy	Total volume assigned to WUA (1+5+7-6)
	Mm^3	% of annual plan	option 1 (Mm^3)	option 2 (Mm^3)	option 3 (Mm^3)	(Mm^3)	(Mm^3)	(Mm^3)
Acámbaro	8.7	17	3.2	2.8	3.5	1.5	0.0	10.7
Salvatierra	26.6	26	6.3	0.0	7.0	1.9	0.0	31.6
Jaral	9.1	24	2.4	0.0	2.7	1.0	0.0	10.7
Valle	19.3	24	4.9	0.0	5.4	2.7	0.0	22.1
Cortazar	21.3	20	6.7	0.5	7.4	1.5	0.0	27.2
Salamanca	4.1	5	5.7	14.6	6.4	0.0	3.6	14.1
Irapuato	4.7	13	2.2	2.7	2.5	0.0	1.5	8.7
Abasolo	0.0	-5	5.1	16.5	5.6	0.0	3.2	8.8
Huanímaro	0.0	-8	0.0	0.0	0.0	0.0	0.0	0.0
Corralejo	0.0	1	0.4	1.1	0.4	0.0	0.3	0.8
Total	93.8		36.9	38.2	41.0	8.6	8.6	134.8

Three options were discussed. In the first option, the WUA that sells charges a price similar to what its own users would have to pay for the same volume. In the second option, the WUA that sells would receive the price that farmers of the WUA that buys normally pay. The third option follows the first one, but deducts their O&M costs for managing the volume that they sell. The difference between the first and second option is particular of interest for Valle, the most important seller in this case. As will be demonstrated in chapter 9, of all the WUAs in ARLID, Valle has the lowest RWS values[11]. Also, whereas other modules use a planned gross irrigation depth of approximately 350 mm for the first irrigation turn in the summer, Valle programs an irrigation depth of 250 mm. Yet, the irrigation fee per hectare is approximately the same across the modules. This means that Valle WUA charges its farmers a relatively high fee per unit of water supplied: US$ 5.30/1,000 m^3, against for instance US$3.45/1,000 m^3 in the case of Abasolo WUA.

The hydraulic committee decided that the second option, which follows the fee paid by farmers of the WUA that buys, was the best. The price required by Valle was considered to be too high. Valle accepted this argument. Although hard to prove, the fact that the president of Valle WUA is also the president of the new LRS might have played a role in accepting this unfavorable trade for Valle.

APPROPRIATE INFRASTRUCTURE AND LOW TRANSACTION COSTS

According to Moore (1989) and Livingston (1995) the physical nature of water alone violates a number of economic conditions, which consequently may hinder the development of water markets. Delivery of irrigation is inefficient because there might be losses that are not accounted for and that may cause third party effects. In most irrigation districts it is difficult to deliver constant and predetermined volumes. Furthermore, there is often an interdependence between surface and groundwater that cannot be controlled.

These arguments certainly hold for water transfers over long distances to a large number of individual users, or when water is to be transported out of the system in the case of for instance rural-to-urban transfers (Rosen and Sexton 1993) or interstate transfers (Booker and Young 1994) which all imply very high transaction costs. However, water trades between WUAs in ARLID are hardly hindered by these conditions. Generally, traded volumes are delivered within the period and in addition to normal deliveries, using the same infrastructure. This means that no extra transaction costs are involved in transporting traded water. Furthermore, water is traded as a bulk to the WUA. The volume bought has to be delivered at the intake point of the module. As a consequence, conveyance losses between the reservoirs and the module intakes are not accounted for. Problems with conveyance losses only occur if a tail-end WUA like Huanímaro wants to buy water, while no other water deliveries take place at the same time. In those cases the hydraulic committee normally decides not to approve the transfer as much more water has to be released from the reservoir in order to guarantee that the WUA receives the water it has bought from another WUA.

Water measurement devices are found at the intakes of each module, which makes daily monitoring of actual deliveries and water transfers easy. As the water law does not account for the obligation to maintain certain levels of return flows to other users within the district, traded volumes are defined in terms of full consumptive use. As a consequence, no additional devices are needed to measure return flows.

SUMMING UP: ALLOCATED, ASSIGNED, TRADED AND ACTUAL SUPPLIES

In the cases described above four different concepts of water supplies were discussed: allocated, assigned, traded and actual supplies. By means of summing up the above observations, the four concepts are briefly explained again and compared. Allocated volumes are the water rights of each WUA defined as the right to the proportional share of available dam storage. This right is a percentage based on the number of hectares with a right to canal water (see table 5.1). These percentages are fixed and do not change over the years unless the official command area of a WUA is expanded.

The second concept used here is that of assigned volumes. This refers to the volumes that are actually assigned to the WUAs by the hydraulic committee at the start of each agricultural year. Assigned volumes are based on the actual available storage and closely follow the proportional allocation percentages. Assigned and allocated volumes deviate in those cases where exceeded volumes in the previous year are deducted from the proportional volumetric share. Deviations can also occur as a result of water trading or when extra water has been made available from the dams during the season. Finally, the concept of actual supplies refers to those volumes that were actually measured and diverted to the WUAs.

A successful implementation of new water rights is partially determined by the possibility and practice of closely monitoring the actual volumes of supplied and traded water over allocated and assigned volumes. Table 8.4 compares these volumes for the 1996-97 agricultural year. The first observation on this table is that at the start of the season the hydraulic committee closely follows the formal rule of proportional allocation of available storage: the percentages of allocations (column 1) are the same as the shares of actually assigned volumes (column 3)[12]. Once this first assignment has been made, the volumes are corrected for volumes that were exceeded during the previous agricultural year (column 4). Finally, the actual total assignment might change as a result of both water trading and when extra water becomes available during the season (column 5, see also table 8.3). The total volume assigned (columns 6 and 7) can now be compared with the volumes that were actually supplied or diverted to the WUAs. Although most WUAs received actual volumes that are close to total assigned volumes (with an average of 106%, meaning that on the average actual supplies exceed assigned supplies by 6 percent, and a CV value of 11.6 percent), particular Jaral, Abasolo-Corralejo and Huanímaro received more water than they were entitled to. As discussed above, this is mainly the result of these WUAs failing to follow their irrigation plan, which for 1996-97 winter season were based on restrictions in areas that could be irrigated. As a consequence, Huanímaro WUA could not receive any of the additional water that CNA wanted to assign to the WUAs in May 1997 (see table 8.3), nor the 2 Mm^3 of water that they bought from Acámbaro WUA (see table 8.2).

Table 8.4 Comparison between allocated, assigned and actually supplied volumes during the 1996-97 agricultural year

	1	2	3	4	5	6	7	8	9	10
	Allocation (% of total available storage)	Assigned volume by Hydraulic committee in Nov 97		Exceeded in 1995-96 (MCM)	Extra volume assigned and traded in May 1997	Total volume assigned		Total actual supply		Actual supply / total assigned
		(Mm^3)	(%)		(Mm^3)	(Mm^3)	(%)	(Mm^3)	(%)	(%)
Acámbaro	8.4	53.649	8.3	1.326	2.000	54.323	8.3	52.327	7.7	96
Salvatierra	16.4	105.434	16.4	3.511	5.100	107.023	16.3	109.104	16.2	102
Jaral	6.2	40.129	6.2	2.478	1.600	39.251	6.0	47.489	7.0	121
Valle	12.6	82.171	12.8	1.746	2.700	83.125	12.7	77.366	11.5	93
Cortazar	17.5	112.354	17.5	6.339	5.900	111.915	17.1	112.731	16.7	101
Salamanca	15.0	96.206	15.0	5.008	10.000	101.198	15.4	96.968	14.4	96
Irapuato	5.9	37.970	5.9	0.735	4.000	41.235	6.3	42.321	6.3	103
Abasolo & Corralejo	14.2	91.195	14.2	6.620	9.500	94.075	14.3	106.474	15.8	113
Huanímaro	3.7	23.864	3.7	0.133	0.0	23.731	3.6	30.571	4.5	129
Total		642.972		27.896	40.800	655.876		675.351		

8.4 Water marketing between individual farmers

Individual users in ARLID were engaged in farmer to farmer water trading long before the water law of 1992 and other neo-liberal reforms that sought to encourage trading were implemented (see sections 3.3 and 3.4). However, the new law has legalized the practice of water trading. Yet, few farmers are aware of this legal change and still believe that trading water is illicit.

Compared to districts like Lagunera, Bajo San Juán and Bajo Río Bravo (Ahlers *et al.* 1998), water trading between individual farmers plays a relatively small role in ARLID. The reason for this is that, as was demonstrated in chapter 5, farmers have relatively good access to adequate surface water. Two types of farmer-to-farmer trade take place. Under the first type of arrangements, a farmer rents or leases land from another farmer with the right to irrigate that land[13]. This can be land that is irrigated by canal water, by wells, or by both. Generally, this type of arrangement is only applied for one or two seasons. The type of payment varies from a flat rent per hectare or irrigation to a share of the produce. Sometimes large farmers rent land from *ejidatarios* or small private growers for longer periods of time.

Reliable secondary data on the extent of this type of arrangement do not exist. One source (no author, no date) estimates that 30% of the irrigated area is leased every year at a rate of US$286/ha/year[14]. The farmer survey done for this study (n=125) reveals that 8 percent of the area irrigated by the sampled *ejidatarios* is rented while 20 percent of the land irrigated by private growers is rented. Of the sample, 9 percent of the *ejidatarios* rent all or part of the land he or she irrigates while 31 percent of the private growers rent all or part of their irrigated land.

The second form of farmer-to-farmer water trade in ARLID is the selling of water by those who have a well to those who do not have a well. Trading of canal water separated from the land hardly occurs in ARLID[15]. Compared to the first type of arrangements, this type of water renting is not related to renting out the right to cultivate the land as well. During the winter of 1995-96, 17 *ejidatarios* (19% of this category in the survey) and 4 private growers (11%) bought water either from a WUA (public deep tubewells) or from private well owners. This water is extra to the volume they receive from the canals or from what they pump from their own wells. For two-thirds of the farmers who follow this arrangement, the water price is set as a share of the produce. This share ranges from 15 to 30 percent of the produce, depending on the actual pumping costs and whether or not labor costs for operating the pump and pump maintenance and repairs are included.

8.5 The value of traded water

PRICES PAID BY WUAS

In the previous section some examples of prices of water transactions between WUAs were discussed. In this section, these prices are compared to the price that individual farmers pay for their water. This comparison only serves as an indication of the value of traded water. However, as water prices for individual farmers and prices for water traded between WUAs are set at different times during the agricultural season (and hence in theory would have different opportunity costs as the level of water scarcity changes during the season) full comparison between the two is flawed. In theory, the value of water might change during the agricultural season when water becomes more scarce or abundant as a result of both changing water availability and water requirements[16]. For instance, at the start of the season, when water availability is still high, opportunity costs for irrigation use within the district might be lower than at the end of the season when availability is low and when water scarcity may result in complete crop failure. On the other hand, one could argue that the price of traded water can be low in cases when "redundant" water (i.e. that part of the assigned volume that is not used) is lost to the WUA if it is not used. Although all these theoretical considerations could play a role in setting the price level of traded water, in practice this hardly occurs in ARLID. The main reason for this is that, as was demonstrated above, the total assigned volumes for a given year is corrected for exceeded and used volumes in the previous year[17]. As a result, opportunity costs of irrigation water do not change dramatically during the season, which makes comparison between prices paid by farmers at the start of the season and prices paid by WUAs at the end of the season (when water is traded) possible.

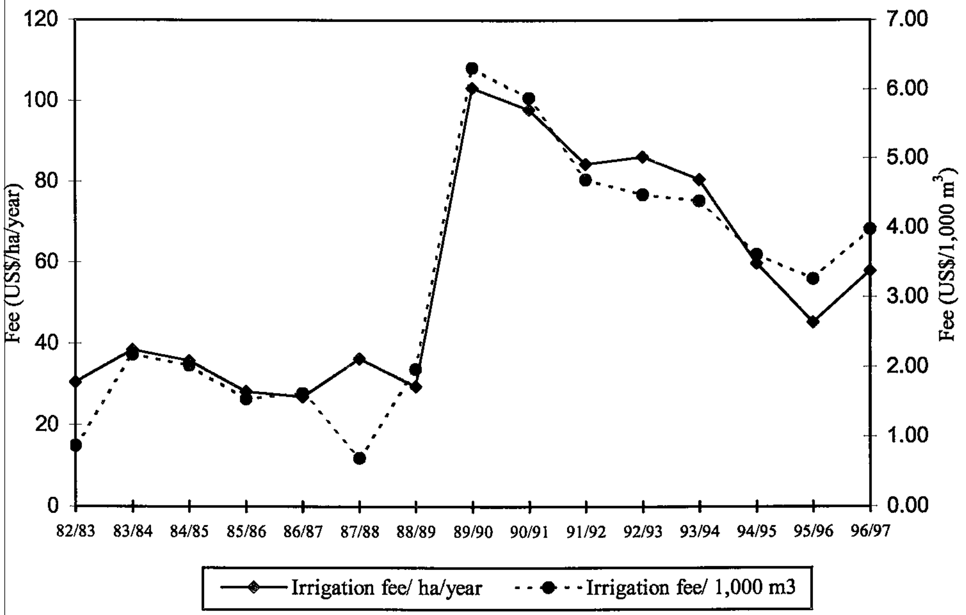
Figure 8.2 shows the price of water, both per hectare irrigated per year (with five deliveries: four in the winter and one in the summer) and per m^3 of irrigation actually supplied in the years 1982-1997. As can be observed from this figure, the fee per m^3 of irrigation supplied closely followed the per hectare fee. Irrigation fees increased by 400 percent in 1989-90 in order to prepare farmers to paying higher fees once O&M responsibilities were transferred to them (see also chapter 7). However, owing to the financial crisis of December 1994, which was followed by an annual inflation rate of 50 percent in 1995, WUAs were not able to maintain the same fee level. Although the nominal fee remained the same between 1992 and 1996, and even doubled in 1997, in constant dollar terms fees dropped from US$85/ha/year in 1992 to US$45/ha/year in 1996 and is back again at US$58/ha/year in 1997.

Irrigation fees for 1995, 1996 and 1997 were US$3.61/1,000 m^3, US$3.26/1,000 m^3 and US$ 3.98/1,000 m^3, respectively[18]. Comparison of these fee levels with prices paid for traded water between WUAs (table 8.2), shows that in 1995 and 1996 WUAs were selling their water to other WUAs for prices much lower than the price they would have received if they had sold the same volume to their own users. Although the difference in net income would have been slightly lower, given that the WUA who sells water saves on O&M transactions costs related to delivering water to the fields.

Although important to those farmers who directly benefit from the additional volumes bought by their WUA, the magnitude of water trading between WUAs is relatively small compared to the total amount water distributed and used within the district. Yet, during the summer irrigation season some WUAs depend almost entirely on traded volumes for their total delivery (e.g. Huanímaro for 86%, see table 8.2). However, in general the contribution of traded water to total water use in the summer averages approximately 30 percent. The share of traded water of all the water used in both the winter and the summer season is less than five percent.

The main reason why some WUAs occasionally want to buy additional water is that they need to deliver irrigation water to those farmers who have already paid for their turns. Particularly at the end of the winter irrigation season, many WUAs have already used their entire yearly concession. This means that they cannot satisfy farmers who have not yet received all the irrigation turns they have paid for. WUAs are very concerned about meeting these commitments because they realize that failing to do so would jeopardize their credibility among their constituencies. This is particularly important if one considers that the WUAs were established only in 1992 under circumstances of complete lack of accountability between the managing agency and the users. Results from the farmer survey (n=125) show that 63 percent of the users are satisfied with system operation by the WUAs; only 20 percent feels that CNA used to manage the system better than the present WUAs.

Figure 8.2 The price of water per hectare irrigated and per m^3 of irrigation supplied, agricultural years 1982-1997 (July 1994 US$)



PRICES OF TRADED WATER PAID BY INDIVIDUAL USERS

CNA is not at all involved in setting the price of water traded between individual farmers. Also the role of the WUAs is limited. When asked, leaders and managers of seven WUAs mentioned that they give advice on what they regard is a reasonable price, but only if farmers explicitly ask for it. In practice few farmers ask the WUA to intervene in the price setting negotiation process.

Results from the farmer survey (n=125) show that the average price paid for traded water by individual farmers is US$22.40/ha/delivery for *ejidatarios* and US$32.70/ha/delivery for private growers. These prices range from US$6.70/ha/delivery to US$75/ha/delivery depending on the total pumping hours. Generally *ejidatarios* bought two irrigation deliveries (average total cost of US$52 per hectare per season), while private growers bought four irrigations (average of US$130 per hectare per season). Table 8.5 shows the corresponding prices per unit of water and as percentages of both the SGVP and the common surface water fee. The price of sold groundwater is three to four times higher than the price of surface water per hectare irrigated (see figure 8.2). Compared to the actual pumping costs, the price of traded groundwater is also three to four times higher, which suggests that farmers who sell water benefit financially. The actual pumping prices mentioned in table 8.5 include electricity consumption as well as maintenance, but exclude the cost of labor that is sometimes hired by a pump owner to operate and guard the pump. According to Carmona-Quiróz (1998), who did a study on water trading in Cortazar module during the winter 1997-98 irrigation season, 60 percent of the sellers include these labor costs in their price, while 25 percent also include the cost of repairs. Yet, the water price is much higher than the actual total cost of operating a well, which suggests that unlike the WUAs, individual farmers trade their water against market prices. This contradicts with the general statement by many farmers that they do not want to gain financially from water trades and only cover actual costs. Table 8.6 shows how farmers perceive the cost of traded water. The majority feels that the prices of traded water have remain more or less the same, while 36 percent believes that those prices have increased.

Table 8.5 Price of sold water versus actual pumping costs, 1995-96 winter season

	Water price	Actual pumping costs[a]
US$/ha/irrigation turn	22 – 33	8
US$/ha/season	52 – 130	32
US$/1000 m^3	9 – 14	3.3
% SGVP/ha	3 – 6	2
% of per irrigation surface water fee	260 – 390	95

Note [a]: these costs include energy consumption and pump maintenance. See also tables 7.6 and 7.7 for further details on pumping costs.

During the summer of 1996, 15 *ejidatarios* (17% of this category) and 4 private growers (11%) bought water from other farmers. The average prices paid per hectare per irrigation were US$19.90 and US$32.70 for *ejidatarios* and private growers, respectively. The average total costs per ha per season were US$27.50 and US$58, respectively.

Table 8.6 Cost of buying water from other farmers, before and after 1992 (%)

	Ejidatarios	Private growers	All farmers
Higher after 1992	44	13	36
Lower after 1992	5	0	2
Same	54	87	63

There are several reasons why individual farmers want to buy water from farmers with wells. First, sometimes farmers with access to only canal water want to buy an extra irrigation when they feel that the authorized number of irrigation turns does not meet crop requirements. Second, sometimes farmers own a well with a low pumping capacity. Yet, having access to groundwater officially exclude them of using canal water (although, as is shown in section 5.6, there are several ways of still getting access to canal water), which encourages these farmers to buy extra water from a nearby farmer with a well. Third, occasionally the dams remain closed as a result of drought. This was the case during for instance the 1997-98 winter season. Carmona-Quiróz (1998) observed that out of the 72 farmers with surface water rights whom she interviewed, 44 (61%) decided to buy water from well owners, while 28 farmers (39%) decided not to grow any crop at all. Of these 44 farmers, 38 had also bought water during the previous winter season of 1996-97, which was a year with normal canal water availability. This implies that the severe drought during 1997-98 had only a minor impact on the increase of water trading in Cortazar module.

Carmona-Quiróz also asked sellers to mention the reason why they sold their water to other farmers. One of the reasons mentioned was that well owners want to meet the number of hectares for which the well was concessioned. According to some farmers, not irrigating the number of hectares that are mentioned in the concession could imply that the farmer would lose this concession. On the other hand, one could argue that this is only a theoretical possibility as few wells have been concessioned yet and even fewer wells are actually monitored by CNA. Another reason why well owners sell water is that they try to help out other farmers, particularly if they are relatives. A third reason mentioned by the farmers interviewed by Carmona-Quiróz is that of reciprocity: "this time I will help you out as next time I might need your help". Finally, as has been demonstrated above, sellers financially gain from water trades.

MARKET PRICING

As discussed in section 1.4, Briscoe (1996) and others argue that the advantage of allowing market forces in the allocation of water is that water will be treated as an economic good: water is priced at its marginal cost and used until the marginal cost is equal to marginal benefits. However, Young (1986) and Perry *et al.* (1997) state that economic benefit-cost approaches are limited as water is also a social and a political good, which makes it difficult to price water at its marginal cost. According to Colby (1988) and others, water transfers between buyers and sellers can only be satisfied if the seller receives a price that covers any costs he has incurred in transferring the water; if the buyer expects returns from the purchase to exceed all costs; and, if the buyer views a market purchase of water as an economically attractive method of obtaining water. Yet, prices paid by WUAs for water bought from other WUAs in ARLID vary widely from year to year and across associations and are generally lower than the price a WUA would receive if it would sell the same amount of water to its own individual members. The examples presented above suggest that the setting of prices for traded water do not always follow economic market mechanisms. There are three reasons that explain this.

First, there is little competition in the water market in ARLID. So far, the only actors involved in water trading are the eleven WUAs. One of the most important reason for this lack of competition is that buyers and sellers belong to the same organizations, whose main objectives are to jointly manage the district: the hydraulic committee and the Limited Responsibility Society. As a consequence, volumes and prices are heavily determined by the relationships between the WUAs within these organizations (see chapter 6). The price that is paid and the opportunity to allocate water to higher value uses are considered less important than the social and political arguments that WUAs use to maintain the level of solidarity in order to be able to effectively negotiate with CNA and other agencies in the public and private sector. WUAs do not seek to receive the highest price for the water they sell, but they have started to argue that the price for traded water should now follow the price paid by individual farmers and hence better reflect the opportunity costs of water. Although these opportunity costs might change during the season as a result of changing water availability and irrigation requirements, the fact that redundant water at the end of the inter sub-season is not lost to the WUAs helps to flatten out the variation in opportunity costs.

Second, traded volumes, and hence the income out of these trades, are relatively small. Given the relatively small revenue from water trades between WUAs compared to revenue from normal water sales to individual farmers, none of the WUAs is prepared to argue for higher prices for traded water if this would disturb relationships with other WUAs.

Third, as is argued by Small and Carruthers (1991), relative abundance of water limits the development of market forces in water allocation and water pricing. Although ARLID occasionally suffers from severe drought, generally water availability is sufficient to meet irrigation requirements for large parts of the command area (see chapters 5 and 9).

8.6 Conclusions

The introduction of the water law of 1992 has had major consequences for the process of allocating water in ARLID. Although the law has had little impact on the development of water trades between individual farmers, it clearly has made possible and induced the establishment of WUAs, who were allowed to bulk trade water among themselves. The law also foresaw in the creation of a hydraulic committee at the district level in which these WUAs participate in important decision making processes concerning water allocation, price setting and traded volumes. Although in theory the latter form of trade could take place in any Mexican irrigation district, so far the ARLID case is one of the few examples. As Mexican irrigation districts vary widely in terms of technical and institutional conditions and arrangements, it is hard to generalize the experience from an unique case to all districts, let alone to other countries. Yet, it might be useful to summarize the conditions that explain why WUAs in ARLID were able to successfully develop a system of reallocating parts of their yearly water concessions through a water market.

First, the new water law clearly allowed WUAs to trade part of their concessions. Although there is still some misconception about the definition of the concession each WUA has, in ARLID it is widely perceived that legal certainty of titles has somewhat increased. Furthermore, all WUAs understand and have supported the law's provision to allow water trades. One of the most important factors that explain why ARLID is among the very few districts that have actually taken this new opportunity to trade their water, is the relationship between these WUAs and the CNA district office. Unlike in some other Mexican districts, the CNA district office in ARLID monitors but does not impose or fully control water distribution practices. Likewise, CNA in ARLID allows the WUAs to participate in decision making at the level of the hydraulic committee, which also decides on price setting and the to be traded volumes of water. In other words, the new water law shapes the conditions for trading, but it has proved to be important that CNA provides local buyers and sellers with sufficient flexibility to negotiate and set their own terms and conditions for trading water.

Third, water marketing between WUAs in ARLID does not entail excessive and additional transaction costs involved in transporting water from the WUAs that sells to the one that buys, nor does it impose externalities on other water users. Fourth, both sellers and buyers can expect returns from the water trade. However, unlike what is sometimes assumed in economic literature, economic returns from water purchases to other WUAs are regarded as less important than social and political returns. As is demonstrated in chapter 6, most WUAs in ARLID have strong leaders but the political and commercial interests of these leaders vary widely. These differences in interest were also observed in this chapter. For WUAs that sell water it is politically important that they occasionally lend each other assistance with additional access to water as they all form part of two institutions that determine the performance and sustainability of all WUAs. These are the hydraulic committee in which WUAs together try to negotiate with CNA the yearly concessions, prices and irrigation schedules; and the Limited Responsibility Society in which all WUAs tried to reduce the role of CNA in main system management. These two organizations are clearly seen as effective examples of scaling-up the institutional capacity that each WUA has started to build up within their own organizations. For the WUA that buys water it is important to have additional access to water if at the end of the season it appears that insufficient water is left from the yearly concession it was granted. Not delivering water to farmers who had already paid for their turns would severely jeopardize the credibility and accountability that the WUAs have tried to create in their short history of existence since 1992.

Notes

1. Parts of this chapter are drawn from Kloezen (1999).
2. The deeds are signed by the elected members of board of the WUAs as well as by 4 members of a committee that oversees the board. This latter committee includes a representative of the State of Guanajuato and one from CNA. The notarial deeds stipulate the bylaws of the WUA, which include, among others, the form of representation of *ejidatarios* and private growers in the general assembly and a number of committees, the rights and obligations of the WUA (especially with respect to O&M and cost-recovery and those towards CNA), its committees and its individual members or users and the form of sanctions.
3. Five documents are attached to and form legal part of the concession: 1) a map that shows the location of the module within the district; 2) an inventory of the infrastructure of which the right of use has been concessioned; 3) a list with all the users in the area governed by the WUA that have the right to receive water from the WUA; 4) the notarial deed that legalizes the WUA; and 5) a manual that describes regulations for O&M as well as for budgeting, cost recovery and financial administration.
4. Ley de Aguas Nacionales, article 67.
5. Generally, the principle of proportional allocation between WUAs of available flow or storage is followed in most Mexican irrigation districts. However, once the WUA has been allocated this volume, further allocation to individual users within the area managed by the WUA varies from district to district. Whereas in ARLID all farmers are in principle entitled to the same number of irrigation turns and the same water depth per turn (irrespective of the crop they grow), in some other district differentiated allocation rules for different crops are more common. For examples, see Ahlers *et al.* (1998) and Rymshaw *et al.* (1998).
6. It is commonly known that the actual number of wells in the State of Guanajuato is much higher than the officially registered number and will probably exceed 22,000 wells.
7. According to article 42 of the Regulations to the National Waters Law, the concession based on the average annual volume does not guarantee that the grantee actually receives this volume as it continues to be subject to water availability at the start of the agricultural year (which in the case of ARLID starts in October).
8. The only concessions that had been recorded were those granted to private well owners.
9. This is documented by Ahlers *et al.* (1998).
10. The REPDA administrator who I interviewed estimated that less than 1 percent of the 'perpetual' groundwater concessions have been sold to other users and that virtually all of these cases concern farmers who sold their land with the appurtenant water concession to the land. Sales of permanent water rights that are separate from land are even more uncommon. Similar observations were made by Bauer (1997), Hearne (1995) and Ríos-Brehm and Quiroz (1995) on Chile, which is often assumed to be an active market of sales and transfers of water rights. Bauer lists a number of factors that help explain why trading in Chile is so limited. These factors include: inadequacy of geography and infrastructure to redistribute water; the continuing uncertainty of many titles; uncoordinated systems of record-keeping; insufficient protection of third parties; the cultural and symbolic importance of water in a semi-arid country; and, relatively low prices ("the value of the water is much higher than its price"). See also Young (1986) and Thompson (1993) for a more theoretical explanation of factors that limit transfer of water rights.

11. The main reason for this is that a relatively great proportion of the canal network in Valle is lined as a result of a World Bank assisted rehabilitation program (PRODEP, see chapter 9).
12. The minor differences between allocation and assigned volumetric shares for Acámbaro and Valle are the result of rounding off numbers.
13. I came across one example in which a farmer sells his (surface) irrigation right to another farmer to be used to irrigate the land of the farmer that buys the water. This arrangement, however, is common in for instance the Bajo Río San Juán and Bajo Río Bravo irrigation districts (see Ahlers *et al.* 1998).
14. It is not made clear whether this includes the irrigation fee of approximately US$60/year (1994 dollars). Generally, the farmer who rents the land pays the fee.
15. Trading of surface water separated from land does occur in other districts. See for instance Ahlers *et al.* (1998) and Fortis-Hernández and Ahlers (1999).
16. Thanks to Gerardo van Halsema for pointing this observation out to me.
17. Although in theory possible, to my knowledge cases of correcting the annual volumetric assignment for unused water during the previous years do not exist. CNA and WUAs realize that owing to high evaporation rates from the reservoirs it does not make sense to store water for a couple of months when irrigation does not take place. Instead, WUAs try to use their full assignment by either trading out some water, or by adjusting the irrigation plan for the (short) summer irrigation sub-season, or both.
18. To compare: one source (author unknown) estimates the price of urban and industrial water in the same area at a rate of US$95/1,000 m^3.

9 The impact of IMT on irrigation performance

9.1 Introduction

In the previous chapters an analysis was made of the processes and mechanisms that shape post-IMT irrigation management in ARLID. This chapter returns to the official policy objectives of the IMT program and assesses its impact on irrigation performance, including: changes in water distribution, ground water use, system maintenance and improvement, land and water productivity, and the provision by WUAs of a series of non-O&M related services to farmers[1]. By applying the comparative indicators that were described in section 1.6, it is demonstrated whether or not a clear change in levels of performance can be observed after IMT. As such it tests the assumption (e.g. Espinosa de Leon and Trava-Manzanilla 1992; Gorriz *et al.* 1996) and claim (e.g. Palacios-Vélez 1994c and 1999; Groenfeldt and Sun 1997) that IMT in Mexico will and has resulted in improvements in irrigation performance.

As was discussed in section 1.6, comparative indicators help to describe changes in performance levels over time, before and after IMT. So far, IWMI has applied a standardized set of comparative indicators to assess the impact of IMT (or similar participatory irrigation management programs) in a number of countries, including Mexico[2]. These indicators rely on the availability and reliability of (secondary) time series data. A common difficulty with this type of data is that they are generally aggregated at higher system levels. Also in the case of ARLID, these data were only available at the levels of the individual modules and for the entire district. Consequently, most of the data presented in this chapter focus on these levels.

As time series data at lower system levels (e.g. sections or selected canals within a module area) were not available, an attempt was made to capture users' and irrigation officials' opinions on the impacts of the IMT program by conducting both semi-structured open ended interviews and a farm survey (see section 1.7).

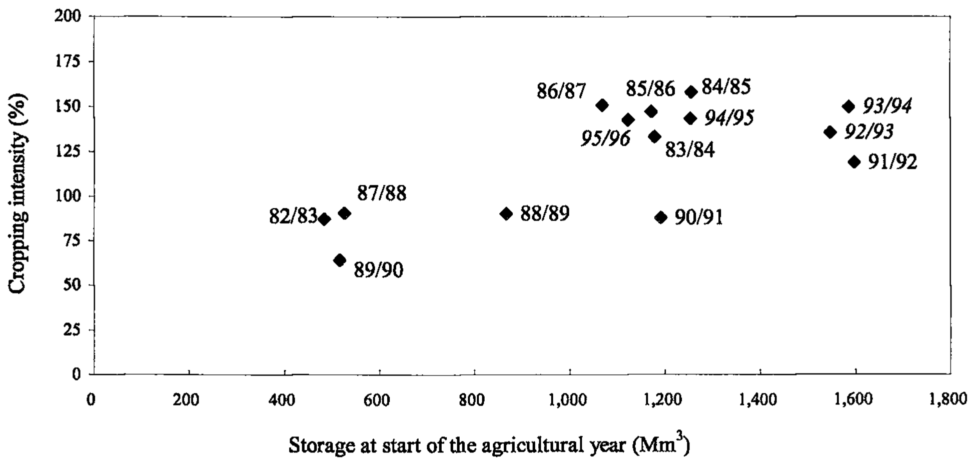
9.2 Impact on water distribution and use

In general, IMT has not resulted in major changes in the way seasonal planning is done. At the district level, the hydraulic committee adopted the same planning method used by CNA prior to IMT. Also, WUAs continue to follow the irrigation scheduling methodologies established by CNA before transfer. Whether irrigation management transfer has led to different actual uses of the water is discussed below.

RESERVOIR MANAGEMENT AND IRRIGATION INTENSITY

The first indication of changing patterns of actual water use at the district level is the relationship between available water at the beginning of the agricultural year and the area that is irrigated with this water. Figure 9.1 shows the relationship between irrigation intensity and dam storage at ARLID for the period 1982-97. This relationship highlights how annual storage management has changed as a result of management transfer. The cropping intensity refers to the total area irrigated for the two annual seasons during a particular year. The graph indicates that if dam storage at the beginning of the season exceeds 1,100 Mm^3, the cropping intensity response curve is rather flat, with an average cropping intensity of 137 percent. For several reasons this flat response has not changed after IMT. Before IMT, CNA tried to keep water in storage (and as a result the area actually irrigated decreased) to avoid running out of water at the end of the season and as a consequence loose their credibility to the users. After IMT water users exerted much pressure on the WUAs and consequently on the hydraulic committee and CNA to increase the number of times irrigation services are provided for the winter season. In this way, farmers tried to guarantee a good wheat crop at the cost of growing sorghum or maize, which needed only one irrigation turn during the wet summer season. As a consequence, although the first few years that followed IMT have had a relatively higher storage, cropping intensities have not increased.

