

Benefits and Second Generation Problems of Irrigation Management
Transfer in Mexico
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Table of Contents:

Glossary.....	4
Summary	5
1 Introduction	6
2 National Context.....	8
Government and Economic Policies.....	8
Agriculture.....	8
Profitability.....	9
Holding Size and Land Tenancy	10
Water Cost.....	11
Water Resource Development	11
Budgetary Constraints	11
Staff Commitment	11
The Civil Service.....	11
3 Legal and Institutional Framework.....	12
Laws and Regulations.....	12
Water Rights in the Agricultural Sector	12
Government Organizations.....	13
National Water Commission	13
Secretariat of Agriculture, Livestock and Rural Development (SAGAR).....	13
Local Organizations.....	13
Water Users Associations	13
Federations of WUAs	14
Contractual Agreements	14
4 Promotional Activities.....	14
Promoting Participatory Irrigation Management.....	14
Forming Water Users Associations	15
O&M in Transferred Modules.....	15
Advance of the Transfer Process	16
5 Results of Management Transfer.....	17
Water Distribution	17
Maintenance	18
Agricultural Production.....	18
Finances.....	19
Tariff Levels and Shares.....	19
Collection	21
Investments.....	21
Change in Public Institutions.....	21
Water Users Associations	21
WUA Federations.....	22
6 Training Programs.....	22
Training for CNA Staff	22
Training for WUA Board and Staff.....	22
In-Service Training.....	23
7 Second Generation Problems.....	23
Water Rights and Other Legal Issues	23
Financial Requirements	24
Fixed and Volumetric Tariffs	24
Sinking Funds and Reserves.....	24
Water Management, Maintenance, and Repairs	25
Operational Problems	25
Infrastructure	25
Coordination	25
Environmental Effects	26
Leadership, Management, and Support	26
8 Problem Solutions	26
Legal.....	26
Financial Requirements.....	27

Water Management, Maintenance, and Repairs	27
Coordination	27
Environmental Effects	28
Leadership and Socio-Political Problems	28
Adopted Solutions	28
Suggestions for the Future	28
References	29

GLOSSARY

ANUR	National Association of Water Users
CNA	National Water Commission
CP	Colegio de Postgraduados - a graduate school operated by
district	Irrigation district - a management unit comprising an entire irrigation system
ejidatario	A small farmer who works land held collectively as an ejido
ejido	A land holding, and the corresponding group of farmers, which is owned by the state and worked by ejidatarios who have use rights to the collective landholding
IDB	Inter-American Development Bank
INIFAP	National Institute of Forestry, Agricultural, and Livestock Research
IMTA	Mexican Institute of Water Technology
IURUDES	Irrigation Units for Rural Development
lamina	The planned water duty to be supplied to a particular irrigated area
M\$	Mexican Pesos (M\$1 = US\$ 0.125 in this paper)
module	A sub-unit of an irrigation district
O&M	Operation and maintenance
REPDA	Public Registrar for Water Rights
SAGAR	Secretariat of Agriculture, Livestock, and Rural Development
SARH	Secretariat of Agriculture and Hydraulic Resources
SEMARNAP	Secretariat of Environment, Natural Resources, and Fishing
SRH	Secretariat of Hydraulic Resources
SRL	Society of Limited Responsibility
units	Small irrigation systems operated by users
usufructuary	Resource rights which convey permission to use the resource, but not ownership
US\$	US Dollars (US\$ 1 = M\$ 8 in this paper)

SUMMARY

Mexico has served as a model for other countries considering irrigation management transfer programs. The transfer program there began in 1988 following a set of sweeping economic reforms which were introduced beginning in 1986. A powerful new water resources agency, the National Water Commission (CNA), was created in 1989 and a new water law enacted in 1992. By the end of 1996, 87 percent of the area under medium and large scale irrigation districts in the country had been transferred to users associations to manage.

CNA had the lead responsibility for carrying out the transfers of management responsibility. They held extensive preliminary meetings with both ejitarios and small landowners touting better and more responsive service and greater efficiency before the user associations were formed. They also promised government assistance with system rehabilitation and equipment purchases, promises which were only partially kept.

Because of tensions between ejitarios and small landowners, an arrangement was worked out whereby a representative of one group served as the president of the board of directors of the association, while the post of treasurer was filled by a representative of the other group. These posts alternate between groups at every election. A general assembly, usually made up of all small landowners and representatives of the various ejidos involved, elects the board of directors. The capability and energy of the directors selected by the general assembly has been a critical determinant of association effectiveness and sustainability.

Federations of users associations are being established at the whole system, or district, level to manage the main system. A representative nation-wide federation has also been established to represent irrigator's interests.

In a farmer opinion survey, about 4 farmers out of 5 indicated the belief that irrigation service and maintenance had improved since the transfer. Data on water use, however, indicates that, on average, systems are using somewhat more water per unit area after the transfer than before. Systems are generally in poor condition and in need of rehabilitation.

The most dramatic results of transfer have been financial. In the early 1980s, the government was providing about 80 percent of the funds needed for system O&M. Today the figure is about 25%. At the same time, irrigation fees have increased more than four-fold. Many associations are branching out into other economic ventures, including credit provision, joint input purchase, and farm equipment rental to members.

Second generation problems are emerging. These include conflicts over water, often with municipalities, due to poorly specified rights; insufficient revenue to support proper O&M; poor accounting and bookkeeping practices; widespread firing and hiring of staff when directors change; nepotism in staff appointments; and the use of director positions as political springboards. Other problems stem from the poor condition of the irrigation infrastructure and the failure of the government to fulfill rehabilitation commitments and duplication of effort and poor coordination between associations and CNA. After its downsizing, CNA is top-heavy with managers and directors and requires a thorough reorganization to adjust its structure to its new role.

1 INTRODUCTION

The climate and soil conditions in most of Mexico are not suitable for rain fed farming. Studies carried out on dryness indicate that almost two-thirds of the country is arid or semiarid. Indeed, an analysis of rainfall with 47 years of data shows that the average expected annual rainfall with a 50% likelihood is 684 mm, whereas the average evapotranspirative demand is around 1400 mm - twice rainfall. Rainfall is generally distributed in the summer and early fall months.

As to the soils, the conditions are not favorable either. Thus despite the nearly two million square kilometer surface of the country, two-thirds are mountains or hills with steep slopes unsuitable for agriculture, and another portion is desert-like. Only 30 million hectares have suitable slopes for farming, most of them in barren lands.

Under these conditions, irrigation is essential to obtain economically productive harvests (See map in the Annex). To illustrate this, Table 1 shows official information on production corresponding to 1993, the last year for which definitive data are available.

Type	Area Cultivated [hectares]	Area Harvested [hectares]	Value of Production [million US\$]	Productivity [US\$/hectare]
Rainfed	13,967,621	12,393,870	\$3,078	\$250
Irrigated	5,238,254	5,029,456	\$3,997	\$795
Districts	3,100,662	3,004,142	\$1,970	\$656
Units	2,137,595	2,025,314	\$2,027	\$1,000
Total	19,205,875	17,423,326	\$7,075	\$406

Source: SARH, 1994

Notice that the value of the irrigated yield is 56% of the total, though the irrigated harvested area is only 28.7% of the total. The productivity of irrigation farming is 3.22 times that of rainfed farming, which shows the importance of irrigation for the supply of food and raw materials.

It can also be noticed in Table 1, that the area under irrigation is divided into two types. Irrigation districts, of which there are 82 comprising an area equipped with an infrastructure of about 3.0 million hectares. The size distribution of the 79 completed districts is shown in Table 2. District irrigation is also called *la grande irrigación* (large irrigation) and was, until recently, managed by the government. There are more than 30,000 small scale irrigation units with a nominal area of about 2.5 million hectares. Unlike the irrigation districts, such units have always been operated by their own users.

Table 2. Sizes of irrigation districts

Irrigated Area [hectares]	Number of Districts	Total Area
Less than 10,000	23	131,900
10,001 to 50,000	39	980,821
50,001 to 100,000	9	690,256
100,001 to 200,000	3	374,817
More than 200,000	5	1,158,377
Total	79	3,336,171

According to the Federal Water Law of 1971, irrigation districts should be managed by the federal government. However, by the end of the 1980s, the government was subsidizing almost 75% of the costs of operation, maintenance and administration of the districts. This fact, contrasted with the total absence of support to the users of the smaller irrigation units, created a privileged group of producers in irrigation districts. Moreover, in spite of the large governmental subsidy, districts were not receiving adequate maintenance, causing deterioration of their infrastructure. Mainly for these reasons, starting from 1988 the federal government decided to transfer responsibility to operate, maintain, and manage the irrigation districts to organizations of users.

