16

Research Report

Irrigation Management Transfer in Mexico: A Strategy to Achieve Irrigation District Sustainability

Sam H. Johnson III

International Irrigation Management Institute

Research Reports

IIMI's mission is to foster and support sustainable increases in the productivity of irrigated agriculture within the overall context of the water basin. In serving this mission, IIMI concentrates on the *integration* of policies, technologies and management systems to achieve workable solutions to real problems—practical, relevant results in the field of irrigation and water resources.

The publications in this series cover a wide range of subjects—from computer modeling to experience with water users associations—and vary in content from directly applicable research to more basic studies, on which applied work ultimately depends. Some research reports are narrowly focused, analytical, and detailed empirical studies; others are wide-ranging and synthetic overviews of generic problems.

Although most of the reports are published by IIMI staff and their collaborators, we welcome contributions from others. Each report is reviewed internally, by IIMI's own staff and Fellows, and by external reviewers. The reports are published and distributed both in hard copy and electronically (http://www.cgiar.org/iimi), and where possible all data and analyses will be available as separate downloadable files. Reports may be copied freely and cited with due acknowledgment.

16 Research Report

Irrigation Management Transfer in Mexico: A Strategy to Achieve Irrigation District Sustainability

Sam H. Johnson III

International Irrigation Management Institute
P O Box 2075, Colombo, Sri Lanka

The author: Sam H. Johnson III is the former Program Leader, Mexico and Latin America, International Irrigation Management Institute. He is presently the Deputy Director of the Consortium for International Development, 6367 East Tanque Verde, #200. Tucson, AZ. 85715.

IIMI's research program in Mexico started in 1994 with encouragement and support from the Ford Foundation, Mexico. Research is carried out in collaboration with the Comisión Nacional del Agua, the Instituto Nacional de Investigaciones Forestales y Agropecuarias, and the Colegio de Postgraduados. IIMI is grateful to the Federal Ministry for Economic Cooperation and Development (BMZ), Germany and the Ford Foundation for financial support for the research program in Mexico.

Johnson, S. H. III. 1997. *Management transfer in Mexico*: *A strategy to achieve irrigation district sustainability.* Research Report 16. Colombo, Sri Lanka: International Irrigation Management Institute.

/ irrigation management / privatization / participatory management / agricultural production / sustainability / private sector / public sector / economic aspects / water user associations / investment / agricultural policy / irrigated farming / water law / user charges / landownership / Mexico /

ISBN 92-9090-347-3
ISSN 1026-0862

Contents

Summary

In Mexico, the percentage of irrigation operation and maintenance costs paid by users declined from 95 percent in the early 1950s to below 20 percent in the early 1980s. As a result of the shortage of funds, the irrigation districts deferred maintenance leading to a serious reduction in output and decline in the infrastructure. To solve this problem, in 1989, the government instituted a program of transferring management from the National Water Commission (CNA) to the water users. The transfer program in Mexico took off very quickly and by the end of 1996 more than 88 percent of the 3.3 million hectares of publicly irrigated land in the country had been transferred to joint management. Water user associations have proven capable of jointly operating and maintaining irrigation districts. Water tariffs collected by the users (in excess of US$180 million in 1995) have supported not only water user operation and maintenance (O&M) activities but also the majority of the O&M activities by CNA staff. In particular, maintenance activities carried out by the water user associations have stopped the deterioration in the infrastructure and hence have accomplished one of the major objectives of the transfer program. To sustain the transferred districts, the users need to establish an investment fund to cover emergencies and future development. In addition, it is necessary to clarify the water laws to protect agricultural water rights.

Irrigation Management Transfer in Mexico: A Strategy to Achieve Irrigation District Sustainability

Sam H. Johnson III

Introduction

Privatization is often defined as a development strategy involving the transfer of function, activity, or organization from the public sector to the private sector. Such a strategy emerged in large part from a conclusion that growth and development are severely limited by the intrinsic nature of activities based on the public sector. As such, it is argued that in their quest for growth and development, developing-countries must work proactively to place the so-called "commanding heights" of the economy in the hands of the private sector. Under this economic model, the public sector is relegated to the setting of the policy framework and the environment, such that market forces can function (Davis 1993).

Over the past three decades, governments in both more-developed and less-developed countries have transferred public companies and other state enterprises to the private sector. In many countries, transfers have been initially concentrated in the manufacturing and transportation sectors, but privatization has now extended to almost all sectors of the economy, including the provision of water services such as potable water and irrigation (ECLAC 1995). In Latin America and Mexico, it is rather ironic that water-based services should now be included in this process as up to the early 1900s most such services in the region were provided by the private sector. Governments in the region decided during the 1920s that water services should be provided by the public sector, and in or after the 1940s they decided that such services should normally be provided by agencies of the central government rather than by the states (Lee 1990).

The primary reason used to justify intervention in the provision of water services was a belief, by both governments and international donor agencies, that strong government intervention in the economy was required to ensure economic growth and it also led to improved economic welfare. Yet, stagnant growth and a failure of the public sector to properly operate and maintain the facilities led to a reversal of this belief. In the 1970s, this ideology changed as many countries decided that the private provision of services is the most efficient means of improving both economic efficiency and social welfare. In the case of irrigation, this involves transferring responsibility for irrigation operation and maintenance (O&M) from the public agencies to water user associations.

Using data from the irrigation transfer program in Mexico, this report takes this

argument one step further to show that transfer to groups of users of the rights to the net benefits generated by public irrigation investment is a means of maintaining economic returns to public investment. In cases where the groups of users also accept responsibility for maintenance, this may be a necessity to ensure sustainability of the infrastructure. The case of Mexico is very important as the country has demonstrated that it is possible to quickly transfer large public irrigation systems to groups of users. The success of the Mexico transfer program and its reputation have attracted visiting study tour groups from all over the world. Their interest in the program and its success attests to the global importance of the Mexico model.

Over time it has been demonstrated that the lack of political will to charge the full O&M costs, not to mention the investment costs, to users of irrigation facilities, complicated by the inability of governments to provide the required O&M funds from the public budget, often results in a situation where public infrastructure is unsustainable over time (World Bank 1994a). This is particularly true with public irrigation schemes. It is very easy to find cases of schemes that were developed with design lives of 50 years, yet have had to be rehabilitated in less than 10 years (Johnson 1990). After watching this cycle of development and decay for more than 40 years, a number of governments in Latin America, Mexico, and the Caribbean have decided to transfer management responsibility to user associations to try to ensure sustainability of the infrastructure (PLANIMAR 1995).

Material presented in this report details the process of transfer of public irrigation districts in Mexico from public ownership to joint management, where responsibility for irrigation O&M is shared between the public irrigation agency and the water user associations. The first two sections present an overview of agricultural policy and irrigated agriculture in the country while the third section describes the irrigation management transfer program in the country. The fourth section examines results of the transfer program in terms of impacts on financing of O&M, staffing changes, production costs, and maintenance expenditures. This section draws on more general data for the entire country as well as specific data from two irrigation districts, Alto Rio Lerma Irrigation District (near Celaya in central Mexico—transferred in 1992) and Region Lagunera Irrigation District (near Torreon in northern Mexico—transfer started in 1991), where IIMI is carrying out long-term field research. The final section discusses future changes needed to maintain the systems.

Mexican Agricultural Policy

Agricultural policy changes in the country occurred during two distinct periods: a period of heavy government subsidies after the revolution and a period of economic liberalization introduced since the late 1980s. Agriculture has played a central role in Mexico's economic development plans. These plans have been based on cheap energy from Mexico's petroleum reserves, cheap labor from the rural sector, and cheap food obtained through the use of highly subsidized agricultural inputs.

Government Intervention

After the end of World War II, as part of the revolutionary creed that argued a strong government presence was needed to ensure economic growth and provide increased social welfare, the Government of Mexico has used both direct and indirect policies to intervene in the agriculture sector. In the process, the government established marketing and input supply parastatals, imposed import controls, guaranteed producer prices, mandated production targets for growers, invested in irrigation and other infrastructure, restricted land transactions and agricultural markets, and subsidized fertilizers, farm credit, agricultural water, and crop insurance (Gorriz, Subramanian, and Simas 1995). Until the late 1980s, the main goal of Mexico's agricultural pricing policy was to keep prices low for consumers, yet ensure high prices for producers. Prices were guaranteed for 12 major crops: maize, bean, wheat, barley, rice, sorghum, soybean, safflower, cottonseed, copra, sunflower, and sesame, as long as they were marketed through a government marketing channel. For 1991, de Janvry, Sadoulet, and Gordillo de Anda (1995) calculated a nominal rate of protection of 77 percent for maize, a producer subsidy equivalent (PSE) of US$92 for white maize and $71 for yellow maize—a result of various government intervention programs for staple crops. In contrast, in the United States and Canada, the PSE was US$28 for white maize and $21 for yellow maize.

Liberalization

Mexico's entry into two international accords - the General Agreement on Tariffs and Trade (GATT) and the North American Free Trade Agreement (NAFTA) - (has altered its trade policy. Under NAFTA, 42 percent of tariff codes were liberalized, with tariffs on foodstuffs and cotton to be phased out over a period of 15 to 20 years. These phaseouts are consistent with GATT agreements regarding reduced agricultural protection for developing countries (World Bank 1995). Mexico's willingness to join NAFTA and GATT signifies that there has been an ideological change in the country. It is now felt that the government should not be involved in agricultural production; efficiency and welfare will improve with increased private involvement. As a result, starting in 1989, guaranteed prices were replaced with market agreement prices for all commodities except bean and maize, and the government began implementing reforms to reduce general food subsidies.

The only basic food products still benefiting from targeted consumption subsidies include maize flour, tortillas, and milk (World Bank 1995).

It should be emphasized that the Mexican divestment program was not implemented solely as a result of GATT and NAFTA, but had actually started in 1983. After expanding from 391 public enterprises (covering all sectors) in 1970 to 1,155 in 1982—where enterprises run the range from parastatals to commercial firms—the government shifted its view of the role that the public sector should play in the economy. Therefore, starting with the sale of some of the smaller public firms in 1983, the government instituted a divestment program. The sale of larger firms dates from 1988 when transfer of mines, steel industry, airlines, the telephone company, and commercial banks was instituted. As can be seen in table 1, the number of firms in the hands of the government was reduced from 1,155 to 280 during the period December 1982 to December 1990.