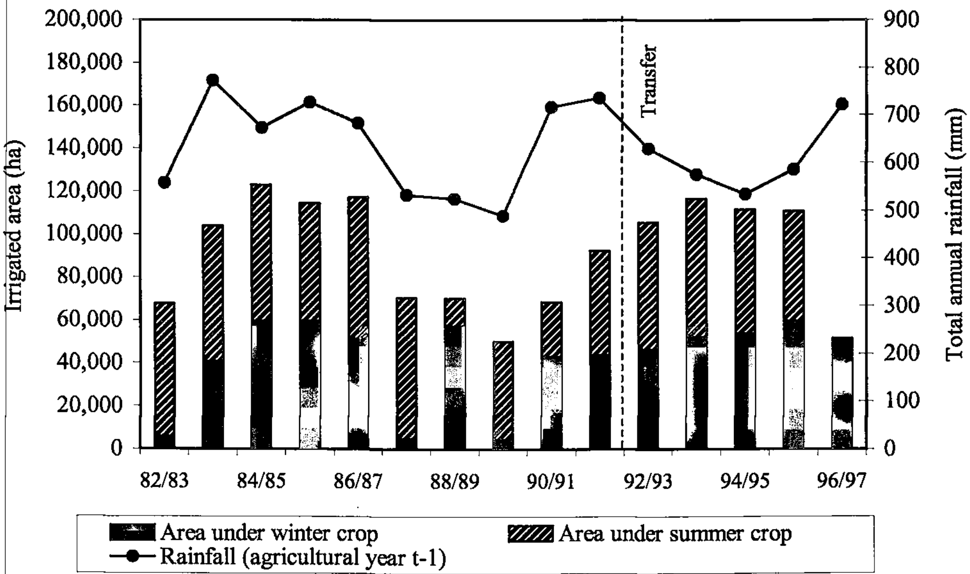
Figure 9.1 Irrigation intensity versus dam storage, ARLID 1982-1996



Note: years in *italics* are post-transfer years

Similarly, also figure 9.2 indicates that no impact in the total area irrigated can be attributed to the IMT program. The total irrigated area depends on annual rainfall of a particular year, which affects dam storage and hence dam management policies for the year that follows. While the graph shows an increasing trend in area irrigated after transfer, given the area fluctuations in previous years, and the very low values of the winter seasons of 1982/1983, 1987/1988, and 1989/1990, no further impacts can be attributed to IMT.

Figure 9.2 Total irrigated area per season and annual rainfall, ARLID agricultural years 1982-1997



CHANGES IN WATER USE

One of the official objectives of the IMT program was to encourage farmers to use water more efficiently. In the case of ARLID this implied that less water should be used per hectare irrigated. As was demonstrated in chapter 5, RWS values at the level of the intakes of the modules exceed 2.0 by far. This is an indication of a high level of oversupply of surface water for irrigation. Figure 9.3 shows the change in water depths applied to land actually irrigated. The average application of water was reduced only slightly after transfer: for the winter crop from 1,285 mm before IMT to 1,227 mm after IMT, which is a reduction of less than five percent. A similar marginal change can be observed for the summer crop: from an average of 435 mm before IMT to an average of 430 mm after IMT.

Similarly, figure 9.4 shows that at the district level the average of the RWS values is 2.8 for the pre-IMT period and 2.6 for the post-IMT period. This suggests that there is no discernible difference between pre- and post-transfer situation. However, the graph shows a clear downward trend after 1993, with 1997 having the lowest value (2.3) of the recorded period. The figure also provides an interesting comparison between Cortazar and Salvatierra WUAs.

While Cortazar generally follows the district values (averaging 2.8 and 2.3 for the pre and post IMT periods, respectively) and shows a slight reduction after IMT, Salvatierra has considerably higher values. Moreover, the average pre-transfer RWS value of 3.4 is much lower than the average post-transfer value of 4.8, indicating that after transfer Salvatierra is applying more water per unit of land irrigated. This is reflected in the low cropping intensity (the percentage of the command area that is actually irrigated) in Salvatierra: an historical average of 42 percent for the winter season, against 56 percent for the entire district and 62 percent for Cortazar module.

Figure 9.3 Applied irrigation depths (per unit of land actually irrigated), ARLID summer and winter sub-seasons 1982-1997

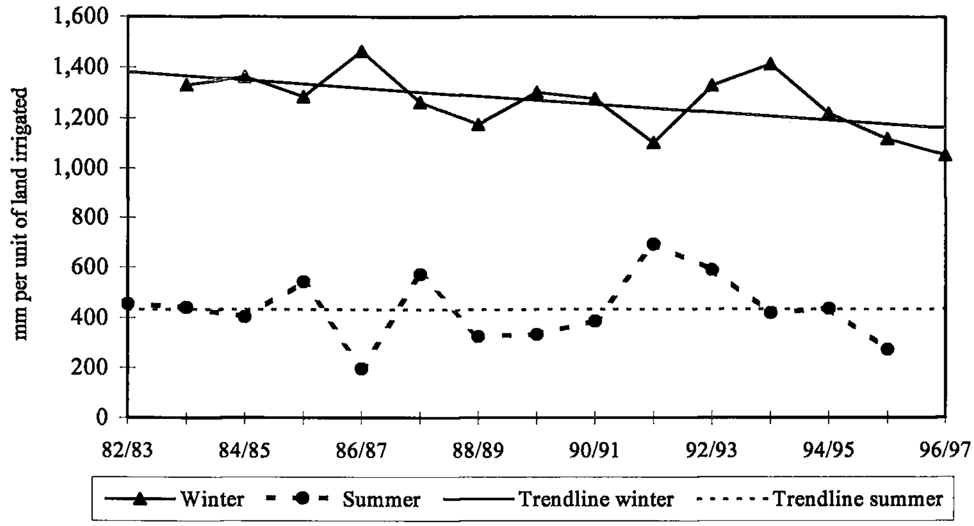
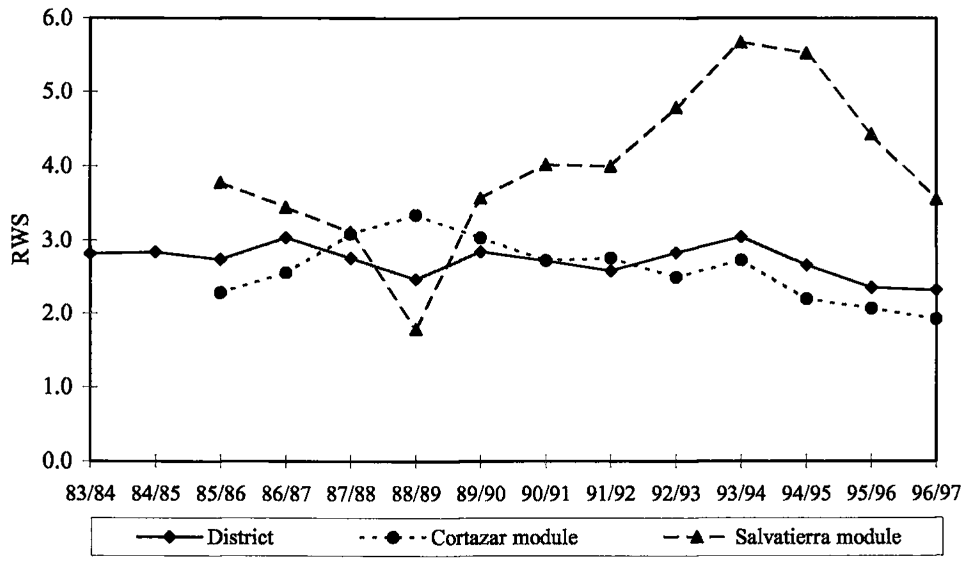


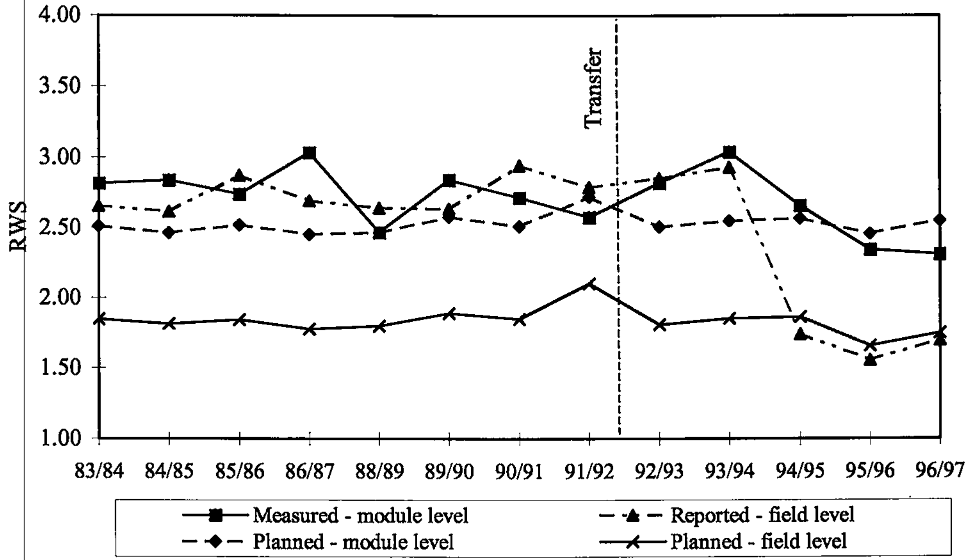
Figure 9.4 Relative water supply (RWS) values, ARLID and Cortazar and Salvatierra modules, winter sub-seasons 1983-97



Among the reasons that explain why Salvatierra concentrates its water on less area, are the difficulty the WUA has to distribute water to its more than 6,000 users (25 percent of the total users in the district, while it occupies 14 percent of the district area) as well as its infrastructure in condition of severe disrepair. One of the strategies that the WUA has chosen to cope with these conditions is to guarantee sufficient water supply to less area. As discussed below, another reason that explains the high RWS values in Salvatierra is the high diversity in crops that have lower crop requirements than wheat. Yet the WUA schedules and delivers irrigation as if all crops require the same volume of water as wheat.

Figure 9.5 shows that for the entire district there is a better match between the planned and reported values at the field level from 1994 onwards. Detailed comparison of actual flows measured for this study with the ditch tenders' flow reports affirms the observation of some WUA leaders and CNA staff that inexperienced ditch tenders have difficulties assessing the volumes they supply to the farmers.

Figure 9.5 Planned, reported, and measured RWS values, ARLID winter crop 1983-1997



The WUAs advise about, but do not have control over cropping patterns. As the planned irrigation depths are calculated on the basis of water requirements of the major crop (resulting in rather flat planned-RWS curves, see figure 9.5), any deviation from cultivating the main crop will result in a further mismatch between the actual water demand and the amount supplied. This system of seasonal irrigation scheduling has significant implications for WUAs whose cropping pattern deviates from the main crop. This is the case in the Salvatierra module. Since 1992, the area grown under beans has become more and more important at the cost of the main crop, wheat (figure 9.6). Even so, the WUA continues to make its irrigation scheduling as if the entire area were under wheat. Since bean and vegetables require less water than wheat, the RWS values increased dramatically (figure 9.7), without the WUA addressing adequately to this situation. The WUA attempted to correct this situation in the last three years of the field study.

Figure 9.6 The change in cropping pattern in the Salvatierra module, winter crop 1985-1997

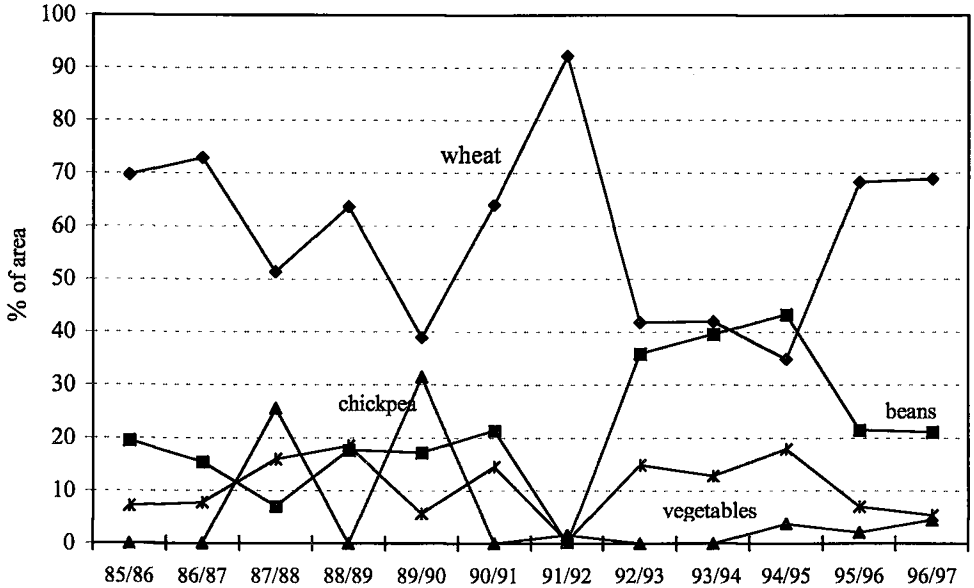
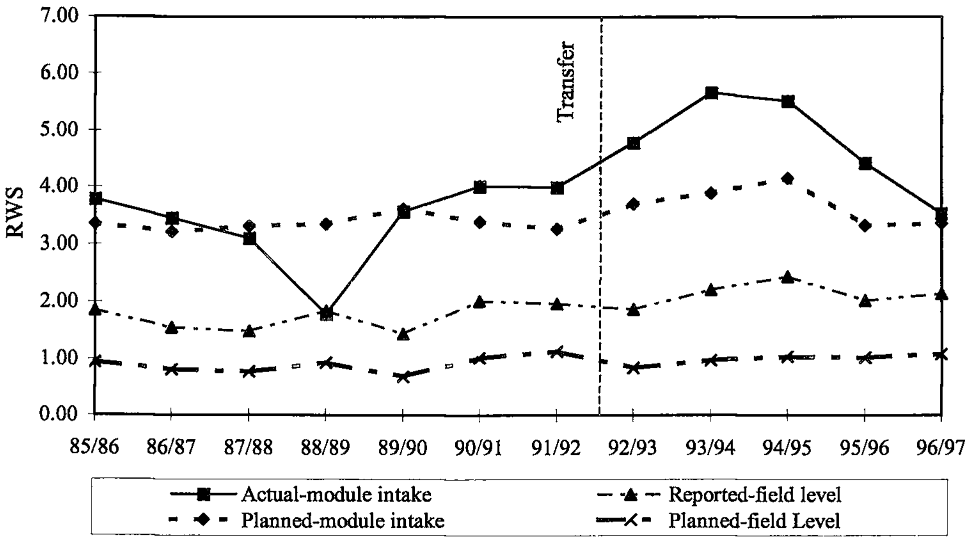
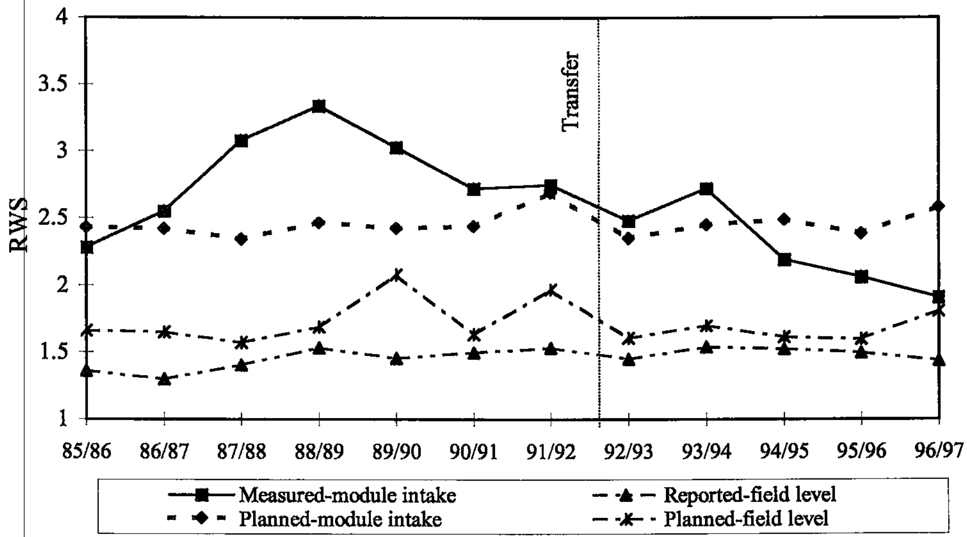


Figure 9.7 Planned, reported, and measured RWS values, Salvatierra module, winter crop 1985-1997



For the case of Cortazar module, figure 9.8 shows a downward course in RWS values after IMT had been introduced. This can be explained by the continuous efforts of the leadership in Cortazar to verify the volumes supplied, improve the performance of ditch tenders by training them and firing those that perform poorly (see box 7.1), and by making physical improvements to the canal and drainage networks (see the example in box 9.3).

Figure 9.8 Planned, reported, and measured RWS, Cortazar module, winter crop 1985-1997



FARMERS' AND WUAS' OPINION ON CHANGES IN SYSTEM OPERATION SERVICES

Pre-transfer data on water distribution between farmers within modules do not exist. Therefore, a "before and after" comparison of system operation services cannot be made. The data on water distribution under post-transfer conditions presented in chapter 5 show that in the sampled study area there is no clear bias towards head- or tail-end farmers and that all farmers receive sufficient water to meet crop requirements.

Results from the farmer survey (n=125) on farmers' opinion on changes in system operation are summarized in table 9.1. Thirty-six percent of the farmers perceive that water adequacy at the field level has improved as a result of transfer while 23 percent report that it has become worse. Data presented in Appendix 7.1 show that there is hardly any difference in water adequacy between farmers located in the head-end, middle, or tail-end reaches of the canals. This supports the detailed one year observations in selected canals (see chapter 5) that farmers generally receive sufficient water irrespective of their location along the canals.

The answers related to timeliness of water distribution and farmers' access to the ditch tender show similar results. Thirty percent of all respondents say that timeliness has improved, while 22 percent think that the post-transfer situation has become worse. As to the location of the farmers, 33 percent of the tail-end farmers sees a real improvement, while 48 percent of the head-end farmers think that timeliness of water delivery was equally good before and after IMT (Appendix 7.2).

Thirty-four percent of the respondents feel that distribution among farmers has improved while 15 percent say that water distribution was better organized before transfer. Farmers in the middle reaches and in the tail-end areas of the canals are more positive about these improvements than head-end farmers, who say that generally distribution was good both before and after IMT (Appendix 7.3).

These farmers' opinions support the observation made earlier, that IMT has not resulted in major changes in system operations.

Table 9.1 Farmers' opinion on the change in system operation as a result of IMT (%)

	Water adequacy at field level	Timeliness of water delivery	Water distribution among farmers	Access to ditch tender	Service provided by ditch tender
Poor before and after IMT	2	2	8	4	2
Poor before, good after IMT	36	30	34	31	40
Good before and after IMT	26	34	31	32	32
Good before, poor after IMT	23	22	15	20	14
Other[a]	13	12	12	13	12
Total	100	100	100	100	100

Note [a]: "Other" includes 'don't know,' 'no response,' and 'not applicable because respondent only uses a private well.'

The only service that has shown considerable improvement, is the one provided by the ditch tender: the way he attends to farmers' requests, the way he solves problems with water distribution between farmers, and the decrease in the level of bribery. Most farmers report that in particular the attitude of ditch tenders towards users has improved: forty percent sees a clear improvement in task performance of the ditch tenders, while only 14 percent say that previous CNA ditch tenders were more service oriented than the current ditch tenders hired by the WUAs. Particularly farmers in the head-end and middle reaches see improvements, whereas almost half of the farmers located in the tail-end areas see no difference between the services provided before and after transfer (Appendix 7.4).

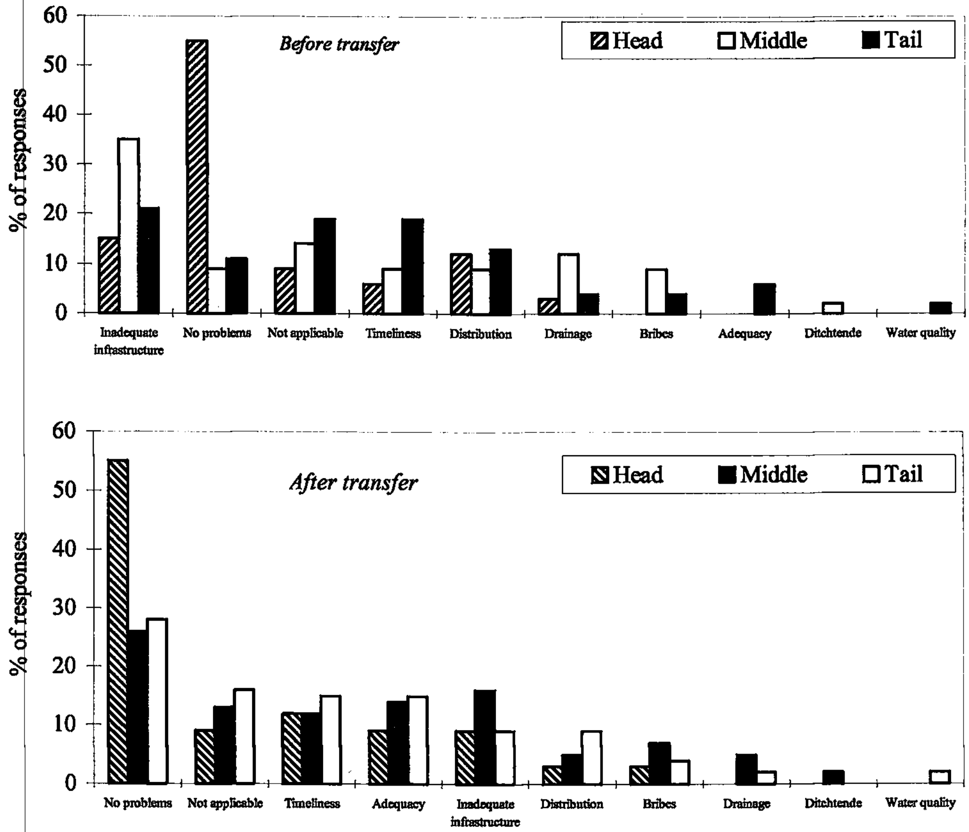
The most important concern of those farmers who complain about the services provided by ditch tenders is that the number of ditch tenders per WUA has decreased by half after transfer. As a result, these farmers perceive that ditch tenders now have to service an area that is too large to operate effectively. On the other hand, unlike former CNA ditch tenders, all WUA ditch tenders now use a motorbike and in some cases even a small truck. This has helped them to move more easily and faster between the sections of the module.

Another complaint frequently expressed by several users is that ditch tenders are too frequently rotated between module sections. As was discussed in chapter 6, WUAs deliberately move ditch tenders as part of their strategies to limit the development of social and political relationships between users and ditch tenders as well as to control rent-seeking attitudes of ditch tenders.

Figure 9.9 shows that 24 percent of all farmer said that inadequate infrastructure was the main cause to poor system operation before transfer. This problem is particularly noted by farmers in the middle reaches of the canals (35%). The majority of farmers (35%) say that after management transfer they experience no problems with system operations. Lack of timeliness (13%) and insufficient water supply (13%) are seen as the main problem. Only 11 percent of all respondents say that inadequate infrastructure continues to be the main factor that hampers water supply and distribution.

Finally, 83 percent of the farmers believe that the WUAs should continue to be responsible for operation of the main and secondary systems while CNA should continue to be responsible for dam operations. This shows the relatively high trust that farmers have in system operation by the associations compared to operation by the agency.

Figure 9.9 Farmers' opinion on the main problems related to system operation, before and after transfer, in the head, middle and tail end areas



SUMMING UP

In summary, analyses of reservoir management, water allocation between modules, and water use by the WUAs indicate that there has been very little impact on water management and use as a result of irrigation management transfer in ARLID. This is because water allocation and irrigation scheduling practices have not changed since the WUAs took over these tasks from CNA. On the other hand, observations of meetings and discussions with WUAs and the LRS suggest that WUAs are becoming more and more concerned about the relatively high water usage. This has become very apparent since some WUAs had to start buying water from other WUAs and even from private well owners (see chapter 8). After taking office, the new president of the recently established LRS publicly stated that looking for better ways to use and conserve water would be one of the major priorities of the federation.

9.3 Impact on groundwater use

OVER-EXPLOITATION OF THE AQUIFERS

The State of Guanajuato has a high concentration of deep tubewells. Approximately 20 percent of all wells in Mexico can be found in Guanajuato. Groundwater is available through 18 different aquifers, three of which are relevant to ARLID: Valle de Acámbaro, Zona Presa Solís, and Irapuato-Valle Santiago. The total area underlain by these three aquifers is 277,200 hectares, which includes the district under study, with an annual recharge of 500 Mm^3/year. Groundwater table fluctuations in the state are monitored by CNA and point towards an annual overexploitation of the aquifers of 829 Mm^3/year, with 117 Mm^3/year corresponding to the ARLID-related aquifers (Muñóz 1996). These values correspond to overexploitation of the aquifer at the rate of 40 percent and 20 percent for the state and the district, respectively.

As is illustrated in boxes 9.1 and 9.2, there are several categories of wells, which are managed under rather distinct institutional arrangements. The most important distinction made in ARLID is the one between the approximately 1,540 privately owned deep tubewells and the 175 so called 'public deep tubewells[3]. The first type of wells are privately owned and managed by (groups of) farmers (both *ejidatarios* and private growers). Before transfer, the second type of wells were managed by CNA, but they were transferred to the WUAs. Farmers who make use of public wells pay an irrigation fee to the associations to cover their O&M costs. These fees are generally twice as high as the fee paid for the use of canal water as O&M costs are considerably higher and water delivery is more secure.

Generally, WUAs exclude irrigation areas that have access to private and public wells from canal water service, although there is no provision in the Water Act to that effect. However, in practice many well users make use of the canal network to transport the water they pump to their fields (see also section 5.6). This practice has increased after transfer. Prior to transfer the CNA-operated public wells were only used to supplement surface water in times of water stress. Currently, users within the areas assigned to public wells are supposed to use pumped water only. However, for almost all these areas, water users have to make use of the canal network to transport their water[4]. As a result, farmers mix canal water and pumped water, which has made the management of canal water more difficult. This situation has sometimes led to cases in which farmers apply more water to their fields than the maximum discharge capacity of the pump, meaning that canal water users receive less than their official entitlement. On the other hand, farmers report that unauthorized use of canal water by owners of private wells has decreased since transfer as the WUAs have more control over the ditch tenders who sometimes allow these practices in turn for some financial gratuities from well owners (see also chapters 6 and 7).

Figure 9.10 illustrates seasonal and total volume pumped by private wells within ARLID for the period 1982 to 1996. The volumes pumped during the dry winter season are higher than those during the summer season. The increase in volume pumped since 1983 can be explained by the relatively dry years of the early 1980s and by a new program to grant concessions to new wells started in 1982. The reduction in volume pumped that followed this period can be explained by the dramatic fall of the static water table, which by 1996 was 2 to 5 meters per year (Muñóz 1996, Scott and Garcés-Restrepo 1999). Although new concessions are not granted anymore, a program to upgrade existing pumps and wells started in 1995.

Box 9.1 Public deep tubewells and their management arrangements

Before transfer public deep tubewells were managed by CNA, who used these well to supplement canal water in times of water scarcity. As a consequence, these wells were almost always located on the bank of a main canal or large distributary. The type size of these wells is 8 inches (with an average discharge of 60 l/s), but public wells of 6 inches do also exist.

With the transfer of canal infrastructure to the WUAs in 1992, also these public wells were transferred to the WUAs. Contrary to CNA management of these wells, based on the pump capacity and the expected cropping pattern in the fields that neighbor these wells, the WUAs assigned areas to each of the public wells. Farmers within these areas are supposed to use public well water only, for which they have to pay the association a service fee (per hectare and per irrigation delivery). The level of these fees differ from module to module but are generally twice the price of the service fee paid for the use of canal water.

One of the major problems that WUAs face with the management of these wells is the extraordinary high maintenance cost. In addition, in comparison with the fee level also the cost of operation rose unproportionally as a result of the subsidy cuts for energy. After a few years of operation under the above mentioned arrangements, some WUAs started to introduce strategies to try to reduce the O&M costs associated with management of their public wells. The first strategy applied was to try to entirely transfer the ownership (and hence the full financial responsibility for O&M) to groups of farmers. However, so far few farmer groups have accepted this as they doubt whether they can manage the wells in a financially viable way.

The second strategy followed by some WUAs is to change the fee system. In some cases this meant that the WUA considerably raised the level of the fee. In other cases, the WUA decided to only pay for regular O&M costs whereas the costs of any additional maintenance or repair would have to be shared between the users and the associations. One such cost is the replacement of transformers of the pumps, which are frequently stolen. Other WUAs decided to differentiate between their public wells and relate the fee to the actual O&M costs of each of the wells. Finally, whereas the above arrangements still follow the payment per water delivery, some WUAs discussed the possibility to levy a flat annual per hectare fee, irrespective of the number of deliveries the users of the public well would receive.

A third strategy that all WUAs followed was to try to get access to funds from the Program on Efficient Use of Water and Energy. This program seeks to upgrade the pumping efficiencies of wells (both private and public) as well as to reduce conveyance loss by introducing buried pipe systems. Activities under this program are co-funded by the Federal Government (50%), the State of Guanajuato (25%) and the beneficiaries (25%). However, given the high number of applicants both within and outside the irrigation district, few public wells actually received this type of assistance.

Figure 9.10 also provides information on the estimated annual recharge for the entire three aquifers that serve the district as well as the estimated annual recharge for those parts of these aquifers that underlie ARLID[5], being 500 Mm^3/year and 205 Mm^3/year, respectively. Comparison between these recharge levels with the total volumes pumped points to overexploitation of the aquifer. The graph shows that the withdrawal during the winter season almost exceeds the annual recharge to the district. This means that for the remainder of the year the district mines groundwater at the cost of aquifer users outside the district area. This leads to high competition with domestic and industrial users in urban areas near the district.

Contrary to popular belief among CNA managers involved in ARLID, cropping patterns of areas irrigated by wells have not changed as a result of transfer or other agricultural reforms. Figure 9.11 shows that there has been hardly any change in RWS values for the winter season. This continues to be around 2.25, which again indicates the alarming high level of excessive groundwater use.[6] Fluctuations in values for both the first and second summer

Box 9.2 Private deep tubewell groups and their arrangements

In addition to individual farmers that own their private deep tubewells, some private well are jointly owned by groups of farmers. This is particularly the case in modules like Salvatierra, where the relatively small land holdings and disperse distribution of plots do not allow for financially viable management of wells for individual farmers and small plots.

These well-groups range in size from four members to over twenty members. Sometimes these groups entirely comprise members from the same *ejido* or family, but in many cases group membership is determined by the plots that can physically be irrigated by a particular well. Groups that have members from different *ejidos* or in which *ejidatarios* and private growers share a well are also common.

Membership rules, water rights and cost-sharing arrangements of these groups are closely related but vary from group to group. In most cases members have communally invested in the sinking and development of a well. Normally these investment are proportional to land, but not necessarily so. Also, rights to pumped water are commonly proportional to land, but cases in which members all have equal rights to a fixed number of pumping hours or volume do also exist.

Membership of these groups is further characterized by the fact they have the right to exclude other users. Generally, these groups do not allow other farmers to enter (as this would imply that the pump capacity is exceeded) unless one of the members has left the group. In the later case the group will decide on the payment the new farmer has to made to become a member. Normally the level of this entry-fee is related to the capital investment made by the group.

In addition to sharing the cost of capital investment, group members also share recurrent O&M costs. Here a wide set of arrangements exist. In some cases members pay a fixed fee per hectare and per irrigation delivery, similar to the arrangements for users of public wells. In other cases members pay a rate per pumping hour. Occasionally groups have not developed a system of pre-fixed rates, but members share the electricity bills once they arrive and share costs of maintenance whenever they occur. Only a few groups maintain a small emergency fund, from which they can pay major repairs and other contingency costs.

crops are explained by the fact that well users generally try to avoid the risk of late onset of rainfall and start pumping as soon as possible. This leads to high RWS values in years with normal to high rainfall.