Many problems arose as the transfer process got started, as discussed later. The most important of these are listed below.

- The Water Law forced the irrigation agency to divide districts into smaller irrigation units that would later be called "modules" in order not to get them confused with "units."
- Water charges were raised more than 400% in order to achieve financial self-sufficiency as a precondition for transfer
- Opposition from a great part of the National Water Commission (CNA), because staff thought they would be negatively affected by the transfer
- The difficulty of organizing water users Associations (WUA) which would be in charge of operating the modules
- The process of dividing the irrigation districts into modules.

Despite initial difficulties, the process has been carried out successfully, and, so far, more than 88% of the districts' area has been transferred. However a "second generation" of problems is being detected. These problems require study, analysis, and action to resolve.

2 NATIONAL CONTEXT

GOVERNMENT AND ECONOMIC POLICIES

After the convulsive phase of the Mexican Revolution from 1910 to 1920, another 20-year period of adjustments and socioeconomic changes followed, an industrialization policy started, and major hydraulic works were begun. These allowed agricultural production to increase. In the 1950's, a stabilizing period of growth began. Financial, fiscal, and monetary policies suppressed inflationary pressure and created a suitable atmosphere for increased internal savings and expanded private and foreign investment. A change in the agricultural sector took place in this period with the advent of the green revolution, which led to significant increases in the production of food and raw materials and kept the peso stable (Wionczek, 1971).

However, from the 1960s on, the Mexican government pursued a closed economic policy in order to strengthen national industry. In the agricultural sector, a policy of subsidies was defined, both for inputs and outputs. During the 1970s, the policy of subsidies was expanded, along with government take-over of many companies. This provoked a significant increase in the government's internal and external debt. The resulting instability of the peso brought about its devaluation, after having been stable for more than 20 years.

These policies compelled the government to significantly increase the external debt, which grew from US\$ 4 billion in 1970, to more than US\$ 80 billion in 1982 and government subsidies were being covered mostly with the funds obtained from foreign credits. The discovery of large oil reserves in the southeast of the country collateralized the borrowing, however, when the price of oil fell, the ability to borrow was reduced.

By the end of 1981, the economic situation was very serious, with an overvalued peso and a large government debt that required foreign currency for the payment of the interest. This forced the government to devalue the peso once again in early 1982. Eventually, the government could not pay its international creditors, and another devaluation took place affecting the entire national economy. Nevertheless, policies of protectionism and subsidies was kept in place for another five years. The price was a considerable increase in the rate of inflation, which reached an annual 200% in early 1988, and a contraction of the gross domestic product (IDB, 1984).

The dire situation forced the government to significantly modify its economic policies. Starting from 1986, a series of changes was introduced - economic opening, the entry into GATT, the reduction of subsidies, changes in the fiscal policy, and the beginning of a wide program of privatization.

As the six-year presidential term (1988-1994) started, the new National Plan of Development 1989-1994 was presented and a new economic program of opening all sectors of the economy was ordered. The plan also called for the privatization of most state companies. These policies also served as the basis for a change in the agricultural policy. Based on the new National Plan, the Integral Program for Agricultural Modernization, 1990-1994 was elaborated.

Among the most noteworthy changes in the agricultural policy, the modification of Article 27 of the Constitution stands out. The outcome of this change was a policy which allowed ejidatarios to become owners of their plots and to form marketing associations for the exploitation of their lands. Another change in the Water Law allowed the creation of a market of rights to water and established a Public Registrar for Water Rights (REPD). Moreover, fiscal policy was significantly modified to support the processes of privatization. One consequence of those changes was the government's decision to transfer the operation, maintenance, and management of irrigation districts' infrastructure to organizations of users created for that purpose.

AGRICULTURE

As mentioned in the introduction, water is a vital element for agricultural production, and for economic development in general. On the other hand, the spatial and temporal distribution of

water restrains its use. Because of this, it has been necessary to build a major infrastructure in order to capture, store and distribute this element among water users.

Profitability

In Table 1, the importance of irrigation to the agricultural production of the country is seen to be marked. More than half of agricultural production is obtained by irrigation farming, though the harvested area represents less than 30% of the total. The productivity of irrigation farming is 3.2 times that of rainfed farming. Productivity in the urderales is 50% greater than that of irrigation districts, both because the cultivation patterns are more profitable (Table 3) and because, due to their smaller size, they use resources more efficiently. Nevertheless, productivity in the smallest urderales units is low, and this has placed them out of the market.

Table 3. Distribution of crops in irrigation districts and units, 1993		
Crop	Irrigation Districts [%]	Irrigation Units [%]
Basic grains	49.2%	41.5%
Oil seeds	15.2%	3.6%
Sugar cane	3.0%	6.2%
Vegetables	3.8%	6.3%
Orchards	3.5%	14.2%
Forage	14.0%	21.8%
Fibers & tobacco	2.7%	1.2%
Other crops	8.6%	5.2%
Total	100.0%	100.0%

Agricultural productivity has increased in recent years for two reasons - first, less efficient producers have gone out of the market, which can be confirmed because harvested areas have decrease from 1987 in both the rainfed and irrigated areas. Second, better technology has been acquired by producers in order to be able to compete in the broadened North American market. However, due to this intense competition, the withdrawal of subsidies, the decrease in the prices of many products, and a raise in input costs, many producers are having serious financial difficulties.

Holding Size and Land Tenancy

As shown in Table 4, 536,438 users on 3,522,323 hectares were registered in irrigation districts in 1993. Of those users, nearly three-quarters are ejidatarios. In the same year, a similar number of users were registered in 19,996 irrigation units. However one estimate of the number of registered and unregistered units is 39,718, suggesting a substantial undercounting.

Table 4. Land tenancy in irrigation districts and units									
System Type	Area [hectares]			Users			Area/User [hectares]		
	Ejido	Private	Total	Ejido	Private	Total	Ejido	Private	
Districts	1,948,423	1,573,900	3,522,323	388,712	147,726	536,438	5.0	10.7	
Share	55.3%	44.7%	100.0%	72.5%	27.5%	100.0%			
Units	1,070,395	828,270	1,898,665	378,453	140,518	518,971	2.8	5.9	
Share	56.4%	43.6%	100.0%	72.9%	27.1%	100.0%			

Source: CNA

Note: Units not registered are not considered. Area without irrigation rights is considered to be within the irrigation district

Notice the average areas per user are relatively small, particularly in the Irrigation Units. However, disparities in holding size are pronounced since both ejidal and private plots of less than one hectare per user are common. At the same time, there are also many land owners who have farms of more than 50 hectares. And when family firms are established by combining the land holdings of individuals, land areas may surpass 500 hectares. According to the new Agrarian Law, it is now possible to establish family farms with areas of up to 2,500 hectares. Sometimes small farmers do not get enough profit to make a living out of agriculture, so they take other off-farm jobs to increase family income.

Water Cost

Since water is a scarce resource in many parts of the country, its marginal cost should be very high. When water comes from over-exploited aquifers, like those in the Lagunera region or in the Bajio, pumping depths are often greater than 100 meters and the total cost of water supply, including fixed and variable costs, can be as high as M\$ 120/thousand m³ (US\$ 15/thousand m³).

In spite of water's value, the cost for gravity irrigation service is relatively low. This is because, first, water is generally not charged by volume, and secondly, even when it is charged by volume, the cost is less than M\$35/thousand m³ (US\$ 4.38/thousand m³).

WATER RESOURCE DEVELOPMENT

Starting from 1947, the government defined a clear policy relating to water resource development and management and founded a state secretariat for that purpose, The Secretariat of Hydraulic Resources (SRH), where all decisions about the use, exploitation, and management of this resource were concentrated. In 1976 the secretariat was divided into three different secretariats, with the Secretariat of Agricultural and Hydraulic Resources (SARH) responsible for irrigation. In subsequent years, more changes followed as secretariats disappeared and new ones created every six years (in accordance with the Presidential cycle) until 1989. In that year, the National Water Commission was created with a mandate that encompassed most aspects of hydraulic policy, similar to the situation that existed under the SRH, many years earlier.