With almost 10 years of experience in privatization, Mexico had confidence in its ability to reduce the government's role in the economy, including agriculture. From 1989 onward, under President Salinas de Gortari, Mexico instituted bold agricultural reforms on many different fronts, including:

- privatization of most parastatals in marketing, fertilizers, seeds, insurance, and the provision of other inputs used to transfer massive subsidies to agriculture
- extensive reorganization of the financial sector with reprivatization of commercial banks
- elimination of credit subsidies
- elimination of the national basic commodities board's (CONASUPO) monopoly over the marketing of basic foods except maize and bean sharp reductions of public budgets for agricultural research and extension services with private delivery and the charging of user fees expected to substitute for free public extension services
- gradual transfer of the management of irrigation districts to water user associations with the introduction of sharply increased fees for water use (Salinas de Gortari 1991).

TABLE 1.
Privatization of public firms in Mexico: December 1982 to December 1990.

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Decentralized institutions	102	87	95	96	94	94	89	88	82
Firms with major state participation	744	700	703	629	528	437	252	229	147
State trust funds	231	199	173	147	108	83	71	62	51
Firms with minor state participation	78	78	78	69	7	3	0	0	0
Total	1155	1074	1049	941	737	617	412	379	280

Source: Rodriguez 1992, p. 158.

Given the extent of the overall policy changes in the economy, reforms in the irrigation sector must be viewed against the backdrop of the larger set of agricultural policy reforms that have been instituted since the late 1980s.

Legal Changes

Agriculture has played an important political role as land reform was a major component of the revolution of 1910. As a result of land confiscated during the revolution and subsequently distributed to the workers, more than half the cultivated land in Mexico are *ejidos* (land reform communities) where the farmers can use the land but cannot own or sell it. Until 1992, ejido farmers had permanent and hereditary use rights but could not transfer these rights through sale, and thus could not pledge their land as collateral for guaranteeing credit. Due to the legal status of the ejido land, farmers in the ejidos have not had access to improved agricultural technology and credit and, hence, over half the cultivated land in Mexico has had a very low productivity.

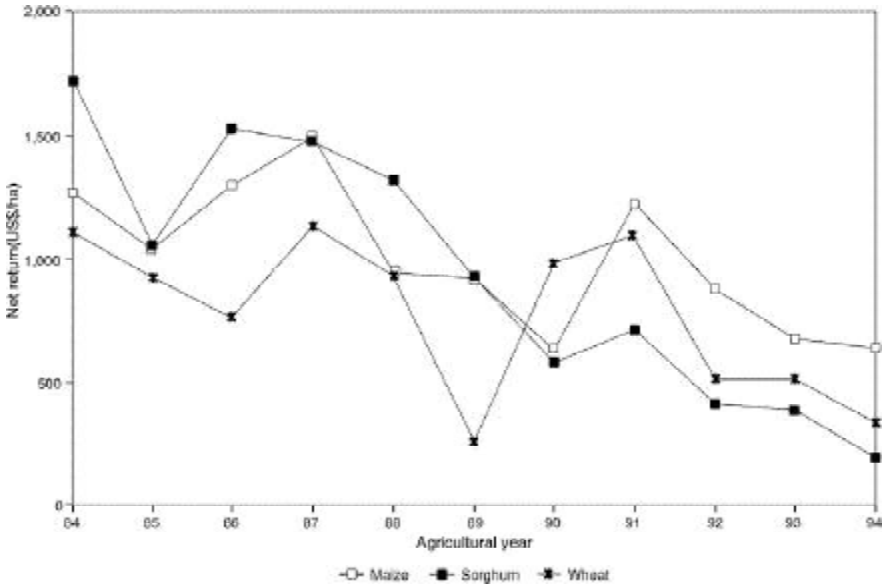
To facilitate the transfer of public irrigation districts, article 27 of the constitution was modified in 1992 so that farmers in ejidos could be given the right to form associations and to rent and sell their water and land rights as well as pledge their land as collateral for loans (Foley 1995). In addition, the national water law was revised so that water rights were clarified and the possibility for selling and leasing water to higher-value uses was established (Comisión Nacional del Agua 1992; Rosegrant and Gazmuri 1994a). These measures were meant to encourage investment and productivity on the assumption that security of tenure will ensure increased capitalization and that productivity gains in agriculture can only be achieved through realizing economies of scale (Salinas de Gortari 1992).

Terms of Trade

Over the past 10 years, the terms of trade of agriculture changed drastically. During this period, with the removal of the subsidies on inputs and the elimination of most price guarantee programs, profitability of grain crops declined to only around 30 percent of what it was in 1984 (figure 1). Net returns for maize, wheat, and sorghum suffered serious declines over the 10 years from 1984 to 1994. This trend poses a threat to the ability of users, particularly the small private growers and members of the ejidos, to continue to pay the water fees needed to sustain the transferred irrigation systems. Reduced economic returns often encourage users to underfund O&M (Svendsen and Vermillion 1993).

FIGURE 1.

Changes in profitability (1984-1994) in the Alto Rio Lerma Irrigation Disttrict: Wheat, maize and sorghum.*



* In constant 1994 US dollars (US$ 1.00 = Mexican pesos 3.4)

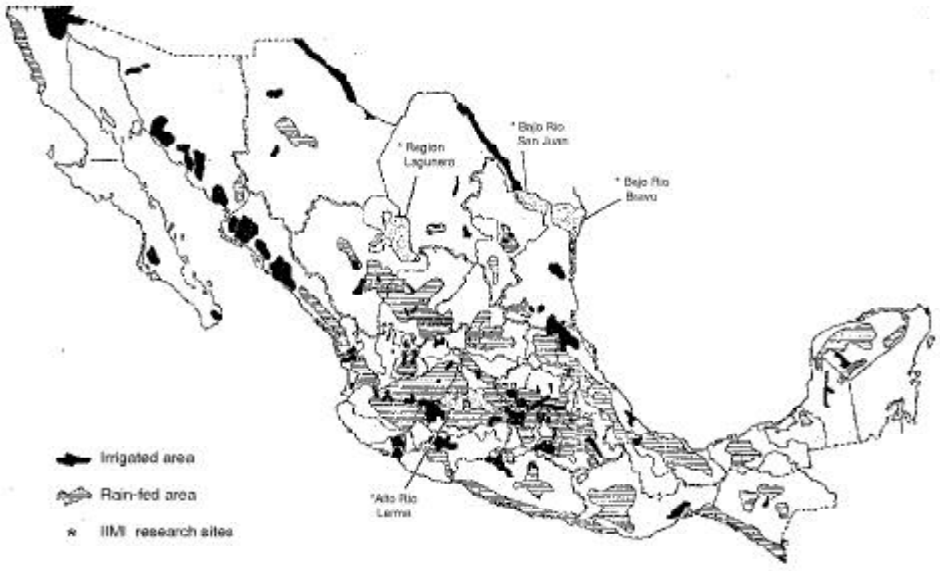
Irrigated Agriculture

Mexico has a vast land area of approximately two million square kilometers. Over 75 percent of the country is classified as arid and semiarid and water is the constraining agricultural production factor in many areas. The annual rainfall of over 40 percent of the country is under 500 millimeters. As a result, the total cropped land is only around 20 million hectares, with about 10 million hectares farmed by members of ejidos and 10 million hectares farmed by private growers. With such a large extent of arid land, irrigation plays a critical role in terms of overall agricultural production. Within the agriculture sector, irrigated land contributes about 50 percent of the total value of agricultural production and accounts for about 70 percent of agricultural exports. Productivity of irrigated land is 2.3 times that of rain-fed land (Espinosa de León and Trava Manzanilla 1992) while the value of agricultural production from irrigated land is 3.2 times that of the production from rain-fed land (Comisión Nacional del Agua 1996b).

Irrigation has been practiced in Mexico since pre-Hispanic times, with many small diversions and canals built to meet the agricultural needs of the population. It has been estimated that at the beginning of the revolution there were approximately 1.2 million hectares of irrigated land. Much of this land had been developed by various land companies, mainly American, for the purpose of growing plantation crops such as sugarcane and cotton. The constitution of 1917 nationalized the country's water resources and all of these irrigation systems became the responsibility of the state. To manage irrigation in the country, an Ir-

FIGURE 2.

Irrigated and rain-fed areas, and IIMI reserch sites in Mexico.



rigation Directorate was established in the Department of Agriculture and Development, followed by the National Irrigation Commission in 1926 that was given responsibility for all irrigation affairs. During the period 1926 to 1934, the first large, public irrigation districts were established in the country (Comisión Nacional de Irrigación 1940). Although in the 1930s irrigation development was slow, by 1960 the agricultural census reported a total of 4.3 million hectares in the country (Trava 1994).

TABLE 2.

Distribution of public irrigation districts in Mexico by size.

Range of area (ha)	No. of districts	Total area (ha)
<10,000 24	131,900	
10,001 - 50,000	39	980,821
50,001 - 100,000	9	690,256
100,001 - 200,000	3	374,817
>200,001	5	1,158,377
Total	80	3,336,171

Source: World Bank 1994b.

Irrigation Districts

Irrigation districts were created and developed as part of the public policy to foster food grain self-sufficiency. These were large public irrigation systems (50,000-300,000 ha) that were operated by the government irrigation agency with little direct involvement of the users in the operation and maintenance of the district. By the end of 1982, the total land area under irrigation was 5.3 million hectares. By the late 1980s, Mexico had approximately 6 million hectares in irrigation, with 3.3 million hectares in public irrigation districts (figure 2) and the remaining 2.7 million hectares in 27,000 communal and private irrigation units with approximately 50 percent of these served by small reservoirs. Table 2 details the distribution of the public irrigation districts in Mexico by size. At the end of the 1980s, Mexico had approximately 1,300 storage dams, 2,100 diversion dams, 68,000 km of canals, 47,000 km of

drains, 54,000 km of service roads, and over 60,000 deep irrigation wells (World Bank 1991).