The lack of impact on groundwater use as a result of transfer is something that could have been expected. The transfer program primarily affects the administration of facilities and resources related to the use of surface water. Yet, the question remains whether the WUAs can play a role at all in controlling groundwater mining. Managers of the modules complain about their lack of control over private well owners. These owners are also those who use the canal network and surface water without paying for it. Although CNA remains the entity responsible for controlling the aquifers, WUAs could play a more powerful role than they have done so far in monitoring the exploitation of groundwater

Figure 9.10 Seasonal and total volumes pumped by private wells in relation to aquifer recharge, ARLID agricultural years 1982-1996

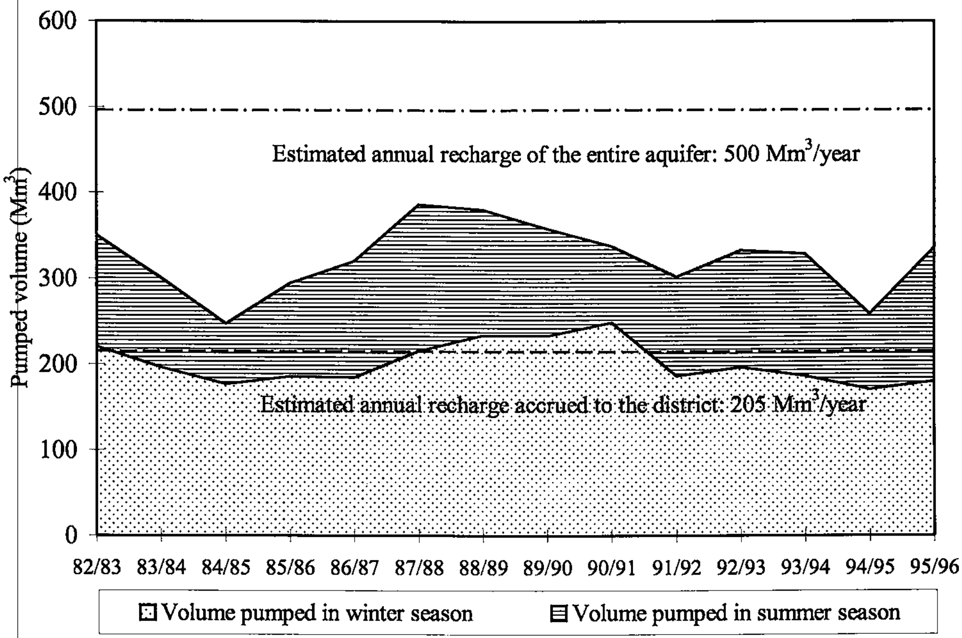
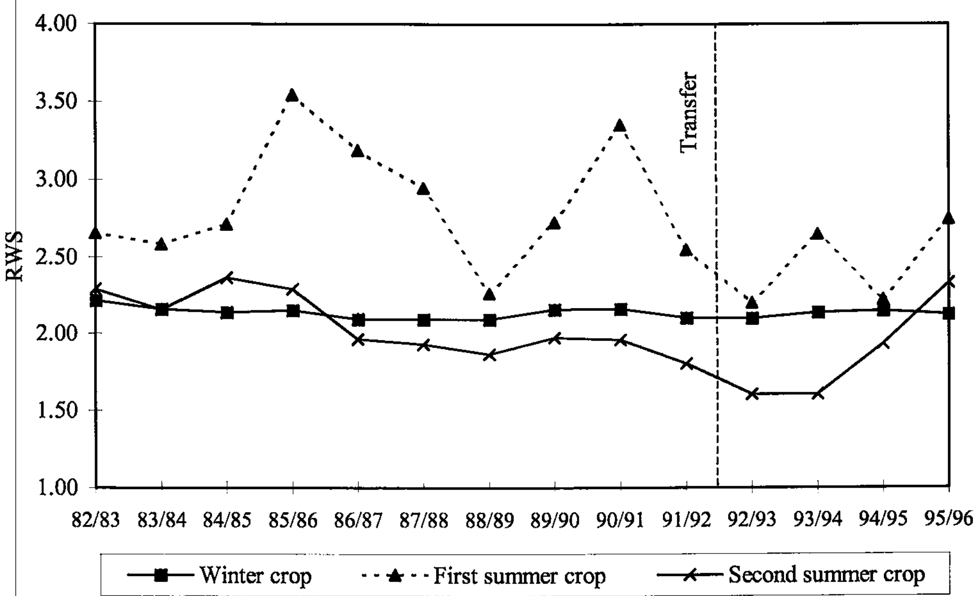


Figure 9.11 Seasonal actual RWS values for private wells, ARLID agricultural years 1983-1996



9.4 Impact on system maintenance

IMPACT ON MAINTENANCE AND PRIORITY SETTING

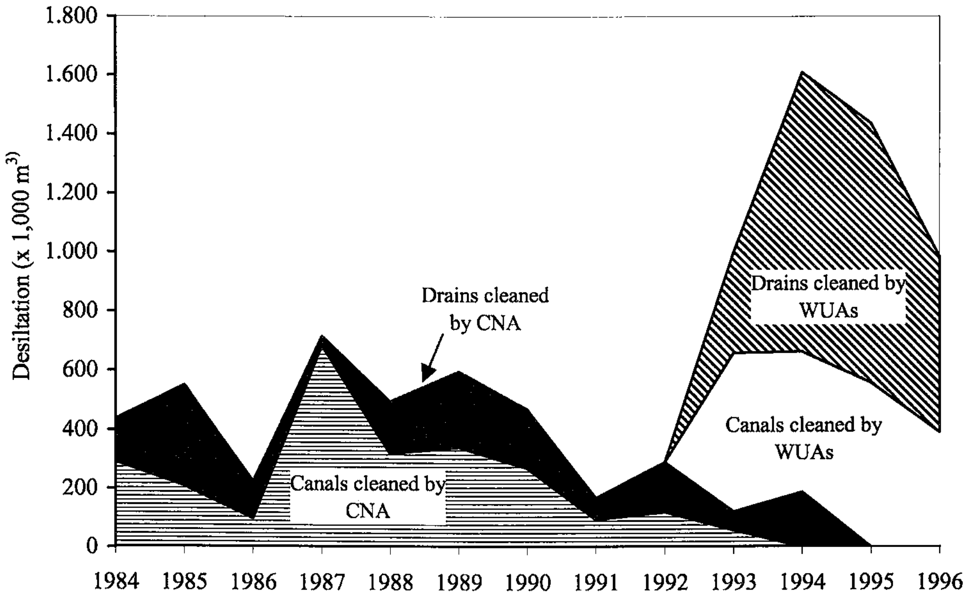
In the three years preceding transfer (1989-1991), 48 percent of O&M expenditures by CNA went to maintenance of the dams, and main and secondary canal infrastructures. The average maintenance expenditure per hectare was US$24/ha/year (July 1994 dollars). After transfer, maintenance costs have been shared between CNA and the WUAs. CNA pays for maintenance of the dams, the five main diversion structures, and main canals and drains. The WUAs pay for maintenance of all secondary canals, irrigation canals, and drains. After transfer, 63 percent of the total O&M expenditures went to maintenance, which was an increase by 15 percent compared to pre-transfer years. After transfer, 82 percent of the total maintenance budget has been spent within the modules, while 18 percent has been spent for maintenance of the dams and the main system. Also in the 3 years after transfer, the average cost of maintenance was US$24/ha/year (July 1994 dollars). This suggests that the level of maintenance investment has remained the same[7].

One problem with the above comparison of expenditures before and after transfer is that it conceals an important impact: the higher quality of maintenance services provided following transfer (Svendsen 1996). The constant US$24/ha/year expenditure level could mean that no real improvements have occurred; it could also mean that the WUAs use their staff and machinery more efficiently. The total number of staff responsible for maintenance decreased from 81 before transfer to 65 after transfer, with 19 staff still being employed by CNA and 46 by the WUAs (see table 6.4). This would suggest that after transfer the same level of maintenance is achieved with fewer staff.

Another approach is to compare actual quantities of maintenance work before and after transfer. Figure 9.12 shows such a comparison for the example of total desilting work done by CNA and the WUAs. The figure clearly points towards two shifts in priority setting between CNA and the WUAs. First, there has been a tremendous increase in total volume of desilting done in primary and secondary canals and drains after transfer: 438,581 m^3/year (average of 1982-1992) compared to 1,257,421 m^3/year (average of 1993-1996). The figure shows that CNA had virtually stopped desilting the main canals after 1993, although officially it was still under CNA's responsibility. Secondly, the figure demonstrates that the WUAs have been particularly concerned with cleaning the drains, including the main drains that still fall under CNA's responsibility.

These observations suggest that not only is there an increase in volume of work done, but also that maintenance work has shifted proportionately more towards lower system levels—the secondary canals and the drains—and away from main canals. There are several reasons that explain why CNA first mainly focused on maintaining the main system and subsequently after transfer completely failed to comply with its tasks to maintain the main system. The first reason is that before transfer the CNA district office almost entirely depended on central federal funding. The financial self-sufficiency rates during the years that preceded transfer only averaged 50 percent (see table 7.3). This means that the office virtually had no control over their own funds. In this situation it is hard to execute all the required O&M tasks and it is clear that only the most important maintenance tasks could be done. As failing to maintain the main system would affect all farmers, it is understandable that main canal maintenance was CNA's first priority under the given budget constraints.

Figure 9.12 Desilting of canals and drains by CNA and the WUAs, ARLID 1984-1996



The second reason why prior to transfer CNA mainly focused on maintaining the main system at the cost of cleaning secondary canals and drains, is that their machines were not suitable to clean the smaller secondary canals and drains. CNA lacked the modern light-weight equipment needed to excavate smaller canals. Moreover, most of this machinery was already in a condition of severe disrepair and the office they did not have sufficient funds for major repairs or replacements. Thirdly, as is also observed by Sijbrandij and van der Zaag (1993) in the case of the Autlán-El Grullo irrigation system in Western-Mexico, before transfer there was a complete lack of accountability of the CNA's maintenance department to its users. Unlike the current situation with the WUAs, there were no clear mechanisms and procedures to channel farmer reports and complaints on (lack of) maintenance to the CNA office other than through complaining on an *ad hoc* basis. With this lack of accountability, technical staff of the maintenance department were never confronted by their own performance.

Although these reasons explain why CNA focused on main canal maintenance before management transfer took place, they do not explain why CNA hardly complied with its obligation to clean the main canals after 1993 (figure 9.12). The first reason for this was that with IMT the CNA office in Celaya lost even more control over financial resources. As was explained in chapter 7, CNA received approximately 20 percent of the WUAs' revenue from fee. The remaining funds were directly used by the WUAs. CNA needed almost all of their income from the WUAs to cover their own recurrent O&M costs associated with the management of the dams and the main system. During these years CNA had to spend a disproportional amount to clean the dams and to control the increasing problem with weed growth in Lake Yuríria. The second reason why CNA could hardly comply with its task to clean the main canal was that they had officially concessioned the use of almost all of its machinery to the WUAs. As a result, CNA frequently had to borrow machinery from the WUAs. Moreover, in many cases CNA had to hire external contractors for most of the main system maintenance. Finally, WUAs were very much aware of the necessity to keep the main canal in a good condition. As they saw that CNA was not meeting its obligation to clean the main canals, WUAs like Cortazar, Salamanca and Irapuato decided to start cleaning parts of the main canals themselves, using their own machinery, staff and funds. By doing so, they experienced that they could do a better maintenance job than CNA. This experience proved to be important when the WUAs started to negotiate with CNA for the creation of the LRS in 1997, aimed at taking over from CNA complete responsibilities for both operation and maintenance of the main canal system.

The problem with the above discussed approaches to compare expenditures and volumes of maintenance works is that they do not measure the impact of these observed changes in maintenance on the ability of the system to transport and control water (Svendsen 1996). Unfortunately, accurate and reliable data on the physical condition of the system before transfer are not available. As a consequence, a before and after comparison in this respect is not possible[8].

Interviews with system managers and farmers also reveal how they perceive maintenance work has affected system performance. WUA field staff and managers alike report that farmers were very dissatisfied with the level of maintenance done by CNA before transfer, especially at the level of the drains. Several respondents said that this dissatisfaction was an important argument for them to take over O&M responsibilities from CNA in 1992. They felt that they could do a much better maintenance job, particularly at the levels of the secondary canals and the drains. Some of these canals and drains had not be cleaned for more than 10 years. This explains why the WUAs felt an obligation to meet their commitment to the users to first clean the drains as soon as possible after transfer. However, some CNA staff (while acknowledging the enormous increase in volume of desilting done by the WUAs) felt that most of the desilting done (especially in the drains) was redundant. According to them, this has led to over-excavation of some canals and hence has had no positive impact on the hydraulic performance of the system. Some WUA leaders and managers supported this perception. Yet, they believed that farmers liked to see the canals and drains to be cleaned, which explains why they have pressured the WUAs to do so. WUA leaders and managers justified their high investment in desilting by using this as a way to gain managerial credibility among the users and to show them that the WUA leaders and managers are accountable to users' requests for better system maintenance.

FARMERS' OPINION ON MAINTENANCE

Table 9.2 shows the results of the farmer survey on how farmers perceive IMT has affected system maintenance. More than 70 percent of the farmers reported that the condition of irrigation network has been good after transfer, while 64 percent of the *ejidatarios* and 47 percent of the private growers felt that the condition has improved after transfer. With respect to the drainage network, 54 percent of the *ejidatarios* and 38 percent of the private growers believed that the condition has improved as a result of transfer. Only 11 percent of the farmers reported that there were no major maintenance problems before transfer. Fifty-five percent perceived there were no such problems after transfer. These percentages show the high level of satisfaction about current maintenance work done by the WUAs.

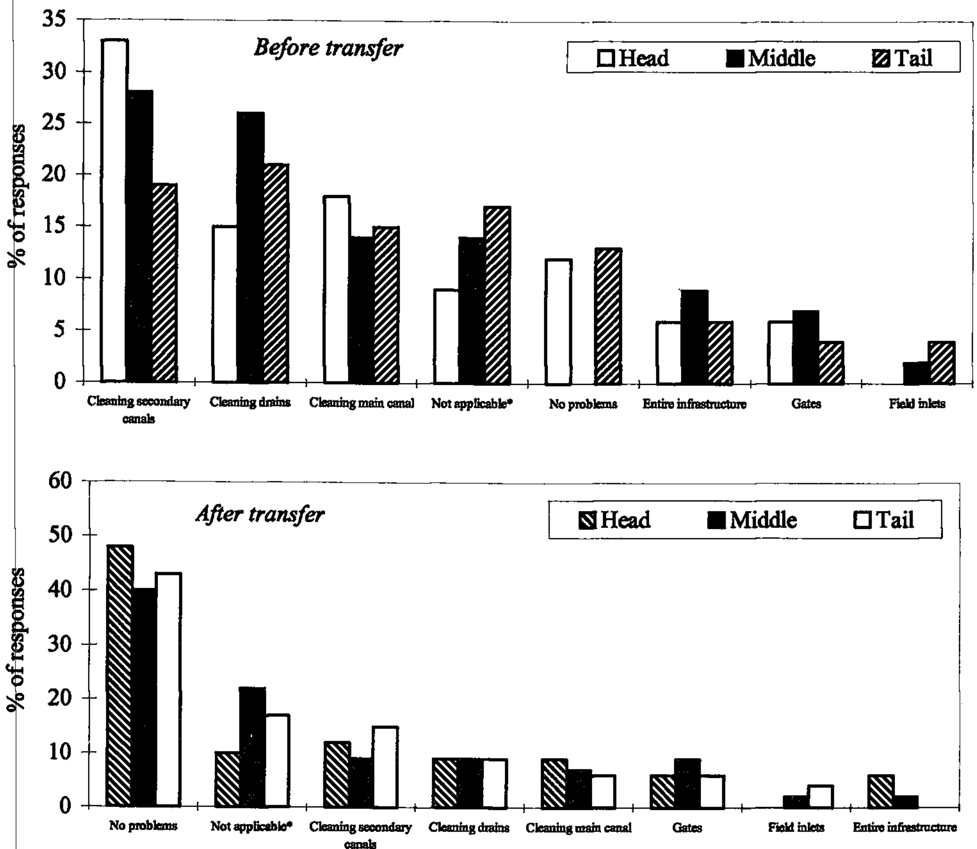
Before transfer, lack of cleaning of secondary canals (26% of all respondents of the farmer survey) and drains (21%) were seen as the main problems related to maintenance. Figure 9.13 shows that particularly head-end farmers were complaining about the lack of cleaning in secondary canal. Although poor maintenance in head-end reaches would also have affected tail-end enders, most tail-end farmers were used to clean their own reaches any way. In fact, they were often not even aware that cleaning should have been done by CNA.

Table 9.2 Farmers' opinion on the change in maintenance service as a result of IMT

	Ejidatarios (n=90)		Private growers (n=35)	
	Condition of the irrigation network (%)	Condition of the Drainage network (%)	Condition of the irrigation network (%)	Condition of the drainage network (%)
Poor before and after IMT	7	3	6	0
Poor before, good after IMT	64	54	47	38
Good before and after IMT	11	33	24	41
Good before, poor after IMT	9	1	6	9
Other[a]	9	9	17	12
Total	100	100	100	100

Note [a]:"Other" includes 'don't know,' 'no response,' and 'not applicable because respondent only uses a private well.'

Figure 9.13 Farmers' opinion on the main problems related to system maintenance, before and after transfer



Forty-four percent of all respondents report that after transfer there are no serious maintenance related problems. Only twelve percent of the farmers still complain about the lack of maintenance in secondary canals while less then 10 percent still sees poor maintenance of the drains as a major problem. Furthermore, unlike the situation before transfer, after transfer there is no clear head-tail-end bias in farmers' opinion on maintenance problems (figure 9.13). This indicates that the WUAs are doing an equally good maintenance job in all canal reaches.

COMPARISON ACROSS WUAS

Comparison of maintenance levels among the 11 WUAs shows the variation in the way WUAs deal with system deterioration. Figure 9.14 shows that WUAs desilt their canals approximately once every three years (135% in 4 years). Some WUAs do this every 2 years, while others have cleaned only 60 percent or less of their network during the 4 years after transfer.

Similarly, figure 9.15 shows the variation in maintenance levels per module. The figure shows a striking decline in total maintenance expenditures per hectare from head-end to tail-end WUAs. The two exceptions are Cortazar and Salamanca WUAs, which make more use of the two main canals than any of the other WUAs (see also figure 2.2). Although not their responsibility, both WUAs invested heavily in maintaining these main canals in addition to their assigned reaches, to guarantee reliable supply to their secondary canals. The decline in expenditures from head to tail cannot be explained by different levels of fee collection rates (see figure 7.2), nor by the fact that these WUAs have less problems with siltation since they are further away from the dams. Comparison of module data indicates that tail-end modules are relatively smaller and have relatively less infrastructure to maintain: on average, 40 meters of canal and drainage network per hectare for the six head-end modules versus 30 meters per hectare for the 5 tail-end modules. Furthermore, data show that some of these WUAs spent relatively more on operational and energy costs as some pump water directly from the river Lerma.

Figure 9.14 Percentage of canal network desilted by the WUAs, ARLID 1993-1996

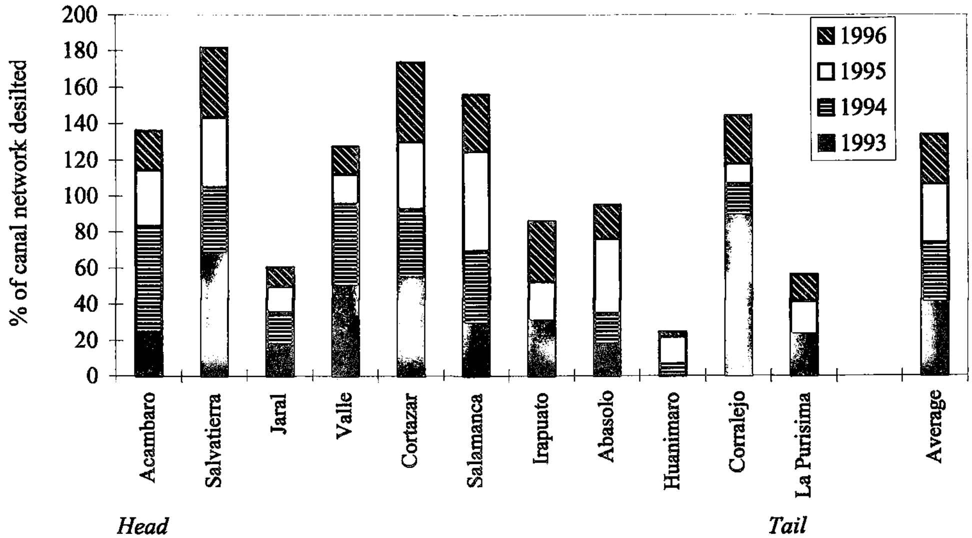
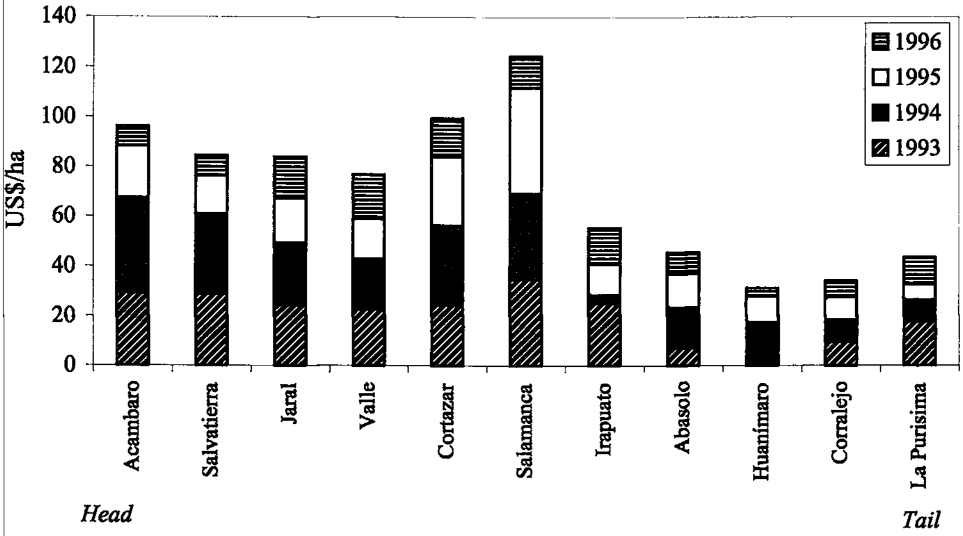


Figure 9.15 Comparison of maintenance expenditures (July 1994 US$) per hectare by modules, ARLID 1993-1996



9.5 Impact on system improvement programs

The general belief among farmers in ARLID was that IMT should have been accompanied by an intensive system rehabilitation and modernization program under the World Bank and Inter-American Development Bank assisted Irrigation and Drainage Sector Project loan (Gorriz *et al.* 1995). However, in ARLID no system modernization or rehabilitation activities took place as part of the IMT project[9]. Some minor rehabilitation and system improvement activities were initiated only a few years after these Bank assisted projects were completed. These activities include four externally funded programs to which some of the WUAs in ARLID had access: PRODEP, Efficient Use of Water and Energy, Fertigation, and a more recent program on System Improvement and Rehabilitation.

PRODEP

Of all these programs, PRODEP (*Programa de Desarrollo Parcelario*) is probably the most important in terms of both total funding and number of beneficiaries[10]. The program was initiated by SAGAR (Ministry of Agriculture) with World Bank assistance and aims at on-farm improvements by providing WUAs with laser equipment for land leveling, trucks and buried pipe systems for public deep wells that are managed by the WUAs.

So far, the WUAs of Jaral, Irapuato and Valle have participated, while at the end of 1997 assistance to other associations (including La Purísima and Cortazar) was committed. The activities are financed through a match fund, in which the government (50%) and the WUAs (50%) share the costs. Generally, the WUAs ask the direct beneficiaries (users) to contribute financially. For instance, Jaral WUA asked its users to pay 100 pesos per hectare to cover the cost of those activities that benefit all users. So far, they have collected more than 520,000 pesos from their users, which is approximately 15 percent of the total of 3.5 million pesos involved in PRODEP activities in Jaral. In addition, direct beneficiaries of for instance new buried pipe systems pay an extra contribution. The WUAs of Valle and Jaral and started to sell land leveling services (by using the PRODEP laser equipment) to those users who are interested. So far, they have only charged rates at actual cost prices.

Efficient Use of Water and Energy

Another important program that aims at the improvement of efficiencies at the farm level is the Efficient Use of Water and Energy program (*Uso Eficiente del Agua y de la Energía Eléctrica*). The program includes incentives for capital investments to improve pumping equipment, construction of pressurized systems and land leveling (CNA 1993, De la Cruz and Peña 1994). Unlike PRODEP, this program does not exclusively focus on WUAs and users within irrigation districts. Individual well owners and well users outside the districts outnumber the beneficiaries within the districts. Beneficiaries include both individual users and WUAs (for their public deep tubewells). The program is a co-financed between the federal government and the direct beneficiaries. Many farmers and all WUAs have applied to take part in the program.

A major problem with the execution of the program is that government funds have been released much slower than expected, resulting in long waiting lists and tremendous delays in selecting beneficiaries, testing pumps, and implementing the actual technical improvements. As more farmers and WUAs have applied for this kind of technical assistance that program funds allow, a lottery system (*por sorteo*) is used to 'select' potential candidates. However, it is not clear to what extent selection really takes place through this lottery system. Some users and WUAs have complained that there is some degree of favoritism involved as well.

Although WUAs and individual users compete for the same funds, all WUAs in ARLID have started to help their users to fill out their application forms in order to facilitate access to the program. Once potential candidates are selected, program staff pay visits to the sites to check whether the well also meets the technical criteria (such as poor electromechanical efficiency of pumping equipment, pumping height, low application efficiencies) for getting upgraded[11].

In addition to their complaint of favoritism in the selection of potential beneficiaries, leaders of WUAs particularly complained about the lack of control they had on the selection of external contractors who would execute the improvement works. This selection was entirely done by CNA, without consulting the beneficiaries first. As a result, users were very concerned that possibilities of rent-seeking on the part of CNA staff would become a more important criteria that the quality and cost-effectiveness of the work delivered by these contractors. Although these suspicions on rent-seeking could not be confirmed by empirical data from interviews or other sources, field observations in Salvatierra and Cortazar and inspection of several pumping installation and buried pipe systems that were installed by the selected contractor in these modules learned that numerous design and construction errors were made and that in many cases inferior materials were used[12].

By the end of 1997 approximately 40 (out of 175) public deep tubewells had been upgraded, serving about 1,500 hectares or 400 farmers. The level of subsidy received ranged from US$ 7,500 to US$ 11,000 per well. It is not clear how many individual farmers had access to funds from this program[13].

Fertigation Program

A third activity that mainly focused at field level improvements is the fertigation program (*Programa de Ferti-irrigación*). This is part of much wider package of technical and financial support under the *Alianza Para el Campo* program that was started in 1994 to boost the 'modernization' of Mexican agriculture and to compensate for the loss in income as a result of the neoliberal reforms. According to SAGAR (1997) a total amount of 57.9 million pesos (around 8 million dollars) was spent on fertigation in 1997 for the entire State of Guanajuato, benefiting more than 12,000 hectares (i.e. US$ 640/ha). The total number of beneficiaries in ARLID is unknown, but information from the 11 WUAs reveal for instance that in the module of Jaral six wells were equipped with fertigation, serving 52 users, in Cortazar 14 wells and in Corralejo four wells.

System Rehabilitation and Modernization Program

Of the four system improvement programs mentioned here, the activities under the program on System Rehabilitation and Modernization of Irrigation Districts (*Programa de Rehabilitación y Modernización de Distritos de Riego*) are the only ones that really focus at improvement works of irrigation infrastructure at the module and district levels. These activities include rehabilitation of canals, drains and service roads as well as the construction and installation of 'modern' water control and measuring devices.

The program was initiated in 1986, but the first agreement to actually start activities under this program was signed between CNA and the National Association of Water Users (ANUR) in October 1996[14]. In ARLID, the first rehabilitation works were started no earlier than by the end of 1997. The program is co-financed by the Federal Government (i.e. CNA, 50%), the State Government (25%) and the beneficiaries (25%). Potential beneficiaries that can apply for program funds are the WUAs and the LRSs. Applications for funds and activities are analyzed and can be approved by the technical committee which mainly comprises representatives from CNA and ANUR.

Once applications have been approved, the works are technically and financially supervised and executed by the regional or State offices of CNA. This means that CNA plays an important role, both in granting the application for funds (and hence the kind of rehabilitation works that will actually take place) and in controlling all project funds. In most cases the actual works will be done by external firms, who will have to compete for the contracts. Both CNA and those WUAs that directly benefit from the works decide to which firm the contract will be granted. Prices, quality of the work and reputation of the firm are the most important official selection criteria, but according to some leaders of WUAs factors like favoritism and nepotism are hard to avoid in the Mexican context of doing business. However, generally these leaders prefer this system above the selection procedure used in for instance the Efficient Use of Water and Energy Program, where the eventual beneficiaries are not involved in the selection of the firms that install pumping equipment and pressurized systems in the farmers' own fields.

As program activities started only after most of the field observations for this thesis were completed, a complete overview of the kind activities that were approved for ARLID cannot be included here. Yet, among the activities that were started before the end of this study were the rehabilitation of the Irapuato main canal, the installation of pressurized pipe systems for public deep tubewells in Cortazar and Valle, and a small pilot project on water distribution in a secondary canal using a pressurized pipe system (see box 9.3). The rehabilitation of the canal in Irapuato aimed at the construction of the right slope of the canal bed. At the time when the canal was built, it was constructed with a reverse-slope, which meant that less water could reach the tail-end area of the module than needed. With help of funds from the rehabilitation program reconstruction works were started at the end of the 1997-98 winter season. The total contribution from the farmers was planned at approximately US$ 43,000 (or US$ 13.5/ha).

As these four programs were started a few years after management transfer had taken place, one would have expected that the actual activities that were approved would better reflect the farmers' ideas on how to improve water distribution and use at all levels of the system. Furthermore, as problems with water distribution and use are very local specific, one would have expected a high diversity on the kind of (new) technologies that were introduced as a result of these programs. However, among all these programs one find surprisingly little variety in technologies.

All approved activities either aimed at improving water distribution and application efficiencies by introducing standard packages of new technologies (pressurized buried pipe systems, land leveling, fertigation, measuring devices), or at reconstructing and upgrading existing designs, using conventional technologies (electromechanical pumping efficiencies, lining, improving bed-slopes). The main reason that explains this, is that most of these works were either initiated or had to be approved by government agencies, with very little involvement from the direct beneficiaries. In most of these cases farmers only had the option to apply or to not apply for already pre-selected packages of technologies. In addition, in the case of the Efficient Use of Water and Energy and the Fertigation programs, farmers did not have control over the ultimate design, construction and installation of the technologies as even the contracting firms were selected by the agencies. Similarly, although its direct beneficiaries had more control over the selection of consultant firms that were hired to do the works), also beneficiaries of the Rehabilitation and Modernization program had no control over how the funds were going to be spent.

From the point of view of the users the choice for standardized and conventional technological solutions that mainly aim at reducing conveyance and application losses is not necessarily a problem. Interviews with technical staff and leaders show that they share a common concern on the high levels of water usage (which are confirmed by the high RWS values that were measured) particularly at the field and distributary levels. On the other hand, it was noticed several times that leaders and managers of WUAs were interested in improving water distribution between and within the distributaries of their module areas, by introducing division structures that would help ditch tenders to distribute the water with a higher level of accuracy (actual over planned distribution). In addition, they expressed a high preference for using more and better measuring devices at the level of the intakes of main distributaries. They realized that the ditch tenders' rough estimations of flows that are released into the larger distributaries can lead to the kind of discrepancies between planned and actual flows as reported in section 5.5. As they treat water more and more as an economic commodity (see chapter 8), that can either be traded to other WUAs, or be used to increase the irrigation intensity, or both, they feel that better measuring devices would serve them tremendously[15]. However, no new measuring devices were installed under these programs.

Only one example could be observed of a WUA requesting and gaining approval to test its own ideas on how to improve distribution efficiencies and a new system of secondary canal water distribution under the System Rehabilitation and Modernization Program. This case is illustrated in box 9.3 and concerns a pilot project in the first (head-end) distributary of Cortazar module. The idea of this project was initiated by both the general manager of the Cortazar WUA and the 112 users of this particularly distributary, who suffered from both irregular and insufficient water delivery. The idea was approved under the condition that the direct beneficiaries along the distributary would contribute 12.5 percent of the total cost, while the WUAs (i.e. including all the other users in Cortazar) would bear an additional 12.5 percent. The remaining funding would come from Federal Government (50%) and State Government (25%) subsidies. In addition, the direct users would have to pay 200 pesos per hectare per irrigation delivery, compared to approximately 100 pesos for the regular canal irrigation service fee.

Box 9.3 WUA initiated system rehabilitation: an example from Cortazar

Unlike the other 51 distributaries in Cortazar, the first distributary does not take water from the Coria canal main canal. Instead, it takes water from the Toro de Lomo headworks. Next to the main gate that serves the entire Coria canal, this first distributary has its own small and fully adjustable slide-gate. As this gate was constructed after completion of the main gate, its distributary is locally still called 'New Gate' (*toma nueva*). Since the time of construction, the 112 farmers who try to irrigate their 138 hectares along this distributary have suffered from two problems. First, the relatively small 'new gate' is constructed at a too high level. As a consequence, when the water level of the river at the Toro de Lomo headworks is low, the distributary cannot take in water. As the water level fluctuates, farmers never know whether they will actually receive the scheduled deliveries. Second, and partly as a result of the first problem, water flows in this distributary do not meet the planned target flows, which results in water shortages particularly in the tail-end area of the distributary.

In order to resolve this problem, the general manager and the president of the WUA, together with the users of the distributary, developed the idea to submit a proposal on rehabilitation of this distributary to the System Rehabilitation and Modernization Program. The idea was to not only aim at solving the reliability and adequacy problems mentioned above, but also to use this project as a test case to see whether conveyance losses within the distributary could be reduced. If successful, the experiment in this distributary could serve as an example to improve other distributaries that suffered from similar problems of reliability, adequacy and high conveyance losses. According to the president of the WUA, this project would help to convince both other water users and external funding agencies to financially contribute and invest in similar projects once the funds from the Rehabilitation and Modernization program had come to an end. The WUA asked the direct beneficiaries to show their confidence in the project by contributing 12.5 percent of the total construction cost as well as by committing themselves to pay a water fee which was twice as high as the regular fee paid by farmers who use canal water.

The WUA invited several firms to submit proposals and ideas. A firm from the neighboring State of Michoacán was selected as it had the most favorable price and could still guarantee good quality work. The design itself was basically developed by the general manager of the WUA, in frequent consultation with the users and the president. All these stakeholders liked the idea as it could meet the three objectives. The design was as follows. Instead of using the original intake at the head-works, the distributary would now receive water by pumping it directly from the Coria main canal. In that case it would have the same reliability as the other distributaries: as soon as the Coria canal runs water, accessibility would be guaranteed, irrespective of the water level. To avoid problems with total pump break-downs, two pumps with a pumping capacity of 60 l/s were installed. The double irrigation fee would be sufficient to pay for the additional pumping cost. Rather than pumping into the existing open canal, water would now be distributed via a buried pipe system using 12", 10" and 8" pipes. The two advantages of this system would be that conveyance losses would be reduced considerably and that a new and simple way of water rotation could be introduced, particularly to guarantee water delivery to the tail-end area of the distributary. The system pipe would have 12 outlets, each having a capacity of 40 l/s. Three farmers could irrigate simultaneously to meet the full capacity of 120 l/s of the two pumps. Rotation would be scheduled following the same principles of requesting and paying turns as the ones used for farmers along the other distributaries (see chapter 3).

The system was still under construction when the field observations for this study were ended, so unfortunately information on its actual performance and whether it received a follow up in other distributaries is not available.

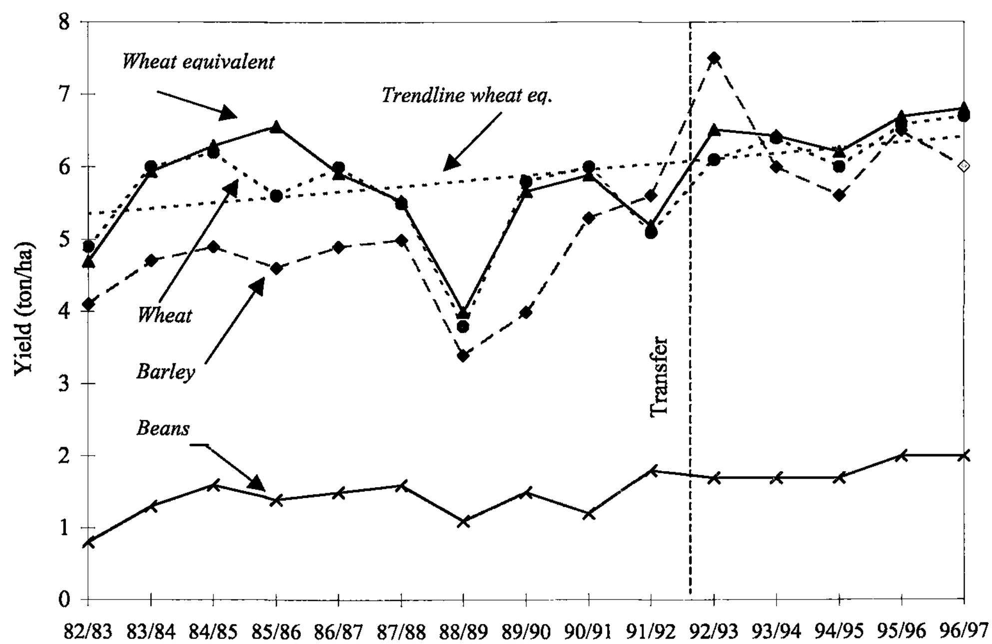
9.6 Land and water productivity

COMPARISON OF PRODUCTIVITY OVER TIME

To assess the impact of the IMT program on the agricultural and economic productivity of ARLID, change in crop yields (ton/ha), water productivity (kg/m^3), standardized gross value of production (SGVP) per unit of water supplied and consumed, and the SGVP per irrigated cropped area and command are analyzed (for definitions see Appendix 4).