Budgetary Constraints

From 1971 to 1988 investment in the hydro-agricultural sector was very significant, representing an average of 80% of the public investment in agriculture. Since that time, investment has declined significantly. After most irrigation districts were transferred to users associations, funding for both capital investment and operations and maintenance declined even further. The enormous public debt, internal and external, still restricts government budgets and makes a return to the days of massive investments in the water sector unlikely.

Farmers in irrigation districts and irrigation units are concerned about the lack of government resources for the rehabilitation of deteriorated hydraulic infrastructure. They are also worried about the reduction of governmental technical assistance to water users resulting from the decreasing budget that has shrunk operating funds and reduced the hiring of new technical staff.

Staff Commitment

When SARH existed, a technical group responsible for the management of the irrigation districts was formed. Another group provided technical assistance to users in irrigation districts and units.

During the critical period from 1982 to 1988, most of the qualified staff providing this technical assistance left the agency. Technical training for government personnel was significantly reduced, and many laboratories built in irrigation districts disappeared. A Training Center which had been created in the 1970's in Carrizo, Sinaloa for SRH staff and irrigation district personnel was also closed.

When CNA was created in 1989, it made worker's training and education a part of its strategy to improve management of irrigation water. The agency involved the Mexican Institute of Water Technology (IMTA) in preparing technicians to manage irrigation districts. These technicians, in turn, trained many of the technicians who were hired by the new user-controlled irrigation management organizations after the transfer. Many of the technical staff who provided this training have now left government service, so there is a need to create a system which can provide on-going training and assistance.

THE CIVIL SERVICE

When it existed, SARH operated within the civil service system and filled most vacancies from within. This allowed the agency to retain qualified staff with experience in the SARH's

different areas of work. There was a similar situation in the Secretariat of Agriculture and Livestock.

This situation has now changed and many qualified staff have been laid off or have left their posts because of turmoil caused by the extended period of unstable and change in the structure of the water-related government institutions which characterized the sector until 1989. New personnel who have replaced the previous technicians are often not technically well-trained.

3 LEGAL AND INSTITUTIONAL FRAMEWORK

LAWS AND REGULATIONS

In Mexico surface water is generally the property of the nation under Article 27 of the Constitution. Groundwater is not clearly defined as national property, notwithstanding the fact that the Federal Executive is to regulate its exploitation and use, as established in that Article of the Constitution. The same article also establishes that the state has the right to grant the control of water to legal entities for its use, exploitation, and harnessing through titles of concession.

To implement Article 27, several laws on the use and management of national waters were enacted, starting with the Law on Irrigation and Federal Waters of January, 1926. The National Water Property Law was issued in 1929 and modified in 1934 and defines Juntas de Agua, users organizations which would receive irrigation districts after their construction. Implementing regulations were issued in March 1936. Additional implementing regulations relating to groundwater were issued in December 1956. Other complementary laws were the Law on Irrigation, the Federal Law on Sanitary Engineering, and the Law on Cooperation for the Allocation of Drinking Water.

In 1971 these laws were reviewed and a new federal water law formulated that authorized a major role for the State in administering hydraulic resources. The Federal Waters Law was enacted and approved in December 1971, but implementing regulations were never issued.

In the 1980s it became apparent that the Federal Waters Law needed to be complemented with fiscal laws that could control the over-exploitation of groundwater aquifers and water pollution. The Federal Law of Rights, enacted in 1982, divided the country in zones, according to the availability of groundwater, and established charges for the right to use water that reflected the degree of scarcity of the resource. Other modifications have been made to this Law relating to charges for discharging sewage waters. Another important law enacted that relates to water quality is the General Law of Ecological Balance and Environmental Protection.

At the beginning of the present decade, the legal framework regulating water resources was modified again to bring it into line with new liberalized economic policies of the government. In 1992 the new National Waters Law (the Law) was enacted. Implementing regulations were approved in January, 1994. Other laws that round out the legal context of the new water policy are the Law on Contributions to Improvements for Public Works of Agricultural Infrastructure, enacted in 1991, and the Laws on Drinking Water and Sewers Affairs which had been enacted between 1969 and 1994 in the 32 individual states.

WATER RIGHTS IN THE AGRICULTURAL SECTOR

According to Article 20 of the Law, the use and exploitation of national waters by civil personae (personas físicas o morales in Mexican legal parlance) would be carried out through concessions granted by the Federal Executive through CNA. In Article 50 of the same Law, it is stated that concessions are granted to civil personae, such as water user associations (WUAs), for the individual use and exploitation of national waters for farming purposes, and to civil personae for administration and operation of irrigation systems or for shared exploitation and use of national waters for agricultural purposes.

The granted rights, expressed as average volumes obtained from natural or artificial water supplies, are to be registered in the REPGA and can be transferred temporally or permanently. This implies that it is possible to establish a market of rights across a basin, aquifer, district, or irrigation module which would be regulated by the Law.

Articles 51 and 66 of the Law contain regulations that define appropriate management practices for concessioned resources and the irrigation districts which manage them, and

sanctions which apply when regulations in the Law are violated. More serious infractions require the intervention of authorities with legal power such as a government ministry or municipal authorities.

The lack of clear implementing regulations relating to the management of water at the level of districts, units, and associations leads to conflicts, many of which are solved by CNA. These problems should be easier to work out when the respective implementing regulations are approved, since the resolution of conflicts will not depend on a limited number of public officials but on a set of established rules.

GOVERNMENT ORGANIZATIONS

There has been much change in the institutions created to regulate the exploitation and use of the hydraulic resources of the country after the Revolution. An early creation was the National Irrigation Commission (CNI) which was principally responsible for planning, design, construction, and operation of irrigation and drainage infrastructure. In 1946, this Commission became the Secretariat of Hydraulic Resources. Later it was merged with the Secretariat of Agriculture and Livestock to form SARH, creating a gap in water resource management in sectors other than Agricultural. In 1989, acknowledging that water is a natural resource independent from the economic sectors which exploit it, CNA was created as a decentralized institution of SARH. Then, in December 1994, the Secretariat of Environment, Natural Resources and Fishing (SEMARNAP) was created and CNA attached to it as a decentralized body, administratively independent from the secretariat.

National Water Commission

CNA's mandate is to:

- manage all national surface and groundwater resources, both in its amount and quality
- be responsible for the efficient use of water resources and the maintenance of their quality for all uses and by all users
- introduce economic mechanisms and the financial incentives that foster efficient use of water and, at the same time, increase financing possibilities of the sector
- preserve hydraulic works as a basis for the sustainable development of the country and the welfare of the population

Secretariat of Agriculture, Livestock and Rural Development (SAGAR)

At one time, SAGAR was the parent Secretariat for CNA, and it was supposed that the actions of both institutions would be well coordinated. Under the new organizational set up, the two are separate, and SAGAR is responsible for agricultural planning. Coordination with CNA is carried out through the directive boards of rural development districts, within which the irrigation districts and units are located.

SAGAR has direct responsibility for supporting irrigated farmers, providing technical assistance for production and assistance in obtaining inputs such as seeds, fertilizers, and pest treatments. Some of these inputs are made available by a SAGAR branch, the National Institute of Forestry, Agricultural and Livestock Research, (INIFAP).

LOCAL ORGANIZATIONS

Water Users Associations

Associations whose main function is the operation, maintenance, and management of the irrigation infrastructure can be established as civil associations and granted certain fiscal privileges. The boards of directors of these associations are selected by the assembly comprised of water users of the irrigation modules in the irrigation districts or units. When the

number of users is considerable, as with modules with many ejidatarios, the members of the assembly are delegates who are elected from each ejido (Figure 1).

A board of directors is formed by a president, a secretary, and a treasurer, with their respective alternates. These posts are usually held for two or three years, and sometimes the same people can be re-elected. Positions on the board of directors are not compensated. In addition, there is an Oversight Committee comprised of a board member, and representatives of ejidos and of small farmers. This committee serves an inspection and auditing function to prevent blatant corruption.