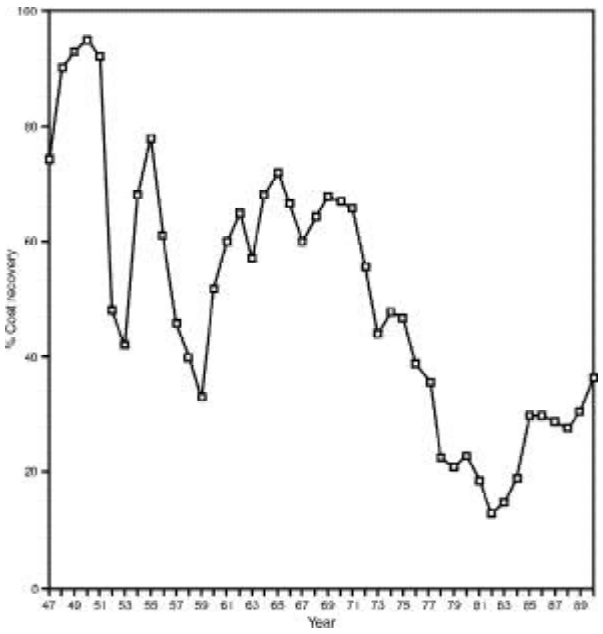
Initially, the costs of administration and O&M of the irrigation districts were paid by the government and the farmers, the latter through water fees. Over time, the percentage of total irrigation O&M costs covered by farmer contributions declined. As can be seen in figure 3, in the early 1950s, farmers were paying above 85 percent of the actual O&M and administrative costs, but by the early 1980s, farmer contribution to the budget had fallen to less than 20 percent[1] (Espinosa de León and Trava Manzanilla 1992). The remainder of the budget was being paid by public expenditure, although in most cases, maintenance activities were deferred due to lack of funds (World Bank 1991). No precise estimates are available for the amounts and volumes of work needed for deferred maintenance, although a World Bank 1983 publication estimated the overall costs would be US$3.5 billion (in 1981 dollars).

The golden era of rapid irrigation development was stopped by the financial and resulting budgetary crisis of August 1982. With the collapse of the peso (Mexican pesos), and the resulting devaluation, investment funds for new irrigation systems as well as funds for the maintenance of the existing systems were not available. Throughout the rest of the 1980s public investment funds were scarce such that, in nominal terms, public investment in the sector declined from US$3,600 million in 1981 to $230 million in 1990. In 1988, investment in irrigation infrastructure was less than 3 percent of total public investment compared with around 10 percent in 1978 (Gorriz 1995). As a result, the rate of expansion of irrigated land, which had reached an average of nearly 150,000 hec-

[1]Irrigation fees varied between US$2 and $3 per irrigation between the mid-1960s and the early 1980s.

FIGURE 3.

Percentage cost recovery of irriagtion districts in Mexico 1947-90.*



*Data provided by CNA.

tares per year in 1979-81, was reduced to less than 5,000 hectares per year in 1988 (World Bank 1991).

The reduction in public funding for O&M led to deterioration in the performance of the irrigation systems. Between 1982 and 1987, irrigated agricultural production declined at an average rate of 0.4 percent per annum (World Bank 1991). The economic crisis not only reduced the availability of funds for new irrigation investment but also significantly constrained government funds available for maintenance. By the end of the decade, around 800,000 hectares of irrigated land were estimated to be out of production or being used only at a reduced level due to deterioration of the infrastructure. Another 1.5 million hectares required rehabilitation to bring overall system efficiency back to its original level (Figueroa Hernandez 1992). In some districts unionized employees were starting to demand extra compensation for working in excess of 8 hours during a day while improper use of maintenance equipment had become chronic as lack of budgetary funds resulted in the machinery being used less than one-third of its normal schedule (Trava 1994). Consequently, at the end of the 1980s, the 3.3 million hectares of land served by public irrigation systems were under heavy stress.

Irrigation Management Transfer

In 1989, recognizing the problems in the irrigation subsector (World Bank 1989), as part of the National Development Plan (1989–1994), the government created the National Water Commission (CNA). CNA was created with an explicit mandate to define a new policy for the management of the waters of the country. This led to the development of the National Program for Decentralization of the Irrigation Districts under the National Development Plan.

The National Program for Decentralization of the Irrigation Districts (or the transfer program) was designed to establish a system of co-responsibility between CNA and the water users where the 80 public irrigation systems would become financially self-sufficient (Espinosa de León and Trava Manzanilla 1992). Phase I of the transfer program gradually shifted government-managed irrigation districts to the water user associations (WUAs), with each WUA being responsible for O&M within a module. In the context of the Mexican transfer program, a module is defined as an irrigated area that usually starts at the secondary canal intake and extends to the individual farm intakes. Depending on the size of a district, there can be from 4 to 60 modules within an irrigation district.

Modules were formed as legal civil associations with a concession granted by the government that allows the module to use the associated irrigation infrastructure as well as have a right to use the water that is allocated to the district. CNA retains responsibility for managing the water source and the main canal. The transfer program was explicitly designed to reduce government subsidies to the transferred districts to zero. As a result, it was necessary to increase user water fees to cover all O&M and administrative costs, including the costs incurred by CNA in operating the water source and the main canal.

Phase II of the transfer program creates Limited Responsibility Societies (SLRs), which are federations of the individual modules within a single district. SLRs are legal entities and are responsible for operating all the main canals, drains,

and roads of the irrigation district. The idea is that SLRs would also have the capability to pool the maintenance equipment provided to the modules and thus have economies of scale in the use of equipment. Once SLRs are in place, CNA is responsible for managing the water source itself, as well as playing a larger role in overall water resource planning and development in the country.

The decision to implement the transfer program was made at the highest level of the government, the Office of the President. In general, this decision was strongly supported by the farmers in the more commercial irrigated areas in the country, primarily in the Northwest where more than 45 percent of the irrigated area in the country is located. Farmer support was based on the recognition that the irrigation systems were only going to get worse as the government did not have the funds to properly operate and maintain them. As a result, in a number of these districts, groups of growers had approached the government and requested that management responsibility for O&M of the public irrigation districts be transferred to the water users.

Consequently, when the transfer program started, the initial systems trans-

TABLE 3.
Program of transfer (1990-1992).

District No.	Region	District name	Total area (ha)	Transferred area (ha)
10	Northwest	Río Culiacán, Sin.	272,807	272,807
14	Northwest	Río Colorado, B.C. y Son.	206,350	38,447
38	Northwest	Río Mayo, Son.	97,046	97,046
41	Northwest	Río Yaqui, Son.	232,944	232,944
63	Northwest	Guasave, Sin.	100,125	100,125
75	Northwest	Río Fuerte, Sin.	207,888	207,888
76	Northwest	Valle del Carrizo, Sin.	43,259	43,259
108	Northwest	Elota-Piaxtla, Sin.	18,256	18,256
01	Northeast	Pabellón, Ags.	11,938	11,938
05	North	Delicias, Chih.	75,220	75,220
17	North	Región Lagunera, Coah. y Dgo.	94,670	28,377
26	Northeast	Bajo Río San Juan, Tamps.	86,102	84,984
11	Lerma-Balsas	Alto Río Lerma	112,772	112,772
13	Lerma-Balsas	Estado de Jalisco	51,110	29,618
23	Lerma-Balsas	San Juan del Río, Qro.	11,048	10,447
85	Lerma-Balsas	La Begoña, Gto.	10,823	10,823
87	Lerma-Balsas	Rosario-Mezquite, Mich.	67,570	12,530
94	Lerma-Balsas	Jalisco Sur, Jal.	12,346	9,817
		Total	1,712,274	1,397,298

Source: Comisión Nacional del Agua (CNA) 1995b.

Notes: Ags. = Aguascalientes; B.C. = Baja California; Chih. = Chihuahua; Coah. = Coahuila; Dgo. = Durango; Gto. = Guanajuato; Jal. = Jalisco; Mich. = Michoacan; Qro. = Queretaro; Sin. = Sinaloa; Son. = Sonora; Tamps. = Tamaulipas

ferred were concentrated in the more commercial areas. The clear bias toward larger systems in the Northwest is obvious from the data presented in table 3. As can be seen in table 3, of the first systems transferred, while most of the transferred districts in the Northwest were around 100,000 hectares and larger, only the Alto Lerma in the Lerma-Balsas region was in excess of 100,000 hectares. By concentrating on an area where the program had strong local support as well as an area where the systems were relatively large, Mexico was able to jump-start the transfer process. It proved that transfer of O&M responsibility to large associations was a viable strategy. More than 2.45 million hectares were transferred from 1990 to 1994 exceeding a target of 1.96 million hectares (Comisión Nacional del Agua 1995).

Irrigation Modules

The Mexico transfer program is built around the creation of irrigation modules, operated by WUAs, which are legal civil associations under Mexican law. Modules cover a specified service area. The physical boundaries of a module are based on (Trava 1994):

- *Hydraulic considerations.* Water delivery to the area should be easy and efficient to accomplish and, where possible, fit within existing irrigation sections as the control structures are already in place.

- *Social aspects*. In cases where there were irreconcilable differences between groups, such as between two ejidos or an ejido and a private grower, adjustments should be made to try to minimize such conflicts as long as the hydraulic conditions could still be met.

- *Economic concerns.* The module should not be of an uneconomic size and consequently unable to pay its O&M costs. In Mexico, it was found that the minimum size is around 4,000 hectares with larger modules more cost-effective as long as they did not get too large with resulting social and organizational problems.

To persuade users to accept the transfer program as well as to encourage them to agree to the proposed module boundaries, a very intensive program of promotion was organized by CNA. This included the use of audiovisual materials prepared by the Mexican Institute of Water Technology (IMTA) as well as a number of promotion teams contracted from the private sector. In late 1989 and early 1990, the first modules were formed and responsibility for O&M in the irrigation districts was transferred to WUAs. Initially, the modules were relatively small (around 2,000 to 5,000 ha) as it was felt these would be easier for the users to manage. However, with experience it became obvious modules that were too small could not afford the fixed overhead costs of administering O&M in the area. The fixed staff and facilities costs were too great for the size of the service area and therefore the water fees were too high for farmers to afford to pay them. Consequently, to have a viable management size the districts that have been transferred more recently have much larger modules (5,000-50,000 ha) than those in the districts transferred earlier.