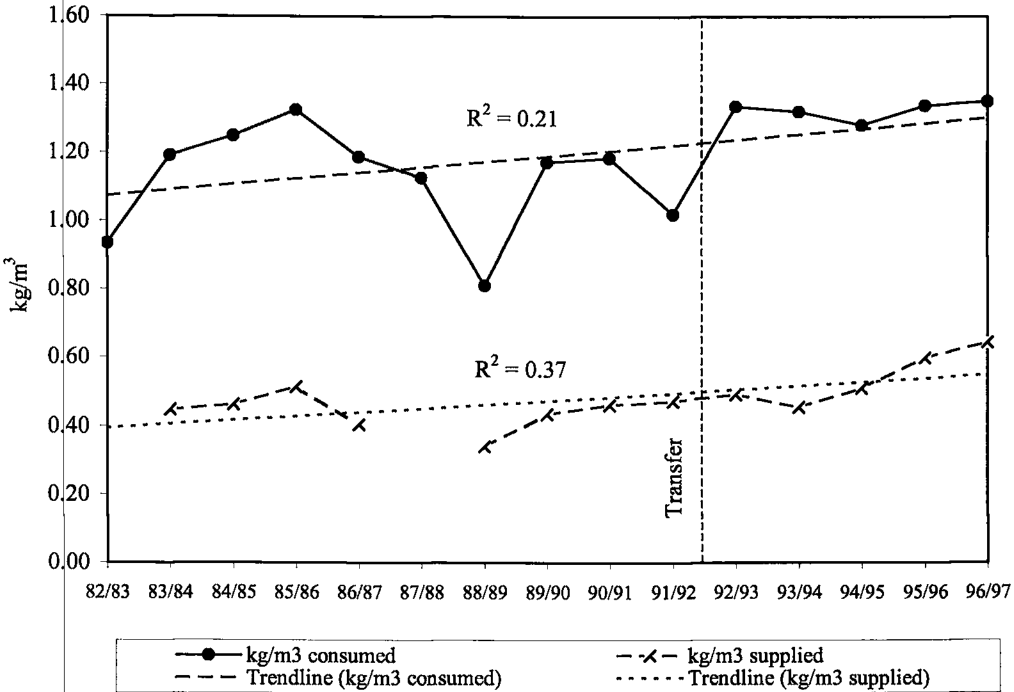
Figure 9.16 shows the development in yields for both the major winter crops and the wheat equivalent of all crops grown. The figure shows an upward course for wheat and barley yields: an average yield of the wheat equivalent of 5.9 ton/ha, with a CV of 13.2%, but with a R^2 as low as 0.19. The average yield of the wheat equivalent was 5.6 ton/ha (CV = 13.7%; R^2 = 0.03) in the recorded years preceding transfer, against 6.5 ton/ha (CV = 4%; R^2 = 0.23) in the four years after transfer. However, the line with years before transfer (1982-1991) is heavily distorted by the dramatically low wheat and barley yields in the winter 1988-89 season. Eliminating this year produces an average wheat equivalent yield of 5.7 ton/ha (CV = 10.1%; R^2 = 0.01). The low R^2 values do not warrant the general belief among CNA staff that IMT has resulted in better yields. As transfer did not take place until the end of 1992, the recovery that was started after 1988 cannot be attributed to the transfer process alone as it could (though not studied for this thesis) also be the result of better crop varieties and cropping practices. At the same time, it can also be argued that the period since IMT has not shown yield declines, which can (given the increase in the cost of agricultural inputs) be considered as a positive achievement.

Figure 9.16 Average yields for major crops, ARLID, winter seasons 1982-1997



Before we arrive at presenting the economic productivity indicators discussed in 1.6 and Appendix 4, first another more commonly used agricultural indicator is applied: water productivity (kg/m^3 of water) for the wheat equivalent crop. In figure 9.17 a distinction is made between productivity per m^3 of water supplied (gross irrigation depths) and per m^3 of water consumed (i.e. CROPWAT water requirements).

Figure 9.17 Water productivity for wheat equivalent, ARLID winter seasons 1982-1997



The years after transfer show a slightly upward course for the water productivity per m^3 of water supplied (CV = 16.6%; R^2 = 0.81), against a rather flat line for the years preceding transfer (after elimination of the dramatic poor year of 1988): CV = 11.6% and R^2 = 0.01. This might suggest that farmers use water more efficiently, leading to higher values water productivity. However, these results are a combination of both lower irrigation depths (see figure 9.3) and increasing yields (figure 9.16) and as such cannot be attributed to the transfer process alone.

As was discussed at length in chapters 1 and 4, one of the aims of market-oriented interventions such as IMT was to encourage farmers to use water more economically. In order to assess whether the IMT program in ARLID has achieved this aim, the comparative economic productivity indicators (see section 1.7 and Appendix 4) were applied in Cortazar and Salvatierra modules.

Figure 9.18 shows the change in SGVP per unit of land and water for the case of Cortazar module. The average equivalent wheat yields for the reported period is 6.1 ton/ha. Standardized gross values of production per unit of land cropped range between 950 US$/ha and 2,100 US$/ha (with an average of US$ 1,300 per hectare; CV = 23%), whereas the output per unit of command of irrigable area range from 66 US$/ha to 1,720 US$/ha (average US$ 795; CV = 55%). In comparison to irrigation districts in, for instance, north-east Mexico

(Rymshaw 1998) and 25 other systems studied by IWMI world wide (Molden *et al.* 1998; Sakthivadivel *et al.* 1999), these returns to land cropped are medium to high, while the returns to unit of command are medium to low. The output per unit of water supplied range from 0.06 US\$/m^3 to 0.14 US\$/m^3 (average of 0.11 US\$/m^3), which compared to the other systems is low. The output per unit of water consumed closely follows the trends in output per unit of land cropped and ranged from 0.18 US\$/m^3 to 0.41 US\$/m^3 (average of 0.27 US\$/m^3), which is relatively high.

Figure 9.18 Standardized gross value of production (SGVP) per unit of land and water, Cortazar module, winter seasons 1985-1997

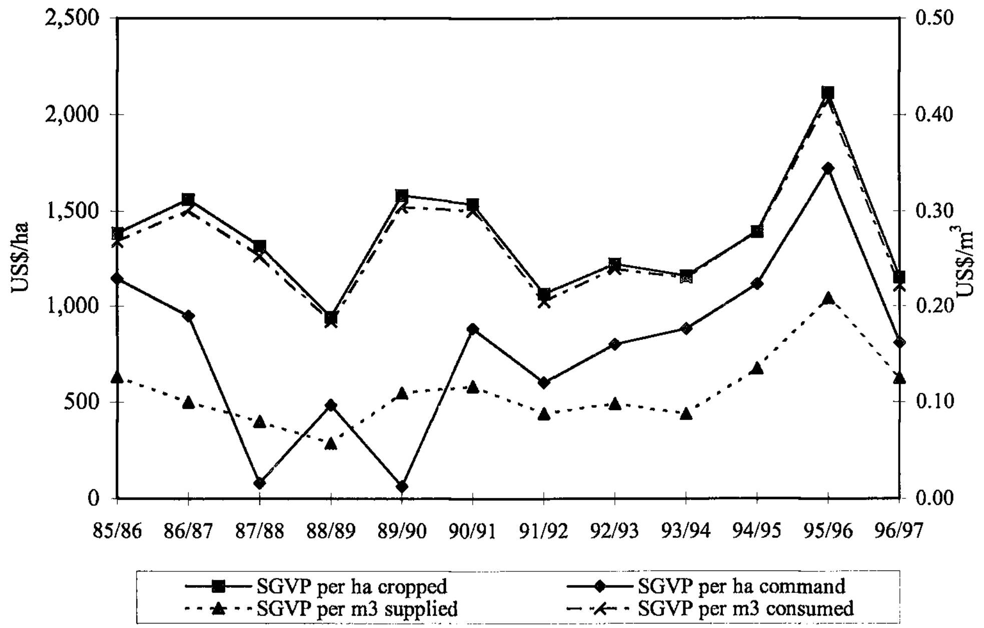
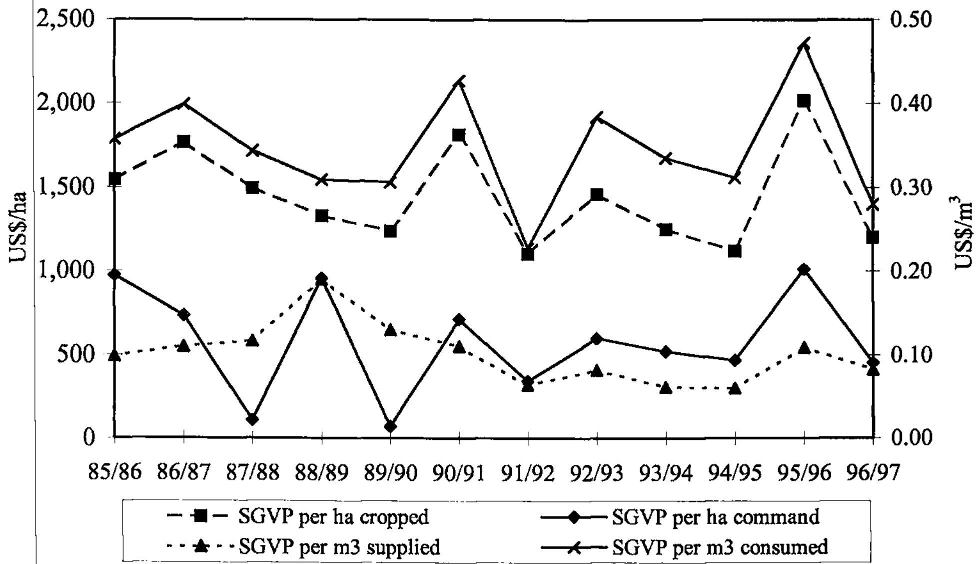


Figure 9.19 shows the outputs per unit of land and water in Salvatierra module. The average equivalent wheat yield is 6.4 ton/ha, which is slightly higher than in Cortazar. The SGVP per unit of land cropped range between 1,100 US\$/ha and 2,200 US\$/ha (with an average of US\$ 1,450; CV =19%) and are also higher than in Cortazar, basically as a result of a higher percentage of high value crops like beans and vegetables. However, the output per unit of command of irrigable area range from 72 US\$/ha and 1,014 US\$/ha (average US\$ 580; CV = 52%), which is much lower than in Cortazar (and among the five lowest values in the set presented by Molden *et al.* 1998 and Sakthivadivel *et al.* 1999) and reflects the low cropping intensities in Salvatierra. Although more water is applied to the crop, the higher returns to land make that the output per unit of water supplied are still similar to Cortazar, ranging from 0.06 US\$/m^3 to 0.19 US\$/m^3 (average of 0.10 US\$/m^3).

The output per unit of water consumed by the crop ranges from 0.28 US\$/m^3 to 0.47 US\$/m^3, which is high compared to Cortazar. The high outputs per m^3 of water consumed combined with the high RWS values and low crop intensities indicate that in theory Salvatierra farmers could crop more land by applying less water per hectare irrigated and hence increasing their productivity of the water supplied to their fields.

Figure 9.19 Standardized gross value of production (SGVP) per unit of land and water, Salvatierra module, winter seasons 1985-1997



9.7 Provision of non-irrigation services

As was discussed in section 6.3, some WUAs have started to fill in the institutional void in the provision of agricultural services to farmers. This void was created after the dismantling of various State agencies and banks during the neo-liberal reforms of the late 1980s and early 1990s (see chapter 3). In addition to providing O&M services, WUAs have become particularly involved in activities that aim to reduce the cost of production to water users. Table 9.3 summarizes to what extent water users make use of WUAs as a source of gaining access to some non-O&M services.

One of the most ambitious strategies that these WUAs follow is to establish new organizations parallel to the WUAs that are involved in trading agro-chemical inputs and seeds. As is shown in table 9.3, after IMT seven percent of the respondents have started to buy their agro-chemical inputs through the WUAs. Private companies continue to be most important source of these inputs, both before and after IMT. Whereas official rural credit institutions and banks like BANRURAL used to be an important source of inputs (in combination with formal credits), especially for *ejidatarios*[16], only ten percent of all farmers still receive their inputs through credit programs of these banks. Another remarkable figure in this table is the relatively high percentage of farmers that report not to use these agro-chemical inputs. Although the reasons for this were not studied in detail, two factors might explain this development. The most obvious (and most reported) reason is that, as a result of price liberalization programs, agro-chemicals have simply become too expensive for users to buy. One would expect that farmers' abstention from using inputs for this reason result in yield reductions. However, the data presented in the previous section of this chapter do not indicate these reductions[17]. Other farmers report that they have stopped using agro-chemical inputs as they have recently shifted to practices of zero or minimum tillage. ARLID is an irrigation districts with a relatively high number of farmers who practise these tillage methods. This is clearly the result of a rather progressive training program given by a training center near Jaral. Many farmers have attended these programs, often after the WUAs have facilitated access to them.

Table 9.3 Percentage of farmers (n=125) who receive agro-chemical inputs, credit and technical assistance from WUAs and other sources, before and after IMT

Source	Agro-chemical inputs		Credit		Technical assistance	
	before	after	before	after	Before	after
WUAs	0	7	0	0	0	3
Other farmers	13	17	1	4	0	0
Private companies	46	44	0	0	0	1
Banks	31	10	46	11	8	1
SAGAR/SARH	0	0	0	0	2	0
Cooperatives	6	6	1	0	0	1
Other sources	0	1	2	1	2	1
Don't use	2	15	48	84	87	93
No answer	1	1	1	0	0	0

Probably the most dramatic impact of the neoliberal reforms so far, has been the farmers' problems with gaining access to credit. Table 9.3 clearly shows that after IMT (however not as a result of it, but rather of the change in credit policy of BANRURAL) only 16 percent of the farmers still have access to credit in comparison to 51 percent before the start of the IMT program in 1992. Although some WUAs (like Salvatierra) occasionally provide small credits to their users if this helps them to get access to government sponsored system improvement programs, none of the farmers surveyed reported to make use of such credit facilities. Although WUAs do not play a role in filling the credit gap that was created as a result of the reforms, they do play a role in facilitating farmers to gain access to still existing state subsidy programs like PROCAMPO and as such indirectly assist farmers financially.

As for technical assistance (including agricultural extension), three percent of all farmers report to use the WUAs as the main source of assistance. However, compared to the 93 percent of farmers who say not to receive any assistance or extension, this percentage is relatively insignificant.

9.8 Conclusions

The following summarizes the main impacts of the IMT program on the O&M performance at ARLID.

Water use

Farmers' increased involvement in system O&M has not led to major improvements in operational performance. Although the hydraulic committee has become an important institution in which users participate in planning the use of and control over the water source, there is no evidence that transfer has resulted in significant improvements in the way water is allocated and distributed. With the exception of some WUAs like Cortazar, generally WUAs have so far followed the same allocation and distribution principles and practices as used by

CNA. As a result, RWS values at all levels continue to be high. Similarly, no changes in the area irrigated or cropping patterns can be attributed to transfer.

Farmers' increased involvement in decision making and control has increased operational accountability. The farmer survey shows that the majority of farmers perceive that the quality of system operations has either remained the same or has improved. Individual users still feel that they do not receive relevant information on the approved irrigation plan (which defines the number of irrigation a farmer can receive) in time. This suggests that the arrangement of user representation in the general assemblies of the WUAs does not guarantee an improvement in the quality of the services that are provided. On the other hand, most respondents are very positive about the changes they observed in the attitude of both operational staff (particularly ditch tenders) and administrative staff. This is clearly the result of greater control of the users over WUA technical and administrative staff.

Unlike individual users, leaders and most technical staff of WUAs are provided with adequate and very up to date climatological and hydrological information that help to better decide on their irrigation plans and schedules. The most important reason for this is the leaders' active participation in the hydraulic committee. In this committee, leaders not only have better access to the information that is provided to them by CNA, but also actively control decision making processes based on this information.

One of the problems that most WUAs face is the high turnover in technical staff. As a result, there is an almost continuous need for training of new staff, as well as upgrading the skills of existing staff. Although CNA and IMTA provided the new WUAs with ample technical training during the initial stages of the IMT program, most WUAs now feel that CNA and other organizations could play a more active role.

As the transfer program mainly aimed at improving the use of surface irrigation, it was not expected that major changes in groundwater use would occur as a result of transfer. Yet, it is apparent that the alarming level of overexploitation of aquifers by well owners in ARLID is not being reduced. Although CNA will continue to be the authorizing institution that controls the aquifers, IMT has resulted in a considerable reduction in the role and mandate of CNA in the State of Guanajuato. As a consequence, it will become more and more difficult for CNA to adequately monitor aquifers. WUAs do not seem to have the interest, nor the legal power to assume that role.

Maintenance

One of the most positive impacts of the IMT program in ARLID has been the considerable improvement in maintenance services, especially at lower system levels. Other improvements include: the purchase of modern machinery by the WUAs; a moderate increase in the proportion of the total O&M budget spent on maintenance; and maintaining the level of maintenance expenditures per hectare in constant dollar terms, or doubling this level in real peso terms. These improvements are clearly acknowledged by the farmers surveyed.

Compared to the delivery of operation services, individual water users are more positive about the provision of services in the fields of maintenance and system improvements. Unlike the pre-transfer situation, users can now daily observe that WUAs actively try to maintain the irrigation canals and drains. Although it is too early to observe any impacts of the tremendous increase in maintenance activities on actual water distribution, the WUAs active role in maintenance has certainly helped to build up credibility of WUAs in the first few years after the transfer program was implemented.

Whereas individual users are positive about the changes in maintenance and system improvements, WUAs still complain about the lack of support from CNA. Although CNA wants the WUAs to spend 60 percent of their O&M budgets on maintenance, they do not provide the associations with adequate methodologies that help them to better set priorities within their maintenance programs. Nor are the maintenance programs monitored in an adequate way. Furthermore, as water distribution between and within the secondary canals also depend on the level of maintenance service in the main canal system, WUAs complain heavily about the deterioration of maintenance in the main canals done by CNA. Finally, although most WUAs appreciate the active role that CNA plays in helping WUAs to get access to externally funded system improvement programs, they feel that they have too little control over the way these funds are used.

Soon after transfer in 1992, CNA stopped cleaning the main canals as well, which caused much concern among the WUAs and eventually led to the WUAs taking over responsibility for managing the main system as well as the distributary subsystem. While it is apparent that the amount of maintenance work has increased since transfer and has helped the WUAs to increase their credibility, it is not clear what this has meant for the physical capability of the system to transport water to farms.

Land and water productivity

The data that is presented in this chapter does not provide convincing evidence that there has been a marked effect of the transfer program on agricultural and economic productivity. Although fluctuations can be observed, even after transfer, it is believed that these are related to other recent developments in the agriculture sector such as the dismantling of credit and subsidy systems, input price policies, and, most of all, price changes in the world commodity markets.

Non-irrigation related services

As was noted earlier, the introduction of new institutional arrangements for irrigation management did not come on its own but was accompanied by several other institutional reforms. Interviews with leaders, staff and farmers of WUAs clearly indicate that both the providers and receivers of support services are far more concerned about the dismantling of former government services other than those related to O&M. Farmers mention particularly the difficulties they have with having access to cheap inputs and credit. Most WUAs in ARLID have picked up this concern and have started to try to provide some of those services through their associations. However, there are legal as well as financial limitations to further develop these initiatives, which explain why so far few farmers were able to actually make use of these service. Moreover, there exists a genuine concern on the part of the Mexican irrigation bureaucracy that the involvement of WUAs in the provision of non-irrigation services might shift their attention away from delivering adequate O&M services, as some leaders will find this the provision of this type of services more lucrative, both financially and politically. Although so far field observations in ARLID have not supported these concerns, it is important to closely monitor whether indeed the provision of non-irrigation services by WUAs does not negatively affect their main responsibility, i.e. the provision of irrigation services.

Notes

1. Parts of this chapter are drawn from Kloezen *et al.* (1997).
2. For the IMT impact assessment studies in Mexico, see Kloezen *et al.* (1997) for ARLID, Levine *et al.* (1998) for Lagunera irrigation district, and Rymshaw (1998) for the Bajo Río Bravo and Bajo Río San Juan irrigation districts. Whereas the former two studies focused particularly on changes in performance as a result of IMT, the latter study focuses more on the impact of sudden droughts. Other IWMI studies in which comparative indicators were used to assess the impact of IMT and PIM programs in other countries include Vermillion and Garcés-Restrepo (1996 and 1998) on Colombia; Kloezen (1995 and 1996) and Samad and Vermillion (1999) on Sri Lanka; and Vermillion *et al.* (2000) on Indonesia.
3. The Spanish term used for these wells is '*pozo oficial*', which literally means 'official well'. Here 'official' refers to State owned and managed and not to 'officially registered', as some people believe. As these wells were transferred to the WUAs in 1992, they ceased to be 'publicly' managed. In order to both avoid confusion and to clearly distinguish these wells from privately owned wells, I prefer to use the English translation of 'public well'. Here 'publicly managed' refers to CNA during the time before management transfer and to the WUAs for the period after transfer.
4. For instance, out of the 21 public tubedeep wells that are managed by the WUA in Salvatierra, 10 pump directly in one of the main canals of the module, whereas the remaining wells discharge into one or more field ditches.
5. The two levels indicated in the graph are based on data collected by the CNA district office in Celaya. Although annual recharge will vary as a consequence of changes in annual rainfall patterns, reliable historical data on this variation are not available.
6. There are no data on how much of this excess water recharges the aquifer.
7. Expressing expenses in dollar terms only masks the improvements made by the WUAs under conditions of the economic crisis that followed the devaluation of the peso in 1994. In constant pesos terms, maintenance expenditures have increased from 56 pesos/ha in the pre-transfer years to 108 pesos/ha in the post-transfer years, which is an increase of 93 percent.
8. CNA and the WUAs only maintain a rough estimate of the condition of the infrastructure. The table below shows how CNA has rated the condition of both the main canals (maintained by CNA) and the secondary canals (maintained by the WUAs). However, it is not clear what kind of criteria they used to make this condition assessment. Moreover, the fairly positive condition assessment of the main canal compared to the one of secondary canals is not consistent with the results demonstrated in figure 9.14. A possible reason for this might be that the condition assessment is based on the construction materials of the canals, where concrete lined canals (as in Acámbaro and Purísima) rate higher than earthen canals (as in Salvatierra) irrespective of their actual maintenance condition.

CNA's own system condition assessment rating for ARLID

	Condition of the main canal infrastructure	Condition of the secondary canal infrastructure
Acámbaro	Very good	Very good
Salvatierra	Fair	Poor
Jaral	Good	Good
Valle	Good	Fair
Cortazar	Good	Good
Salamanca	Good	Fair
Irapuato	Poor	Fair
Abasolo	Good	Good
Huanímaro	Good	Good
Corralejo	Good	(does not exist)
La Purísima	Very good	Very good

9. It is not clear to what extent these system modernization programs have been implemented nation wide. However, observations (not only from ARLID but also from short visits made to irrigation districts of Lagunera, Bajo Río Bravo and Bajo Río San Juan) show that very few activities have taken place in this respect.
10. Ramos-Valdés *et al.* (1999) report that between 1996 and 1999 78.5 million US dollars were invested in this program (including a planned investment of 24.4 million USD for 1999).
11. Technical criteria also determined the level of subsidy and kind of assistance that the beneficiaries of the Efficient Use of Water and Energy program could receive. Farmers with pumps at less than 40 percent efficiency received 50 percent of the capital expenditure to upgrade their wells and pumping equipment to a maximum of US$ 30,000. Those with efficiencies higher than 40 percent would receive 50 percent of the costs involved in the construction of small (field) storage reservoirs, land leveling and pressurized systems (up to 30,000 dollars). And those who wanted to improve both their pumping and irrigation systems could receive a subsidy for up to 50 percent of the actual costs to a maximum of US$ 45,000 (De la Cruz and Peña 1994).
12. I am grateful to Ian Makin (IWMI) and Gez Cornish (HR-Wallingford), who once accompanied me on a field trip and showed me several of these design and construction errors.
13. The program has office space in the CNA district office in Celaya, although it works more or less independently from this office. Here, I had several interviews with the people responsible for the selection of candidates and execution of the program in the entire State of Guanajuato. Unfortunately, they could not provide me with reliable data on the progress of the program (such as the planned and actual number of beneficiaries, both within and outside ARLID), but they clearly indicated that because of lack of available funds the program was seriously delayed.
14. Ramos-Valdés *et al.* (1999) report that between 1997 and 1999 71.9 million US dollars were invested in this program (including a planned investment of 29.96 million USD for 1999). This number equals a nation wide average investment of approximately 23 US$/ha if one assumes that all the 3.1 million hectare under the IMT program benefited equally. Unfortunately the authors do not mention how many hectares actually benefited from the System Rehabilitation and Modernization Program.
15. Several WUAs in ARLID have approached me to either request whether they could use our digital flow probes and data loggers, or to provide them with information on US firm that could sell this equipment directly to them. Their interest for using these devices was twofold. First, as explained in the main text, they want to have more control over how much water they actually deliver to some of the main distributaries. Second, they want to have an instrument to cross-check the volume that is delivered to them by CNA at the module intake. As explained in section 5.2, measuring devices are only installed at the heads of the modules, while distribution within the modules is entirely based on flow estimates made by the ditch tenders.
16. Before IMT, thirty-six percent of the *ejidatarios* and 19 percent of the private growers surveyed (n=125) made use of banks to get access to inputs. After IMT, these numbers were 11 and 7 percent, respectively. This shows the greater dependency of *ejidatarios* on State programs.
17. Moreover, as was argued before, from a methodological point of view changes in yields are very hard to attribute to one single factor and are generally the result of a wider package of changes that were introduced at the same time, such as changes in cost of production, provision of irrigation services, seed varieties, and availability of credit.

10 Discussion and conclusions

10.1 Introduction

Worldwide market-oriented irrigation reforms, and IMT in particular, are very much in vogue. Yet, as was discussed in chapter 1, discussions on the pro's and con's of these reforms are generally ideologically driven and are hardly ever supported by empirical evidence. Detailed analysis of the way these programs were implemented, and the way managers and users cope with the daily problems in irrigation management that evolve as a result of these programs, remained undocumented. This lack of empirical evidence on the viability and impacts of institutional arrangements that were introduced as part of pro-market reforms in irrigation, provided the justification for this study. In addition, this study aimed at exploring methods to assess impacts of institutional interventions like IMT and water markets.

This chapter first summarizes the key empirical findings on the viability and impacts of IMT and water marketing in ARLID. Subsequently, it revisits some of the conceptual and methodological considerations in studying the viability of institutional arrangements for local water management under market-oriented conditions. These reviews are followed by some considerations and recommendations for changing the policy agenda on institutional interventions in the irrigation sector. This chapter concludes with some ideas on how to re-direct the research on institutional interventions and their impacts on integrated water management.

10.2 Viability and impacts of new institutional arrangements: empirical findings

Do formal institutional arrangements matter?

Much of the international policy and research interests in IMT is narrowed down to formulating and implementing design principles for institutional arrangements. The formulation of the IMT program in Mexico is a typical example of what one could call "institutional engineering": a top-down policy approach for designing and implementing institutional principles for local water management. In ARLID this manifested itself for instance in CNA drafting and dictating contracts, bylaws, rules and regulations. Although there was not substantial room for the new WUAs and other interest groups to become actively involved in drafting and modifying these model documents, they were still supposed to work with them. Future members of WUAs were basically informed about the program and subsequently were asked to organize themselves into WUAs. Being convinced that formulation and implementation of new institutional arrangements could only be successful if a bottom-up approach had been followed, this study was started with the assumption that the new WUAs in ARLID would not be able to internalize the new arrangements into their practices of water management. However, this study has shown that there is a paradox as to whether institutional designs matter or not.

This study has shown that indeed for ARLID these formal institutional design principles and guidelines *do not* matter. Despite all the effort that CNA put in formulating and implementing technical and institutional guidelines and directives for system O&M and WUA management, these proposed rules have proved to be of little significance for actual structuring of irrigation management activities in the context of new institutional arrangements. In general, and this follows the observations by Zaag (1992) and Long (2001), local irrigation managers and users attempt to solve problems pragmatically and strategically by creating institutional flexibility and room for negotiation and not through following formal rules. Yet, when the first reports on politicized WUAs came to the notice of CNA, their immediate reaction was to regulate political opportunistic behavior on the part of WUA leaders by imposing new WUA bylaws that should regulate the election of leaders (Palacios-Vélez 1999).

Yet, the paradox of this study lies in the observation that acts, directives and O&M regulations *do* matter. Users certainly did not perceive these new principles and arrangements as mere paper designs that could be simply disregarded. Although the formal guidelines, documents and regulations were by no means simply adopted and interpreted in the way the policy designers have had in mind, leaders and managers of WUAs did take them seriously. This has two reasons. First, because they did help to structure the organization of the tasks and O&M responsibilities of the new WUAs. Second, they helped the WUAs to use them strategically as a resource to negotiate flexibility in the way the new institutional principles and arrangements were going to be applied and transformed by both the WUAs and local CNA staff. Rather than using them as prescriptive dictates on how to manage irrigation, the new principles and arrangements served as a *strategic starting point* for the WUAs for *negotiating* irrigation fee levels, water marketing, mode of user representation, maintenance programs and re-distribution of O&M responsibilities between the WUAs and CNA *after* IMT had started.

This paradox shows how interventions for institutional reforms should be approached as a *process* around envisaged structure rather than as an *instruction*. As will be discussed below, the mixture and articulation of formal new institutional arrangements and existing informal arrangements for managing water, funds and other resources shaped the creation of accountability mechanisms that influenced the viability of the new institutions.

Mechanisms that influence institutional viability

The bylaws, rules and O&M manuals used in ARLID included basically all institutional design principles that are suggested by Ostrom (1992) and Tang (1992) to create viable institutions for irrigation management (see section 1.3). For instance, membership inclusions, user representation, water rights, conflict resolution and other principles were well being dealt with. However, these design principles could as such not guarantee the viability of the new institutions in ARLID. This was influenced by other factors and mechanisms, both internal and external to the new institutions.

This thesis has shown that the *process* in which new and old actors together "practice" and modify institutional arrangements is more important than implementing institutional design principles that form these arrangements. The process of together practicing, molding, re-negotiating and modifying new institutional arrangements have helped WUA leaders, their members, and irrigation managers of both CNA and the WUAs to collectively re-define and re-establish mechanisms of operational, financial and political accountability. Some of these mechanisms have clearly helped to strengthen the organizations, while others have weakened WUAs and in some cases put them in jeopardy of existence. The most important mechanisms that strengthen or weaken the new institutions are summarized below.

1. Supporting institutional and constitutional reforms

An important precondition for IMT and water markets to work in ARLID, was that they were linked to similar pro-market institutions in the wider economy. Simply designing and establishing new WUAs, and asking them to take on O&M and financial responsibility would certainly not have worked if these new WUAs in ARLID would not have been imbedded and be supported by and framed around constitutional revisions of land (Article 27) and water acts. These revisions gave the new WUAs concessions for the use of water and government owned irrigation infrastructure. They also formed the institutional foundation for the WUAs to become financially autonomous. Similarly, formal manifestations of these revisions, such as the PROCEDE land titling program, helped WUAs to organize their membership and the representation of *ejidatarios* and private growers in the new WUAs. Hence, introduction of IMT and water markets in ARLID was an example of a clever mixture of institutional interventions that mutually supported each other.

2. Earning operational accountability: credibility, flexibility and transparency

To a great extent the viability of the irrigation institutions in ARLID is related to how the relationship between the local CNA office in Celaya and the new WUAs has provided room to jointly create operational accountability. The case of IMT in ARLID shows that accountability is not a mechanism that can be introduced by implementing and dictating new institutional arrangements. Instead, it has to be worked on to become effective. Effective accountability is something that has to be earned through a continuous process of negotiation. This study shows that three factors are important preconditions for earning accountability: *credibility*, *transparency* and *institutional flexibility*.

One of the strengths of the new irrigation institutions in ARLID is that both CNA and the WUAs have created sufficient institutional room and time to jointly work on creating and earning accountability. An important reason why CNA Celaya was able to become accountable during the later stages of IMT, was that already during the implementation stage of IMT, CNA had effectively seeded the process of earning accountability. This was done in the following ways.

- CNA kept their word on the conditions of IMT in terms of (among others): co-management and co-responsibility during the first 6 months of IMT; the handover of heavy machines; and, none of the former agency staff had to be taken over by the WUAs. Keeping their word certainly helped to make CNA *credible* towards the WUAs. On the other hand, CNA did lose quite some credibility as they did not keep their word on the kind of system improvement works that they had promised the new WUAs to arrive as part of the IMT program;
- Rather than imposing and prescribing the new arrangements that were drafted by CNA at higher bureaucratic levels, local CNA staff in ARLID operated quite *flexibly* with the new formal rules, regulations and O&M manuals. This has two reasons. As will be discussed below, the high levels of RWS values allowed both CNA and the new WUAs to continue the practice of administering water distribution, rather than managing water distribution. As a consequence, there was no felt necessity to apply and control stricter water management rules. Second, the practice of administering water also helped the CNA staff in Celaya to continue to be responsive to its management in CNA central offices (e.g. by monthly sending in their planned and reported performance figures). Being

administratively responsive towards higher bureaucratic levels, allowed local CNA staff to be flexible with the new institutional arrangements towards the new WUAs;

- Negotiations between WUAs and CNA over the conditions of operational arrangements for water allocation, water distribution, maintenance, system improvements and water marketing primarily took place in the hydraulic committee in which all WUAs participated. Although this committee is presided over by CNA, the local agency earned *credibility* from the WUAs as they effectively supported the committee to become an arena of negotiation for all kinds of O&M issues, rather than resisting or controlling the committee. Furthermore, CNA was prepared to share their experiences and information on water management issues with the WUAs in a *transparent* and accessible way.
- On those issues where CNA had difficulties in *earning credibility* (e.g. providing maintenance services for the main system and system improvements) they did not resist the WUAs' initiative to take over further responsibilities from CNA. Again, CNA gave the WUAs and their new federation (LRS) the room to build their own arrangements, which resulted in dramatically changing practices of maintenance;
- On the other hand, the factor that particularly weakened the process of creating operational accountability was CNA's poor performance in providing *clarity and transparency* about the volumetric water concessions (especially in times of water scarcity), and registration and monitoring of (both collective and individual) water rights in REPDA.