Federations of WUAs

In several irrigation districts that have been transferred, federations of WUA's are being established as societies of limited responsibility (SRL) which are given charge of the operation and maintenance of the major canal, drain, and road networks and serve all WUAs within their jurisdiction (Figure 2). In some relatively large districts, more than one SRL have been formed.

At a national level, a federation of WUAs called the National Association of Water Users (ANUR) has been established and represents WUAs in negotiations with CNA, SEMARNAP, and SAGAR.

CONTRACTUAL AGREEMENTS

To transfer the responsibility to operate, maintain, and manage irrigation infrastructure, and to operate the equipment and installations that the government previously managed, each WUA receives a concession title, or concession, issued by CNA. An appendix to the concession contains a technical instruction booklet in which regulations for operation, maintenance, and management of the infrastructure works and equipment are specified. Rights and obligations of WUA's and NWC are stated in the concession and in the attached appendix.

CNA is the supervising organization for the operation, maintenance, and management of the transferred infrastructure and equipment. CNA also provides WUAs with technical assistance in carrying out operational activities.

4 PROMOTIONAL ACTIVITIES

PROMOTING PARTICIPATORY IRRIGATION MANAGEMENT

Organizing meetings with water users of the districts was the first action carried out in all transferred districts. The purpose of these meetings was to explain the transfer program, its advantages, and the responsibilities the organization of users would take on. Hundreds of meetings to introduce and promote transfer were held.

These informational meetings were organized mainly by CNA staff, though IMTA and, later on, some private companies also participated. Existing organizations were employed in setting up these meetings. Firstly, there were the ejidos, whose members can be assembled very quickly by summoning their common-land commissioners. This group of users required very clear information about the advantages of the transfer. Other important groups of producers, mainly small landowners, were credit unions, producers' associations of particular commodities, and organizations of farmers such as the Farmers' National Confederation, the Independent Farmers' Confederation, and others that exist at a local level in most of the irrigation districts.

Various advantages were described to users in these meetings, starting with the advantages that management by users organization has over management by the government. This was a very convincing reason in many places, due to the slow response from the government agency to problems that required immediate solution. Not only were responses slow, but they were also expensive. Another advantage described was better service when staff in charge of distributing water and maintaining works were hired by water users, compared with services provided by unionized government workers.

One serious obstacle to transfer was the low irrigation tariff then in force, which were grossly inadequate to cover the cost of proper operation and maintenance. Convincing water users of the need to raise tariffs was not easy. Yet users eventually accepted that they were the

principal beneficiaries of good irrigation service and good maintenance of the infrastructure, and so they should be in charge of it. Prior to 1989, agreements reached with the users were to raise water tariffs gradually until financial self-sufficiency could be achieved. However, once the process got started, the increases were speeded up, and agreements on this were reached with the WUAs.

At the beginning of the transfer process, most districts were told that the deteriorated infrastructure would be rehabilitated and that new machinery and equipment for maintaining that infrastructure would be acquired. However, the government has allocated insufficient funds to rehabilitate the infrastructure works of all irrigation districts. Funds to be used for that purpose were from a loan by the World Bank, which, along with the corresponding contribution from the government, totaled about US\$1.25 billion. However, only a few of the irrigation districts were actually benefitted.

CNA has been providing some of the districts with new machinery, and has gotten a new loan from the World Bank for the farm level improvements of irrigation and drainage infrastructure in the transferred modules. However, because of the government's financial problems, this program has not proceeded smoothly.

FORMING WATER USERS ASSOCIATIONS

Before the current transfer program, there were antecedent users organizations that operated, maintained, and used the irrigation infrastructure. Irrigation units have long been operated by organizations of users. Moreover, in a very important district, the Rio Yaqui district in Sonora, the operation and maintenance of secondary systems of canals and drainage channels were already the responsibility of users associations.

Taking into account these antecedents, several possible forms of users organizations were considered by the government. It was decided to create civil associations because they offered certain advantages from the fiscal point of view, for they would be considered as non-profit, untaxed associations that would operate profit-making ventures.

At the beginning of the transfer process, an important legal obstacle for transferring responsibility to operate and maintain the infrastructure emerged. According to the Federal Waters Law, the only body that could legally operate and maintain irrigation infrastructure in the districts was SARH. In order to clear this obstacle, districts were artificially divided into smaller irrigation units, called modules, which could be legally operated and maintained by their users. These modules were formed taking into account existing infrastructure, topography, the number of users, and the existing administrative division of the district for water distribution.

Establishing an association involves a series of steps as shown in Figure 3. In organizing the association, the water users select a board of directors comprising a president, a secretary, and a treasurer and their corresponding substitutes. This was not easy at the beginning because of the different forms of land ownership. Some ejidatarios would not accept a small landowner as a president, and small landowners would not accept an ejidatario in this position. To solve this problem, the users agreed to form mixed boards in which a board with an ejidatario president would have a small landowner as the treasurer, and visa versa. They further agreed that these roles would change at the next change of directive board. They also form an oversight committee.

O&M IN TRANSFERRED MODULES

The transfer program includes a period of shared management between CNA and the WUA. During the first phase, there is parallel management of the works of the minor network of canals, drains, and roads, in which CNA and WUA staff jointly carry out O&M so that the new staff receives on-the-job training in these activities. This shared O&M generally lasts for about six months. After that, CNA staff is removed, and operation and maintenance of the minor network of canals, drains, and waterways are performed by the WUA.

During the second phase, the WUAs operating and maintaining the minor network become part of a Society of Limited Responsibility (SRL) which assumes charge of the operation and maintenance of the major networks of canals, drains, and waterways. CNA's responsibilities after that time are limited to operation and maintenance of the head works, drainage and irrigation technical assistance, and the supervision of the activities carried out by WUAs and SLRs.

At present, most irrigation districts are formulating new regulations, according to the instructions contained in Law of National Waters. These regulations are to include a specific chapter on water management under conditions of scarcity. One interesting aspect of this chapter is the instruction to compact the regions that would be possible to irrigate with the available water. That is, to gather the irrigation allocations corresponding to various rights on the lands that have less problems in irrigating. The redistribution of the available water is up to the WUAs. Two proposals are offered to accomplish this. The first proposes that the available amount of water be distributed in proportion to the volumetric water right that each user has registered. The second proposes that the available amount of water be distributed among the registered plots and, where the amount of water assigned to a plot is more than the average irrigation lamina of the district, the remaining water would be distributed among other water users. The first alternative is advantageous for users with small irrigation areas and the second one is advantageous for users with larger irrigation areas. The alternative chosen by the WUAs will be specified in the module regulations.

ADVANCE OF THE TRANSFER PROCESS

By the end of December 1996, 88% of the total gross area of the irrigation districts in Mexico had been transferred to 386 WUAs. Of 82 irrigation districts, 59 had been totally transferred to WUAs, 13 were partially transferred, including 3 which were still under construction, and 10 had not been transferred. In Table 5, a summary of the progress of the transfer process is shown.

Table 5. Area, users, and modules transferred up to December 1996						
		Annual		Cumulative		
Year	Area [ha]	Users	Modules	Area [ha]	Users	Modules
1990	130,564	14,128	19	130,564	14,128	19
1991	425,158	43,520	53	555,722	57,648	72
1992	945,076	128,246	114	1,500,798	185,894	186
1993	726,090	105,301	97	2,226,888	291,195	283
1994	232,086	32,844	33	2,458,974	324,039	316
1995	295,087	70,628	45	2,754,061	394,667	361
1996	162,224	32,967	25	2,916,285	427,634	386

Source: CNA, 1996

5 RESULTS OF MANAGEMENT TRANSFER

WATER DISTRIBUTION

The Colegio Posgraduados (CP) carried out a study on WUA performance in a sample of transferred districts by administering questionnaires to the WUA directors and users (CP, 1994). The survey questioned 700 users from 4 transferred irrigation districts to learn their opinions about the service offered by the WUAs in terms of water distribution and system maintenance (Table 6).

Table 6. Users' opinions about water distribution in four transferred districts	
Topic	Positive Percentage
Water distribution improved	84%
Receive enough water	79%
Receive water timely	79%
Water is received in the appropriate amount	64%
Source: CP, 1994	

A study was also carried out in Alto Lerma, Guanajuato, to learn how water in the Salvatierra module is being distributed. The study employed the Molden and Gates (1990) indicators which estimate the adequacy, efficiency, reliability, flexibility and equity of irrigation service. The study found that the operational performance was, by and large, good during the agricultural year 1995-1996. It was found that there are limitations in the capacity of some structures which prevent better performance (Melgarejo, 1996).