For example, the Rio Yaqui Irrigation District in Sonora with 22,056 users was one of the first districts transferred in 1991. The service area of 232,944 hectares was divided into 51 modules with an average size of 4,500 hectares. In contrast, Alto Rio

Lerma Irrigation District with 22,676 users and a service area of 112,772 hectares was transferred in 1992 and divided into 11 modules each with an average size of 10,000 hectares. Similarly, the Rio Mayo Irrigation District with 11,563 users and an area of 97,051 hectares was transferred in 1990 and divided into 16 modules each with an average size of 6,000 hectares. The Culiacan-Humaya Irrigation District with 27,499 users and 272,807 hectares was transferred between 1991 and 1992, and divided into 16 modules each with an average size of 17,000 hectares.

Legal Framework

In contrast to many countries, particularly those in Asia (Korten and Siy 1988), that first attempted to create water user associations (WUAs) at the block level (100-500 ha), Mexico decided to create them at the module level with no formal structure below this level. According to Mexican civil law, the General Assembly is the WUAs' supreme authority. However, as the number of users within a single association may be in excess of 5,000 farmers and, as it is difficult to bring members of such a large group all together in an assembly meeting, the law allows for the appointment of delegates representing subareas within the module. These delegates represent individual farmer interests at the General Assembly level. Rules to select delegates vary within the different districts and even across modules within a district. These are decided by the local users. Some possible rules for selecting delegates are:

- one delegate per ejido and one delegate to represent the private producers
- two delegates for each ejido and two to represent private producers
- one delegate for every 100 ejido farmers
- two delegates for each irrigation section, one to represent the ejido farmers and the other to represent the private producers

The selection rule is based on the social structure in the particular module and can vary from module to module within a single district.

Another aspect of the Mexican model is that the water concession granted by the government is part of the legal agreement between the government and the module (the water user association). As such, the users do not have individual water rights but instead each association has a proportional right (the proportion is based on area) to the supply of water (normally the estimated surface supply) available to the district for that season. Concessions are for a fixed time frame, 5 to 50 years, and can be taken away if an association does not fulfill its agreement with the government (i.e., CNA). Concessions are not for a fixed volume of water but are for the use of a proportion of the available water supply. Therefore, the associations do not have a firm, volumetric water right as is found in the US. It must be emphasized that even after a Limited Responsibility Society (SLR) is formed, the concession is still in the name of the association and the SLR is only granted authority to manage water by the individual associations.

Many of the districts also have groundwater systems, including private wells and public wells (that are usually included in the transfer program), and it is not unusual for a district to have access to water from more than one reservoir. Groundwater well concessions are granted by CNA. The concessions granted are designed to reflect the estimated annual re-

charge and thus maintain a steady groundwater level. Since groundwater levels are falling in almost all the major agricultural areas in the country, this system is not working (Cummings et al. 1989).

Role of CNA

At the beginning of each season, it is the responsibility of CNA to estimate overall water availability for the coming season (including groundwater quantities). This information is provided to the district. A hydraulic committee that includes the head of the district and head of operations from the district (both CNA employees) as well as a representative from each module is responsible for coming to an agreement concerning the water allocation plan for the season or year, as the case may be, and also for developing a water program for irrigation deliveries. In addition, when there is a critical decision required, usually the hydrologic committee meets to make this decision, although normally it only meets 2-4 weeks before the beginning of the season to develop the seasonal irrigation plan.

Also as part of the transfer program, CNA transferred the majority of the maintenance equipment to the modules so that the latter would have the equipment required to maintain their respective ditches and drains. Access to maintenance equipment was a strong incentive for farmers to accept the transfer program as they realized that without the equipment they could not maintain the systems. However, as much of this equipment was very old and in poor condition, many of the modules purchased additional equipment for maintenance as well as for carrying out agricultural tasks such as land leveling using lasers to help increase irrigation efficiencies in the module.

Results of the Transfer Program

The transfer program was designed to promote institutional change in the districts, to move from publicly managed government irrigation systems toward self-sufficient systems managed by local WUAs (Trava 1994). As the irrigated districts contain some of the most productive agricultural areas in the country, the overall thrust of the program was to ensure that these areas continued to be highly productive by keeping the irrigation systems in operating condition. Over time it was expected that agricultural production would continue to increase, but that was not the primary objective.

The Mexican transfer program was designed to:

- ensure sustainability of the irrigated districts
- reduce the financial burden on the government
- pass responsibility for O&M to the users
- increase efficiency of the use of water, and improve and sustain system performance
- reduce the number of public employees in the irrigation districts

By December 1996, under the transfer program, 2.92 million hectares had been transferred to 386 modules. This represents 88 percent of the service areas in the 80 irrigation districts and involves 422,474 users (CNA 1996a). In 59 districts, the government has transferred responsibility for O&M and administration for all the secondary canals and those below them and for drains and roads. In another 14 districts the government is in the process of transferring management responsibility. Additionally, the program has created 8 Limited Responsibility Societies (SLRs) that have grouped together 108 of the modules in 7 of the larger districts in the country. These cover in excess of 855,000 hectares of irrigated land (Comisión Nacional del Agua 1996a). The government has also created a National Association of Users of Irrigation (ANUR), an organization for grouping the modules together. When functioning actively, ANUR is expected to serve as an official voice for the modules, help with human resource development, and serve as a mechanism for the modules to access credit and technical assistance (Palacios-Valez 1995).

Financial Impacts on O&M Funding

The transfer program was designed to ensure water user associations had adequate financial resources to be self-sufficient. This meant that the irrigation fees or water tariffs had to reach a level where the costs of operation, administration, and maintenance at the module level were covered. In addition, the water tariffs had to be sufficient to meet the modules' share of the costs of operations, administration, and maintenance at the main canal and water source level as well. As the modules became financially self-sufficient, the subsidy from the federal government was to be reduced to zero. This requirement is clearly stated in the concession agreement signed between each association and CNA.

Table 4 presents three examples of the base budgets negotiated between CNA and modules in three irrigation districts. These budgets clearly specify what percentage of the irrigation fees should be paid to CNA and what percentage of the fees is retained by the module. This agreement is signed by CNA and the representatives of the modules at the time the concession agreement is signed. The wide variation in water fees (table 4) reflects the differences in water availability, cropping intensity, and operating costs in the individual irrigation districts.

All of the transferred modules have a similar agreed-upon base budget designed to achieve financial self-sufficiency. These budgets were developed through an extensive series of negotiations and often the amount proposed by CNA was reduced by the associations. For example, in the case of Rio Fuerte Irrigation District (235,914 ha) in Sinaloa, although CNA proposed a budget of around US$11, 875,000 (Mexican pesos 38 million) for self-sufficiency, the users only agreed to a budget of $9,375,000 (Mexican pesos 30 million).

Figure 4 illustrates the distribution of the irrigation service fees between CNA and the water users for the Alto Rio Lerma Irrigation District for 1995.

Using the base budget of the concession agreements for the transferred districts as well as an estimated required budget for the non-transferred systems, a total "normal" budget for operating and

TABLE 4.

Base budget for financial self-sufficiency for three modules agreed and signed between CNA and module officers (1993 US dollars [1]).

Module name and irrigation district	Area (ha)	Minor canals		Principal canals		Headworks		Administration charges	Total budget (1993 US dollars)		
		Operations	Maintenance	Operations	Maintenance	Operations	Maintenance		WUA	CNA	Total
Mod. II-1[2] La Antigua Irrigation District	10,000	54,677	118,132	23,433	44,323	18,519	15,379	114,319	287,127	101,655	388,782
Module Cortazar[3] Alto Rio Lerma Irrigation District	18,448	82,625	363,093	23,875	76,312	4,062	29,594	39,026	452,799	165,788	618, 587
Module V[4] Region Lagunera Irrigation District	4,391	89,250	42,812	13,050	37,369	666	2,825	24,912	153,187	57,697	210,884

[1]Converted to 1993 US dollars at new pesos 3.2 = 1 US dollar—differences from original due to roundoff errors.

[2]Based on an assumption of an annual net volume of 162,825,000 m^3 at US$2.34/1000 m^3.

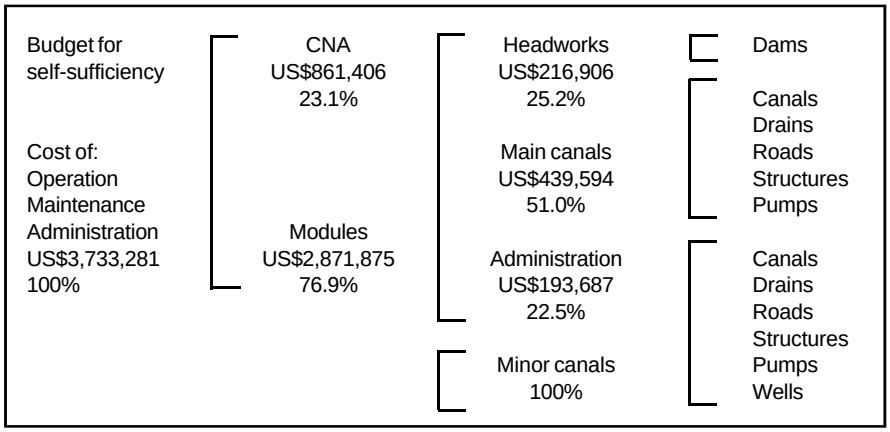
[3]Based on an assumption of an annual net volume of 63,510,000 m^3 at US$9.74/1000 m^3.

[4]Based on an assumption of an annual net volume of 46,200,000 m^3 at US$4.29/1000 m^3.

Sources: Original water user association and civil association documents for the respective modules.

FIGURE 4.

Distribution of irrigation service fees, the Alto Rio Lerma Irrigation District (No. 011),1995.



Note: US$1.0 = Mexican pesos 3.2.

maintaining all the 80 irrigation districts in Mexico is estimated (table 5). In 1993, this budget was calculated at US$190 million (Mexican pesos 609.54 million). With a service area of around 3.2 million hectares, this works out on the average to approximately US$60 per hectare per year.[2] As can be seen in table 5, US$149 million (78% of the total budget) was paid by the users as water fees. The transfer program and the associated increases in water tariffs have allowed the irrigation districts to go from 37 percent self-sufficiency in 1991 to 80 percent self-sufficiency in 1994.