Also in the case of the new WUAs factors such as credibility, flexibility and transparency were important preconditions for starting to create accountability of the WUAs towards their members. Particularly Cortazar WUA's good performance in system maintenance, financial transparency and professional support from the administrative staff at the office has made the organization credible. Although farmers could not directly see the effects of increased maintenance on water delivery to their fields, they were very satisfied that for the first time in two decades they could see that the WUA took the farmers' request for improved maintenance seriously. Credibility among Cortazar farmers also increased after they observed that the leaders of the WUAs were prepared to fire ditch tenders and even higher management staff who had proved to practice rent-seeking in distributing water and in allowing illicit access to water.

However, the extent to which the WUAs have become operationally accountable varies considerably among the WUAs. The reason for this is that WUAs like Salvatierra have started to mix up operational and financial accountability with political accountability. Critical factors that encourage this mixing up of accountability are lack of both transparency and credibility as well as the lack of probity and supportive attitude on part of the WUA's leadership.

3. Being committed and engaged to sharing responsibility and authority

A crucial factor that allowed and induced the process of attaining credibility, stimulating transparency and creating institutional flexibility in ARLID, was the *supportive and responsive attitude* of the local CNA staff. This was particularly the case of the chief engineer of ARLID. This manifested itself for instance in the way this engineer supported the hydraulic committee and the LRS, or in his non-paternalistic way of being responsive to farmers' requests to mediate in their conflicts with WUA leaders.

Similarly, the joint process of earning accountability between CNA and the WUAs, would never have worked out without ambitious leaders like the ones from Cortazar and Valle WUAs, who were willing and strategically able to put their past negative sentiments about CNA aside and allow local CNA staff to prove their willingness to collaborate.

This study has shown that it takes a handful of committed people, like the above mentioned chief engineer and leaders of WUAs such as Cortazar and Valle, to start to carry the process of 'entrenching' new institutional arrangements in others' people's minds and behaviors. In the end, it needs probity, commitment and engagement of actors to get the work done. Before IMT these actors practiced irrigation management in a clear line of bureaucratic hierarchy, with CNA being the one that commanded. Also under IMT, CNA staff in Celaya could have chosen to maintain this attitude, trying to impose formal arrangements. However, the WUAs in ARLID were fortunate that the local CNA management was committed to jointly create room for co-management and new institutional relationships.

As actors and the way they behave are unique, it is important to realize that the above findings on ARLID can by no means be generalized for all Mexican irrigation district where institutional interventions take place. In his study on El Grullo irrigation district, Zaag (1992) observed that CNA engineers dictated the agenda of the irrigation commission, and monopolized information, resulting in discussions that had nothing to do with daily irrigation practices in the field.

4. Creating financial accountability: signaling out poor performance and favoritism

Cost-recovery by farmers and allowing the WUAs to be financially autonomous have helped the new WUAs to strengthen mechanisms of financial accountability in the following ways. The high fee collection rates on part of the WUAs helped them to create *room for negotiating* the reformulation of important institutional arrangements such as the percentages of total revenue that had to be paid to CNA, the level of water pricing, and the conditions and prices for water trading.

Similarly, the high level of cost-recovery by the WUAs put the CNA-Celaya office in a comfortable position as it met completely with the administrative goals of CNA central office in Mexico. As long as the administrative and financials goals set by CNA central office in Mexico City were met, CNA-Celaya could allow the new WUAs to practice and re-shape their own financial arrangements. To the WUAs this flexible attitude on the part of the local CNA office was a clear signal that they were taken seriously and that they were provided sufficient institutional *flexibility* to create their own ways of coping with daily management issues.

Financial accountability from the WUAs towards their users is strengthened by financial transparency. Cortazar's effort to openly share their financial statements and to hire external auditors clearly helped to build credibility and trust among their users. Similarly, their commitment to fire ditch tenders and other WUA staff that had proved to take bribes from users, also showed users that the WUA's leadership was responsive to farmers' complaints about rent-seeking practices.

Where the case of Cortazar has demonstrated how transparency can help to strengthen financial accountability on part of the WUAs, the case of Salvatierra has shown how lack of transparency and probity can weaken financial accountability. Evidence of manipulation of financial data, making illicit cheque payments, paying high salaries to befriended (but incapable) management staff, and openly allowing bribing practices gave rise to complete loss of financial credibility.

The example of Salvatierra also shows how lack of financial transparency and the consequent weak financial accountability mechanism is compensated by another financial mechanism that has forced the leadership of Salvatierra WUA to become more accountable. Although farmers from Salvatierra could never completely default from paying irrigation fees, they effectively used their refusal to pay higher fees as means to signal to the leaders their dissatisfaction with the WUA's policy of employing too many well paid management staff that were loyal to the WUA president's political aspirations. Similarly, they used this refusal to signal their dissatisfaction with the WUAs' maintenance policy.

5. Scaling up institutional capacity: reproduction of political accountability

The example of local shaping of institutional arrangements through the creation of operational and financial accountability mechanisms in ARLID, has shown how this can effectively encourage the scaling up of institutional capacity. When the WUAs were started, leaders and other WUA members had no idea about the functioning and the consequences of these WUAs for the control over water management in ARLID. As a result of the process of jointly creating operational and financial accountability, CNA, WUAs and individual water users realized that they were able to create their own institutional capacity for controlling decision making in irrigated agriculture.

Soon after their first experiences with creating institutional capacity for the WUAs, some WUA leaders started to scale up this capacity to higher institutional levels. Examples of this include the WUAs' increasingly important role in the hydraulic committee, and their success in establishing the federation of WUAs (LRS) to take over from CNA the control for main system maintenance. When the field work for this study was ended, leaders of the LRS and some other WUAs started to discuss the possibility of scaling up institutional capacity to the level of the entire basin through collaborating with WUAs of other districts, e.g. to jointly control decision making over water allocation within the entire basin.

Similarly, leaders of the LRS and of WUAs such as Cortazar, Valle and Salamanca have started to scale up institutional capacity to gain more control over other aspects of irrigated agricultural production. This is done by establishing side-line organizations for marketing inputs and produce, and by compensating the dismantling of previous institutional government services, such as handing out PROCAMPO statements. As a result, WUAs in ARLID now have also started to become important actors themselves as part of new institutions. A genuine danger here is, that new WUAs gain control over major parts of the agricultural production in ARLID, making water users institutionally too dependent on the WUAs. Although the scaling up of institutional capacity has certainly helped the WUAs to build up credibility among their members, it also bears the danger of increasing nepotism and political favoritism in it as it opens up opportunities for the new WUA leaders to extend their commercial and political networks. This requires check-and-balance mechanisms to control political accountability within these organizations. In this respect, particularly the experience with Salvatierra WUA has pointed to mechanisms that negatively influenced the institutional viability of the new institutions in ARLID.

The most important observation in this respect is the ease with which leaders of WUAs can reproduce and strengthen their control over decision making processes through the re-election and remobilization of WUA leaders. Although the *de jure* distribution of farmers representation in the boards and general assemblies of WUAs is well organized, evidence from WUAs such as Salvatierra demonstrate that the *de facto* control can remain in the hands of the same leaders. The two most important factors that support this kind of reproduction of control by these leaders, are favoritism and the expansion of networks and institutional capacity as described above.

Examples from Salvatierra and la Purísima WUAs also show that users have developed mechanisms that help to signal out and to some extent also balance the reproduction of control in the hands of leaders. The first mechanism used here shows similarities with the case studied by Moore (1989) in Taiwan: water users use their refusal to pay incremental fees as a signal of dissatisfaction with the leaders' employment (i.e. favoritism) and management policies. A second mechanism is the opportunity that particularly users in Salvatierra have taken to call for CNA and lawyers to mediate in conflicts between users and their WUA leaders. Rather than trying to ignore CNA as the former paternalistic and bureaucratic agency, under IMT farmers still strategically call for agency staff to monitor and regulate the financial and political externalities that emerged as a result of transfer of management responsibilities to WUAs.

6. *Matching institutions with irrigation technology*

This study has shown that the design of the irrigation infrastructure influences the institutional capacity needed for operating and maintaining the system.

ARLID is designed and operated to deliver water on demand to individual fields scattered over a large number of distributaries (which consequently all need to carry water continuously). As a consequence, there is a need for a high number of ditch tenders that have to run the canals in order to open and close gates of distributaries, field canals and individual plots. Similarly, this system of delivery on demand causes daily changes in volumes of water that have to be taken in by distributaries and field canals. This requires daily adjustments of the gates. Both factors influence the organizational requirement needed to operate the system: it takes organizing, employing and training a high number of committed and qualified ditch tenders to make such an irrigation system work. As was demonstrated with the example of Salvatierra, some WUAs lack the institutional capacity to meet these organizational requirements.

Vice versa, the institutional design of water management in ARLID also demands physical characteristics of the infrastructure that could help these institutions to work. For instance, one of the institutional components chosen as part of the new institutional arrangements is to build in mechanisms of financial sustainability through charging users a volumetric fee per hectare irrigated. This requires continuous monitoring of actual water deliveries to the fields. However, as was demonstrated in chapter 5, ditch tenders hardly measure volumes. In addition to the reason related to the reproduction of administrative accountability mentioned above, another reason why ditch tenders report scheduled rather than actually measured volumes, is that the irrigation infrastructure does not allow for measurements at individual plots. One way to solve this problem is to better match irrigation technology and institutional design, for instance to install simple measurement devices at the intakes of the distributaries (rather than at tertiary canal or plot levels) and at the same time introduce a system of volumetric charging at the level of distributaries rather than at individual plot level.

This study has also demonstrated how the quality of the infrastructure influences institutional requirements. In addition to the high level of land fragmentation in Salvatierra, also the poor condition of the irrigation canals and structures (and the consequent difficult water distribution) in this module contributed to the need to employ a relatively high number of ditch tenders. Similarly, the CNA office in Celaya lacked the institutional capacity to maintain and improve the main canal and its structures in ARLID. Lack of professional staff and CNA's earlier difficulties to recover fees from the users, were among the reasons that explained this institutional incapacity. Whether the new federation of WUAs (LRS) will be able to better maintain the main canal system, will depend in large on their capacity to employ and train staff for maintenance, as well as on their institutional capacity to jointly develop arrangements to allocate costs and benefits of improved maintenance among the WUAs.

7. *Linking institutions with water availability*

This study has demonstrated that the viability of the new irrigation institutions in ARLID is highly dependent on water availability. The associations in ARLID rely almost entirely on irrigation fees for their revenue. The amount of revenue is related to the number of irrigation deliveries that can be sold to the farmers. As a consequence, in years of low water availability and hence no irrigation deliveries, the WUAs will not have sufficient income to survive financially. As a result, during the dry year of 1997-98 some WUAs such as Salvatierra had to fire staff and close their offices. These experiences emphasize the need for creating a contingency fund. This, however, is hampered by high annual inflation rates. Other WUAs, such as Valle, could survive this dry year as they started to generate revenue from side-line businesses such as the renting of land leveling equipment.

Is water treated as an economic good?

This study has shown that market-oriented irrigation reforms have only partly stimulated water users to treat water as an economic good. This means that economic valuing of water by individual users, cost-recovery and water pricing, the process of fee setting, and water marketing are only in part determined by mechanisms of rational choice and economic maximization. As is illustrated by the three examples below, the use costs and opportunity costs of water continued to be determined by administrative and socio-political processes of decision making as well.

Cost and value of water. The cost (i.e. price) of water to farmers has increased as a result of IMT. Yet, unlike general belief this increase has not been dramatic. Certainly compared to other costs of production, the price of water is relatively low. As a result, farmers did not change their irrigation practices in an attempt to use water more efficiently, nor did they re-allocate their water use to economically more beneficial export crops. Rather than maximizing net economic returns per m^3 of water, farmers are more concerned about maximizing net returns to overall (water, inputs, etc) crop investments per hectare. The cost of water plays a relatively little role in this respect.

Although the cost of water is low, farmers in ARLID are aware of the value of water. However, they perceive water as a productive agent rather than a cost. As was discussed at length in chapter 5, farmers apply high levels of RWS to avoid the risk of crop failure. Rather than spreading water more thinly over a larger area, they prefer to maximize returns per hectare cropped. In the context of diminishing crop subsidies and dismantled state credit and insurance systems, and consequently the high production investments farmers make, they cannot risk any crop failure. As such, market-oriented policies other than increased water pricing have had a much greater effect on the way farmers value water. Even with prices of water much higher than those that are paid currently, farmers will prefer to apply large volumes of water as they feel that this would guarantee them economic returns to high investments in other inputs. This is also reflected in the high prices farmers are willing to pay tubewell owners for additional water that need to safeguard their investments during dry seasons when canal water is hardly available.

Cost-recovery, water pricing and fee setting. IMT has resulted in a dramatic increase in cost-recovery rates by WUAs and in a consequent high level of financial self-sufficiency of ARLID. In that sense, the establishment of WUAs in ARLID has been very instrumental to achieving the government goal of reducing public investments in systems like ARLID. So, in this respect IMT has been beneficial to CNA.

To the WUAs and users, cost-recovery and water pricing have proved to be useful mechanisms to make CNA and the WUAs accountable. As was discussed above, this has helped the WUAs to negotiate greater room for financial autonomy with CNA as well as to negotiate the fee level. However, unlike general economic assumptions, in ARLID full cost-recovery and financial autonomy have not provided incentives to price water at its opportunity cost. This is even the case in ARLID, where the presumed (Saleth 2001) necessary technical conditions (e.g. water measuring devices) and supportive institutions (e.g. water rights; financially autonomous WUAs; regulatory agency) were by and large in place. What then are the reasons why water pricing did not reflect the scarcity value of water, or did not equalize opportunity costs?

Water pricing and setting of irrigation fee levels were the result of both administrative directives on the part of CNA and of negotiations between WUAs and CNA in meetings of the hydraulic committee. These negotiations were fed by strategies other than those related to economic maximization, and included: creating solidarity and equity among WUAs, whose main concern was to stay together in the LRS; and, creating trust and credibility among the users, and hence trying to keep prices as low as possible. As a result, although not subsidized by CNA, irrigation fees were held low and did not keep pace with other economic developments such as the dramatic increase in annual inflation rates that followed the economic crisis of 1994.

To farmers the political and social meaning of irrigation fees is often more important than the economic one. As was demonstrated with the example of Salvatierra, the reason why farmers refused to pay higher fees, was to signal their dissatisfaction with the WUA rather than to attempt to reduce the cost of water.

Water marketing and opportunity costs. Also in the case of water marketing, water is hardly treated as an economic good. According to Kemper (2001), water markets and the consequent re-allocation of water on higher-valued uses, will emerge when institutional arrangements such as tradable water use rights, appropriate infrastructure and transaction mechanisms are in place. Although ARLID meets these arrangements, water trading is still limited and certainly not organized around economic principles such as pricing traded water at opportunity cost levels.

As was demonstrated in chapter 8, prices paid for traded water are generally much lower than prices paid by farmers for water that is allocated under regular arrangements. This is even the case during the summer irrigation season, when some WUAs depend almost entirely on traded volumes for their total water delivery. This suggests that the opportunity cost of water should have increased. Yet, prices of traded water are very low. In ARLID, the most important factor that explains this, is the WUAs' willingness to build up solidarity within the hydraulic committee. This has particularly become important after all WUAs were federated into a LRS to jointly negotiate with CNA the taking over of responsibilities for main system maintenance. Although both buying and selling WUAs do include economic considerations on opportunity costs in their negotiations over prices and volumes of traded water, prices are eventually determined by socio-political factors rather than economic ones.

Similarly, also prices that individual farmers need to pay for water that is traded between WUAs are kept low. Rather than trying to sell water at its highest possible price, WUAs prefer to sell water at a low price. The reason is that even when a WUA has used all of its concessioned volume, it sometimes can still buy and deliver water to those farmers who had already paid for an irrigation delivery. WUAs do not want to default on these farmers as they are afraid that this might hamper the credibility that they have earned among the users.

These findings show that to farmers and WUAs market oriented incentives such as the (use and opportunity) cost of water have hardly encouraged users to treat water more efficiently. To individual producers in irrigated agriculture neoliberal reforms such as the diminishing of crop subsidies and credit, as well as the constitutional revision which encourages land markets, have had more effect on their economic positions than IMT and the introduction of water marketing.

Although economic efficiency in water use has proved to be a minor factor in irrigation management under market oriented arrangements of IMT and water marketing, these policies have provided opportunities to create room for negotiating new institutional arrangements for local water managements. These have particularly resulted in improved mechanisms of financial accountability between the new management organizations and the users. Yet, it does not necessarily need market-oriented policies such as IMT to establish the same. However, the government needed policies such as IMT for achieving their neoliberal aim to reduce public expenditures in irrigated agriculture.

Impact of IMT and water markets on irrigation performance

Much of this thesis deals with assessing the impact of IMT and water marketing on local irrigation performance. Chapters 5 and 9 provide detailed analysis of these impacts, which can be summarized as follows.

Water use. Farmers' increased involvement in system O&M through IMT has not led to major improvements in operational performance. With the exception of some WUAs like Cortazar, generally WUAs have so far followed the same allocation, distribution and reporting practices as used by CNA prior to IMT. By continuing the practice of reporting water deliveries close to planned targets, rather than actual deliveries, the water management regime continues to be one that can be characterized as "water administration" as it complies with the bureaucratic practices and requirements that they were used to before IMT. In that sense, one can conclude that effective mechanisms to support operational accountability that complies more with actual institutional requirements have not been introduced as a result of IMT. Instead, as far as system operations are concerned, mechanisms of *administrative accountability* (see next section) have been reproduced.

As a result of the continuation of administrative accountability, operational accountability is neglected: reporting administratively desired levels of water deliveries are considered to be more important than negotiated actual deliveries. As a result, RWS values at all levels also continue to be high. Particular in Salvatierra, RWS values were extremely high during the first years after IMT. This indicates that the new WUA was not able to deal with the module's high level of land fragmentation; nor to match its water distribution regime with the poor quality of its infrastructure, *or vice versa*. Although it is hard to correlate this kind of over-usage of water to the quality of the WUA management, the political unrest and high level of favoritism in the employment of well paid WUA staff would certainly not have helped to bring RWS values in Salvatierra more in line with the district's average.

As was discussed in chapter 5, these high RWS values at all system levels also explain why clearly observed spatial differences in the distribution of water hardly affects the access of farmers to water. Preferential access, however, does exist in the case of some large farmers, friends of WUA leaders, and particular by farmers (small and large) who also have access to well water. As was described in detail in chapter 6, a main mechanism to illicitly get access to water is through bribing ditch tenders and in some cases management staff of WUAs. This practice already existed before IMT and as such has not changed. However, the establishment of WUAs, and particularly the election of some leaders, has brought another mechanism of getting access to water to the light. As the case of Salvatierra has shown, favoritism can dramatically influence the water management regime. This brings us back to the question of how to deal with checking mechanisms of political accountability discussed above.

Some initial studies point out that high levels of RWS in surface irrigation are necessary to reduce the dramatic decline of the groundwater table (Scott and Garcés-Restrepo 1999). As the transfer program mainly aimed at improving the use of surface irrigation, it was not expected that major changes in groundwater use would occur as a result of transfer. Yet, it is apparent that the alarming level of overexploitation of aquifers by well owners in ARLID is not being reduced. Although CNA will continue to be the authorizing institution that controls the aquifers, transfer has resulted in a considerable reduction in the role and mandate of CNA in the State of Guanajuato. As a consequence, it will become more and more difficult for CNA to adequately monitor aquifers. WUAs do not seem to have the interest, nor the legal authority to assume that role.

Maintenance. One of the most positive impacts of the IMT program in ARLID has been the considerable improvement in maintenance services, especially at lower system levels and in the case of drainage canals. Whereas individual users are positive about the changes in maintenance and system improvements, WUAs still complain about the lack of support from CNA at the main system level. This has stimulated the WUAs to found the LRS, which has taken over from CNA the responsibility for maintaining the main canal system. Furthermore, it is not clear what the impact of increased maintenance has been on the performance of water delivery at all levels of the systems. However, as was explained above increased maintenance certainly helped to build credibility and accountability of the WUAs' management towards their members.

Productivity. The findings presented in chapter 9 do not provide convincing evidence that there has been any effect of the transfer program on agricultural and economic productivity. Although fluctuations can be observed, even after transfer, it is believed that these are related to other recent developments in the agriculture sector such as the dismantling of credit and subsidy systems, input price policies, and, most of all, price changes in the world commodity markets.

These findings might disappoint policy makers as they do not reflect the general belief of many irrigation policy makers and researchers that IMT and water marketing will have major impacts on irrigation performance. However, it is still important to realize how in ARLID IMT and water marketing have affected irrigation arrangements, practices and management strategies. These have helped most WUAs to gain more control over decision making for local water management.

10.3 A conceptual and methodological revisit

Some conceptual considerations and lessons

Need for a more integrated approach to study irrigation institutions

Most IMT studies referred to in this thesis use neo-institutional approaches and economic parameters to describe changes and trends as a result of intervention programs. As was argued in section 1.3, a complementary and more extended approach is needed to analyze the practices, strategies and interactions of local irrigation managers and users involved in IMT. Rather than applying and testing institutional design principles for irrigation institutions (e.g. Ostrom 1992; Vermillion and Sagadoy 1999), this study has shown that an extended approach is also useful to analyze the mechanisms and processes that influence the viability of institutions.

This study shows that ideas on the *institutional requirements for use* of irrigation technology should be further conceptualized and be added to the general notion of the Wageningen school that irrigation is a sociotechnical phenomenon. Similarly, this study shows that conceptual frameworks used for analyzing institutions are limited in their understanding on how technology, water scarcity and environmental conditions shape the viability of institutions.

This study has also shown that the formulation, implementation and working of institutions should be viewed at as a continuous *process* of reformulation and negotiation of institutional arrangements. Rather than focussing on the description of the manifestations of institutions (such as design principles, bylaws, rules and regulations), analyzing processes and mechanisms help to explain why institutions work the way they worked. By observing *practices*, *strategies* and *interactions* between all actors involved in constructing, implementing and applying new institutional arrangements, it can be explained why and how these arrangements are adopted and transformed. It also shows that institutional arrangements are a mixture of formal prescriptive arrangements, existing arrangements and newly negotiated arrangements. This explains why new institutions, once they are implemented, manifest themselves as being *contingent* rather than static structures.

The recognition that both existing and new institutions are the result of a process of continuous negotiation, and consequently contingent, is an important one. It requires the application of a set of conceptual tools other than the ones more commonly used in the perspective institutional design models and rational choice approaches (see section 1.3). Of these concepts, accountability was central to this thesis. Its applicability will be briefly discussed below.

Different forms of accountability

Three forms of accountability were introduced in section 1.3: operational, financial, and political. Operational and financial accountability are concepts that have proved to be easy to apply. The reason for this is that both concepts refer to monitoring and controlling the liability of irrigation managers and leaders to show that there has been efficient management and adherence to agreed upon O&M targets and use of funds, respectively. Both O&M service levels and use of funds can relatively easy be defined, understood and monitored in a transparent way. The concept of political accountability, though useful, has proved to be more difficult to apply. 'Service levels' related to control over decision making processes, election of leaders, equitable access to water and resources are difficult to capture in agreements that can be monitored and controlled. Still, an important lesson that can be drawn from this research is that political accountability cannot be disregarded as it dramatically influences the way key actors cope with new institutions.

In irrigation literature, notions of operational accountability and financially accountability are often taken together, mixed and referred to as if they were similar concepts. This is particularly the case in those studies that link cost-recovery and financial autonomy to levels of O&M services in the situation where the latter depends on the former (e.g. Svendsen 1993, Oorthuizen and Kloezen 1995). This thesis has demonstrated that indeed operational accountability and financial accountability are related in the sense that success in cost-recovery was used to re-negotiate O&M service levels as well as to signal dissatisfaction with O&M service levels. Yet, this thesis also shows that is it useful to separate different forms of accountability for three reasons.

First, separation of different forms of accountability pointed to liability of service providers that go beyond those related to O&M services. As was discussed at length in chapter 1, much of the literature on irrigation reforms takes a rather deterministic and instrumentalist approach in planning institutionalized change. Particularly in the case of IMT, water marketing and other 'less state more market' policies, successes and failures are measured against changed levels in financial and O&M performance. Although useful, this approach is limited in the sense that it perceives accountability (in general terms) to be exclusively led by considerations of financial efficiency and by cost-related water use, and little more. Yet, this thesis has shown that the viability of new irrigation institutions are also influenced by the way the providers of irrigation services meet 'targets' other than those merely related to cost-recovery and O&M performance. A conceptually clear separation between operational and financial accountability, has helped to also make important observations on the way irrigation managers and leaders show liability for the way they create more transparency, and how they cope with rent-seeking behavior. Similarly, applying the concept of political accountability also facilitated to study mechanisms other than those related to efficient management of funds, water and resources, but yet important for understanding the viability of irrigation institutions.

The second reason why it has proved to be useful to separate three forms of accountability is that this has helped to unravel in *what way* providers of irrigation services are accountable, or not. Rather than concluding that IMT or water marketing has helped to make irrigation managers and WUA leaders more accountable for achieving O&M performance targets, it can be made explicit how these accountability mechanisms work, and how they do not work.

Separation of different forms of accountability also led to observations of a fourth form of accountability, which only came to my notion through detailed observations on the other forms of accountability. This fourth form is what earlier in this chapter was referred to as *administrative accountability*. The example of irrigation management staff (both from CNA and the WUAs) reporting planned volumes rather than actually measured volumes, suggest that they are less concerned about efficient water use (operational accountability), nor about delivering volumes that a user has paid for (financial accountability). Instead, all irrigation managers, from WUA ditch tenders up to the level of the CNA district engineers seemed to be predominately concerned about showing their liability for achieving *administrative targets*. These actions do not only encompass producing and submitting data that adhere to targets and budgets at the level of the irrigation agency. Administrative accountability also includes the commitment of the local CNA engineers to steering and fulfilling policies and programs while also allowing institutional flexibility for WUAs to develop effectively.

The fact that the four forms of accountability can, but do not necessarily, refer to achieving similar sets of targets, brings us the third reason why they should be studied both separately and in relation to each other. The 'marriage' between operational and financial accountability in most irrigation literature, implicitly implies that all providers of irrigation services aim at achieving similar targets and goals, i.e. thus related to cost-efficient use of scarce resources such as water. However, as Du Gay (2000) has convincingly argued, private and public agencies hardly ever share the same interests, targets and management ethos. Yet, particularly in the field of IMT debates, public and private organizations are considered to be mutually exchangeable. This ignores the differences in management values these entities have. As a result, it also ignores the fact that in the context of public-private co-management, these different organizations can have competing management values and targets. As a consequence, also the way they aim to be accountable can be different and competing. An exclusive emphasis on private (or more market) values as efficiency, economy and effectiveness in irrigation management and hence the exclusive focus on operational and financial accountability, can have serious implications for the degree to which administrative and political accountability can be secured. Certainly in the context of IMT and other forms of joint agency-farmer management in irrigation, further conceptualization of different forms of accountability is needed, as well as on how they are related. This would help to show how different organizations (and different levels within these organizations) negotiate different sets of targets, norms and values to which they want to adhere. Whether these targets, norms and values compete with each other, or enforce each other will to a great extent determine the viability of new institutions in which both private and public agencies are supposed to be accountable for achieving improvements in irrigation management.

Finally, this study was also started with the recognition that accountability has to be *earned* through processes of *negotiation*. This study has shown that accountability cannot be just installed as part of a set of new institutional arrangements. Rather, these arrangements are contingent. The notion of *contingent institutional arrangements* emphasizes that arrangements by process are more important than arrangements by recommended design to allow for local transformations of proposed design principles. As was demonstrated in the empirical discussion above, factors that help to explain the viability of contingent institutional arrangements include: room to create and earn institutional flexibility to modify arrangements; time and institutional room to earn credibility; probity and committed attitudes towards institutional change on the part of key actors involved in intervention processes; and transparency in flows of information.

Treating water as an economic good

Concepts such as use costs, opportunity costs, value of water, water pricing, financial accountability, financial autonomy have proved to be useful, particularly to describe to what extent government and management goals have been achieved or not. However, these concepts are limited in the sense that they do not recognize strategies other than the ones related to economic maximization and rational choice. An important conceptual recognition is that cost-recovery, financial autonomy, water pricing and water marketing are socio-political constructs as well. This helps to understand why irrigation managers and users often do not follow economic incentives to treat water as an economic good. Even when all technical (infrastructure; measuring devices) and institutional arrangements (water rights; regulatory agency; cost-recovery; financial autonomy) are in place to support water pricing at opportunity cost levels or to support water marketing, water users (buyers and sellers) still might value water far below its opportunity cost.

Assessing impacts of institutional interventions: some methodological lessons

Validity of comparative indicators

This study has shown that application of comparative indicators is a useful tool to *measure* and *describe* the *trends in changes* that have occurred as a result of the type of market-oriented interventions that were discussed in this thesis. However, these indicators are not enough by themselves. The nature of these indicators are clearly economic input and output oriented. This makes them useful for assessing directions of effects of institutional interventions whose goals follow a similar economic orientation. However, their usefulness is limited to assess impacts other than economic ones, such as changes in equity, livelihood, health and environmental hazards.

Policy makers and interveners of IMT and water markets clearly were aiming at improving the economic performance of the irrigation sector in Mexico: less public expenditures, higher cost-recovery, higher economic outputs per unit of water and land, and more 'efficient' use of available scare water resources. Particularly the SGVP per unit of land cropped and per unit of water delivered proved to be useful for testing the assumptions behind these policy goals. They helped to test the assumption of policy makers that farmers will use water more economically as a result of market forces. Calculation of outputs per ha of command and per m^3 of water consumed require a considerable extra research investment, and were only useful to compare with outputs per ha cropped and per m^3 of water delivered, respectively. This comparison supported the general observations that were made during the field stay, that farmers prefer to maximize outputs per unit of land cropped, rather than spreading water more thinly or maximizing outputs per unit of water.

The main problem, however, with the productivity oriented indicators is, that they do not clearly help to assess the impact of a single policy like IMT on land and water productivity. The most important reason for this is a simple one: IMT is only one out of a range of market-oriented policies that were implemented since the early 1990s. As such, changes in trend-lines, if any, cannot be fully correlated to IMT. However, the validity of these indicators for this thesis is still that they helped to demythologize the general belief among many people involved in the formulation and implementation of IMT in Mexico, that this policy has had positive impacts on land and water productivity. However, given the investment needed to generate these indicators (see Appendix 8), their usefulness on a large scale for policy impact assessments remains questionable.

The RWS indicator is the one that was most used in this thesis. Application of this indicator proved very useful for two reasons. First, unlike the more commonly used indicator of "efficiency", RWS has no normative connotation, meaning that high values do not necessarily reflect poor performance (see the discussion in section 5.8). This makes it a powerful indicator to describe changes, rather than to normatively judge changes in water management. Second, when compared to planned and reported values, the measured RWS values proved to be a good indicator of internal operations as well. Using one type of indicators for both comparative assessment and internal assessment is important to arrive at the kind of standardization of indicators that irrigation researchers and managers are looking for (Bos *et al.* 1994).

The validity of the financial indicators for assessing the impact of IMT on financial performance of irrigation districts is self-evident, as they exactly generate the type of information wanted by policy interveners and irrigation managers alike. However, the problem that arises here is more related to the meaning and accessibility of the secondary data that are needed to calculate the financial indicators. This is discussed below (see also Appendix 8).

Applicability of comparative indicators

One of the methodological assumptions tested in this study was that comparative indicators for assessing impacts of institutional interventions are less time and resource consuming than the application of internal operations indicators, which most irrigation researchers still prefer to use (also for the assessment of impacts of interventions). This would make these indicators, it was assumed, appealing to policy makers, interveners and managers of irrigation systems.

Appendix 8 gives a detailed evaluation of the methodological problems and constraints that were encountered while collecting and processing the data needed for applying both methods. Compared to the application of internal operations indicators (which generally requires daily measurements at different system levels), the application of comparative indicators is less time and resource consuming. However, the large size of the system, the several system levels, the diversity in crops, irrigation technologies and seasons explain why collecting, verifying, and processing the basic data for comparative indicators were more complex and time-consuming than anticipated.

Generation of comparative data relies on availability and quality of secondary data. This study has shown that simultaneously applying comparative and internal operation indicators, was useful to both cross-check the quality of secondary data and to deconstruct the meaning of these data. As was demonstrated in detail in chapter 5, reported data (aggregated from individual plots to entire modules) do not necessarily reflect actual deliveries, but rather match planned deliveries. Only as a result of our daily and intensive measurement program and observations of irrigation practices at several levels within the system, the real meaning of the reported data that were collected from the CNA office came to light. Most research programs, however, do not allow for such an investment in time and resources and will no doubt start using official reported data that can be found at the district office.

Collection of financial data pointed to a similar problem. It took months to really grasp the meaning and quality of the data that were collected at several levels. Compatibility of data sets proved to be the most problematic one. This is highly related to the number of institutional changes within the agency and the consequent change in data entry formats.

Choosing several WUAs within one system

The idea behind selecting Cortazar and Salvatierra as the two main units for this study was that this would show the diversity in ways farmers and local irrigation managers cope within a framework of similar and new institutional frameworks, such as IMT, and under similar physical, environmental and managerial conditions of the district. Was this a wise choice and what lessons can be drawn from this?

- The empirical material of this thesis shows the diversity observed between the two WUAs, which appeared to be too wide to make a clear comparative study possible. Although both WUAs operated in the same institutional and environmental context, there were simply too many characteristics that were unique to each of these two WUAs. The high level of land fragmentation and the high number of small holdings (including private growers) in the case of Salvatierra; a WUA leader in Cortazar with more than 20 years of commercial farming experience in the United States; to name just a few;
- Yet, there has been a major advantage of making daily observations in two WUAs that differ so much. It certainly helped to better challenge the kind of generalizations that had become so common in the Mexican debate on IMT. Had this research be done only in Cortazar, it certainly would have arrived to similar kind of uncritical and unconditional positive conclusions on IMT discussed in section 1.2. Instead, the selection of two entirely different WUAs showed the high level of diversity in strategies to cope with building and strengthening their institutions;
- Doing research in two different WUAs has helped to clearly flag out mechanisms of the modes of accountability, that otherwise would have remained unobserved. For example, only by observing general assembly meetings in two different WUAs, the different mechanisms that influence financial and political accountability emerged. Similarly, the idea of creating accountability through allowing institutional flexibility in the arrangements for maintenance would not have become so apparent without the opportunity to observe how CNA and the WUAs of Salvatierra and Cortazar used such different strategies and styles of interactions in the process of creating accountability within the same institutional framework of one irrigation district.