According to the Law, each user is entitled to receive an amount of water proportional to the size of his plot from the allocation CNA provides to each module. However, at present, water is not being distributed by volume, as specified in the Law. It is expected that allocational rules will be developed and approved by the modules in a nearly future and that the delivery of measured volumes of water will improve the quality of irrigation service.

As water management shifts to a volumetric basis, some problems are expected - particularly in districts having varied crop patterns. In some districts in northwestern Mexico, for example, where crops with high consumption demands such as sugarcane and rice, are grown along with shorter-season crops like beans and vegetables with lower water demands, growers of high consumption crops will not have enough water to meet their crop needs. It is expected, therefore, that they will be forced to buy additional water rights from those users who have a surplus.

MAINTENANCE

In most districts, infrastructure is in bad condition. In some cases, this is because the infrastructure is very old. In other cases, it is because there has been poor maintenance due to a lack of funds. Although, many WUAs have started programs to clear away the maintenance backlog and are trying to modernize their systems, funds are generally insufficient to carry out these tasks.

In the CP study (CP, 1994), about 80% of those interviewed considered that maintenance had improved since the WUAs have been in charge. However, these studies also show that not all modules perform adequate maintenance.

CNA checks the annual maintenance programs that WUAs propose and makes corrections and suggestion. Funding the programs is the responsibility of the WUAs. The author feels that WUAs are doing a better job of carrying out maintenance of the infrastructure than was CNA. Reasons for this feeling are that unit costs have gone down and WUAs' are more flexible in administering funds.

Because of the poor condition of much of the infrastructure in many districts, it is essential to rehabilitate and modernize these works. ANUR has recently come to an agreement with CNA on cost-sharing for rehabilitation. Under the agreement, the government will pay 50% of the cost and the users pay the other 50%. Large districts are expected to have an easier time mobilizing their share of the funds through credits than are smaller districts. Some special assistance for the smaller districts may be needed.

AGRICULTURAL PRODUCTION

Several changes in irrigated agricultural production are evident before and after the transfer period. These include a notable reduction in oilseed production, an increase in the production of grains, an improvement in land productivity, and a reduction in harvested areas as the less competitive producers are left out of the market. However, because the transfer program was a part of a much larger liberalization of the agricultural economy, it is not possible to assert that the changes taking place in the crop patterns and productivity are due to the transfer. These changes are more likely due to the changing price structure of agriculture, including the reduction of subsidies on production inputs, increases in output prices, and the disappearance of guaranteed output prices.

Although the productivity of water has increased in nominal terms following implementation of the economic reforms, in real terms there have been declines in both output per unit land and output per unit water since 1992 (Table 7). These declines are most probably due to severe drought which affected the northern part of the country where much of the irrigation is located, rather than to the transfer program. For 1996 prices of outputs went up and the water availability diminished, so productivity should also have improved, but data are not yet available. A 1994 CP survey in four transferred districts indicates that 80% of the producers interviewed think that association management has led to an improvement in agricultural production (CP, 1994).

Table 7. Harvested areas, water volumes, value of production, and productivity of Mexican irrigated agriculture, 1990-95

Year	Area	Volume	Value	Value	Duty	Land Productivity	Water Productivity
	[10 ⁶ ha]	[10 ⁹ m ³]	[10 ⁹ M\$]		[m/ha]	[10 ⁹ 1990 M\$]	[1990 M\$/m ³]
1990	3.0320	30.6720	10.3099	10.3099	1.01	3,400	0.336
1991	3.0976	33.6582	13.1164	11.0407	1.09	3,564	0.328
1992	2.8410	29.9858	14.1957	10.6780	1.06	3,759	0.356
1993	3.0041	33.7730	15.7573	10.9751	1.12	3,653	0.325
1994	3.1033	35.9223	16.7818	10.9507	1.16	3,529	0.305
1995	2.7979	29.8443	19.9053	8.5453	1.07	3,054	0.286

Source: CNA

Note: Values in columns 5,7,and 8 deflated to constant 1990 M\$ using the national index of consumer prices

Somewhat surprisingly, water duty increased even during the drought years of 1993 and 1994. This may suggest a tendency for user-controlled districts to use more water per unit area, but district-level figures should be consulted to evaluate this possibility. For 1995, duty values returned to pre-transfer levels, perhaps indicating a "learning period" following the transfers during which the new managers developed their operating skills.

FINANCES

Tariff Levels and Shares

An essential requirement for successful transfer was that the users attain financial self-sufficiency. Consequently irrigation water charges went up in a majority of districts. As financial self-sufficiency was attained, the transfers were carried out. However, this process was not an easy one because the necessary increases to achieve financial self-sufficiency were as much as 400%. For example, in the Río Lerma irrigation district the cost of service per hectare per irrigation went up from M\$9.50 to M\$55, an increase of 578%.

Districts' financial self-reliance levels between 1947 and 1990 are shown in Figure 5. As seen, the share of the O&M budget recovered from users reached crisis levels in the late 1970s and early 1980s, when 4 dollars of every 5 spent were coming from the central government. This situation helped precipitate the subsequent transfer reforms which had reduction of subsidies

as an important goal. Since that time, cost recovery levels have risen to the point where nearly 4 dollars of every 5 are coming from the users.

However, financial sufficiency is hard to retain for several reasons. First, the associations' income not only depends on the level of the tariffs but also on the amount of water that the districts have. This dependency is even stronger when tariffs are volumetric or quasi-volumetric, since the amount of available water will largely determine the income received. Another important factor affecting associations' financial sufficiency is the high inflation rate in Mexico. Although WUAs should index their tariffs to adjust for this, most do not.

Users' share of O&M costs rose sharply in the years just prior to transfer, peaked in 1994, and has declined slightly since that time, due to the failure of fee levels to keep pace with inflation (Table 8). The government subsidy, provided in terms of unreimbursed expenditures on main system operation and maintenance by CNA, is steady at 15%.

Table 8. Shares of O&M costs of transferred districts			
Year	Users' Share	Government Subsidy	Deficit
1990	39%	35%	26%
1991	52%	22%	26%
1992	62%	17%	21%
1993	72%	15%	13%
1994	78%	15%	7%
1995	73%	15%	12%
1996	72%	15%	13%

According to the Federal Law of Rights, WUAs are exempt from paying for the right to use water - they must pay only the cost incurred by CNA in the bulk delivery of water to the module or district. All charges should be based on the volume of water supplied.

To prevent variation in WUA income based on the water supply, the instruction booklet attached to the concession right indicates that the tariff should be calculated each year by dividing the estimated O&M budget by the amount of water that is authorized to the module. This approach supposes that water fees are charged by volume. In fact, irrigation tariffs are not charged this way. The WUA directors have to negotiate with the users over the amount users will have to pay for irrigation service. In many modules, fees are assessed per hectare. In others they are assessed per irrigated hectare, in others by type of crop and area planted, and, in a few cases, it is assessed by volume.

Collection

In most irrigation districts, the practice is to require users to pay the irrigation tariff in advance of receiving service. This form of charging for service is an advantage for the WUAs because it provides income from the beginning of the irrigation cycle. Even during the last two years, during which severe drought and attendant financial crises occurred, more of 90% of users payed water charges.

It is indicated in the instruction booklet that irrigation tariffs are to be paid in banks when they are available, which is the case in most irrigation districts. This makes the process of collecting the tariffs relatively simple. The user who wishes to irrigate applies to the module's administration, where the user's personal information is requested, and it is verified that the plot for which he will pay is in the census of water users. The user is then given a document which indicates the amount he must pay, according to the prevailing assessment in the module. The user then goes to the bank with this document, pays, and receives a receipt which he will show to the ditch tender when he requires irrigation service to prove payment. Since the money is managed through a bank account and most of the expenses are paid by check, the control of entries and expenses is relatively easy.

