ADVANCES OF THE IRRIGATION MANAGEMENT TRANSFER IN THE LARGE-SCALE IRRIGATION SCHEMES IN MEXICO

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ABSTRACT

Mexico is a world leading country in relation to Irrigation reform. An Irrigation Management Transfer of the large-scale irrigation schemes to Water Users Associations, locally known as Irrigation Districts, took place in Mexico since 1989. Until today, the IMT program has transferred irrigation infrastructure, below the main canal level, commanding 3.273 Mha to around 474,000 water users organized into 474 Civil Associations (or *Modulos*). Likewise, at main canal level 13 federations of water users associations known as Societies with limited Liability (or SRL) have been established so far. The main objectives of IMT were, among others: to ensure the sustainability of the irrigation districts, to reduce the financial burden on the government, to pass the responsibility for O&M to the users, to increase efficiency in the use of water, to improve and sustain system performance, and to reduce the number of public employees in the irrigation districts.

In early 2001, FAO through its AGLW Service and the International Network on Participatory Irrigation Management (INPIM) joined forces to document on-going worldwide efforts on irrigation water reforms. An international e-conference event was held which, included the IMT Mexican case. In this document, is presented an updated version of the review of the IMT program in Mexico making especial emphasis on the actual advances and outcomes, impacts and lessons learned. Results show that the irrigation cost has increased for farmers and decreased for government, efficiency of fee collection has improved in most of the cases, and quality of maintenance has also improved. However equity of water delivery remains unchanged as well as productivity since the Gross Value per Production has a decreasing trend and improvements on irrigation efficiency and yields have a very narrow margin.

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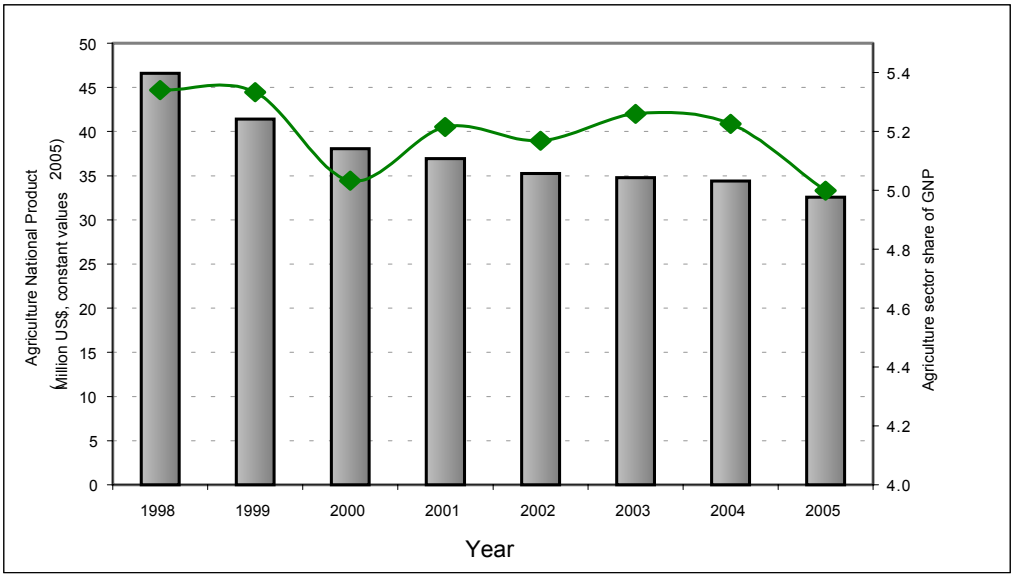
INTRODUCTION[1]

THE AGRICULTURE SECTOR AND IRRIGATION SUB-SECTOR IN MEXICO

The Republic of Mexico has an area of 1.97 Million km^2 and a population fast approaching 100 Million and presents a Gross Domestic Product per capita (GNP) of US $ 6,450. The agricultural sector plays an important role in the development of the country, however, the Agricultural GDP has been experiencing, in constant values, a decreasing trend with the Agricultural share of GDP fluctuating around 5 percent, as shown in . Agricultural sector employment contribution stands now around 18 % of the economically active population, while industry has increased to 27 % and manufacturing stands at 20% (INEGI, 2002).