10.4 Some implications for market-oriented policies in irrigation

Market-oriented reforms need IMT, not necessarily vice versa

Chapter 3 shows how IMT and water market polices were shaped by a number of other privatization, deregulation, liberalization and political democratization movements that were started in the early 1980s. Many of the water-minded technocrats involved in these movements have become key-actors in re-organizing the administration of water related government responsibilities (by creating CNA), and subsequently implementing the IMT program. In this light it is important to realize that the Mexican government has used IMT and the introduction of water markets as logical *instruments* to achieving these wider political economic goals. This may sound obvious, but it contrasts with some of the support to IMT on the part of advocates of participatory irrigation management (e.g. Groenfeldt and Sun 1997), who seem to narrow down their focus to *participation as a goal in itself*, without placing this in a wider political-economic and policy context.

There are three problems with this narrow focus on IMT or participatory irrigation management. First, 'participation' has a positive connotation, and few people would argue against greater farmer involvement in irrigation. However, the populistic and uncritical use of the concept of participatory irrigation management becomes problematic if it does not invite policy makers and interveners that advocate participatory management to make the economic and political agenda that are attached to participation explicit. Is farmer participation promoted from the point of view of inducing greater farmer's control in decision making and policy formulation, or are the reasons more instrumentalist in the sense that participation is seen as a tool to achieve improved irrigation management?

The second problem with the narrow focus on IMT and participatory irrigation management, is that it directs the eye away from the policy context in which farmer involvement is encouraged. Indeed, in the case of Mexico, IMT and water markets are clearly designed and implemented along market-oriented lines. However, not in all cases is the promotion of farmer participation in the local irrigation management geared towards neo-institutional issues of cost-recovery and utility maximization in irrigation. Hence, the international and rather deterministic attention for IMT policies as *the* market-oriented policy in irrigation does not help to really understand why and how these policies were designed and implemented, and the kind of effects they have on farmers' positions and irrigation performance at the local level. What helps, however, is to recognize that IMT does not necessary need market-oriented reforms. However, the kind of market-oriented reforms as they were envisaged by the Salinas and subsequent administrations and the international loan agencies by whom these administrations were supported, do need IMT-like programs to be successful in achieving their wider political economic goals.

The third problem with stressing the perceived need for farmer involvement in irrigation too much is closely related to the one described above. The overwhelming attention for farmer participation, generally through the establishment of WUAs, leaves little room for discussing, analyzing and restructuring the other end of the institutional chain, where at least a part of the problem with ineffective institutional arrangements are located: the irrigation bureaucracies. It is striking how little academic and policy attention is paid on the processes of institutional change within these bureaucracies. In most cases of IMT, the scale and mode of farmer participation is predominately designed by irrigation agencies. However, so far little has been documented on these institutional design processes within the bureaucracies, nor on the political and institutional implications of farmer participation for these bureaucracies.

Mexican IMT as a policy model for similar programs worldwide?

The Mexican IMT program includes all the ingredients to classify it as a typical institutional blue-print model: it follows a top-down and bureaucratic approach; its implementation is centrally organized; it was initiated and formulated by a very small and selected group of government officials and international representatives of loan agencies; there was very little room for farmer involvement at the stage of policy design, nor for public discussion; future leaders and farmers of WUAs were taken by surprise when they learnt about the program; it was very prescriptive in the sense that it used detailed manuals that dictate rules and regulations; and, it has been implemented speedily at a wide scale rather than using a long-term process and learning approach at a much smaller scale.

These blue-print models have been heavily criticized since the 1970s. Yet, as was described in chapter 1, worldwide the Mexican IMT model is regarded as an example of how IMT could be implemented. Although the scale and speed of the program will certainly be appealing to policy makers in other countries, the question remains whether the Mexican model is applicable for countries as diverse as Turkey, India or Pakistan.

In order to answer this question, one should take a look at the characteristics of this model and evaluate to what extent these can be translated to conditions outside of Mexico.

No reform without political commitment

Probably the most important characteristic and lesson that can be drawn from the Mexican model of market-oriented irrigation reforms are that they were designed and implemented with the full commitment at the highest political (presidential) and administrative (senior irrigation bureaucrats) levels. As discussed above, the reason for this support was that these politicians and bureaucrats realized that they needed IMT-like programs to achieve their wider set of neo-liberal and pro-market reforms. At the same time, they were supported by international loan agencies that envisaged the same kind of reforms as these would help Mexico, for instance, to join NAFTA. This kind of support clearly helped to face out any kind of resistance from the labor unions within the agency. This in turn helped the future WUAs to negotiate that none of the former agency staff (particularly ditch tenders that had proved to be corrupt) had to be taken over by the WUAs. Instead, they were made redundant and WUAs started to hire their own staff.

Supported by and part of constitutional reforms

An important feature of the Mexican irrigation reforms, is that it was clear to both implementers of the IMT model and the farmers that had to adopt IMT that these reforms did not come on their own. Rather, they realized that it was part of a wide range of similar reforms, of which the constitutional revision of Article 27 of the Agrarian Law and the revision of the Water Act were the most important ones as they totally reshuffled the way control over land and water rights would be organized. IMT could never haven been introduced without these other reforms and constitutional revisions. In many countries revisions that support the re-distribution of land water rights along market lines as well as devolution of authority and management control meet a lot (of political) resistance (see e..g. Kloezen 1995 and 1996 on Sri Lanka). Unlike these countries, Mexican political leaders were very consistent in their ways to push these reforms as a package of interventions that are closely interdependent. When farmers were confronted with the idea of IMT, they realized that it was already too late to effectively resist IMT as such. Although this might be appealing to policy makers and interveners, the experiences reported in this thesis show that farmers will only adopt and carry the reforms –irrespective of how effectively they have been introduced- if sufficient credibility, transparency and institutional flexibility are created by local managers and farmers to reshape the new arrangements that have come with the reforms.

The fact that IMT and water markets were manifestations of much more radical and enduring reforms like the two constitutional revisions made farmers realize that the establishment of new WUAs framed around these legal revisions was a policy that was going to last.

Safeguarding equity: building on existing institutions

A third important characteristic deals with the way the Mexican government has used the existing institutional infrastructure as a vehicle to promote and implement IMT. Rather than drawing new institutional lines for the organization of WUAs, the design, promotion, implementation of IMT were clearly built on existing institutions: the *ejidos* and the organization of private growers. By institutional design, both groups had to be represented in the new WUAs; *ejido* meetings were used to promote IMT; and representatives of both groups were appointed to start implementing the program. This thesis has shown that in the case of market-oriented irrigation reforms in ARLID, *ejidatarios* were generally still able to use existing institutions to safeguard their socio-economic position in the new institutions for local water management. As long as WUAs are able to build in mechanisms that prevent WUA leaders from using their positions for further political and economic aspirations through nepotism and favoritism, there is no reason to suspect that the new institutional arrangements for water management by themselves will induce further socio-economic differentiation between private growers and *ejidatarios*.

However, although IMT was built on existing institutions of *ejidos* and organizations of private growers, there is a growing concern that at the same time the wide package of constitutional and market-oriented reforms will dismantle these institutions. In general the constitutional changes have been received with a lot of concern on the part of socially and politically engaged scholars (see e.g. Cornelius and Myhre 1998, De Grammont 1996a and 1996b, and Randall 1996). They are particularly concerned about the effects of the revision of Article 27, which makes it possible to trade *ejido* land. This will totally reshuffle the organization of agrarian production, particularly in irrigated areas. This might cause increasing social and economic disparities between *ejidatarios* and private growers. As was noted earlier, the package of institutional reforms was overwhelming, leaving little room for negotiating equity issues such as the redistribution and marketing of land rights.

Creating financial autonomy and financial accountability

The Mexican government realized that the only way to boost cost-recovery in irrigation and at the same time provide (financial) incentives to improve irrigation performance, was to give the newly established WUAs a certain level of financial autonomy. As many farmers were disappointed by the levels of O&M services provided by the agency prior to IMT, they were eager to take on the financial responsibility to manage these funds and use them to improve the quality of irrigation services. The example of ARLID has shown that permitting financial autonomy is an important precondition for creating mechanisms of financial accountability. However, financial autonomy and financial accountability only function if mechanisms that prevent favoritism and mere political and economic abuse by WUA leaders are worked on as well.

Institutional irrigation reforms and technological modernization

There is a relationship between the physical lay-out, water supply and management regime of the irrigation system and its organizational and institutional requirements-for-use. Yet, under the new institutional arrangements neither water users nor CNA have started to introduce or facilitate system improvement works that would be more compatible with the institutional capacity of the new WUAs.

As was discussed in chapter 4, the World Bank loan for system improvement works had not fully arrived. However, other funds for system improvement works were generated and new technologies have started to be introduced into the irrigation districts (see section 9.5).

Unfortunately, these technologies comprise standard packages of techniques that basically aim at improving water use efficiencies at the field and lateral levels rather than irrigation technologies that better meet the management objective and organizational capacity of the new WUAs.

This example of a mismatch between institutional reforms and technological modernization interventions is not an exception. Rather than being introduced simultaneously, often institutional interventions such as IMT *follow* investment policies for modernizing irrigation infrastructure. Examples from e.g. Pakistan (Halsema, forthcoming) and Indonesia (Bruns, forthcoming) show that the call for technical modernization have a better reception on the part of loan agencies and national governments than the call for institutional transformation. Bruns (*ibid.*) even reports how a program, which initially aimed at institutional strengthening, was transformed into a construction program. Although initially farmers contributed to discussing the type of construction needed, soon the discussion on construction was controlled by the agency, resulting in permanent headworks that the WUAs had no need for.

These examples demonstrate that technical and institutional components of these "integrated" modernization programs are often clearly separated in two ways. Not only does the introduced technology not match with the organizational capacity of the WUAs, it also does not match with the institutional capacity of the irrigation agency to construct, operate and maintain the new technologies.

This kind of mismatches between modernized irrigation technology and institutional interventions in irrigation certainly call for more in-depth synthesis of two issues. First, how are technology and institutional requirements-for-use related? Second, how are modernization policies and institutional intervention policies ideologically and politically constructed, and how are these policies related?

Rather than confronting WUAs with new technologies, which maybe they cannot manage financially and organizationally, loan agencies, CNA and similar agencies worldwide could play an important role in helping the new WUAs to get access to investment and system improvement funds. These funds could be spent on technologies that better match with existing institutional arrangements and practices for managing irrigation technologies. Whether these technologies are fully automated control structures, or more simple technologies is then a choice that WUAs themselves will have more control over. As a consequence, the chance that these technologies are adopted, co-financed and maintained by the WUAs is expected to be much higher.

Is there still a role for irrigation agencies?

Some authors estimate that by 1997 approximately 5,000 out of more than 7,000 CNA staff had been released (Svendsen *et al.* 1997). As was discussed in chapter 4, the new WUAs were not obliged to take over agency staff that had been made redundant. Instead, the WUAs started to hire their own staff. The sized-down agency realized that they had to undergo major restructuring and that consequently a new mandate and other roles had to be sought. CNA-Celaya felt it was going to face a difficult time to find and internalize these new roles. By 1998, when field work for this thesis had come to an end, the local CNA office had not yet fully changed its new mandate and roles. Yet, the contours of these new mandate and roles were becoming more and more visible and provided the following ideas on the future of CNA, and possibly similar agencies in other countries.

First, the agency could play an important role in managing water at the level of the entire basin. As was demonstrated in chapter 2, there are clearly problems in terms of sustainable and equitable water allocation within the basin. The primary institutional mandate of CNA could be to clearly define, give out and monitor water rights and concessions at the basin. It could also play an important role in facilitating the process of scaling-up of irrigation management organizations and federations at the basin level. This could be similar to how it has institutionally facilitated the creation of the hydraulic committee and the federation of WUAs at the district level.

Second, rather than dealing with daily O&M issues, CNA could play a more active role in guaranteeing, establishing and monitoring the institutional pre-conditions for the functioning of viable WUAs. These pre-conditions include clearer water rights and concessions; facilitating technical and administrative training for WUAs staff; facilitating access to system improvement and rehabilitation funds; and, stimulating the creation of contingency or sink funds to make the existence of WUAs less dependent on revenue from irrigation fees, especially during years of water scarcity.

Third, the primary focus of CNA (and many similar agencies worldwide) has always been on both surface water and water quantity. However, as was demonstrated in chapter 5, the environmental threat for the near future is not so much the availability of surface water (although major concerns exist here too), but rather the dramatic over-exploitation of ground water as well as severe problems with water quality. Much of the future role of agencies like CNA could be found in the institutional (legal, financial en organizational) restructuring of the monitoring and safeguarding of groundwater and high water quality.

Fourth, local agency offices (such as the CNA office in Celaya) contain an enormous pool of historical knowledge about the environmental, physical and institutional aspects of the irrigation district and levels above as well as managerial experience and technical expertise. Generally, this type of knowledge, experience and expertise in the hand of agencies is more stable and better organized than in the hands of new WUAs. The reason for this is (as was demonstrated in chapter 6) the high turnover of leaders and management staff of the WUAs. As such, irrigation agencies could play an important role in safeguarding the "institutional memory" of the irrigation district.

The above, and other, new roles cannot be internalized overnight, but take a long process. The four most important factors that shape this process are: 1) the political willingness to actually transform irrigation bureaucracies to better adhere to their new mandates and roles; 2) the willingness to invest in training remaining staff on their new roles and the commitment to hire new staff; 3) the capacity to change bureaucratic and administration-oriented management values towards values of co-management based on mutual respect and sharing of similar management targets (and hence accountability forms) between agencies and WUAs.

10.5 Research items and orientation on institutional interventions in water management

Previous sections of this chapter have already indicated the need for integrated and interdisciplinary research on issues of institutional interventions in irrigation. Some of these issues include: linking institutional reforms in irrigation to political and other processes in the wider economy; studying processes of institutional transformation within the irrigation bureaucracies; and studying institutional viability in relation to technology, water scarcity and environmental sustainability. Rather than further discussing these and other research items, I prefer to end this chapter by directing the attention to a more strategic discussion on orientations for developing research capacity for universities and international research institutes.

Shift away from irrigation management towards integrated water management in basins

For more than three decades now, the primary unit of analysis has been the irrigation system, or lower system levels (canals, tertiary units fields, and so forth). The challenges that most irrigation agencies, organizations and social movements concerned with issues of water management now face are related to a wide range of issues that go beyond the physical and institutional boundaries of single irrigation systems. Some of the issues and challenges include: water rights and concessions between the different users and uses are unequally dispersed over vast areas; water scarcity and competition over water between agriculture, industry and tourism is becoming more and more a problem; negotiating access to funding for system improvement works and water saving technologies needs the scaling-up of institutional capacity; and, issues of conjunctive water use and environmental impacts and sustainability of irrigated agriculture affect interests of third parties outside the irrigation system. Other examples can be easily added.

For all these issues, a more logical and politically more strategic unit of analysis would be the water basin. Rather than focusing on irrigation management within irrigation systems, more emphasis could be given to integrated water management at the level of water basins.

Examples from ARLID illustrate this. In order to solve their problems with unclear water rights, WUAs in ARLID and their LRS realize that they have to start building institutional relationships with their colleague WUAs in other districts within the basin as their access to water is also determined by water allocation policies between irrigation districts. Similarly, the qualification of RWS levels and economic outputs per unit of land or water in ARLID cannot be delinked from qualifications in similar and often hydrological connected districts elsewhere in the basin. The assumed over-exploitation of surface water within the district cannot be analyzed without a clear understanding of the relation between surface water use and recharge of aquifers, which generally underlie more than one irrigation district.

Creating local institutional research memory

This thesis has shown that studying institutional interventions and their impacts implies studying processes of constructing, transforming and adopting new arrangements. This takes time. Unfortunately, research policies of universities and international research institutes hardly make it possible to observe processes and changes over longer periods of time. Generally they depend on funding agencies with short research and policy horizons. As a result, universities and institutes tend to frequently shift their research attention to issues and locations that suit these funding agencies best. Although understandable, these frequent shifts undermine the development of local institutional research memory needed to test and understand new ideas and concepts in an intensive way. Also, they have to do research in the context of a globalizing world and with globalized research agendas. These globalized research agendas tend to include extensive, quantitative and comparative studies during a short period of time, rather than intensive, qualitative case studies over longer periods of time.

Universities, research institutes and their local collaborators invest heavily in developing research capacity. They have an enormous impact on encouraging the development of local research capacity. The challenge that universities and research institutes face is that they need to work out new research strategies. Ideally, these strategies should support intensive local research, encourage the development of local research capacity, and help to develop local institutional research memory.

Epilogue: changing pillows for a headache?

Several years ago, I studied the implementation and the impacts of irrigation management transfer and participatory water management in Sri Lanka. Similar to the case of Mexico described in this thesis, the reception of IMT ranged from positive and enthusiastic to negative and skeptical. Some authors concluded that the institutional reforms in Sri Lanka had been partial, and consequently the benefits were also partial, thereby implying that full transfer of management responsibilities *would* result into full benefits (Samad and Vermillion 1999). A Sri Lankan politician whom I cited in my studies was less positive when he stated that: charging irrigation fees from farmers and encouraging greater farmers' involvement in managing irrigation system is nothing more than "*changing pillows for a headache*" (Kloezen 1995 and 1996).

While doing my research in Mexico, I often recalled those words and wondered whether any Mexican politician would conclude the same after reading this thesis. My guess is that he would not. He would probably conclude that the changes in ARLID have been radical and that they have not yet engendered the effects on irrigation performance that most people had hoped. He would probably also share my concern about the viability of the new institutions, in the context of further liberalization of land and water markets. Yet, unlike his colleague in Sri Lanka, he would probably see that the irrigation reforms in Mexico were supported by a mix of policies and laws, and more importantly that the engagement of local interveners and users in ARLID had allowed for a flexible interpretation of the new institutional arrangements.

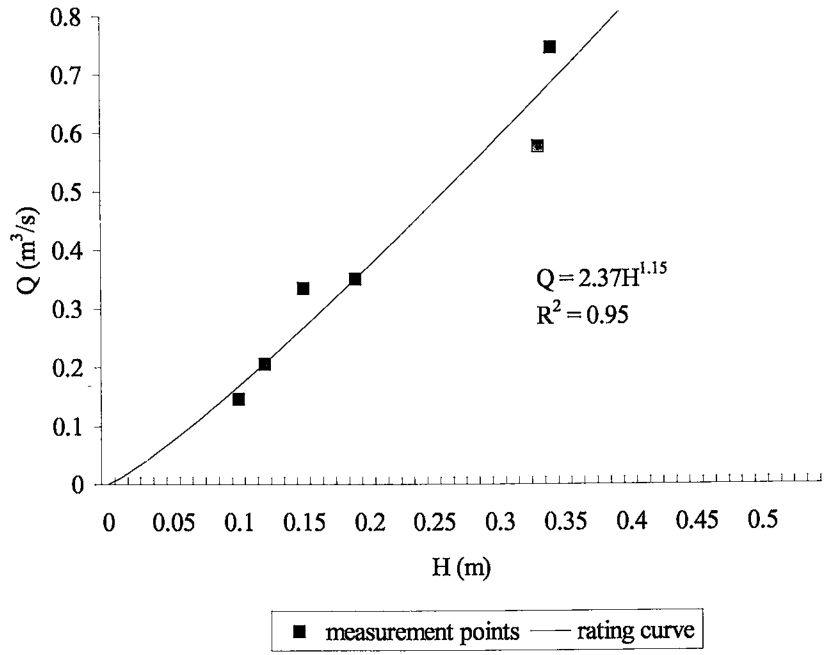
The case of ARLID has demonstrated that within the socio-economic and political context of Mexican agrarian change, there at least is a potential for creating new irrigation institutions that do go beyond changing pillows for a headache.

Appendices

Appendix 1: Salient features of the 11 modules in the Alto Rio Lerma irrigation district

Module	Area (ha) Ejido sector	Area (ha) Private growers	Area (ha) Total	Number of ejidos	Number of users Ejido sector	Number of users Private growers	Number of users Total	Area by irrigation source (ha) Surface	Area by irrigation source (ha) Public wells	Area by irrigation source (ha) Private wells	Area by irrigation source (ha) Total	Irrigation network (km) Main canals	Irrigation network (km) Secondary canals	Irrigation network (km) Total	Drainage network (km) Main drains	Drainage network (km) Secondary drains	Drainage network (km) Total
Acambaro	6.545	2.304	8.849	23	1.622	308	1.930	6.727	257	1.724	8.708	43	101	144	28	96	123
Salvatierra	13.561	2.336	15.897	44	5.082	972	6.054	12.775	565	2.753	16.093	116	120	236	42	176	218
Jaral	3.236	3.453	6.689	16	1.062	401	1.463	4.381	371	1.992	6.744	60	73	134	12	80	92
Valle	7.359	6.319	13.678	31	1.773	536	2.309	7.990	778	3.955	12.723	31	162	193	52	83	135
Cortazar	9.781	8.668	18.448	35	2.169	993	3.162	10.934	1.964	5.796	18.694	75	238	312	23	85	108
Salamanca	5.165	8.992	14.157	37	1.178	1.534	2.712	12.109	573	3.426	16.108	61	174	235	10	91	101
Irapuato	4.078	4.312	8.391	19	984	285	1.269	4.810	688	3.090	8.588	18	102	120	18	43	61
Abasolo	5.229	11.136	16.365	38	1.164	1.259	2.423	10.911	1.152	3.390	15.453	28	141	169	33	39	72
Huanimaro	2.261	1.470	3.731	18	611	229	840	2.802	430	491	3.723	20	20	40	15	41	56
Corralejo	1.219	297	1.516	5	264	11	275	653	643	217	1.513	12	0	12	0	1	1
La Purisima	3.437	982	4.419	15	936	118	1.054	3.605	0	820	4.425	11	52	63	27	27	54
Total	61.871	50.269	112.140	281	16.845	6.646	23.491	77.697	7.421	27.654	112.772	475	1.183	1.658	260	761	1.021

Appendix 2: Example of a Q-h rating curve, established for point 2 in distributary canal B in Cortazar



Appendix 3: Sample frame for the farm survey in the Alto Rio Lerma irrigation district

	Ejidatarios	**Private growers**	**Total**
Group 1, Valle (with Acambaro and Purisima)	23	5	28
Group 2, Salvatierra (with Jaral)	33	7	40
Group 3, Cortazar (with Salamanca, Abasolo, and Irapuato)	29	21	50
Group 4, Huanimaro (with Corralejo)	5	2	7
Total	**90**	**35**	**125**

Appendix 4: Performance indicators defined

$$\textbf{Relative Water Supply} = \frac{\text{Total water supply (Irrigation + Total rainfall)}}{\text{Total crop demand at field level}}$$

where, the denominator includes consumptive use, non-beneficial ET, losses to drains, and net flow to groundwater. It is an non-dimensional parameter. The consumptive use calculation is standardized by using FAO's CROPWAT method. See also Levine (1982 and 1999).

$$\textbf{Relative Irrigation Supply} = \frac{\text{Irrigation supply}}{\text{Irrigation demand at field level}}$$

where, the denominator equals the crop demand, less effective rainfall.

$$\textbf{Water Delivery Capacity} = \frac{\text{Capacity to deliver at (sub) system head}}{\text{Peak consumptive demand}}$$

$$\textbf{Production Per Cropped Area (US\$/ha)} = \frac{\text{Standardized gross value of production}}{\text{Irrigated cropped area}}$$

where, *'standardized'* refers to the process of obtaining the gross value of production (GVP) following a three-step process: i) select a base crop—typically the internationally traded crop covering the largest area—and convert all yields to *'equivalent'* on the basis of the specific crop yield multiplied by the ratio of the specific crop price to the base crop, at farm gate; ii) multiply the equivalent yields by the percentage area under each crop to give the production equivalent per hectare of total cropped area for each crop and add them up; iii) multiply the production equivalent per hectare by the world market price of the base crop to obtain the standardized GVP.

$$\textbf{Production Per Unit Command (US\$/ha)} = \frac{\text{Standardized gross value of production}}{\text{Command area}}$$

$$\textbf{Production Per Unit Irrigation Supply (US\$/m}^3\textbf{)} = \frac{\text{Standardized gross value of production}}{\text{Diverted irrigation supply}}$$

$$\textbf{Production Per Unit of Water Consumed (US\$/m}^3\textbf{)} = \frac{\text{Standardized gross value of production}}{\text{Volume of water consumed}}$$

where, the denominator includes ET, non-beneficial ET, and losses to sinks. This indicator measures the contribution of the irrigation activity to the economy related to the consumption of the increasingly scarce water resource. Under conditions where the water resource is not necessarily scarce, the indicator is useful to judge whether there is enough water that can be utilized downstream or transferred somewhere else.

$$\textbf{Gross Return on Investment (\%)} = \frac{\text{Standardized gross value of production}}{\text{Cost of irrigation infrastructure}}$$

where, the cost of the distribution system refers to the estimated current cost of construction for an equivalent delivery system.

$$\textbf{Financial Self - Sufficiency (\%)} = \frac{\text{Water charges}}{\text{Cost of O \& M}}$$

where, water charges include potential revenues from all types of fees related to the water service; and the O&M costs are based on the accounts of either the agency or WUA, whichever is appropriate. Where farmers themselves undertake individual or collective O&M, the costs should be identified and quantified.

Appendix 5: Basic data set for the irrigation district and the Cortazar and Salvatierra modules, winter 1995-96 and summer 1996

Area supplied by	Alto Rio Lerma irrigation district	Cortazar module	Salvatierra module
	Gross Command Area (ha)		
Surface irrigation	77,697	10,934	12,775
Public wells	7,421	1,964	565
Surface irrigation plus public wells	85,118	12,898	13,340
Private wells	27,654	5,796	2,753
	Cropping Intensity (%)		
Surface and Public Wells			
Winter 1995-96	70	81	50
Summer 1996	60	71	54
Private Wells			
Winter 1995-96	75	89	23
Summer 1996	90	83	130
	Main Crop (% of total cropped)		
Surface and Public Wells			
Winter 1995-96	Wheat (92%)	Wheat (94%)	Wheat (68%)
Summer 1996	Sorghum (81%)	Sorghum (90%	Maiz (39%)
Private Wells			
Winter 1995-96	Wheat (62%)	Wheat (54%)	Wheat (70%)
Summer 1996	Sorghum (82%)	Sorghum (74%)	Maiz (53%)
	Production (ton/ha)		
Surface and Public Wells			
Wheat equivalent, winter 1995-96	6.7	7.4	6.6
Sorghum equivalent, summer 1996	9.8	8.8	11.9
Private Wells			
Wheat equivalent, winter 1995-96	8.9	11.1	7.2
Sorghum equivalent, summer 1996	9.6	10.7	9.6
	Gross Irrigation Supply (x 1,000 m^3)		
Surface			
Winter 1995-96	667,440	106,123	123,651
Summer 1996	139,236	26,743	22,227
Private Wells			
Winter 1995-96	191,370	42,156	5,182
Summer 1996	111,002	22,584	24,624

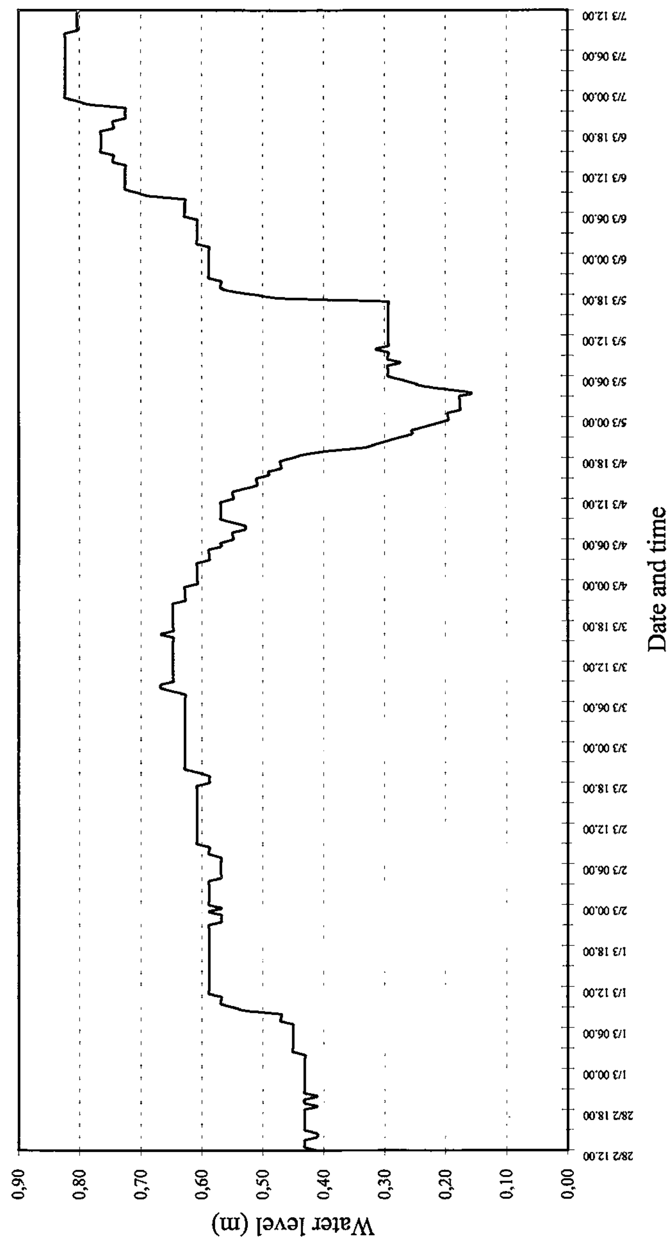
Continue next page

Continued from appendix 5

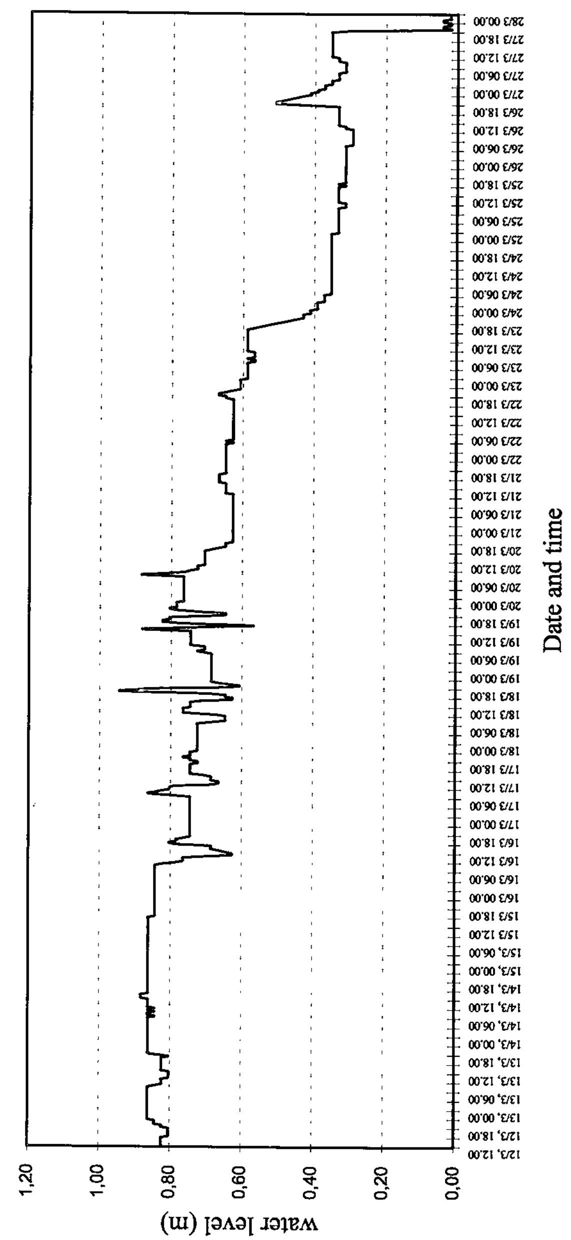
	Rainfall (mm)		
Total, Winter 1994-95	54	53	51
Effective, Winter 1994-95	44	42	41
Total, Summer 1995	683	724	670
Effective, Summer 1995	510	523	506
	Evaporation (mm)		
Winter 1995-96	929	1,068	822
Summer 1996	1,098	1,262	893
	CROPWAT Water Requirement (mm)		
Surface and Public Wells			
Winter 1995-96	500	511	428
Summer 1996	497	546	501
Private Wells			
Winter 1995-96	467	411	412
Summer 1996	507	536	526
	Sales Prices (US$ / ton)		
Farm Gate Price, Wheat Winter 1995-96	247	245	247
Farm Gate Price, Sorghum Summer 1996	120	120	120
World Market Price, Wheat Winter 1995-96	262	262	262
World Market, Sorghum Summer 1996	105	105	105

Note *: The overlap of winter and summer cropping in Salvatierra explains why the reported actual irrigated area under wells for the summer season exceeds the gross command area.