Staffing Impacts

Responsibility for O&M from the secondary canals down was transferred to the modules. In the process, the employees who worked for CNA were to be hired by the modules if the latter felt they were needed and were competent, or they were to be released. In many cases, the module administrators realized they could not afford to take all the staff involved in the transfer from CNA. In other cases, the staff were considered dishonest or incompetent. Where the unions were very strong, the modules did not want to hire union employees as union action was one of the major problems during CNA's operation of the irrigation system.

One clear impact of the transfer process is a reduction in the number of CNA employees working in O&M in irrigation (table 6). From 1990 to mid-1994, 42 percent of the CNA personnel involved in irrigation O&M were retired or released. This reduction primarily impacted on CNA staff at the secondary canal level. It also led to a reduction in CNA's staffing levels at the district office. In some cases, this reduction was in administrative personnel but in others it actually eliminated some of the more experienced operational personnel in the district, with direct impacts on the management of the irrigation system.[3] In the case of Alto Rio Lerma Irrigation District, the 280 CNA staff prior to transfer in 1992 came down to less than 100 in the district in 1996. In Rio Mayo

[2]A small number of pump irrigation systems with water fees in excess of US$300/ha artificially increase this value. Excluding these, the average water cost is around US$40/ha per year. (US$ values are in constant 1993 dollars where US$1.0 = Mexican pesos 3.2.)

[3]The modules replaced many of the former CNA irrigation system operators with recently graduated engineers. This improved the educational level of the module staff, but removed some of the more experienced system operators.

TABLE 5.
Degree of self-sufficiency by region (in constant 1993 dollars).

Irrigation region	Area (ha)	Normal budget (US$1,000)	Fee collection (US$1,000)			Budget shortfall (US$1,000)	Self-sufficiency (%)
			For CNA	For WUAs	Total		
Northwest-transferred	988,248	44,868	9,801	35,067	44,868	0	100
Northwest	501,670	75,618	8,842	46,811	55,653	19,965	73.6
North-transferred	87,158	3,819	1,453	2,366	3,820	0	100
North	229,944	9,450	3,183	3,045	6,228	3,221	65.9
Northeast-transferred	128,668	5,110	1,743	3,367	5,110	0	100
Northeast	435,955	16,038	6,672	1,932	8,603	7,435	53.6
Lerma-Balsas-transferred	144,370	5,345	1,345	4,000	5,345	0	100
Lerma-Balsas	395,006	48,701	4,792	3,332	8,124	9,327	46.6
Valley Mex-transferred.	25,018	457	125	323	457	0	100
Valley Mex.	160,599	6,246	1,496	609	2,105	4,141	33.7
Southeast-transferred	16,028	1,303	242	1,124	1,366	0	100
Southeast	79,176	4,775	406	777	1,184	3,592	24.7
Total transferred	1,260,822	60,965	14,709	46,256	60,965	0	100
Total non-transferrd	1,931,218	129,516	25,269	62,741	88,010	41,506	32
Total for all districts	3,192,040	190,481	39,978	108,997	148,975	41,506	78.2

Note: US$1.0 = Mexican pesos 3.2.

TABLE 6.
CNA staffing before and after transfer.

Region (1990)	No. of personnel before transfer	No. of personnel needed after transfer reduced (1994)	No. of personnel retired or	No. of personnel to be retired or reduced	
				Union	Non-union
Northwest	3,467	1,023	1,660	774	10
Northcentral	1,881	525	696	633	27
Northeast	423	137	75	194	17
Lerma Balsa	1,587	363	682	551	1
Valley of Mexico	313	80	149	84	0
Southeast	137	16	30	90	1
Total	7,808	2,134	3,292	2,326	56

Irrigation District, the 319 employees prior to transfer in 1990 came down to 169 employees after transfer.

However, in some districts the reduction in CNA staff did not necessarily mean a reduction in overall staff; it simply meant a change in the number of public employees. For example, in the Lagunera Irrigation District there were 90 ditch tenders and 324 other employees in 1990—all public employees of CNA. After transfer, in 1995 there were 107 ditch tenders and 119 other workers employed by the respective modules, and 49 ditch tenders and 219 other workers still employed by CNA. Thus after transfer there are now 494 employees in Lagunera compared to 414 prior to transfer. However, it must be pointed out that only 17 of the 20 modules have been transferred in Lagunera and thus the number of CNA employees is higher than it is expected to be after complete transfer.

Water Charges and Production Impacts

In line with the policy of making irrigation districts more financially sustainable, it was recognized that the users would have to pay the real O&M costs for the irrigation service. This meant significantly higher water costs for the farmers. Prior to transfer, for example in 1990, farmers were only paying 37 percent of the actual O&M costs on average. Table 7 illustrates the changes in irrigation fees as a result of transfer in the Bajo Rio Bravo Irrigation District, No. 025 in the State of Tamaulipas. The authorized water fees increased from US$12.49 per hectare per year to $42.09 per hectare per year in late 1993 (the district was transferred in early 1993). Table 8 shows how water costs increased in a number of other districts after transfer.

TABLE 7.

Analysis of base service fees for self-sufficiency, Irrigation District No. 025, Bajo Rio Bravo.[a]

Year	Water fee required for self-sufficiency (US$)	Authorized water fee (US$)	Degree of self-sufficiency (%)
1989	34.35	12.49	36.00
1990	33.87	16.94	50.00
1991	35.94	13.98	38.00
1992	34.72	20.83	60.00
1993	42.09	31.25	79.00
1993-94	42.09	42.09	100.00

[a]Service area=200,609 ha.

Note: US$ values are in constant 1993 dollars.

Source: CNA, Gerencia Estatal Tamaulipas.

TABLE 8.

Increases in water fees as a result of transfer in selected districts and modules.

District	Modules	Region	Transfer year	Water fee (US$ per 1,000 m^3			% Increase 1992-1994
				1992	1993	1994	
Don Martin	7	North	1992	5.11	5.78	7.43	57
Culiacán-Humaya	III-2	Northwest	1990-93	5.27	5.20	7.79	59
Edo. De Zacatecas	6	North	1992-93	3.10	3.07	5.33	85
Bajo Rio San Juan	IV-1	Northcentral	1992	0.86	2.22	2.25	180
Tulancingo	II	Valle Mex	1993	4.41	4.37	5.94	45
Metztitlan	I	Valle Mex	1993	2.94	2.91	4.88	79

Source: Gorriz, Subramanian, and Simas 1995.

For total revenue generation from irrigation service fees, the percentage of the users that pay is as important as the irrigation service fee rate itself. Because in most modules the users pay before they receive water, Mexico has in effect achieved a 100 percent irrigation service fee collection rate. This is in contrast to the Philippines where the collection rate is less than 60 percent. In the majority of the transferred irrigation districts in Mexico, the users pay for the water before they are able to schedule the next irrigation turn with the ditch tender.

Therefore, the collection rate is around 100 percent in most of the modules. In some modules, users pay a flat rate for water per season per hectare. Under this system, in some cases, users are allowed to irrigate prior to payment, or they pay part of the fee with an agreement to pay the rest of the fee after the end of the season. In the small number of systems and modules where this system is used, the collection rate is sometimes below 100 percent—although those who owe the module generally have to pay their dues before they can obtain water the next season or year.

As the modules are completely dependent upon the irrigation fees paid by the users, they cannot survive unless the users pay their irrigation service fees. Table 9 gives an analysis of irrigation service

TABLE 9.

Irrigation service fee collection in the Alto Rio Lerma Irrigation District, 1992-1996.

Module	Irrigation service fee[a] collected (in constant 1993 US dollars) The collected fee as a percentage of the planned (required) fee is given with parenthesis							
	1992-93		1993-94		1994-1995		1995-96	
Acambaro	193,062	(77%)	260,125	(97%)	247,750	(63%)	454,687	(72%)
Salvatierra	839,687	(116%)	840,781	(75%)	802,031	(112%)	972,000	(130%)
Jaral	332,906	(116%)	381,437	(100%)	383,187	(135%)	348,875	(99%)
Valle	586,062	(146%)	655,844	(75%)	608,812	(118%)	757,625	(101%)
Cortazar	963,969	(147%)	1,064,969	(118%)	1,086,968	(137%)	1,067,844	(125%)
Salamanca	807,875	(136%)	888,375	(114%)	796,000	(130%)	863,000	(144%)
Irapuato	255,437	(118%)	321,594	(67%)	264,156	(100%)	360,219	(122%)
Abasolo	615,812	(123%)	784,312	(88%)	819,343	(128%)	967,844	(139%)
Huanimaro	144,406	(81%)	178,094	(116%)	193,156	(132%)	172,719	(99%)
Corralejo	60,156	(126%)	94,687	(83%)	100,093	(286%)	197,406	(474%)
La Purisima	221,812	(117%)	237,187	(71%)	156,187	(126%)	237,406	(‘131%)
Averageb	456,471	(116%)	518,855	(92%)	496,153	(120%)	581,784	(116%)
Total	5,021,184		5,707,405		5,457,683		6,399,625	

[a]In the district, the amount necessary to cover all O&M costs is calculated prior to the irrigation season. Based on the expected amount of water in the reservoir, the number of irrigations that can be supplied is determined. The total cost of O&M is divided by the number of irrigations to obtain the per hectare charge per irrigation. For example, if there is water for three irrigations, a charge of US$30/irrigation/ha may be established. However, during the winter, unanticipated rains may occur, which means more water is available than expected. This water is sold at the same amount, i.e., US$30/irrigation/ha, which then results in a collection rate in excess of 100 percent for the season.

[b]Excludes Corralejo as this module is solely dependent upon river pumping and the required iIrrigation service fee is much higher than that planned by the district.

Note: US$1.0 = Mexican pesos 3.2.

TABLE 10.
Changes in the cost of water as percentages of total production costs.