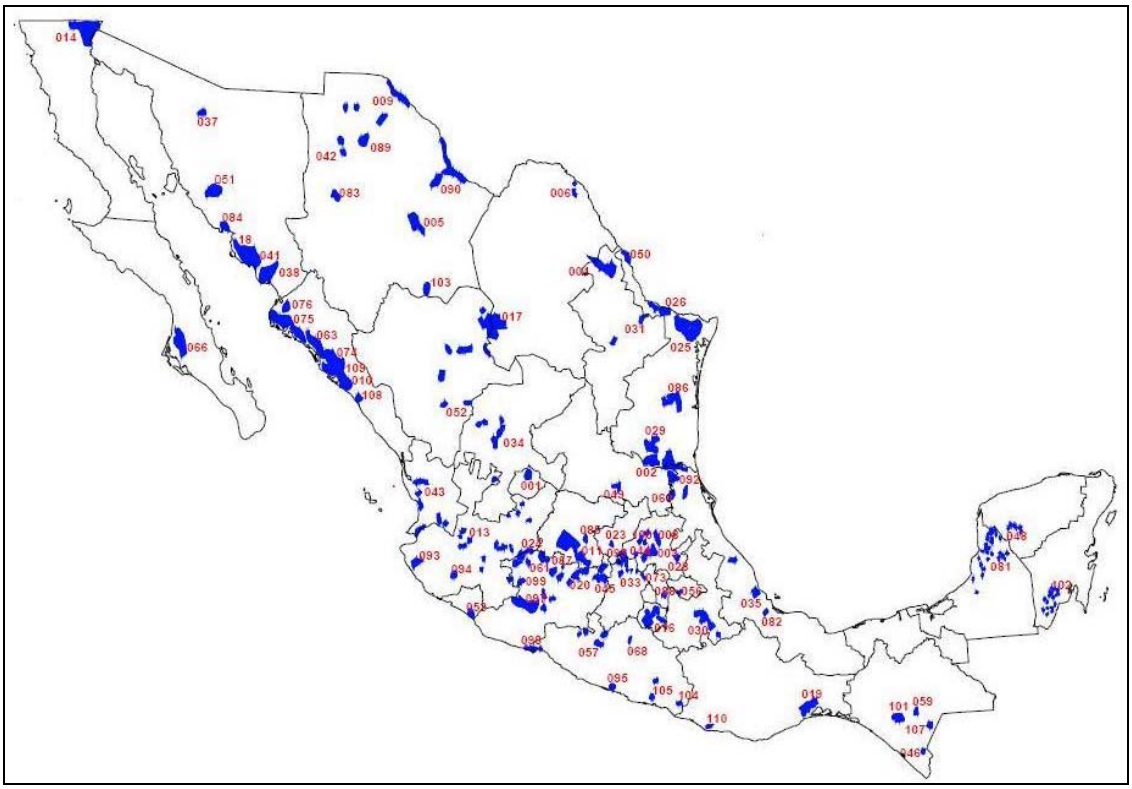
SOURCE: GDP: INEGI, Sistema de Cuenta Nacionales; CPI: BANXICO, IPC por objeto de gasto nacional, Indice general

Figure 2 Agricultural Gross Domestic Product and share

Irrigated agriculture is essential in order to obtain fully productive crops since two thirds of the country's surface is classified as arid or semi-arid. The average rainfall over 42 percent of the nation is less than 500 mm and less than a third of the country's water lies within 75% of the land area where most of the large cities, industrial facilities and irrigated land are located. Irrigated agriculture represents less than 30 percent of the total area harvested in the country, contributes about 56 percent of the total value of agricultural production and accounts for roughly 70 percent of agricultural exports. Furthermore, irrigated yields are roughly 2.5 times those of rain-fed areas. At present, of the 20 million hectares (Mha) that are under cultivation in the country, only 6.3 Mha have irrigation and drainage infrastructure. Of these, 3.5 Mha correspond to 85 to large-scale irrigation systems (see) locally known as Irrigation Districts (ID) and the rest, 2.8

1- This paper is based on Irrigation Management Transfer Case Study UPDATED: Irrigation Management Devolution in Mexico conducted by FAO. See: http://www.fao.org./landandwater/aglw/waterinstitutions/default.stm

Mha, correspond to around 39,400 small-scale irrigation systems locally known as Irrigation Units (IU), (CNA, 2005). The former initially were managed by the government and then were the subject of the Irrigation Management Transfer (IMT) program; and the latter were built with government support but have always been managed by water users.



Source: CNA, 2006.