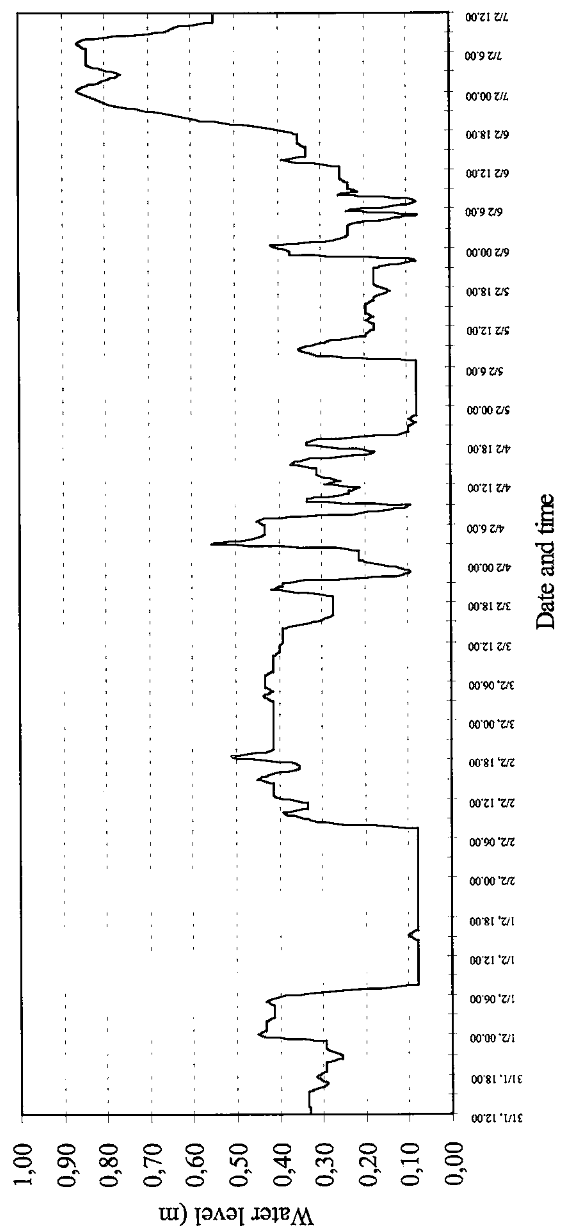
Appendix 6.1: Fluctuation of water level in the head-end reach of distributary canal B, Cortazar module, 3rd irrigation turn (28/2 – 7/3 1997)



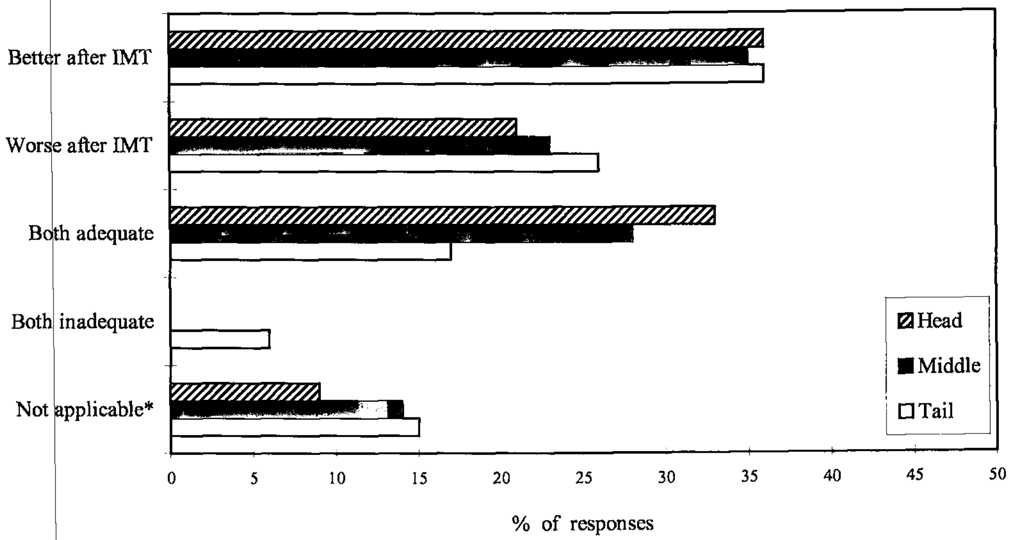
Appendix 6.2: Fluctuation of water level in the middle reach of distributary canal A, Cortazar module, 3rd irrigation turn (12/3 – 28/3 1997)



Appendix 6.3 Fluctuation of water level in the tail-end reach of distributary canal B, Cortazar module, 2nd irrigation turn (31/1 – 7/2 1997)

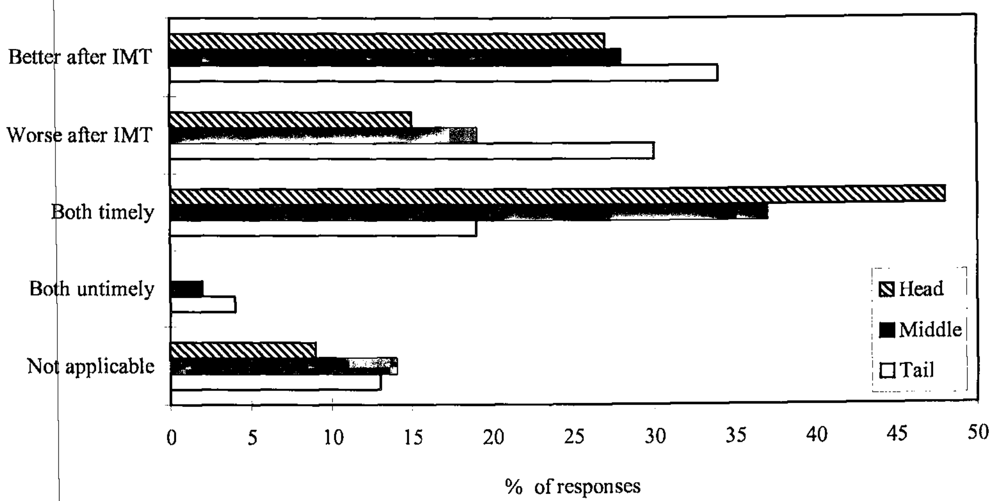


Appendix 7.1: Farmers' opinion about adequacy of canal water supply, before and after IMT

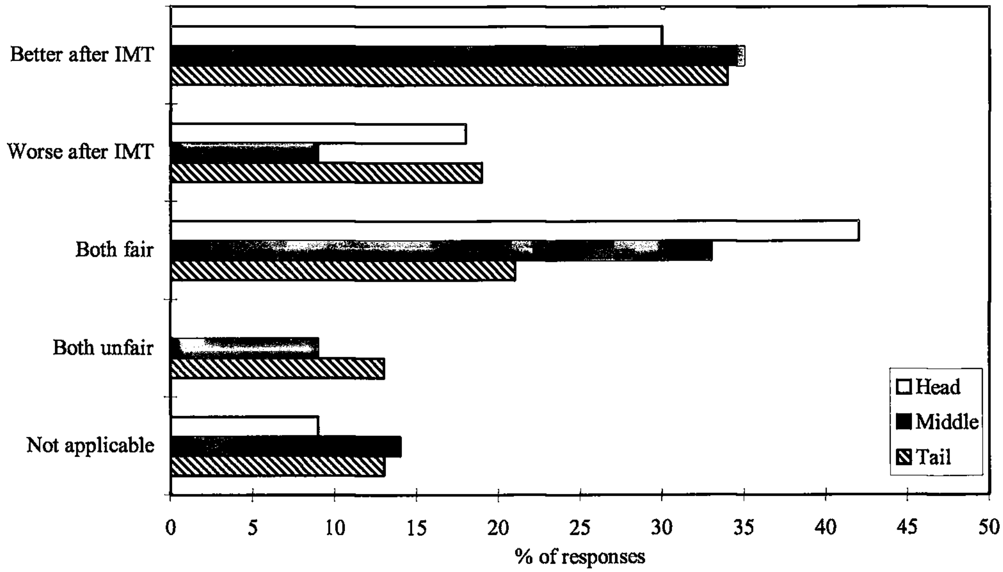


Note *: not applicable, because farmer only irrigates with own private well.

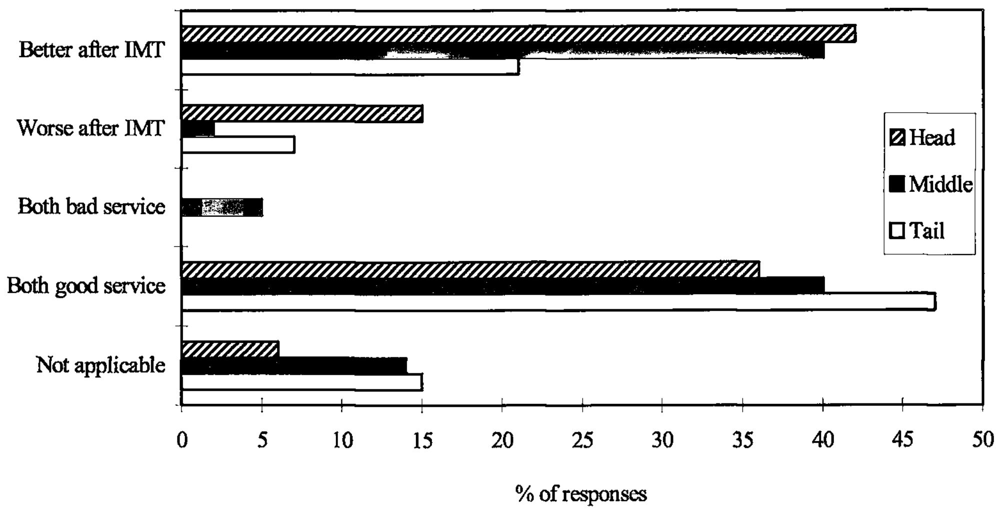
Appendix 7.2: Farmers' opinion about timeliness of canal water supply, before and after IMT



Appendix 7.3: Farmers' opinion about fairness of water distribution, before and after IMT



Appendix 7.4: Farmers' opinion about the over-all service provided by the ditch-tender, before and after IMT



Appendix 8: Evaluation of data collection procedures

This appendix provides an evaluation of the data collection procedures that were used to obtain the performance results. It provides a comparison between the time and resources needed for calculating comparative indicators to the effort needed to measure the limited set of selected internal operational indicators.

Comparative indicators.
The comparative indicators rely heavily on the availability of secondary data. Once contacts and good working relationships with CNA and the WUAs were established, we were provided with full and unconditional access to the requested data. As CNA and most WUAs use computers to enter and process their data, often, computerized data files could be copied and used. Yet, data collections took more time than the one month anticipated. There are several reasons that explain this.

For the purpose of cross-checking and control of data quality, where possible, module-level data were aggregated and compared with system-level data. In a large system like ARLID, visiting the 11 modules took a logistical and time-consuming effort. Moreover, often module-level data were not yet entered completely at the time of our visit, and new visits had to be made.

It took CNA and the WUAs months to process their seasonal data. As a consequence, many visits had to be made to try to update the data required for this study.
Often, modules used different formats to enter their data, which made it difficult to compare module data and aggregate module-level data to district-level data.

In a complex system like ARLID total volumes supplied to the modules had to be calculated by adding daily water measurements taken at a large number of control points. This was a time-consuming process.

Yields and farm gate prices varied from module to module and needed to be cross-checked with data from other sources. Converting cropping patterns and yields of more than 30 crops to a base equivalent crop at several system levels, for two annual seasons, and for both surface irrigation and wells, required the development and management of extensive and rather complicated Excel databases. This was particularly the case for the time series data used in chapters 5 and 9, for which data had to be collected from 11 WUAs.

Given the differences in climate across the district, climatic data from several stations had to be collected. Visits to more than 10 stations were made to check the quality of the collection procedure used by the stations. Because of the poor quality of the equipment used or awkward location of the station, several weather stations were rejected. Also, the remaining stations appeared to have considerable data gaps.

Sometimes, historical data were difficult to find, mainly as a result of the three administrative changes that the Ministry of Agriculture and CNA underwent over the last 10 years. As a result, archives and files were lost or data formats had changed frequently, which made historical comparisons difficult.

Collection of financial data proved to be time-consuming because it took time to understand, interpret and cross-check the different items and monetary flows presented in the books. In addition, financial years and agricultural years did not correspond.

Development and modification of the spreadsheets and entering and processing the data took approximately 2 weeks. Data collection and checking took about 3 months for both the researcher and his assistant. A secretary was hired and trained to enter the data, on which approximately 1 month was spent. In theory, most of the data could have been obtained at the district level (collected and aggregated by CNA). However, it was felt that for the purpose of cross-checking and quality control, data should be collected as much as possible at the primary source. This has improved the reliability of the data presented in this study.

Internal operational indicators.
In comparison to the comparative indicators, data collection procedures for applying operational indicators are more complex and time- and resource-consuming. A distinction must be made between data required for applying internal operational indicators at the module and district levels, and applying indicators at the level of selected canals and fields.

For the former purpose, in addition to the data required for the comparative indicators, secondary data on dam storage, dam releases, and volumetric concessions, as well as data on planned and reported values were collected. Basically the same problems as described above were encountered. An additional month was estimated to be needed to collect and process the planned and reported values.

Together with my two field assistants, I worked full-time for more than a year to collect primary data and make measurements to apply operational indicators at the level of selected canals and fields. In addition, the work in Salvatierra was supported by an M.Sc. student, while in Cortazar a part-time assistant engineer was hired to take the staff gauge readings twice daily and to provide assistance with the calibration of the gauges. Calibration of the staff gauges installed by us proved to be the most time-consuming activity. In addition, much time was spent on visiting the selected fields and taking several flow measurements per field, per irrigation. Calibrating selected wells, measuring flows from wells, taking energy consumption readings, as well as applying the farmer survey to obtain crop budgets, production costs, and cost of water appeared to be a relatively easy activity. Five more months were spent on entering, cleaning, and processing primary data.

Presentation of research process and results.
During the data collection process, frequent visits were made to CNA to discuss the data collected. This proved to be an excellent way to verify our preliminary interpretation of the data, encounter new questions, and request additional data. Several informal meetings were held with management, staff, and farmers of the two selected modules to discuss the same. In addition, I was given the opportunity to attend several hydraulic committee meetings, in which the research progress was discussed with representatives of other modules as well. Finally, three reports with preliminary result were presented at more formal occasions, such as workshops and seminars. This provided good opportunities to get feedback from a much wider audience, including system managers, policy makers, and researchers.

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Summary

During the past decade, many countries throughout the world have attempted to improve their generally poor performance record of agency-managed irrigation systems by designing and implementing institutional policy programs. This thesis analyses the institutional viability and the local impact on irrigation performance of two such institutional intervention programs. This is done in the context of the Alto Río Lerma irrigation district (ARLID), a large-scale irrigation system with a command area of more than 112,000 hectares located in the State of Guanajuato, Central Mexico. The central notion that runs through this study is the recognition that new institutional arrangements do not necessarily follow institutional design principles and top-down directives from policy makers and government interveners, but rather are created in a process of local negotiation between water users, farmer leaders and irrigation managers. This requires detailed observations on local practices, strategies and interactions on how users, leaders and managers cope with building and transforming irrigation institutions.

The first intervention program analyzed in this thesis aims to transfer management responsibilities from the irrigation agency (CNA) to local newly established water user organizations (WUAs) and to make them responsible for cost-recovery. The neoliberal belief behind this program is that greater farmer involvement in irrigation management and financing would eventually lead to a reduction in public investments in irrigated agriculture as well as to higher levels of irrigation performance. The second institutional intervention program that is analyzed in this thesis deals with the introduction of water markets, aiming at re-allocating water use to uses of higher economic value. Both intervention programs clearly embark on the 'less state, more market' approach to design and implement institutional arrangements for more use and cost-effective management of scarce resources such as water and funds. The central theme of this thesis is to study how water users and local water managers deal with the problems that result from these interventions and arrangements.

In 1992, ARLID was one of the first of Mexican districts were irrigation management transfer (IMT) was introduced. The Mexican IMT program is worldwide considered to be the most successful and ambitious institutional programs in its kind, both because of its scale and the speed with which the policy was designed and implemented. The claims on the successes of these and similar programs are generally ideologically driven, and empirical evidence to support the policy claim that these institutional interventions have achieved these goals remain largely undocumented. This thesis fills some of this empirical void.

This thesis comprises ten chapters. After the conceptual and methodological introduction in chapter one, two contextual chapters follow. Chapter 2 introduces the research site, and chapter 3 presents the political economic history and context in which the institutional interventions took place. Chapters 4 to 9 provide the empirical data from the intensive case study in ARLID. Chapter 10 evaluates the main empirical, conceptual and methodological findings and discusses possible implications for policy and research orientations.

The first chapter provides a review of the conceptual approaches and methodologies used to study the viability of new institutional arrangements in the context of market-oriented reforms. This thesis explores the kind of conditions, processes and mechanisms that help to create viable institutions. These mechanisms do not only refer to institutional and economic relationships, but also to the relationship between institutions, and water scarcity and irrigation technology. In that sense the thesis follows the notion that irrigation technology is a sociotechnical phenomenon, with institutional requirements for use.

A key concept used for analyzing the viability of new irrigation institutions is accountability. This study shows that four forms of accountability can be separated: operational, financial, political and administrative accountability. Studying these forms of accountability (and the relationship between them) demonstrates that practices and strategies of decision making in water management are only partly

influenced by rational choice and (economic) incentives for utility maximization. They are also influenced by socio-political factors.

The methodological concern of this thesis is to develop a set of tools and indicators that help to assess the impacts of institutional interventions, both in terms of changes in irrigation performance levels, and in qualitative terms of processes of institutional viability. Two sets of performance indicators are presented. The first set comprises indicators that measure actual performance against set performance targets. The second set compares performance levels over time and across different system levels. The field work for this thesis comprised a wide set of methods and research techniques, ranging from intensive observations of practices and strategies for coping with the new institutional arrangements, to daily measurements of water flows in two selected WUA areas and several canals and fields in the irrigation district. Field research took place during the period from early 1995 to mid-1998.

Chapter 2 provides background information on the location, history, water availability and layout of ARLID. It also introduces the two main groups of farmers that now jointly are organized in the new WUA: *ejidatarios* and private growers. It shows how these two groups have historically and economically been separated for almost 70 years. The chapter also provides a brief description of the Cortazar and Salvatierra module areas, their canals and WUAs that were selected for the intensive case study.

Two important notions form the basis of the chapter 3, in which a detailed description of the historical and political economic context of IMT and water marketing is given. The first notion is that the legitimization for institutional interventions should be viewed in the political economic context of privatizing the Mexican country-side through dramatic constitutional revisions in the way distribution of land and water rights are organized. These reforms and revisions were started in the 1980 as a result of both a political and an economic crisis and were accompanied by wave of programs on the liberalization, decentralization and technocratization of the economy. Institutional intervention programs like the Mexican IMT program do not come on their own, but are preceded, accompanied and followed by other intervention programs that share the same neoliberal legitimization for restructuring the political and economic control over resources. The second notion is that to achieve the economic goals of these neolibral programs, the Salinas and subsequent administrations needed intervention policies such as IMT and water marketing as these would help to recover costs from the users. However, to improve greater involvement of farmers in water management, neoliberal programs are not a necessity.

Chapter 4 shows how IMT and water markets were implemented, both at the national level and in ARLID. The IMT program is a typical example of institutional engineering, comprising detailed prescriptions on institutional design and a top-down approach for implementing these designs. Yet, farmers and local managers do not fully disregard these proposed arrangements. Rather than using them as prescriptive dictates, the new principles and arrangements served as a strategic starting point for the WUAs for negotiating irrigation fee levels, water marketing, mode of user representation, maintenance programs, and redistribution of O&M responsibilities between the WUAs and CNA. Local recipients have partly adopted and accommodated the new institutional arrangements. The IMT program allowed local irrigation managers, new leaders of WUAs and farmers to jointly create room and institutional flexibility to alter the proposed arrangements. This was made possible mainly because from the initial stage of implementation, CNA officials in ARLID have shown to users that they are credible and willing to share knowledge and information in a transparent way. Credibility, transparency, institutional flexibility and probity were among the most important factors to explain how operational accountability from CNA to WUAs, and from WUAs to water users, was earned in a continuous process of negotiating institutional arrangements. Furthermore, given the wider set of market-oriented reforms and constitutional revisions that farmers had become familiar with, they realized that they could hardly resist IMT.

Chapter 5 provides a detailed analysis of practices, results and operational accountability for local water management. It demonstrates that official post-transfer arrangements for O&M in ARLID do not always reflect actual irrigation practices. As result, outputs of these practices in terms of relative water supply and land and water productivity remained unchanged after IMT. The main reason for this is the conflict in forms of accountability, which could not be resolved under the new institutional arrangements. Rather than adhering to new principles of using water as an economic good, farmers and local managers adhered to pre-IMT arrangements and practices of distributing water. Daily measurements of water flows and observation of irrigation practices revealed that ditch tenders (who are now employed by the WUAs) generally report planned water deliveries rather than actually supplied volumes. In that sense, they continued the practice of being administratively accountable to both users and CNA. This runs counter to the idea of encouraging efficient water use through water pricing and cost-recovery and hence being both financially and operationally accountable. Comparison of water use per hectare or per m^3 of water across the 11 module areas in ARLID, shows that although water is the limiting factor in ARLID, the irrigation management strategy chosen by farmers is to maximize returns per hectare rather than increasing returns per m^3 of water. As a result, water deliveries per hectare of irrigated land are generally very high. The chapter also provides some evidence that existing irrigation technology and water management regimes do not always match with the institutional capacity of the new WUAs to operate the system. The chapter also explores some ideas of approaching issues of relative water scarcity in the context of conjunctive use and in a wider setting of the entire water basin.

Chapter 6 gives a detailed account of how practices, processes and mechanisms of user representation, leadership election and conflict resolution affect political accountability and institutional viability. Detailed analysis of election procedures and processes over a period of two WUA administrations demonstrate that the *de jure* distribution of farmer representation in the boards and assemblies of WUAs is well organized. However, the *de facto* control over decision making remains in the hands of a few farmer leaders. These leaders have developed several strategies to reproduce this control. These include political coercion to become re-elected; favoritism in the employment of board members and irrigation staff; corruption; and extending economic and political networks. Particularly in the case of Salvatierra WUA, these strategies have caused that accountability was hardly created. Farmers use two strategies in their trying to counter-balance these mechanisms that weaken accountability. First, they refuse to pay higher fees to signal their dissatisfaction with the WUA's management policies. Second, they call for CNA to resolve disputes over illicit payments and the performance of the WUA leadership.

In chapter 7 an analysis is made of how mechanisms of financial accountability influence the institutional viability of the post-transfer institutional arrangements for irrigation management. WUAs in ARLID succeeded to boost cost-recovery and to become financially autonomous. In that sense IMT has been very instrumental to achieving the government goal of reducing public investments in irrigation. However, improved cost-recovery and financial autonomy have also helped WUAs to create room for negotiating the reformulation of important institutional arrangements such as the percentages of total revenue that had to be paid to CNA; the level of water pricing; and the conditions and prices for water trading. Financial transparency, the use of computers and external auditing helped the WUAs to become financially accountable to fee payers. Moreover, particularly in the case of Cortazar, leaders showed that they were credible when they started to use revenues from fee payments to dramatically improve canal maintenance. They also showed their willingness to fire irrigation staff that had proved to be corrupt. Yet, financial viability is threatened in two ways. First, as a result of lack of political accountability (such as in the case of Salvatierra). Second, because of the WUAs' total dependency on water availability to generate income.

In chapter 8 the focus of analysis is shifted towards issues of water marketing. WUAs in ARLID indeed have used the now legal opportunity to market water with other WUAs within the district. However, unlike the common belief among neoliberal advocates of water marketing, trading is not used to price water at opportunity cost levels. Rather, the process of water marketing is used to create solidarity among the WUAs. This solidarity is needed to be able to work together in the new federation of WUAs, which has opted to take over from CNA maintenance responsibilities for the main canal system. Water trading is also used by WUAs to show their members that they are credible in the sense that they will try to deliver water at any time; even when they have to buy it from other WUAs during times of water scarcity. As a result, prices of traded water are generally lower than water prices paid for normal water deliveries during times of sufficient water availability.

Chapter 9 returns to the official objectives of the IMT program and assesses the program's impact on water management. By applying a set of comparative indicators, it is shown that the result of IMT and water marketing in terms of changes in performance levels are disappointing. With the exception of improvements in cost-recovery and maintenance, there is no evidence that water is used more efficiently or that IMT has resulted in higher levels of productivity per hectare or per m^3 of water.

Chapter 10 first provides a full synthesis of the empirical findings discussed above. It subsequently revisits some of the conceptual and methodological tools used for this study. This shows that the conceptual notion of social requirements for use of irrigation technology should be further elaborated to institutional requirements for use. An important notion in this respect is that institutional arrangements are a mixture of formal prescriptive arrangements, existing arrangements and newly negotiated arrangements. Existing and new institutions are the result of a continuous process of creating, negotiating, earning, and maintaining accountability. This explains why institutions manifest themselves as being contingent rather than proposed static structures that follow designed institutional principles.

A revisit of the accountability concept shows that it is useful to separate different forms of accountability. This separation helps to analyze accountability mechanisms that go beyond those related to providing mere O&M services or cost-recovery; it also helps to unravel in what way providers of services are accountable, or not; and it helps to recognize in what way different forms of accountability can compete with each other. This is particularly of interest in the case of joint WUA-agency management of irrigation system, where different organizations can have competing management values and targets, and hence try to be accountable in different ways.

The methodological revisit on the different sets of impact assessment tools shows that comparative indicators are useful to assess changes over time as a result from institutional interventions. Yet, they are limited in the sense that they exclusively focus on economic and productivity output oriented results. Furthermore, applying these indicators was more time and resource consuming than assumed. The reason for this are the complexity and amount of secondary data needed as well as the difficult process it takes to deconstruct the meaning of these data.

This study has several implications for market-oriented policies, both in and outside of Mexico. Because of its unique political economic and constitutional context, the 'Mexican IMT model' cannot simply be copied to other countries where similar attempts of planned institutional changes are underway. Particularly the fact that IMT and water marketing in Mexico were supported by political commitment at the highest levels and by dramatic constitutional revisions and other agrarian reforms, explains why the new institutional arrangements for water management could be speedily implemented on such a wide scale. This study also suggests that institutional 'modernization' programs (such as IMT and water marketing) and physical modernization programs in irrigation should be better matched. Although physical improvement programs are often used to sell institutional reforms (and the consequent burden) to water users, they hardly ever are matched in such a sense that the proposed new technology matches with the proposed new institutional arrangements to use this technology.

Chapter 10 ends with a discussion on why to orient research on institutional interventions in water management to the level of entire water basin rather than irrigation systems. Also, irrespective that universities and international research institutes need to do research in the context of a globalizing world and with globalized research agendas, a plea is made to not shift too frequently to doing extensive, quantitative and comparative studies during a short period of time. Understanding institutional change processes and their impacts at the local level requires intensive and qualitative case studies over longer periods of time. Only in this way collaboration with local research partners can fully develop, resulting in the level of creation of institutional research memory that is needed for this understanding.

Resumen en español

"CONTANDO" EL AGUA

Viabilidad institucional e impactos de las intervenciones orientadas al mercado en el riego, en el centro de México

Durante la última década, muchos países a través del mundo han intentado mejorar el desempeño generalmente pobre del riego manejado por agencias gubernamentales diseñando y ejecutando programas de políticas institucionales. Esta tesis analiza la viabilidad institucional y el impacto local sobre el desempeño del riego de dos de tales programas de intervención institucional. Esto se hace en el contexto del Distrito de Riego Alto Río Lerma (DRARL), un sistema de riego de gran escala con un área dominada de más de 112.000 hectáreas localizado en el Estado de Guanajuato, en el centro de México. La idea central en que se basa este estudio es el reconocimiento de que los nuevos arreglos institucionales no necesariamente siguen los principios de diseño institucional y las directivas de "arriba hacia abajo" de los forjadores de políticas e interventores gubernamentales, sino mas bien son creados en un proceso de negociación local entre los usuarios del agua, líderes campesinos y gerentes del riego. Esto requiere de observaciones detalladas sobre prácticas locales, y estrategias e interacciones en como usuarios, líderes y gerentes enfrentan la creación y la transformación de instituciones del riego.

El primer programa de intervención analizado en esta tesis está dirigido a transferir las responsabilidades del manejo desde la agencia del riego (CNA) hasta asociaciones locales de usuarios del agua (AUA) recientemente establecidas y hacerlas responsables por la recuperación de costos. La creencia neo-liberal detrás de este programa es que el mayor involucramiento de los usuarios en el manejo del agua y su financiación eventualmente llevaría a la reducción de las inversiones públicas en la agricultura bajo riego así como a niveles superiores del desempeño del riego. El segundo programa de intervención institucional que es analizado en esta tesis concierne a la introducción de mercados del agua, dirigidos a la reasignación del uso del agua a usos de mayor valor económico. Ambos programas de intervención claramente se embarcan en un enfoque de "menor estado, mayor mercado" para diseñar y ejecutar arreglos institucionales para mayor uso y manejo efectivo de escasos recursos tales como agua y dinero. El tema central de esta tesis es para estudiar como los usuarios del agua y los gerentes locales del agua tratan los problemas que resultan de estas intervenciones y arreglos.

En 1992, el DRARL fue uno de los primeros distritos Mexicanos donde la transferencia del manejo del riego (TMR) fue introducida. El programa Mexicano de TMR es considerado mundialmente el más exitoso y ambicioso programa institucional de este tipo, tanto por su tamaño como por la velocidad con que la política fue diseñada y ejecutada. Los clamores de éxito de este y programas similares son generalmente ideológicamente impulsados, y la evidencia empírica para apoyar la política que dice que estas intervenciones institucionales han alcanzado estas metas permanece ampliamente indocumentada. Esta tesis llena algo de este vacío empírico.

Esta tesis comprende diez capítulos. Después de la introducción metodológica y conceptual en el capítulo uno, siguen dos capítulos con el contexto. El capítulo dos introduce el sitio de investigación, y el capítulo tres presenta la historia de la política económica dentro de la cual tuvo lugar la intervención institucional. Los capítulos del cuatro al nueve presentan los datos empíricos de un estudio de caso intensivo en DRARL. El capítulo diez evalúa los resultados conceptuales, metodológicos y empíricos principales, y discute las posibles implicaciones para orientaciones de políticas e investigación.

El primer capítulo presenta una revisión de los enfoques conceptuales utilizados para estudiar la viabilidad de los nuevos arreglos institucionales en el contexto de reformas con orientación de mercados. Esta tesis explora los tipos de condiciones, procesos y mecanismos que ayudan a crear instituciones viables. Estos mecanismos no solamente se refieren a las relaciones económicas e institucionales, sino también a las relaciones entre instituciones, y la escasez del agua y la tecnología del riego. En ese sentido sigue la noción de que la tecnología del riego es un fenómeno socio-técnico, con requerimientos institucionales para su utilización.

Un concepto clave utilizado para analizar la viabilidad de las nuevas instituciones del riego es el de la rendición de cuentas. Este estudio muestra que cuatro clases de rendición de cuentas pueden ser separadas: operacional, financiera, política y administrativa. Estudiando estas formas de rendición de cuentas (y la relación entre ellas) demuestra que las prácticas y estrategias en la toma de decisiones del manejo del agua están solo parcialmente influenciadas por alternativas racionales y por incentivos para la maximización del uso de los recursos. También están influenciados por factores socio-políticos.

La preocupación metodológica de esta tesis es desarrollar un juego de herramientas e indicadores que ayuden a estimar el impacto de las intervenciones institucionales, tanto en términos de cambio en los niveles de desempeño del riego, como en términos cualitativos de los procesos y viabilidad institucional. Se presentan dos juegos de indicadores de desempeño. El primer juego contiene indicadores que miden el desempeño real comparado con metas de desempeño. El segundo juego compara los niveles de desempeño a través del tiempo y a diferentes niveles del sistema. El trabajo de campo para esta tesis comprende un amplio conjunto de métodos y técnicas de investigación, que van desde observaciones intensivas de las prácticas y estrategias para enfrentar los nuevos arreglos institucionales, hasta mediciones diarias de los gastos de agua en dos áreas seleccionadas de AUA y varios canales y parcelas del distrito de riego. La investigación de campo se llevó a cabo en el período desde el comienzo de 1995 hasta la mitad de 1998.

El capítulo dos contiene los antecedentes sobre la localización, historia, disponibilidad del agua y la configuración del DRARL. También introduce a los dos grupos de agricultores principales que ahora conjuntamente se han organizado en las nuevas AUA: *ejidatarios* y pequeños propietarios. Muestra como estos dos grupos han estado separados históricamente y económicamente casi 70 años. Este capítulo también presenta una corta descripción de las áreas de los módulos Cortazar y Salvatierra, sus canales y las AUA que fueron seleccionadas para el estudio de caso intensivo.

Dos conceptos principales forman la base del capítulo tres, en el cual una descripción detallada del contexto histórico y político-económico de la TMR y los mercados del agua están dados. La primera noción es que la legitimación de las intervenciones institucionales debe ser vista en el contexto económico-político de la privatización del área rural Mexicana por medio de revisiones constitucionales dramáticas en la forma en que la distribución de los derechos de agua y tierra está organizada. Estas reformas y revisiones empezaron en los 1980 como resultados de una crisis tanto política como económica y estuvieron acompañados por una ola de programas sobre la liberalización, descentralización y tecnocratización de la economía. Los programas de intervención institucional como el programa Mexicano de la TMR no vienen solo, sino precedido, acompañado y seguido por otros programas de intervención que comparten la misma legitimación neo-liberal para la reestructuración del control económico y político sobre los recursos. La segunda noción es que para alcanzar las metas económicas de estos programas neo-liberales, la administración de Salinas de Gortari (y la subsiguiente) necesitó políticas de intervención tales como la TMR y los mercados de agua pues estos ayudarían a la recuperación de los costos incurridos por los usuarios. Sin embargo, el involucramiento de los agricultores en el manejo del agua no necesariamente necesita de programas neo-liberales.

El capítulo cuatro muestra como la TMR y los mercados del agua fueron ejecutados, tanto al nivel nacional como en el DRARL. El programa de TMR es un ejemplo típico de re-ingeniería institucional, conteniendo prescripciones detalladas sobre diseño institucional y un enfoque de "arriba hacia abajo" para implementar estos diseños. Aun así, agricultores y gerentes locales no desechan totalmente estos arreglos propuestos. En vez de usarlos como dictados prescriptivos los nuevos principios y arreglos sirvieron como un punto estratégico de partida para las AUA negociar los niveles de las tarifas de riego, mercados del agua, los modos de representación de los usuarios, programas de conservación, y redistribución de las responsabilidades de la O&M entre las AUA y la CNA. Los receptores locales han parcialmente adoptado y acomodado estos nuevos arreglos institucionales. El programa de TMR permitió a los gerentes locales de riego, a los nuevos líderes de las AUA a los agricultores crear conjuntamente espacios y flexibilidad institucional para alterar los arreglos propuestos. Esto fue posible más que todo por que desde la etapa inicial de la ejecución, los oficiales de la CNA en el DRARL han dejado ver a los usuarios que ellos son confiables y que están dispuestos a compartir información y conocimientos en una forma transparente. Credibilidad, transparencia, flexibilidad institucional y probidad estaban entre los factores más importantes para explicar como la responsabilidad operacional desde la CNA a la AUA, y de la AUA a los usuarios del agua fue alcanzada en un proceso continuado de negociación de los arreglos institucionales. Mas aún, dado el amplio conjunto de reformas con orientación de mercado y revisiones constitucionales con los cuales los agricultores se han familiarizado, estos se dieron cuenta de que difícilmente podrían resistirse a la TMR.

El capítulo cinco presenta análisis detallados de prácticas, resultados y responsabilidades operacionales para el manejo local del agua. Muestra que los arreglos oficiales post-transferencia para O&M en DRARL no siempre reflejan las prácticas de riego actuales. Como resultado, los logros de estas prácticas en términos de la disponibilidad relativa del agua (DRA) y la productividad de la tierra y el agua permanecieron inalterados después de la TMR. La razón principal para esto es el conflicto entre las formas de rendición de cuentas, que no pudieron ser resueltas bajo estos nuevos arreglos institucionales. En vez de adherirse a los nuevos principios de tratar el agua como un bien económico, los campesinos y gerentes locales se adhirieron a los arreglos y prácticas de distribución del agua pre-TMR. Mediciones diarias de los gastos y la observación de las prácticas de riego revelaron que los canaleros (quienes son ahora empleados por las AUA) generalmente reportan los suministros de agua planeados en vez de los volúmenes reales suministrados. En ese sentido, ellos continuaron con la práctica de ser responsables administrativamente tanto a los usuarios como a la CNA. Esto va en contra de la idea de alentar el uso eficiente del agua con base en el precio del agua y la recuperación de costos y por lo tanto ser responsables tanto financiera como operacionalmente. Comparaciones del uso del agua por hectárea o por m^3 a lo largo de las áreas de los once módulos en DRARL, muestran que a pesar de ser el agua el factor limitante en el DRARL, la estrategia del manejo del riego escogida por los campesinos es el maximizar los ingresos por hectárea, en vez de aumentar los ingresos por m^3. Como resultado, la entrega de agua por hectárea regada es generalmente muy alta. Este capítulo también provee evidencia de que la tecnología de riego y los regímenes del manejo del agua existente no siempre concuerda con la capacidad institucional de las nuevas AUA para operar el sistema. El capítulo también explora algunas ideas sobre maneras de abordar la escasez relativa del agua en el contexto de su uso conjunto dentro de un enfoque más amplio que abarca toda la cuenca hidrográfica.