Investments

The irrigation tariff should also include sums for the creation of a contingency fund and the amortization of machinery and equipment indebtedness. In the past, CNA forced users to maintain an amortization fund. However, when it was to be applied, national financial regulators did not permit the use of the accumulated funds. The constant devaluations of the peso and the high inflation rate also actively discourage the establishment of such funds. Such financial discipline is unlikely to be achieved until national level policies which discourage it are altered. ANUR is attempting to create a national contingency fund to cover financial problems in WUAs caused by weather-related disasters.

As mentioned earlier, CNA transferred existing machinery to districts by means of loans. Most of this machinery was in bad condition. CNA has also provided some WUAs with new equipment. However, the equipment at WUAs' disposal is, in most cases, inadequate to meet maintenance needs. On their own many WUAs have made considerable investments in new or reconditioned equipment.

Many WUAs have made significant investments to repair or modernize their infrastructure. To do this, they have turned to bank loans in which the irrigation tariffs have served as guarantee. A number of these WUAs have been negatively affected by the significant raise in interest rates which took place in 1995.

CHANGE IN PUBLIC INSTITUTIONS

Institutional changes have been taking place since the irrigation sector reforms began with the creation of the National Water Commission in 1989. In 1994, SEMARNAP was established and CNA brought in under it.

In 1996, IMTA was founded. The institute is a decentralized unit of CNA which is in charge of generating and transferring technology to water users. Among other functions, it supports the transfer process by promoting the program in user meetings and training irrigation district staff.

Changes within CNA have not all been positive. Among the problems is a proliferation of general assistant offices and management offices, although a decentralization of functions to the state level has started. It is expected that this process of decentralization will result in many CNA functions being carried out by the states. For this purpose, specialized hydraulic departments are being created at the state level, such as the new Water Office in Guanajuato State. Some of these changes have caused confusion among the agricultural producers, since the responsibilities of the new federal and state government agencies are not yet clear (CP, 1996).

WATER USERS ASSOCIATIONS

In general, the WUAs have fulfilled their role better than was expected. Of course, there are deficiencies. Sometimes these are due to a lack of qualifications on the part of the directors

and the new staff. At other times it is due to directors' failure to supply leadership or because of directors' conflicting responsibilities and lack of attention to WUA affairs (CP, 1994).

The degree of participation of water users was evaluated in a 1996 study, which concluded that participation by ejidatarios is less than that of small landowners (CP, 1996). Users' interest in WUA activities is generally stronger in those districts that were transferred some years ago, as evidenced by their greater attendance at assembly meetings and their more active participation.

Elections for the directive boards has become more complex because of the strong interest of users both in the election of directors and in the form of electing them. This has caused conflicts in many modules. Nevertheless, the interest and participation of users is compelling directive boards to improve their performance.

In many districts, the WUAs are not only distributing water and maintaining works but also organizing themselves to assist members of their district in commercializing agricultural production. In the Alto Lerma district, Guanajuato, several WUAs, such as the Jaral del Progreso and Valle de Santiago, distribute fertilizers at a cheaper price than does the local market, are making machinery for minimum tillage available for rent, and are offering other services to association members. In other cases, members are trying to organized themselves as credit unions in order to provide their users with loans for repairs to machinery and equipment and to support them in adjusting to the new commercialized production environment. Similar moves are taking place in WUAs in Cortazar and Salamanca irrigation districts. This kind of effort is spreading in other parts of the country as well, particularly in the North and Northeast where levels of organization are high. Here association members receive loans for purchasing inputs, principally from companies and businessmen.

WUA FEDERATIONS

As of December 1996, 11 SRL had been established, 8 of which were in complete operation. New societies were being established in 5 other districts. Like WUAs, many SRLs are interested in expanding their efforts beyond operation, maintenance, and management of the major infrastructure of the districts into other activities.

ANUR, a federation of most of the WUAs in the country, was founded in 1994, and their directive board reelected in October 1996. In negotiations with CNA and other government institutions, ANUR has succeeded in obtaining (1) agreement to share the costs of rehabilitation and improvement work evenly with the districts, (2) a concession for the use of the Carrizo Training Center, and (3) several other more minor agreements.

6 TRAINING PROGRAMS

TRAINING FOR CNA STAFF

When CNA was created in 1989 and placed under SARH, irrigation districts were integrated into existing rural development districts and staff reassigned, reducing the support and training capability of irrigation field staff. Training of personnel who would operate the irrigation systems thus became of high importance. Training of the staff that would temporally operate the districts was provided by the CP through a contract with CNA. Technicians who had experience in operations and maintenance were hired as trainers, working along with professors from the CP who had formerly worked in the irrigation districts. These technicians then provided training to the new WUA directors and technicians.

TRAINING FOR WUA BOARD AND STAFF

To complement this training, \$24 million (3.5%) from a "time slice" loan from the World Bank was used for institutional development, strengthening of users associations, and training. Most of this amount was used by the IMTA and did not provide sufficient training to WUA boards and technicians. Only older WUAs that were already established received adequate training before the loan funds were exhausted.

The training program involved the promotion ("selling") of the transfer process among users and the training of WUA directors and operating personnel. Initially it was thought that the training program could be coordinated by the United Nations Food and Agriculture

Organization (FAO), however, an agreement to this effect was not reached and most of the coordination was carried out by IMTA staff. However, staff of the irrigation districts were in charge of the training and of the in-service training which took place during the parallel operation period.

IN-SERVICE TRAINING

Operational, technical, managerial, and directive training should be continuous because continuous changes occur in the irrigation districts. These changes occur frequently in make-up of directive boards, which then change some of the district personnel. At present, a program of continuous training does not exist. In recent meetings, WUA directors have asked CNA, SEMARNAP, SAGAR, INIFAP and ANUR for assistance in establishing regular training programs for WUA directors and technicians and for water users.

As result of negotiations between the WUAs, ANUR, and CNA, a program of continuous training is about to start, with participation of the various state governments. In order to establish this program, it is necessary to form, in addition to staff of involved universities and state and national technical institutes, a group of trainers at a regional or state level with knowledge of the basic topics related to the management of water. Funding for the training is to come from the Federal Government and the WUAs. As a first step in organizing these programs, the National Center for Training on Irrigation, located in the irrigation district of Valle del Carrizo in Sinaloa State, has been transferred from the federal government to ANUR.

7 SECOND GENERATION PROBLEMS

Since the districts, divided into modules, were transferred to their corresponding associations of users, a new group of problems have appeared. These are termed second generation problems, so that they are not mistaken for ongoing problems, as mentioned in the introduction. Of course, some problems of the second generation are related to the first ones, and it is important to point out that they are also related to the socioeconomic problems that burden the agricultural sector in general, mainly because of the crisis that the whole country is going through.

Among the problems faced by users organizations, the following types can be pointed out as the most important - legal problems, financial self-sufficiency and investment financing; water management, maintenance and repairs; inter-institutional coordination; environmental impacts; and leadership, management, and support of WUAs.

WATER RIGHTS AND OTHER LEGAL ISSUES

The new National Water Law provides a suitable framework to solve most of the problems related to the use, exploitation and management of hydraulic resources. Water rights are generally defined, a registry for water rights is being established, and the outlines of a market for water rights are given. However, although implementing regulations for this bill already exist, there are many legal gaps. Needed is guidance on ways to solve specific problems at the level of the basin, irrigation district, and users organization, as the Law itself requires.

The most important legal deficiency is the lack of definition about what rights to water are - rights that the WUA should have. A volumetric right of water was not given in the concession title given to the modules. Titles only indicate that the CNA will annually define the supply of water in order for the irrigation districts and the corresponding modules to plan. In this respect, there is great confusion because neither the Law nor its regulation explain the difference between a water right and a water allocation.

It is supposed that rights to surface water flows relate to the average water run-off that a particular water user is entitled to use, whether by concession (for individuals or civil associations) or by appropriation (for government institutions). This is the value considered in the REPGA. Each year, according to the supply of water, CNA will authorize a water supply which should be proportional to the right that was assigned or granted.

This lack of definition about volumetric amounts of water granted to the modules is a cause of many problems and conflicts among the water users. An example is the conflict between the users of Irrigation District N° 26 and Monterrey City over use of water from the Río San Juan. Other conflicts include those in the Las Lajas River in Guanajuato, the Atoyac river in Puebla,

and others where works construction in the upper parts of the basin has been undertaken, even though the water supply was already assigned to the lower area.