Delicias District[a]			Rio Mayo District[b]		
Crop	1990 (%)	1992 (%)	Crop	1990/91 (%)	1992/93 (%)
Alfalfa	6.2	9.1	Alfalfa	7.3	10.1
Cotton	1.1	2.3	Bean	3.2	3.8
Maize	1.9	3.8	Maize	4.3	8.4
Wheat	1.9	3.2	Wheat	3.9	8.1
Soybean	2.1	4.5	Soybean	6.1	6.8
Chili	1.6	2.6	Barley	3.5	5.4
Peanut	1.0	3.6	Sesame	2.6	5.3
Pecan	2.6	6.7	Tomato	2.7	6.1
Oat	2.6	4.4	Watermelon	2.4	3.3
			Squash	2.7	4.3

[a]Transferred in 1991.

[b]Transferred in late 1990.

Source: Valdivia Alcala 1994.

fee collection in the Alto Rio Lerma Irrigation District during 1992-96. It shows that the collection rate is often above 100 percent due to excess inflow into the dams from winter rainfall.

Although increased water costs to match O&M fees are important, the change in costs as a function of the overall costs of production is equally important. In table 10, these changes are illustrated for the Rio Mayo and Delicias, large districts in the Northwest and North, respectively, which were among the districts that were first transferred. As can be seen in table 10, although costs of water with respect to the costs of production have increased since transfer, the percentages are still in the 3-8 percent range, which is not unusual for surface irrigated agriculture (Johnson 1995). In fact, in some irrigated areas, cost of water as a percentage of total production costs for crops such as cotton and vegetables has actually declined. For example, in 1996, in Lagunera water costs for cotton were less than 5 percent of the total production costs.

Maintenance

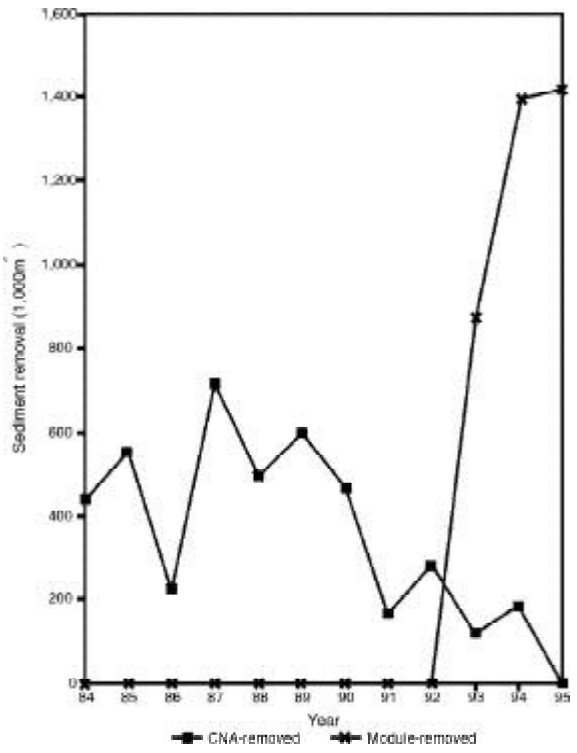
The transfer program in Mexico was built around a concern about the long-term sustainability of the irrigation systems. This concern resulted from the financial crisis of 1982, as a result of which the government deferred a large part of the required maintenance due to lack of funds. In early 1990, as the transfer program was just starting, the irrigation budget was US$109 million (Mexican pesos 225,630,760). User contributions were US$40.4 million and contributions by the government were $31 million for O&M expenses and $37.3 million for staff salaries. This was US$42 million short of the

approximately $150 million needed for sustainable operation and maintenance for the 3.2 million hectares of publicly irrigated land. Approximately 35 million of this US$42 million was accumulated as deferred maintenance (World Bank 1991). In 1991, the estimated budget was US$158 million (Mexican pesos 401,803,460) with 490 million (Mexican pesos 230,768,279) required for maintenance. By 1993, as mentioned earlier, the budget was calculated at US$190 million (Mexican pesos 609,540,000).

In contrast to 1990, the 1993 irrigation fees collected by the users alone were US$163 million while in 1994 they were $170 million. The user-provided funds have been used by the modules to operate the systems, and in particular, to maintain the systems including completing some of the deferred maintenance. Figure 5 shows the amount of sediment removed using these funds, during 1984-95. The amount of sediment removed from canals and drains increased more than five times after irrigation management transfer in the district. Not only have the modules increased the amount of sediment removed, but they have also increased the amount of weeding and maintenance of canal roads. In addition, the modules have started to address some of the deferred maintenance of canals and drains—many of which have not been maintained for more than 10 years (Ramos Valdes 1996).

FIGURE 5.

Sediment removal in canal drains by CNA and modules in the Alto Rio Lerma Irrigation District.



Data from CNA and modules.

The irrigation service fees presently being collected are adequate to cover the O&M costs, and in some years a small percentage of the deferred maintenance. Taking into account all the required deferred maintenance and other types of rehabilitation, a recent study by the Postgraduate College of Agriculture estimated the required investment at about US$559 million (Mexican pesos 44,247 million). On a per hectare basis this works out to about US$186 per hectare. With an average service fee of US$40/ha, spreading this cost over a 5-year period (ignoring interest) would almost exactly double irrigation fees from $40/ha to $78/ha. Including interest of 12 percent over 5 years, the total irrigation service fee would increase to US$105/ha. This is quite high and may be at an uneconomical level for many users, especially those growing bean and grain crops.

Crop Production and Patterns

To date, transfer in Mexico has not had a major impact on crop production. Although increased production was not an explicit objective of the transfer program, with improved irrigation service, crop production was expected to increase over time. The lack of production impact can be explained by a number of factors, the most important being that transfer was originally focused on areas where agricultural production levels were already quite high. In addition, the financial crisis of 1995-06 as well as the drought that struck the irrigation districts in the northeast, north, and northwest tended to reduce available water supply and other inputs, which have led to reduced crop production.

With significantly increased irrigation service fees, the cropping patterns are expected to change from lower-value to higher-value crops. This is happening in some areas, with a shift away from bean and grain crops to vegetables, and fruit and fiber crops.

However, the shift to higher-value crops is driven by financial changes in the economy as well as changes in the agriculture sector and, hence, can only partially be attributed to the transfer program.

Landownership Changes

Changes in article 27 of the constitution allow the ejido farmers to rent and sell their land and water. Some writers have expressed concern that this will lead to land consolidation and negative social impacts on the small growers (Torregrossa 1994). In fact, in a number of the transferred modules, ejido farmers have rented their land and water rights. In Region Lagunera, for example, in excess of 30 percent of the ejido farmers rented their water rights[4] during 1995. This appears to be an exception, rather than the rule as in Alto Rio Lerma, where less than 15 percent of the land and water was rented out. However, it seems there is a trend toward land consolidation in the modules, which will have long-term ramifications in the rural sector.

[4]Given the low rainfall of less than 200 mm/year in Region Lagunera, the land is worthless without the water rights; thus the farmers want to rent the water rights and not the land.

Future Transfer Issues

Effectively, the transfer program started in 1990 and thus the government and users now have 6 years of experience with the program. Approximately 60 districts are all, or almost all, transferred. The transfer program has resulted in a much more stable financial position for the districts. This has been particularly obvious during 1995 when, due to the financial crisis, the government provided almost no operating budget to the line agencies such as CNA. In contrast to the 1982 financial crisis, when the districts almost stopped operating due to lack of funds and all maintenance was deferred, during 1995 funds from the users not only kept the modules operating, but they actually carried out some of the deferred maintenance. The percentage of the water tariffs that went to CNA provided critical funds to ensure that CNA could carry out O&M at the main canal and water source levels. Removing such a heavy dependency upon the vagaries of the federal government budget has improved overall financial sustainability of the transferred districts.

The government now has to focus on transferring the last 15 districts (12% of the total area in irrigation districts). These are all problematic with the difficulties including: (a) land that is located in an area where there is civil unrest such as in Chiapas; (b) irrigation infrastructure with structural problems such that farmers refuse to accept it before it is rehabilitated; (c) land with very low productivity; (d) seriously polluted water such as in Tula Irrigation District; and (e) areas where water is scarce or where there are landownership problems or both. To continue the transfer program in these districts, the government recognizes it will be necessary to change the strategy to one where the modules gradually obtain self-sufficiency (Comisión Nacional del Agua 1995).

In addition, the government is starting to face some second-generation problems with the transferred districts. This is not particularly surprising, given the speed with which the program was implemented. The long-term success of the irrigation sector and the ability of the users and CNA to sustain the transferred districts will depend upon how the government addresses these second-generation problems.

Financial Issues

As illustrated above, the transfer program has significantly increased the actual funds available for O&M. In most districts, these funds have been obtained by a change to volumetric prices for water as recommended by CNA. The system works quite well in that the users pay their water fees and then present the receipt to the ditch tender who in turn schedules delivery of their water. With users paying before the water is received, this system minimizes problems associated with trying to encourage farmers to pay after they have already received the water or at the end of the season.

There are two interlinked weaknesses in the present water tariff system:

1. In the districts there is normally no reserve fund—the fees are set at a level just sufficient to pay the day-to-day expenses for the modules. The modules are literally living hand-to-mouth by collecting the fees for one irrigation cycle just in time to pay the salaries and expenses for the next month. Therefore,

they are not prepared to deal with an emergency.

2. The idea of charging on a volumetric basis seems logical, but it assumes that the districts will always have water. The lack of any kind of base fee that is charged to all users separate from the volume delivered, means that any time a module cannot deliver water, its income drops to zero. Without a reserve fund the module basically goes into bankruptcy.

During the recent drought in the Bajo San Juan, Bajo Rio Bravo, and Lagunera irrigation districts, a number of the modules either went broke or were on the verge of going broke as they did not have a sufficient volume of water to deliver in order to raise the funds needed to meet their basic operating costs. As a result, a number of modules are starting to recognize they must change to a system of a base fee for all users (probably based on land owned in the module) and a volumetric system based on the actual volume of water received (or the number of hectares irrigated as a proxy). Without this they are going to continuously face the same problems they faced during the last drought.

Subsidies

While the original objective of the transfer program was to reduce government subsidies to zero, due to legal restrictions it has not been possible to pay the remaining CNA employees directly from the fees collected from water users. Thus the employees of CNA who are operating the water sources and the main canals, as well as the senior staff in the various CNA offices are still being paid directly by the government. Consequently, the self-sufficiency budgets quoted by the government and the World Bank are not really self-sufficient as they do not cover the costs of the CNA employees. These are still paid out of funds provided by the Ministry of Finance. This dependency upon a subsidy, although reduced significantly from the magnitude of subsidy required prior to transfer, still leaves the districts in a vulnerable position.