El capítulo seis detalla como las prácticas, procesos y mecanismos de la representación de los usuarios, las elecciones de los líderes y la resolución de conflictos afectan la responsabilidad política y la viabilidad institucional. Análisis detallados de los procesos y procedimientos de elecciones, abarcando un periodo de dos administraciones de las AUA, demuestran que la distribución *de jure* de la representación de los campesinos en las juntas y asambleas de las AUA está bien organizada. Sin embargo, el control *de facto* sobre la toma de decisiones permanece en las manos de unos pocos líderes campesinos. Estos líderes han desarrollado varias estrategias para replicar este control. Estas incluyen coerción política para ser reelegidos; favoritismo en el empleo de miembros de la junta y personal del riego; corrupción; y la extensión de redes económicas y políticas. Particularmente, en el caso de la AUA de Salvatierra, estas estrategias han ocasionado que la rendición de cuentas escasamente haya sido creada. Los agricultores usan dos estrategias en tratar de balancear los mecanismos que debilitan la rendición de cuentas. Primero, el rehusarse a pagar tarifas más altas a fin de dar a conocer su insatisfacción con las políticas de manejo de las AUA. Secundo, el empezar a llamar a la CNA para que resuelva las disputas sobre liderazgo de las AUA y pagos ilícitos.

El capítulo siete hace un análisis de como los mecanismos de responsabilidad financiera influyen en la viabilidad de los arreglos institucionales post-transferencia en el manejo del riego. Las AUA en DRARL fueron exitosas en mejorar la recuperación de costos y en establecerse financieramente autónomas. En ese sentido, la TMR ha sido importante en alcanzar la meta del gobierno de reducir las inversiones públicas en el riego. Sin embargo, también han ayudado a las AUA a crear espacios para negociar la formulación de importantes arreglos institucionales tales como el porcentaje de los ingresos totales que debían pagarse a la CNA; el nivel de los precios del agua; y las condiciones del mercadeo del agua y los precios del agua mercadeado. Transparencia financiera, el uso de computadoras y auditorias externas ayudaron a las AUA a rendir cuentas financieramente a los que pagaban tarifas. Más aún, especialmente en el caso de Cortazar, los líderes mostraron que ellos eran confiables cuando empezaron a utilizar los ingresos derivados de los pagos de las tarifas para mejorar dramáticamente la conservación de canales y drenes. Ellos también mostraron su disposición para despedir a personal de riego que fuera corrupto. Sin embargo, la viabilidad financiera es amenazada en dos formas. Primero, como resultado de una falta de responsabilidad política (como es el caso de Salvatierra). Segundo, debido a la total dependencia de las AUA en la disponibilidad del agua para generar ingresos.

En el capítulo ocho el foco de análisis es dirigido hacia temas del mercado del agua. Las AUA en DRARL de hecho han utilizado la ahora oportunidad legal de mercadear el agua con otras AUA dentro del distrito. Sin embargo, al contrario de la creencia común entre los neo-liberales partidarios de los mercados del agua, el mercadeo no es utilizado para establecer el precio del agua al nivel del costo de oportunidad. Más bien, el proceso del mercadeo de agua es usado para crear solidaridad entre las AUA. Esta solidaridad se necesita para poder ser capaces de trabajar juntos en la nueva federación de AUA, que ha optado por tomar de la CNA la responsabilidad de la conservación de la red de canales principales del distrito. El mercadeo del agua es también utilizado por las AUA para mostrar a sus miembros que ellos son confiables en el sentido que tratarán de entregar el agua en cualquier momento; aún cuando ellos tengan que comprarla a otras AUA en tiempos de escasez del agua. Como resultado, los precios del agua negociada son generalmente menores que los precios del agua pagados por entregas normales en tiempos de disponibilidad abundante.

El capítulo nueve regresa al objetivo oficial del programa de la TMR y determina el impacto del programa en el manejo del agua. Utilizando un conjunto de indicadores comparativos se muestra que los resultados de la TMR y de los mercados del agua en términos de cambio en los niveles de desempeño son decepcionantes. Con la excepción en mejoras en la recuperación de costos y la conservación de la red de canales y drenes, no hay evidencia de que el agua sea usada más eficientemente o que la TMR haya resultado en niveles más altos de productividad por hectárea o por m^3 de agua.

El capítulo diez provee primero una síntesis completa de los resultados empíricos, discutidos arriba. Subsecuentemente revisa las herramientas conceptuales y metodológicas utilizadas en este estudio. Se muestra que el concepto sobre requerimientos sociales para el uso de tecnología del riego debe ser ampliado más allá hasta incluir los requerimientos institucionales para su uso. Una noción importante a este respecto es que los arreglos institucionales son una mezcla de arreglos prescriptivos formales, arreglos existentes y arreglos recientemente negociados. Las instituciones existentes y las nuevas son el resultado de un proceso continuado de crear, negociar y mantener responsabilidades. Esto explica por que las instituciones se manifiestan ellas mismas como siendo fortuitas en vez de estructuras estáticas que siguen principios institucionales pre-diseñados.

Una revisión de los conceptos de la rendición de cuentas muestra que es útil separar las diferentes formas de esta rendición de cuentas. Esta separación ayuda a analizar los mecanismos de responsabilidad que van mas allá de aquellos relacionados en proporcionar simplemente servicios de O&M o recuperación de costos; también ayuda a aclarar de que manera los proveedores de servicios son responsables o no; y ayuda a reconocer en que manera las diferentes formas de rendición de cuentas pueden competir entre sí. Esto es de particular interés en el caso del manejo conjunto, AUA-agencia, de los sistemas de riego, donde diferentes organizaciones pueden tener valores y metas de manejo que compiten entre sí, y por lo tanto tratan de rendir cuentas en diferente manera.

Una revisión metodológica de los diferentes conjuntos de herramientas para analizar los impactos muestra que los indicadores comparativos son útiles para determinar cambios en el tiempo como resultados de intervenciones institucionales. Sin embargo, están limitados en el sentido de que ellos se enfocan exclusivamente en resultados orientados a logros económicos y de producción. Más aún, la aplicación de estos indicadores tomó más tiempo y recursos de los esperados. La razón para ello es la complejidad y cantidad de datos secundarios requeridos así como el difícil proceso que conlleva analizar el sentido de esta información.

Este estudio tiene varias implicaciones sobre políticas orientadas al mercado, tanto dentro como fuera de México. Debido a su peculiar contexto político-económico y constitucional, el modelo de TMR mexicano no simplemente puede ser copiado a otros países donde intentos similares de cambios en la planeación institucional están en marcha. Particularmente el hecho de que la TMR y los mercados del agua en México fueron apoyados por un compromiso político al más alto nivel y por dramáticas revisiones constitucionales y de otras reformas agrarias, explica por qué los nuevos arreglos institucionales para el manejo del agua pudieron ser ejecutados rápidamente a tan amplia escala. El estudio también sugiere que los programas de "modernización" institucional (tales como la TMR y el mercado del agua) y los programas de modernización física del riego deben acoplarse mejor. A pesar de que los programas de mejoras físicas son usados a menudo para vender reformas institucionales (y sus consecuentes inconveniencias) a usuarios del agua, rara vez se compaginan en el sentido que la nueva tecnología propuesta concuerde con los nuevos arreglos institucionales propuestos para usar esa tecnología.

El capítulo diez termina en una discusión sobre por que orientar la investigación sobre intervenciones institucionales en el manejo del agua en el ámbito de la cuenca hidrográfica completa, en vez de a nivel del sistema de riego. También, independientemente de que las universidades e institutos internacionales de investigación necesitan adelantar investigación en el contexto de un mundo y agendas de investigación globalizadas, se hace un llamado a no emprender muy frecuentemente estudios extensivos, cuantitativos y comparativos en cortos períodos de tiempo. Entendiendo los procesos de cambio institucional y sus impactos al nivel local, requiere estudios de caso extensivos y cualitativos sobre períodos relativamente largos. Solamente de esta manera la colaboración con compañeros de investigación locales puede ser plenamente desarrollada, resultando en la creación de una memoria institucional de investigación al nivel que se necesita para este entendimiento.

Nederlandse samenvatting

WATER "AFREKENEN"

De institutionele levensvatbaarheid en effecten van marktgerichte irrigatie-interventies in Centraal Mexico

Wereldwijd hebben in de afgelopen tien jaar veel landen geprobeerd het slechte functioneren van de door de overheid beheerde irrigatiestelsels te verbeteren. Dit gebeurde onder andere door middel van het ontwerpen en uitvoeren van institutionele beleidsprogramma's. De institutionele levensvatbaarheid van twee dergelijke interventieprogramma's wordt in dit proefschrift geanalyseerd. Tevens worden hun lokale effecten op het functioneren van een irrigatiestelsel bestudeerd. Dit wordt gedaan binnen de context van het Alto Río Lerma irrigatiedistrict (ARLID) met een waterbeheergebied van meer dan 112.000 hectaren, gesitueerd in de Staat Guanajuato in Centraal Mexico. Als een rode draad door dit onderzoek loopt de erkenning dat nieuwe institutionele maatregelen niet noodzakelijkerwijs institutionele ontwerpprincipes en top-down instructies van beleidsmakers en -uitvoerders volgen, maar veeleer gecreëerd worden in een lokaal onderhandelingsproces tussen watergebruikers, boerenleiders en irrigatiebeheerders. Dit vereist gedetailleerde observaties van lokale praktijken en interacties tussen gebruikers, leiders en waterbeheerders en hun strategieën voor het creëren en omvormen van irrigatie-instituties.

Het eerste interventieprogramma dat in dit proefschrift geanalyseerd wordt heeft als doel beheerverantwoordelijkheden over te dragen van de irrigatiedienst (het CNA) naar pas opgerichte lokale watergebruikersorganisaties (WGO's) en deze tevens verantwoordelijk te maken voor de kostendekking van beheer en onderhoud van irrigatiestelsels. De neoliberale gedachte achter dit programma is dat een toegenomen betrokkenheid van boeren in het beheren en financieren van irrigatiestelsels uiteindelijk zal leiden tot een verlaging van publieke investeringen in de geïrrigeerde landbouw alsmede tot een verbeterd functioneren van irrigatiestelsels. Het tweede institutionele interventieprogramma dat in dit proefschrift geanalyseerd wordt heeft betrekking op de introductie van watermarkten. Deze heeft als doel om het watergebruik zodanig te herverdelen dat dit leidt tot een gebruik met een hogere economische waarde. Beide interventieprogramma's zijn duidelijk geïnitieerd vanuit een benadering die 'minder overheid, maar meer markt' voorstaat voor het ontwerpen en implementeren van institutionele maatregelen om te komen tot een meer gebruiks- en kostenefficiënt beheer van schaarse bronnen als water en geld. Hoe gebruikers en lokale waterbeheerders omgaan met de problemen die het gevolg zijn van deze interventies en maatregelen staat centraal in dit proefschrift.

In 1992 was ARLID een van de eerste Mexicaanse irrigatiedistricten waar overdracht van irrigatiebeheer (OIB) werd geïntroduceerd. Het Mexicaanse OIB programma wordt wereldwijd gezien als het meest succesvolle en ambitieuze in zijn soort, zowel vanwege de schaal als vanwege de snelheid waarmee het beleid was geformuleerd en uitgevoerd. De succesclaim van deze en vergelijkbare programma's is over het algemeen ideologisch van aard. Empirisch bewijs voor de claim dat deze institutionele interventies de beleidsdoelstellingen hebben bereikt, blijft vooralsnog grotendeels ongedocumenteerd. Dit proefschrift vult voor een deel dit empirische vacuüm.

Het proefschrift bevat tien hoofdstukken. Na een conceptuele en methodologische inleiding in hoofdstuk 1 volgen twee contextuele hoofdstukken. In hoofdstuk 2 wordt de onderzoekslocatie geïntroduceerd, terwijl in hoofdstuk 3 de politiek-economische geschiedenis en context waarbinnen de institutionele interventies hebben plaatsgevonden worden gepresenteerd. In de hoofdstukken 4 tot en met 9 worden de empirische gegevens uit de intensieve casusstudie die in ARLID verricht is gepresenteerd. In hoofdstuk 10 worden de belangrijkste empirische, conceptuele en methodologische bevindingen geëvalueerd en worden mogelijke implicaties van het onderzoek op beleids- en onderzoeksrichtingen besproken.

In het eerste hoofdstuk wordt een overzicht gegeven van de conceptuele benaderingen en methodes die gebruikt zijn om de levensvatbaarheid van nieuwe institutionele maatregelen in de context van marktgerichte hervormingen te bestuderen. In dit proefschrift worden de randvoorwaarden, processen en mechanismen die bijdragen tot het creëren van levensvatbare instituties verkend. Deze mechanismen verwijzen niet alleen naar institutionele en economische verhoudingen, maar ook naar relaties tussen deze instituties enerzijds en waterschaarste en irrigatietechnologie anderzijds. Het proefschrift gaat er daarbij vanuit dat irrigatietechnologie een sociaaltechnisch fenomeen is met institutionele gebruikseisen.

Een sleutelbegrip voor het analyseren van de levensvatbaarheid van irrigatie-instituties is die van het geven van rekenschap (*accountability*). Dit onderzoek laat zien dat vier vormen van rekenschap onderscheiden kunnen worden: operationeel, financieel, politiek en ambtelijk. Door deze vormen van rekenschap (en hun onderlinge relatie) te bestuderen, kan worden aangetoond dat de praktijk en de strategieën om te komen tot besluitvorming in waterbeheer slechts ten dele beïnvloed worden door rationele keuzen en (economische) prikkels voor gebruiksmaximalisatie. Ze worden ook beïnvloed door sociaal-politieke factoren.

De methodologische aandacht van dit proefschrift gaat uit naar de ontwikkeling van een groep instrumenten en indicatoren waarmee de effecten van institutionele interventies bepaald kunnen worden, zowel in termen van verandering in het functioneringsniveau (*performance levels*) van irrigatiestelsels, als in kwalitatieve termen van institutionele levensvatbaarheidsprocessen. Twee groepen van functioneringsindicatoren worden gepresenteerd. De eerste groep bevat indicatoren waarmee het daadwerkelijke functioneren wordt gemeten in relatie tot voorgeschreven functioneringsdoelstellingen. Met de tweede groep indicatoren worden functioneringsniveaus door de tijd en met andere systeemniveaus onderling vergeleken. Voor het veldwerk zijn een scala aan methodes en onderzoekstechnieken gebruikt, variërend van intensieve observaties van praktijken en strategieën die gebruikt worden voor het omgaan met nieuwe institutionele maatregelen, tot het dagelijks meten van waterstromen en volumes in twee geselecteerde WGO-gebieden en enkele kanalen en velden binnen het irrigatiedistrict. Het veldwerk heeft van begin 1995 tot halverwege 1998 plaatsgevonden.

In hoofdstuk 2 wordt informatie gegeven over de locatie, de geschiedenis, de beschikbaarheid van water en het fysische ontwerp van ARLID. Daarnaast worden de twee groepen van boeren die nu gezamenlijk binnen de nieuwe WGO's zijn georganiseerd geïntroduceerd: de *ejidatarios* en particuliere landbouwers. Het laat zien hoe deze twee groepen gedurende bijna 70 jaar historisch en economisch gescheiden zijn geweest. In het hoofdstuk wordt ook een korte beschrijving gegeven van de twee voor de intensieve casusstudie geselecteerde WGO-gebieden, met hun kanalen en hun organisaties.

Twee uitgangspunten vormen de basis van hoofdstuk 3, waarin een gedetailleerde beschrijving wordt gegeven van de historische en politiek-economische context van OIB en het vermarkten van water. Het eerste uitgangspunt is dat de legitimatie voor institutionele interventies bekeken zou moeten worden in het licht van de politiek-economische context van de privatisering van het Mexicaanse platteland. Deze privatisering kwam tot stand middels een drastische constitutionele herziening van de wijze waarop land- en waterrechten zijn verdeeld. Deze hervormingen en herzieningen kwamen in de jaren 80 op gang als een gevolg van zowel een politieke als een economische crisis. Ze werden begeleid door een golf van programma's die zich richtten op de liberalisering, decentralisering en technocratisering van de economie. Institutionele interventieprogramma's, zoals het Mexicaanse OIB programma, komen niet vanzelf maar worden vooraf gegaan, begeleid en gevolgd door andere interventieprogramma's die dezelfde neoliberale legitimatie hanteren voor het willen herstructureren van de politieke en economische controle over (natuurlijke en financiële) hulpbronnen. Het tweede uitgangspunt is dat de Salinas (en de daarop volgende) regering een interventiebeleid zoals OIB en het vermarkten van water nodig had om de economische doelstellingen van hun neoliberale programma's te bereiken. Dit beleid zou helpen om de kosten op de gebruikers te verhalen. Neoliberale programma's zijn echter niet per se noodzakelijk om meer betrokkenheid van de boeren in waterbeheer te kunnen bewerkstelligen.

Hoofdstuk 4 laat zien hoe het beleid van OIB en het vermarkten van water werden geïmplementeerd, zowel nationaal als op het niveau van ARLID. Het OIB programma is een typisch voorbeeld van institutioneel ontwerpen. Dit programma bestaat uit zowel gedetailleerde voorschriften over hoe het institutionele ontwerp eruit moet zien als uit een top-down benadering voor het uitvoeren van deze ontwerpen. Toch hebben boeren en lokale waterbeheerders deze voorgestelde maatregelen niet volledig naast zich neergelegd. In plaats van ze als voorgeschreven instructies te gebruiken, hebben de WGO's deze nieuwe principes en maatregelen gebruikt als een strategisch vertrekpunt voor hun onderhandelingen over onder andere de hoogte van de irrigatietarieven, het vermarkten van water, de wijze van vertegenwoordiging door gebruikers, de onderhoudprogramma's, en de herverdeling van verantwoordelijken voor beheer en onderhoud tussen WGO's en het CNA. De nieuwe institutionele maatregelen zijn gedeeltelijk door de lokale ontvangers geadopteerd en op hun situatie aangepast. Het OIB programma stond toe dat lokale irrigatiebeheerders, nieuwe leiders van WGO's en boeren gezamenlijk ruimte en institutionele flexibiliteit konden creëren om de voorgestelde maatregelen aan te kunnen passen. Dit werd hoofdzakelijk mogelijk gemaakt door CNA-functionarissen in ARLID, die vanaf het begin van de uitvoering van OIB aan gebruikers lieten zien dat zij geloofwaardig waren en tevens bereid om hun kennis en informatie op een transparante manier met de boeren te delen. Tijdens het onderhandelingsproces over de vorming van institutionele maatregelen zijn geloofwaardigheid, transparantie, institutionele flexibiliteit en eerlijkheid bepalend geweest voor operationeel rekenschap (*operational accountability*) tussen zowel het CNA en de WGO's als tussen de WGO's en de watergebruikers. Gezien het brede scala aan marktgerichte hervormingen en constitutionele herzieningen waarmee de boeren inmiddels bekend waren geworden, realiseerden zij zich dat zij nauwelijks weerstand zouden kunnen bieden aan OIB.

Hoofdstuk 5 geeft een gedetailleerde analyse van de praktijken, de resultaten en van de mechanismen van het verlenen van operationeel rekenschap binnen lokaal waterbeheer. Het laat zien dat in ARLID na beheeroverdracht de officiële maatregelen voor beheer en onderhoud niet altijd overeenstemden met de daadwerkelijke irrigatiepraktijk. Het gevolg hiervan was dat de resultaten van deze praktijk in termen van relatieve watertoedeling (RWS) en land- en waterproductiveit ook na OIB onveranderd bleven. Het conflict tussen de verschillende vormen van het afleggen van rekenschap was hiervan de belangrijkste oorzaak. Dit kon niet opgelost worden binnen het palet van nieuwe institutionele maatregelen. In plaats van vast te houden aan het nieuwe principe om water te gebruiken als ware het een economisch goed, hielden boeren en lokale waterbeheerders vast aan het verdelen en gebruiken van water zoals dit reeds gebeurde onder de maatregelen van vóór de beheeroverdracht. Het dagelijks meten van waterstromen en volumes, alsmede de dagelijkse observaties van irrigatiepraktijken hebben laten zien dat waterverdelers (die nu rechtstreeks in dienst zijn van de WGO's) over het algemeen de geplande in plaats van de daadwerkelijke volumes van watertoedeling rapporteren aan de WGO's. Op deze wijze zetten zij de praktijk van het afleggen van ambtelijk rekenschap (*administrative accountability*) aan zowel gebruikers als CNA voort. Dit strookt niet met het idee dat efficiënt watergebruik gestimuleerd wordt door gebruikers te laten betalen voor het water (waarmee financieel en operationeel rekenschap afgedwongen zou worden). De vergelijking van de productiviteit per hectare of per m^3 water tussen de 11 WGO-gebieden binnen ARLID laat zien dat ondanks dat water de limiterende factor is, de door de boeren gekozen waterbeheerstrategie gericht was op het maximaliseren van de opbrengst per hectare in plaats van verhogen van de opbrengst per m^3 water. Dit had als gevolg dat de waterverstrekkingen per geïrrigeerde hectare over het algemeen erg hoog waren. In dit hoofdstuk wordt ook het bewijs geleverd dat de bestaande irrigatietechnologie en het waterbeheerregiem niet altijd aansluiten bij de institutionele capaciteit van de nieuwe WGO's om het stelsel te beheren. Het hoofdstuk verkent ook enkele ideeën over hoe kwesties met betrekking tot relatieve waterschaarste in de context van zowel gelijktijdig grond- en oppervlaktewatergebruik als het gehele stroomgebied benaderd kunnen worden.

Hoofdstuk 6 geeft een uitgebreid verslag van de praktijk, de processen en de mechanismen van gebruikersvertegenwoordiging, de verkiezingen van WGO-leiders en van conflictoplossing, en hoe deze de politieke rekenschap en de institutionele levensvatbaarheid van instituties beïnvloeden. Een gedetailleerde analyse van verkiezingsprocedures en processen gedurende twee zittingsperiodes van WGO's laat zien dat de *de jure* verdeling van boerenvertegenwoordiging in het bestuur en de vergadering van de WGO's goed georganiseerd was. Echter, de *de facto* controle over besluitvorming bleef in handen van enkele boerenleiders. Deze leiders hebben verschillenden strategieën ontwikkeld om deze controle te reproduceren. Deze omvatten onder andere het uitoefenen van politieke dwang om herkozen te worden, corruptie, en het uitbreiden van economische en politieke netwerken. Vooral in het geval van WGO Salvatierra hebben deze strategieën er toe bijgedragen dat mechanismen voor het afleggen van rekenschap nauwelijks gecreëerd zijn. Watergebuikers hanteren twee belangrijke strategieën in hun poging om tegenwicht te vormen tegen afnemend rekenschap. Ten eerste weigeren ze de hogere watertarieven te betalen. Hiermee geven ze een signaal af over hun onvrede met het managementbeleid van de WGO's. Ten tweede vragen ze het CNA hen te helpen met het oplossen van conflicten die ontstaan zijn als gevolg van zowel onrechtmatige betalingen als het slechte functioneren van WGO-leiders.

In hoofdstuk 7 wordt een analyse gemaakt van hoe na beheeroverdracht mechanismen van het afleggen van financiële rekenschap de institutionele levensvatbaarheid van de maatregelen ten behoeve van irrigatiebeheer beïnvloeden. WGO's in ARLID zijn er in geslaagd om de kosten van waterbeheer veel meer op de gebruikers te verhalen en om financieel autonoom te worden. Vanuit dat oogpunt is OIB zeer instrumenteel gebleken voor het bereiken van de overheidsdoelstelling om publieke investeringen in de irrigatiesector te verminderen. Echter, het beter verhalen van de kosten op de gebruiker en het tot stand brengen van financiële autonomie hebben er ook toe bijgedragen dat de WGO's ruimte konden creëren om de herziening van belangrijke maatregelen verder uit te onderhandelen. Dit betrof onder andere het percentage van het totale inkomen van een WGO dat aan het CNA betaald moest worden, de hoogte van de watertarieven, en de voorwaarden voor het mogen handelen in water en de prijzen die voor dit water betaald moesten worden. Financiële transparantie, het gebruik van computers en het inhuren van externe accountants hebben er toe bijgedragen dat de WGO's financieel rekenschap konden afleggen naar gebruikers die voor hun water betaald hadden. Vooral in het geval van WGO Cortazar hebben leiders bovendien laten zien dat ze geloofwaardig waren door het inkomen uit watertarieven te gebruiken voor het aanzienlijk verbeteren van de staat van onderhoud van de kanalen. Ze hebben ook laten zien bereid te zijn irrigatiefunctionarissen te ontslaan toen bleek dat deze corrupt waren. Toch wordt de financiële levensvatbaarheid van de WGO's op twee manieren bedreigd. Op de eerste plaats is dit een gevolg van het gebrek aan politieke verantwoording (zoals in het geval van Salvatierra). In de tweede plaats komt dit voort uit een volkomen afhankelijkheid van de beschikbaarheid van water voor het genereren van inkomen voor de WGO.

In hoofdstuk 8 verschuift de aandacht naar de analyse van het vermarkten van water. WGO's in ARLID hebben daadwerkelijk de nu legale mogelijkheid aangegrepen om water te vermarkten aan andere WGO's binnen hetzelfde irrigatiedistrict. Echter, in tegenstelling tot de gebruikelijke opvatting van neoliberale voorstanders van watermarkten, zien de WGO's het handelen in water niet als een mogelijkheid om de waterprijs op het niveau van *opportunity* kosten te krijgen. In plaats daarvan wordt het proces van het vermarkten van water gebruikt om solidariteit tussen de WGO's te creëren. Deze solidariteit is noodzakelijk om te kunnen samenwerken in de nieuwe federatie van WGO's, die er voor gekozen heeft om de verantwoordelijkheden voor het onderhoud van het hoofdkanaal van het CNA over te nemen. WGO's gebruiken waterhandel ook om aan hun leden te laten zien dat ze geloofwaardig zijn door te trachten te allen tijde water te leveren, zelfs indien ze gedurende perioden van waterschaarste water moeten kopen van andere WGO's. Als een gevolg hiervan zijn de prijzen van verhandeld water over het algemeen lager dan de prijs die betaald moet worden voor normale waterverstrekkingen gedurende periodes met voldoende waterbeschikbaarheid.

In hoofdstuk 9 wordt teruggekeerd naar de officiële doelstellingen van het OIB programma. Dit gebeurt door de effecten van dit programma op het waterbeheer te bekijken. Met behulp van vergelijkende indicatoren wordt aangetoond dat de effecten van OIB en het vermarkten van water op het functioneren van het waterbeheer teleurstellend zijn. Met uitzondering van verbeteringen in het verhalen van de kosten op de gebruikers en in het onderhoud van het stelsel is er geen bewijs dat OIB geresulteerd heeft in efficiënter watergebruik noch in productiviteitsstijgingen per hectare of per m^3 water.

Hoofdstuk 10 geeft eerst een volledige synthese van de hierboven besproken empirische bevindingen. Vervolgens worden enkele conceptuele begrippen en methodologische middelen die gebruikt zijn tijdens dit onderzoek opnieuw onder de loep genomen. Dit laat zien dat het conceptuele uitgangspunt van sociale gebruikseisen voor irrigatietechnologie verder ontwikkeld zou moeten worden tot het begrip van institutionele gebruikseisen. Een belangrijke constatering hierbij is dat institutionele maatregelen een verzameling zijn van formele voorschriften, van bestaande maatregelen en van opnieuw onderhandelde maatregelen. Bestaande en nieuwe instituties zijn het resultaat van een continu proces waarin het afleggen van rekenschap gecreëerd, onderhandeld, verdiend en onderhouden wordt. Dit verklaart waarom instituties 'toevallig' (*contingent*) lijken in plaats van voorbedachte statische structuren gebaseerd op institutionele ontwerpprincipes.

Het opnieuw bekijken van het begrip rekenschap (*accountability*) laat zien dat het zinvol is om verschillende vormen van rekenschap te onderscheiden. Naast het analyseren van rekenschapmechanismen die betrekking hebben op het enkel leveren van beheer- en onderhoudsdiensten, of op het verhalen van kosten op gebruikers, helpt het maken van dit onderscheid juist ook andere mechanismen van rekenschap te analyseren. Het helpt ook bij het ontrafelen van de wijzen waarop dienstenleveranciers al dan niet rekenschap afleggen. Tevens helpt het om te laten zien op wat voor manier verschillende vormen van rekenschap afleggen elkaar kunnen beconcurreren. Dit is vooral van belang in het geval van gezamenlijk beheer van irrigatiestelsels door WGO's en overheidsdiensten. Omdat deze organisaties verschillende waarden en doelen kunnen hebben zullen zij op verschillende manieren trachten rekenschap af te leggen.

Een evaluatie van de verschillende groepen methoden voor het bepalen van effecten van institutionele interventies laat zien dat de vergelijkende indicatoren bruikbaar zijn voor het bepalen van veranderingen die het gevolg zijn van deze interventies. Hun bruikbaarheid wordt echter beperkt door het feit dat ze zich met name richten op het meten van veranderingen in productiviteit en op economische effecten. Bovendien bleek het toepassen van deze indicatoren meer tijd en middelen te vergen dan was aangenomen. De reden hiervan moet gezocht worden in de complexiteit en de hoeveelheid van de benodigde secundaire data alsmede in het moeilijke proces van het ontsluiten van de betekenis van deze data.

Dit onderzoek heeft verschillende implicaties voor marktgericht beleid in zowel Mexico als daarbuiten. Vanwege zijn unieke politiek-economische en constitutionele context is het niet mogelijk om het 'Mexicaanse OIB model' zomaar te kopiëren naar andere landen waar vergelijkbare pogingen van geplande institutionele veranderingen reeds gaande zijn. Zowel vanwege het feit dat OIB en het vermarkten van water door het allerhoogste politieke niveau werden gesteund als vanwege de drastische constitutionele herzieningen en andere landbouwhervormingen konden de nieuwe institutionele maatregelen voor waterbeheer in zo'n korte tijd en op zo'n grote schaal worden uitgevoerd. Dit onderzoek wijst er ook op dat institutionele moderniseringsprogramma's (zoals OIB en het vermarkten van water) en infrastructurele modernisering veel beter op elkaar aan moeten sluiten. Ondanks het feit dat infrastructurele verbeteringsprogramma's vaak gebruikt worden om institutionele hervormingen (en de lasten die daar bij horen) aan de watergebruikers te verkopen, worden ze nauwelijks aan elkaar gerelateerd op een manier waarop de voorgestelde nieuwe technologie aansluit bij de nieuwe institutionele maatregelen die nodig zijn om deze technologie te kunnen gebruiken.

Hoofdstuk 10 eindigt met een discussie over de vraag waarom onderzoek naar institutionele interventies zich meer moet richten op het stroomgebiedniveau in plaats van op het niveau van irrigatiestelsels. Daarnaast wordt er een pleidooi gehouden om de onderzoeksaandacht niet al te frequent te verleggen naar het doen van korte, extensieve, kwantitatieve en vergelijkende studies, ondanks het feit dat universiteiten en internationale onderzoeksinstituten gedwongen zijn onderzoek te doen in de context van een geglobaliseerde wereld met geglobaliseerde onderzoeksagenda's. Voor het begrijpen van institutionele veranderingsprocessen en de effecten daarvan op lokaal niveau zijn langdurige, intensieve en kwalitatieve casusstudies vereist. Alleen op die manier kan samenwerking met lokale onderzoekspartners volledig ontwikkeld worden. Dit zal uiteindelijk tot gevolg hebben dat de voor een dergelijk begrip noodzakelijk institutioneel onderzoeksgeheugen gecreëerd wordt.

Curriculum Vitae

Wim Kloezen was born on 13 October 1961 in Zwolle, The Netherlands. For several years he worked as a sales manager, before he came to Wageningen Agricultural University (WAU) in 1983 to study Irrigation and Soil and Water Conservation.

His interest in doing interdisciplinairy research was triggered when he took a course in development economics at the University of Amsterdam in 1985. In 1986, the Center for Environmental Studies (CML) at the University of Leyden gave him the opportunity to further develop this interest by studying the impacts of political and administrative changes on the management of natural resources in two villages in Karnataka, India. This field study was conducted together with two students, in biology and political sciences, respectively, and in collaboration with the Indian Institute of Management in Bangalore. The co-authored thesis was awarded with the CML Thesis Prize. In 1989 he went to Spain to do field work for his second MSc thesis. In the Campo de Cartagena he studied the relationship between labor aspects and the choice of irrigation technology. In September 1989 he graduated *cum laude* from WAU.

Shortly after his graduation he became a staff member with the then Department of Irrigation and Soil and Water Conservation at WAU. For 3.5 years he lectured on the social, economic and institutional dimensions of water management as well as on research methodologies. During this period he was also involved in a research program on the joint farmer-agency management of large-scale irrigation systems in the Terai of Nepal.

He joined the International Water Management Institute (IWMI) in June 1993 as an associate expert, co-funded by the Netherlands Ministry of Foreign Affairs (DGIS). In Sri Lanka he conducted intensive in-depth studies on participatory water management in Kaudulla irrigation system and Mahaweli System C. At the same time he was involved in several other IWMI programs and activities in Bangladesh, India and China.

In 1995 he was transferred to IWMI's office in Mexico, where he worked on impact assessment studies of the Mexican irrigation management transfer program. He did this in collaboration with private user associations, government agencies and universities. During this time with IWMI-Mexico, he was also involved in a project on the integrated management of a small water basin in Northern Ecuador and frequently traveled to Colombia and Argentina to be part of other IWMI activities in the Andean region.

He again joined the Irrigation and Water Engineering group at WAU in 1998. At WAU he worked as a guest researcher to complete this PhD thesis and as a lecturer in research methodologies. In February 2000 he started to work with the Oranjewoud Advise Group, where he became project leader on integrated water management projects in Holland. Since January 2001 he has been heading Oranjewoud's Agriculture and Water Management group as a business manager.

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