The lack of regulations at the levels of the basin, district, and association leaves the solution of problems and conflicts to CNA, creating problems that could be prevented if regulations existed. Among the present problems, the ones generated by the lack of water in the North tend to get worse with the increase of urban and industrial demand, as is the case in the Rio Bravo Basin.

Other legal issues that must be clarified through the issuance of new regulations are:

- The priority to be given to the use of water for human consumption in the districts, since there is a confusion about what domestic, human, and urban uses are and how the priority rights for these uses should be established over the agricultural use of water, mainly in the times of shortage of water
- The need to include amounts of water for ecological purposes in the irrigation plans of districts and modules so that the pollution problems of surface water flows are reduced
- Definition of rights to water at the users level - irrigation district hydraulic committees should clearly propose such definitions in accordance with Article 26 of the Law.

Considering the similarity of many problems whose solutions relate to new regulations, ANUR should participate, and is already working with CNA personnel in the development of new regulations at the district and users organization levels.

FINANCIAL REQUIREMENTS

Two-thirds of the directive board members in surveyed modules indicated that the funds obtained through water charges were insufficient to cover operation, maintenance, and management costs (CP, 1994). They also confirmed that maintenance is reduced when there is a lack of money. In most cases, fee levels had been raised, but at a rate less than inflation because it was felt that water users were facing economic difficulties.

At the same time, more than half of the directors surveyed acknowledged that they haven't been able to get a satisfactory agreement concerning the payment of fees to CNA for bulk water supply. The study concluded that regulations on quantifying such fees were inadequate (CP, 1994). This is because the methodology proposed in the instructions attached to the concession titles is not followed, and those fees are often charged as part of the quotas but not in volumetric terms as established by the law. The percentage has generally been negotiated with CNA by the directors of the individual modules and, therefore, there is variability in the amounts, even in similar conditions of operation.

Because there are no regulations about reporting expenses and keeping books, considerable differences are found in the way accounts are kept among modules. This makes auditing accounts, and comparisons among the modules, difficult.

Fixed and Volumetric Tariffs

There are many ways to charge for irrigation service - from the simplest using annual hectare irrigated to the more complicated volumetric methods. When charges are levied volumetrically, associations risk not being able to recover costs in years of water shortage. Because of this, mixed methods are recommended that contain both a fixed fee which helps cover associations' fixed expenses and a volumetric component linked to the amount of water delivered which makes the user conscious of economy in water use.

Sinking Funds and Reserves

Most associations establish neither a sinking fund that would enable them to replace equipment, nor a financial reserve that could be used for emergencies. Enquiries carried out among module directors indicate that they don't think it advisable to save money given the current high inflation rate and the risk of a new devaluation and consequent loss of value of the reserve.

WATER MANAGEMENT, MAINTENANCE, AND REPAIRS

Problems have arisen in irrigation and maintenance services since WUAs have been in charge of operating the irrigation systems. These problems are due to the lack of adequate training on behalf of the operational staff, to a lack of operational regulations at the association level, and to the poor condition of the irrigation infrastructure.

Operational Problems

A problem that has become general in many modules is that the amounts of water that were considered in the irrigation plans are not sufficient to satisfy the water demand of the established crops. This situation can be due to the irrigation of a larger-than-planned area, or to the fact that the users are using more water than the amount considered in that plan, or to a combination of both conditions.

In either case, if water is available in other modules, the deficit module could buy water from those that have a surplus. However, when there is not such a supply, the modules lacking it will repeatedly request it from the CNA, which will eventually yield because, among other things, there are crops that can't be lost according to Article 68 of the Law. As a consequence, a larger amount of water than that authorized is being extracted from supplying resources. This, in turn, reduces the water supply available for other modules and districts.

If water were delivered to the users by volumetric allocation, its management could be significantly improved, the marketing of water and rights would be facilitated, and many problems would diminish. However, in many cases, an infrastructure to measure water at the users' level does not exist. This is considered the main obstacle to establishing a system of delivery by volumetric allocation in the districts. Actually, the will to deliver the water in such a way does exist, and in some districts in the north of Mexico water is delivered volumetrically. This is a solvable problem and efforts should be made to implement volumetric deliveries.

Infrastructure

Much of the irrigation and drainage infrastructure as well as the maintenance machinery were transferred to the modules without being repaired. Most of the facilities and equipment is still in bad condition, not only because of its antiquity but also for lack of adequate maintenance. In some districts some repairs to facilities were made as a part of the transfer process. However, in most cases, CNA did not have enough funds at their disposal to complete that task. When the transfer process started, CNA promised that at least the most damaged infrastructure would be repaired. However, this was not done.

As a result, modules have problems in providing adequate irrigation service. In some cases, there are specific complaints about the impossibility of providing water in the amounts and at the times required by users because of the poor condition of the infrastructure. In other cases, there are problems of soil salinization because drains do not function properly.

There have also been complaints about the lack of machinery for maintenance. Since repair costs are high, it is sometimes more economical to buy new equipment, and some modules have done this with their own funds. There is discontent in some modules because they consider that the distribution of available equipment was not fair.

The problem of deferred maintenance has been exacerbated in many cases because service fees have not been raised to keep pace with inflation, making fewer resources available to provide maintenance and to preserve infrastructure works.

COORDINATION

According to a survey carried out by the CP, there is, in many cases, a lack of coordination between the activities of WUAs and CNA, resulting in duplication of effort and inefficiency (CP, 1994). CNA's functions in the irrigation districts are now supervisory rather than operational where SRLs have been created.

ENVIRONMENTAL EFFECTS

Irrigated agriculture has the potential to cause serious negative effects in the natural environment. Incorrect handling of water for irrigation tends to raise the water table, causing waterlogging and salinization of the soil. This is very common in irrigation districts. Agrochemical residues pollute drainage water which eventually moves into streams and water bodies with the resultant pollution.

Irrigated agriculture is also seriously affected by environmental effects created elsewhere. Significant damage is caused in upper basins by deforestation which affects irrigation systems downstream with changed hydrographs and increased silt loads. Moreover, other water users, such as those from the neighbor towns and industries, pollute water that is withdrawn lower down by irrigation systems, restricting its use. Complaints to this effect by WUAs deserve consideration.

LEADERSHIP, MANAGEMENT, AND SUPPORT

The directive board elections in the associations have been the key to their effective functioning. Directors with strong managerial skills achieved sound management of the transferred, infrastructure and provided good irrigation service to association members. Where directors lacked managerial skills, modules faced managerial, financial and operational problems.

Many financial and operational variations in module management exist. A great part of the success in achieving good operation and maintenance in the modules depend on the skills of the hired staff and, particularly, of the technical manager. In this regard, the lack of a national or regional system of training and continuous assistance for the technical and managerial staff of the modules is noteworthy. That system should also provide assistance and training to the directors who requesting it, taking into account the frequency with which they are changed.

Another important human resource problem is the frequent change in operational staff as membership on directive boards changes. Often, a number of the new personnel are not even technicians but are the new director's relatives or friends. This situation, common in the government sector, and sharply criticized because of its negative effects, has also become common in associations of water users in the private sector. Of course it is definitely legal and advisable to replace personnel not adequately fulfilling their duties. But the unjustified replacement of technical staff, and the waste of expensive training, must be stopped.

Another problems which require attention relates to the power acquired by directors, since they control a resource of such importance in the agricultural sector. In some cases, directive posts in associations are used as springboards to political positions. There has been at least one case (in Nayarit), where, according to representatives of these associations, association funds have been used for a political campaign. Such actions disrupt O&M and threaten the very existence of the association.

8 PROBLEM SOLUTIONS

LEGAL

The solution to second-generation legal problems involves developing acceptable implementing regulations to the Law at the level of the basin or aquifer. This process will take time, yet, steps have already been taken. CNA has requested the CP to develop regulations in 8 districts that have had problems with water in the past farming cycle and gain agreement of water users with the new regulations. The CP was also asked to prepare a set of model regulation for the modules.

The elaboration of regulations at the level of the basin will be more complex. Nevertheless, the negotiations with water users in two important basins in the northeast of Mexico have already started - the Rio Fuerte in Sinaloa and the Rio Yaqui in Sonora - where all water is already allocated and used. These "high-stress" districts provide an ideal laboratory in which to develop procedures that will permit the balancing of water supply and demand. Ways to regulate demand, including as assessment of conditions in which water markets can be established, must also be developed.