Water Law

As stated earlier, the government passed a new water law to help address some of the problems associated with the transfer program, and the change to more commercial agriculture in general. The water law was passed in 1992 and the regulations that support the law were passed in 1994. Together, the two documents form the basis for the transfer program as well as providing the legal framework to allow the sale of water to higher-value uses (Comisión Nacional del Agua 1994a).

Within a district, water user associations in the individual modules are granted concessions once they fulfill all the filing and registration requirements. In effect, this entitles all the modules to a proportional share of the water available for each season to the land in the district.

Therefore, no matter the size of the module, for any season the allocation in terms of cubic meters per hectare should be equal for all modules. As one research exercise in Region Lagunera and the Alto Rio Lerma Irrigation District, IIMI staff collected the data to determine how equitable the distribution of water has been within the district as a whole before and after transfer. As can be seen in figures 6 and 7, the difference between the amount of water received and the amount allocated

FIGURE 6.
Difference beteween amount of water received and amount allocated before and after transfer, the Alto Rio Lerma District.

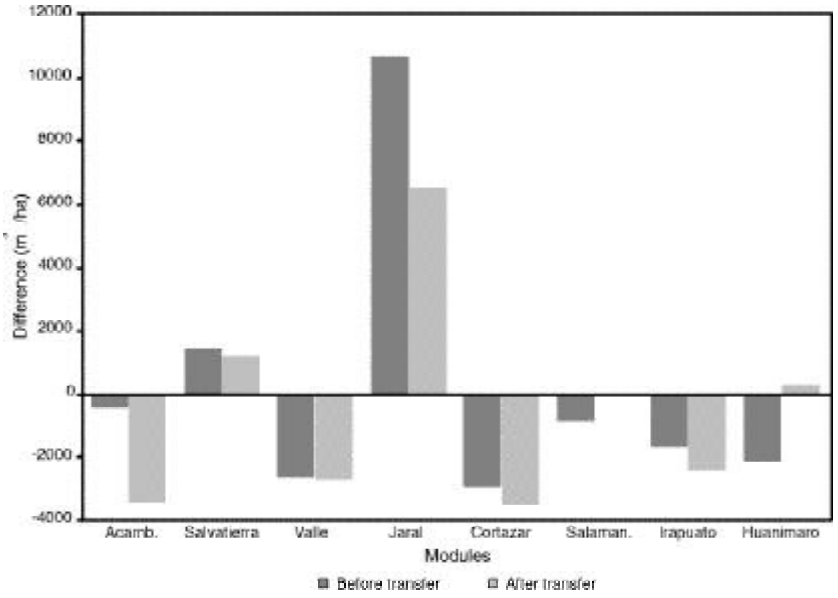
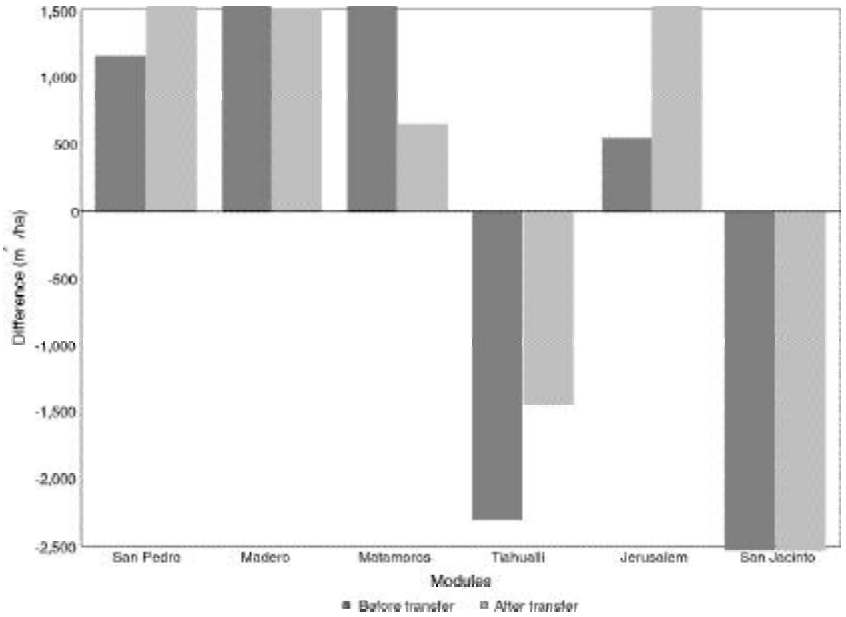


FIGURE 7.
Difference between amount of water received and amount allocated before and after, Region Lagunera.



(where the zero line indicates a perfect fit between allocation and received) has really not changed much before and after transfer. In figure 6, there is a single module, Jaral, that is way off the zero line. In figure 7, the two modules that received less water, Tlahualil and San Jacinto, can pump water directly from the river and have access to canal water as well. Consequently, the volumes they receive are not really as short as it seems from the data.

Concessions are for 5 to 50 years and are renewable if concession holders have not taken any actions that would be the cause for termination as specified in the law. However, the concession document does not actually specify the volume of water associated with the concession (Gorriz, Subramanian, and Simas 1995, Annex 1). [5]

Without a firm volumetric water right, the actual operating procedures are left to the districts and CNA, but these fail to provide any guarantee of quantity of water for those who buy or rent water rights. In contrast to the California system, Mexico does not provide water on a priority basis, but the water right is effectively defined as proportional to streamflow, stored amount, or canal flow. For example, if streamflow is 20 percent below normal, each right holder will receive 20 percent less water (Rosegrant and Gazmuri 1994b). However, the Title of Concession does not clearly define normal flow.

In addition to not actually granting a volumetric right, the law defining concessions also is unclear on priority in case of shortage. Under the sections on agricultural and urban use no priorities are defined but under the section titled Basin Councils, article 13 states: Within the scope of the basin councils, the Commission shall agree with the users on any temporary limitations to existing rights in the event of emergencies, extreme scarcity, overexploitation or declaration of protected areas. In such circumstances, residential use shall have priority (Gorriz, Subramanian, and Simas 1995, Annex 1, National Water Law).

Based on this interpretation, the state of Nuevo Leon and the city of Monterrey have diverted the water of the Rio San Juan into the Cuchillo Dam (Arreola 1996). Yet, the water user associations in the Bajo Rio San Juan Irrigation District have valid concessions that have been approved by CNA for this water and also have a 1952 agreement signed by the President of Mexico stating that this water belongs to the state of Tamaulipas and the Bajo Rio San Juan Irrigation District. This uncertainty associated with their water rights has led to a situation where the users in the Rio San Juan are presently reluctant to pay their water fees as they are uncertain about the security of the water supply. As a consequence, the sustainability of the irrigation system is in doubt.

[5]This is seen in the following quotation from the Title Concession for Rio Yaqui:

DECLARATIONS

The National Water Commission, an administrative organ of the Secretariat of Agriculture and Hydraulic Resources, created by Presidential Decree published in the Official Gazette of the Federation on January 16, 1989, hereafter called "the Commission," hereby grants a concession for the use of water for irrigation purposes, as well as a permit for the use of irrigation infrastructure, to the Rural Development Module or Unit "Farmer-Users Association, Irrigation Unit K-95, Upper Main Canal, Irrigation District No. 041, Rio Yaqui, A.C.," forming part of the above-mentioned Irrigation District, hereinafter called "the Concession Holder."

Conclusions

The transfer program in Mexico took off even faster than planned. Consequently, by the end of 1996, more than 88 percent of the 3.3 million hectares of publicly irrigated land in the country had been transferred to joint management. Water user associations have proven capable of operating and maintaining the modules, even up to sizes in excess of 50,000 hectares, and water fees collected by the users have not only supported the module O&M activities but have also funded most of the O&M activities by CNA staff at the main canal and water source levels. This is in sharp contrast to the situation that existed when the systems were heavily dependent upon government subsidies and consequently were deteriorating rapidly due to lack of stable funding.

The number of CNA staff has been reduced significantly and, in most districts, the systems are being operated with less staff, although in many cases the modules have recruited staff with higher levels of training. The elimination of unionized staff controlling O&M activities has removed one of the major complaints of the farmers. It has been reported that the ability to hire and fire their own staff has improved the responsiveness of the operational staff to the needs of the users. With increased O&M budgets including more funds for maintenance, and more responsive staff, the transfer program has created a situation that is much more sustainable than the situation in the irrigated sector prior to transfer.

For long-term sustainability, there are additional changes that are required to ensure the program is sustainable over time. The system of water fees needs to be changed so that the districts develop a reserve fund for emergencies, future replacement, and rehabilitation. They also need to shift to a system where the module collects a fixed amount to pay the costs of the staff and other facilities of the module as well as a volumetric fee to cover the variable costs of delivering water.

When a major city in the country can expropriate the total water supply from an irrigation district that is operating under a legal water concession, such as the case of the Bjo Rio San Juan Irrigation District, then the irrigation districts are in a vulnerable position. With its population growth rate as well as the structural transformation from an agricultural society to an industrial nation, the competition for water is increasing. Yet, Mexico's legal system does not clearly specify what rights exist for irrigated agriculture and how those rights can be protected against demands for water from municipal as well as industrial users. The government has recognized the problem with the water law and is presently working to clarify terms of the law pertaining to water concessions to reduce future water conflicts between agricultural, municipal, and industrial users.

Mexico's experience with irrigation management transfer is breaking new ground in redefining the relationship between the irrigation users and the State. This program is important for Mexico as well as for many other developing countries that are in the process of shifting irrigation management responsibility to the users. Many countries are watching Mexico to see if the positive impacts of irrigation transfer in the country in the longer term outweigh the negative ones.

Literature Cited

Arreola, Federico. 1996. La Guerra del agua. Mexico City, Mexico: *El Economista,* 12 Jan 1996.

CNI (Comisión Nacional de Irrigación). 1940. *La Obra de la Comisión Nacional de Irrigación.* Mexico City, Mexico: CNI.

CNA (Comisión Nacional del Agua). 1992. *Ley de aguas nacionales.* Mexico City, Mexico: CNA.

CNA. 1994a. *Transferencia de los distritos de riego en Mexico.* Mexico City, Mexico: CNA.

CNA. 1994b. *Ley de Aguas Nacionales y su Reglamento.* Mexico City, Mexico: CNA.

CNA. 1995. *Programa de transferencia de distritos de riego: 1990-1994/ 1995-2000.* Mexico City, Mexico: CNA, Subdirección General de Infrastructura Hidroagricola. Gerencia de Distritos de Riego, Subgerencia de Transferencia.

CNA. 1996a. *Programa de transferencia de distritos de riego: Avance.* Mexico City, Mexico: CNA, Subdirección General de Infrastructura Hidroagricola. Gerencia de Distritos de Riego, Subgerencia de Transferencia.

CNA. 1996b. *Requeriminetos de inversion para incremento de la productividad en distritos de riego.* Mexico City, Mexico: CNA, Subdirección General de Operación. Gerencia de Distritos y Unidades de Riego.

Cummings, Ronald G., Victor Brajer, James W. McFarland, Jose Trava, and Mohamed T. El-Ashry. 1989. *Waterworks: Improving irrigation management in Mexican agriculture.* World Resources Institute paper #5. Washington, D.C.: World Resources Institute.

Davis, Carlton G. 1993. *Sustainable development, poverty reduction, and agricultural sector privatization in the developing world: Whether the complementarity?* Publication IW93-2. Gainesville, Florida, USA: University of Florida, Institute of Food and Agricultural Sciences, Food and Resource Economics Department.

de Janvry, Alain, Elisabeth Sadoulet, and Gustavo Gordillo de Anda. 1995. NAFTA and Mexico's maize producers. *World Development* 23(8):1349-1362.

(ECLAC) Economic Commission for Latin America and the Caribbean. 1995. *Private participation in the provision of water services: Volume I, Alternative means for private participation in the provision of water serv ices.* Santiago, Chile: ECLAC, Natural Resource Unit, Division of Environment and Natural Resources.

Espinosa de León, and Joss Luis Trava Manzanilla. 1992. Transferencia de los distritos de riego a los usuarios. Paper presented at the ICID (Comisión Internacional de Irrigación y Drenaje). Tercera Conferencia Re gional Panamericana, Mazatlán, Sinaloa, Mexico, November 1992.

Figueroa Hernandez, Armando. 1992. La Asistencia technica en la transferencia de obras y funciones a los usuarios de la infrastructura hidroagricola. Paper presented at the ICID (Comisión Internacional de Irrigación y Drenaje). Tercera Conferencia Regional Panamericana, Mazatlán, Sinaloa, Mexico, Novem ber 1992.

Foley, Michael W. 1995. Privatizing the countryside: The Mexican peasant movement and neoliberal re form. *Latin American Perspectives* (Issue 84) 22 (1): 59-76.

Gorriz, Cecilia. 1995. *Transfer of irrigation districts to water users organizations in Mexico.* GRID, Issue 6. Wash ington, D.C.: World Bank.

Gorriz, Cecilia, Ashok Subramanian, and Jose Simas. 1995. Irrigation management transfer in Mexico: Process and progress. Paper presented at the International Seminar on Participatory Irrigation Management. Mexico City and Celaya, Mexico, February 8-15, 1995.

Johnson III, Sam H. 1990. Progress and problems of irrigation investment in South and Southeast Asia. *Water International 15(1):15-26.*

Johnson III, Sam H. 1995. Selected experiences with irrigation management transfer: Economic implica tions. *Water Resources Development 11(1): 61-72.*

Korten, Frances F., and Robert Y. Siy. 1988. *Transforming a bureaucracy: The experience of the Philippine National Irrigation Administration.* West Hartford, Connecticut, USA: Kumarian Press.

Lee, Terence Richard. 1990. *Water resources management in Latin America and the Caribbean.* Studies in Water Policy and Management no. 16. Boulder, Colorado, USA: Westview Press.

Palcios-Velez, Enrique. 1995. *La transferencia de los distritos a las organizaciones de usarios.* Montecillo, Edo. de Mexico: Colegio de Postgraduados en Ciencias Agricolas.

PLANIMAR. 1995. *Reunion internacional sobre los distritos de riego en Latinoamerica.* Maracaibo, Venezuela, 28 Nov - 1 Dic 1995. p. 181.

Ramos Valdes, Cesar Octavio. 1996. *Transferencia de los distritos de riego en Mexico.* Memorias, II Seminario Internacional: Transferencia de Sistemas de Riego, Colegio de Postgraduados en Ciencias Agricolas, Montecillo, Mexico.

Rodriguez, Flavia. 1992. The Mexican privatization programme: An economic analysis. *Social and Economic Studies 41(4):149-171.*

Rosegrant, Mark W., and S. Renato Gazmuri. 1994a. Establishing tradable water rights: Implementation of the Mexican water law. (Irrigation Support Project for Asia and the Near East [ISPAN] Discussion Pa per). Washington, D.C.: ISPAN.

Rosegrant, Mark W., and S. Renato Gazmuri. 1994b. Reforming water allocation policy through markets in tradeable water rights: Lessons from Chile, Mexico and California. (EPTD Discussion Paper no. 6). Washington, D.C.: International Food Policy Research Institute.

Salinas de Gortari, Carlos. 1991. *Tercer informe de gobierno: Anexo*. Mexico City, Mexico: Office of the President.

Salinas de Gortari, Carlos. 1992. Iniciativa del Presidente Salinas. In *El Nuevo Art. 27: Cuestiones agrarias de Venustian Carranza a Carlos Salinas,* ed. Eduardo Valle Espinosa, 75-94. Mexico City, Mexico: Editorial Nuestra.

Svendsen, Mark, and Douglas Vermillion. 1993. *La transferencia del manejo del riego en la cuenca del rio Columbia, estados unidos de America: Lecciones y connotaciones internacionales.* Pp 98. Colombo, Sri Lanka: International Irrigation Management Institute.

Torregrosa, Maria Luisa. 1994. Social aspects of irrigation district transfer. *Water Resources Development 10(3):351-360.*

Trava, Jose. 1994. Transfer of management of irrigation districts to WUAs in Mexico. In *Indicative action plan and proceedings of national seminar on farmers' participation in irrigation management,* ed. David Groenfeldt. Aurangabad, Maharashtra, India: WALMI.

Valdivia Alcala, Ramon. 1994. El contexto global y los efectos economicos de la transferencia de los distritos de riego. Presentado del Seminario Internacional: Transferencia de Sistemas de Riego en Cd. Obregon, Sonora, Mexico. Montecillo, Mexico: Colegio de Postgraduados.

World Bank. 1983. *Mexico irrigation subsector survey—first stage, improvement of operating efficiencies in existing irrigation systems.* Washington, D.C.: World Bank.

World Bank. 1989. *Mexico agricultural sector report.* Report no. 7609-ME. Washington, D.C.: World Bank.

World Bank. 1991. *Irrigation and drainage sector project.* Staff Appraisal Report no. 9779-ME. Washington, D.C.: World Bank.

World Bank. 1994a. *A review of World Bank experience in irrigation.* Report no. 13676. Washington, D.C.: World Bank, Operations Evaluation Department.

World Bank. 1994b. *On-farm and minor irrigation networks improvement project.* Staff Appraisal Report no. 12280-ME. Washington, D.C.: World Bank.

World Bank. 1995. *Mexico: Rural financial markets.* Report no. 14599-ME. Washington, D.C.: World Bank, Natural Resources and Poverty Division, Country Department II, Latin America and the Caribbean Regional Office.

Research Reports

2. *Alternative Approaches to Cost Sharing for Water Service to Agriculture in Egypt.* C. J. Perry, 1996.

3. *Integrated Water Resource Systems: Theory and Policy Implications.* Andrew Keller, Jack Keller, and David Seckler, 1996.

4. *Results of Management Turnover in Two Irrigation Districts in Colombia.* Douglas L. Vermillion, and Carlos Gracés-Restrepo, 1996.

5. *The IIMI Water Balance Framework: A Model for Project Level Analysis.* C. J. Perry, 1996.

6. *Water and Salinity Balances for Irrigated Agriculture in Pakistan.* Jacob W. Kijne, 1996.

7. *Free-Riders or Victims: Women's Nonparticipation in Irrigation Management in Nepal's Chhattis Mauja Irrigation Scheme.* Margreet Zwarteveen, and Nita Neupane, 1996.

8. *Institutional Design Principles for Accountability in Large Irrigation Systems.* Douglas J. Merrey, 1996.

9. *Satellite Remote Sensing Techniques to Aid Assessment of Irrigation System Performance: A Case Study in India.* S. Thiruvengadachari, and R. Sakthivadivel, 1997.

10. *A Plot of One's Own: Gender Relations and Irrigated Land Allocation Policies in Burkina Faso.* Margreet Zwarteveen, 1997.

11. *Impacts of Irrigation Management Transfer: A Review of the Evidence.* Douglas L. Vermillion, 1997.

12. *Water Distribution Rules and Water Distribution Performance: A Case Study in the Tambraparani Irrigation System.* Jeffrey D. Brewer, R. Sakthivadivel, and K.V. Raju, 1997.

13. *Rehabilitation Planning for Small Tanks in Cascades: A Methodology Based on Rapid Assessment.* R. Sakthivadivel, Nihal Fernando, and Jeffrey D. Brewer, 1997.

14. *Water as an Economic Good: A Solution, or a Problem?* C. J. Perry, D. Seckler, and Michael Rock, 1997.

15. *Impact Assessment of Irrigation Management Transfer in the Alto Rio Lerma Irrigation District, Mexico.* Wim H. Kloezen, Carlos Garcés-Restrepo, and Sam H. Johnson III, 1997.

16. *Irrigation Management Transfer in Mexico: A Strategy to Achieve Irrigation District Sustainability.* Sam Johnson III, 1997.

INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE
P O Box 2075, Colombo, Sri Lanka
Tel (94-1) 867404 • Fax (94-1) 866854 • E-mail IIMI@cgnet.com
Internet Home Page http://www.cgiar.org/iimi

ISBN 92-9090-347-3

ISSN 1026-0862