As to environmental improvement, it is still hard to convince water users to use "ecological" amounts of water whose run-off is necessary to guarantee the survival of aquatic plants and animals. In order to achieve this objective, it will be necessary to carry out a promotional campaign directed to water users from both the agricultural and the urban-domestic and agro industrial sectors.

It is necessary to regulate the over-exploitation of aquifers. CNA has contracted for studies to define the actions that will stop the over-exploitation and then begin the process of restoration. Actions considered include using more efficient irrigation methods, advertising campaigns alerting users to the importance of maintaining this resource, limiting rights of water extraction, and reducing energy subsidies.

FINANCIAL REQUIREMENTS

At present it is difficult for many WUAs to generate sufficient income to achieve financial self-sufficiency. Several solutions have been proposed. One calls for indexing irrigation tariffs to the prices of agricultural products. Another proposes a tariff structure having a fixed component, estimated in terms of water rights, and a variable component, based on water delivered. These proposals are included in the regulations currently being negotiated with users in pilot districts. Acceptance of a component in the irrigation tariff earmarked for a contingency fund will depend on successful government efforts to control the inflation, or else on the creation of an national contingency fund.

A set of standard bookkeeping practices is needed for WUAs nationwide. It is also necessary to mandate both technical and accounting audits on an annual basis in all WUAs. ANUR could participate in recommending bookkeeping and accounting standards and in developing software to improve financial management.

CNA is seeking to obtain a new loan from abroad in order to support the repair of the infrastructure works in the irrigation districts. ANUR and CNA have agreed that the WUAs and the Federal Government should share the costs of rehabilitation equally.

WATER MANAGEMENT, MAINTENANCE, AND REPAIRS

The lack of water measurement and flat rate charging systems for irrigation water have fostered waste of this resource, lack of equity in its distribution, low yields, salinization and waterlogging of soils, and aquifer mining. The obligations of managers and the tariff system are being considered in the regulations that are currently being negotiated. Still, the users' agreement is necessary for the regulations to be effective.

The training of directors and operating technicians hired by the WUAs is essential to improve the management of water. There is a consensus among users on this need, and it is an issue that is being negotiated at present with CNA and the state governments.

The problems generated by the poor condition of the infrastructure are important because they make the delivery of water more difficult, diminish the flexibility of the network, delay the delivery of water, and lead to delivery of too much or too little water. For all of these reasons, WUAs are trying to solve these problems by means of modifications to the infrastructure, adaptations, and improvements in maintenance. However, in many cases major rehabilitation is needed, which generally requires more funds than WUAs are able to muster. The proposed cost sharing arrangement with CNA will contribute importantly to the solution of this problem.

COORDINATION

It is supposed that the roles of WUAs, SRLs and CNA are well defined in the instructions for system operation, maintenance, and management. Instructive booklets are given to WUAs as annexes attached to the concession titles. However, good coordination in system operations is not always achieved in practice, in part because CNA's structure in the irrigation districts has not adapted to its new functions of supervision. For this reason, the posts of Heads of Units, Maintenance Residents, and Chiefs of Zones, in some cases, are still kept. This situation also contributes to high CNA operating costs.

CNA's structure should be modified and adapted to its new functions. Also, since some of CNA's operational functions are to be transferred to state governments, the prospective role of state governments should be considered in the restructuring.

ENVIRONMENTAL EFFECTS

Irrigated agriculture plays a role in environmental deterioration, though when contrasted with the damage caused by urban and industrial sectors, it is relatively modest. Some of the legal and managerial solutions suggested earlier will help meliorate these impacts. Moreover, new regulations tighten control of the dumping of agro-chemical wastes. Nevertheless, the need to make users aware of the importance of preserving the environment should be emphasized.

At the same time, it is of utmost importance to propose practical actions to prevent the dumping of sewage water from towns and industries, and to reduce the pollution of rivers and aquifers, since irrigation users are the ones directly affected. Not only are they forced to use polluted water, but water quality constrains their crop choices, particularly the more profitable fresh fruits and vegetables.

LEADERSHIP AND SOCIO-POLITICAL PROBLEMS

The election of WUA directive boards generated conflicts in the beginning when the associations were formed. Since that time, however, water users are participating more actively in the election of their executives and conflict has declined. These processes will improve as experience is gained, particularly if additional training is made available.

The problem of changing the WUAs' qualified staff without a justification following the selection of new directors can be solved if the new regulations for the modules define the guidelines to be followed in order to lay off qualified personnel. Such provisions are currently being considered in the preparation of draft regulations.

Also, regulations may help to control the politicization of the directive posts and the misuse of the operation and maintenance funds for political purposes. The problem experienced in some modules of the use of a director's seat as a springboard to political office and the neglect of association duties should thus be limited.

ADOPTED SOLUTIONS

Progress in addressing water resource problems over the last 8 years has been impressive. A new national water agency (CNA) was created, as were a set of WUAs, which now manage modules covering 85% of the irrigation district area in the country. SRLs have been established to manage entire districts, and subsidies have been reduced from 90% to only 25% in a period of just five years.

From these successes have come second generation problems. CNA, the WUAs, and ANUR are carrying out actions to address many of the problems that have been described. Some of these actions are already contributing to solutions. For instance, the elaboration of the provisions of the new National Water Law through court cases and issuance of regulations, modification of the Law of Rights defining groundwater zones according to the availability of water and setting water taxes accordingly, and exemption of WUAs and SRLs from paying income taxes on incomes from irrigation tariffs.

The establishment of REPDAs and the possibility of commercializing water rights will help to regulate water demand. Negotiations that are being carried out with the users in order to apply the Law and its regulations will enable those users to improve the management of this resource.

Nevertheless, there is still a lot to be done; it is the beginning of a new culture of water, and what has been done so far is little compared to what remains to be done.

SUGGESTIONS FOR THE FUTURE

There is no doubt that a lot has been learned in the process of transfer. In the beginning, WUA directors did not know clearly what their duties were, and how they would react to operation, maintenance, and management problems was unknown. Results show that the directors are learning quickly, and have acted responsibly to solve problems. Most modules are managed well and, in the opinion of the users, there is a better service than that offered by government staff in the past.

Yet challenges remain. There are still 14 irrigation districts to be transferred and another 11 that are only partially transferred. These districts have social and infrastructure problems that

have to be corrected before transfer is carried out. Nevertheless, with the knowledge acquired so far, it should be possible to design a strategy to complete the transfer.

From the experience gained in Mexico, several suggestions can be offered to other countries considering similar programs.

- Promotional programs explaining the advantages of participatory irrigation management are essential initial activities for successful transfer programs. This can be done through meetings, workshops, and distribution of pamphlets.
- It is important to raise irrigation tariffs to the level of financial self-sufficiency before the transfer so that WUAs can support adequate operation and maintenance programs.
- Government agencies should provide for ongoing programs of rehabilitation and modernization of infrastructure and support for WUA directors.
- The larger modules are, the cheaper are their operations costs per unit area.
- The election of a WUA's first set of directors is a critical action for the future of the association. When the directors are representative of the membership and have leadership capacity and managerial spirit, the WUA will likely be successful.
- Successful transfer requires an appropriate legal framework. This framework must define clearly the rights to water, forms of organization, the responsibilities of each party, and the manner in which activities should be regulated. Fiscal benefits must also be considered for companies that manage the irrigation and drainage infrastructure.
- A transfer program should be accompanied by training for both WUA directors and their operating staff. The system of training should be ongoing.
- In order to finance programs of support, the government should provide subsidies. It should also foster the participation of users in support programs, and, if possible, the participation of state or county governments. Users' participation will guarantee not only better management of funds but also a major interest in the programs on the part of users.
- Once the process of transfer is carried out, public agencies previously in charge of water management should be restructured. Their new roles should be oriented toward guidance and supervision of the new managing entities and acting as a linkage point between WUAs and the government. To perform this new role, they must have an adequate staff with an appropriate mix of skills. In the case of Mexico, since investment in constructing new hydraulic structures will be significantly reduced, CNA's role should be oriented to helping to solve problems of operation, use, negotiation, and management of water, and to supervise and support WUAs and the application of the Water Law.

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