Figure 4 Location of irrigation districts in Mexico

In terms of the water source, 76 percent of the total volume granted in concessions is use for agriculture and livestock. Out of this volume, 67 percent is captured from surface waters with the remaining from groundwater sources. and for the ID, the distribution is respectively 91 and 9 percent (CNA, 2005 and 2006). Land tenure in the irrigation sub-sector –as well as in the whole agriculture sector– is represented by two main groups: the *ejidatarios*[1] and small growers. In the IDs this relationship in terms of area is split roughly 55 to 45%, respectively. In terms of their size, the irrigation districts are distributed as follows: 32% with less than 10,000 ha; 47% between 10,001 and 50,000 ha; 11% between 50,001 and 100,000 ha; 4% between 100,001 and 200,000 ha, and 6% with areas greater than 200,001 ha.

1- *Ejidatarios* are the owners of the *ejidos* which are agrarian communities established in Mexico in the early 1930s. Land and water resources were held as common property with private usufruct rights. Today, the *Ejidos* are being titled through the Program for certification of *Ejidos* rights (PROCEDE, for spanish acronym). The Program began in late 1999 and by mid-2003 had certified and titled 81 % of *Ejidos* nationwide accounting for 65.8 million Ha and around 3.4 million people.

WATER SECTOR REFORMS

In 1989 the government sought to provide more independence in the management of natural resources and decided to establish a new organization –the National Water Commission (CNA)– as an autonomous body under the Agricultural and Animal Husbandry Secretariat. With the establishment of CNA the decision was made to make part of its mandate the transfer of the operation, maintenance and administration of the irrigation districts to new water users associations. This, of course, gave origin to the Irrigation Management Transfer (IMT) program in Mexico.

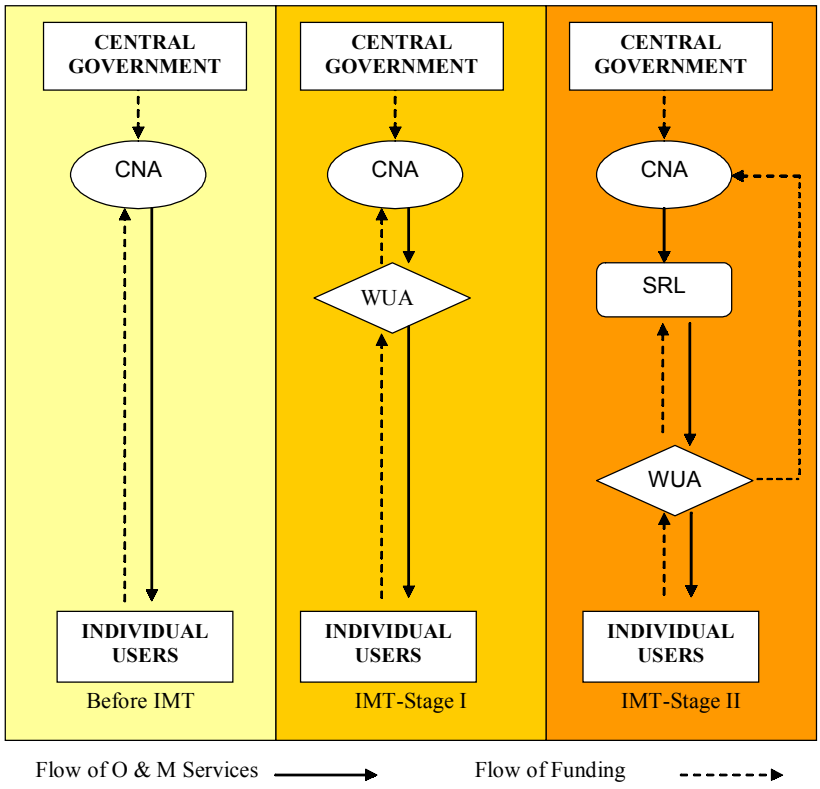
In 1992 a National Water Law was promulgated promoting the management transference of the large-scale irrigation systems to the water users and in 1994 the corresponding bylaws were announced. Also, in this year, the Secretariat for the Environment, Natural Resources and Fisheries was created and the CNA was placed under them, but again with a high degree of autonomy and independence. Additionally, in late 2004 a set of reforms on the National Water Law were approved by Congress but not yet officially implemented since the required bylaws have not been prepared. This new legal framework could allow a more decentralized water management reinforcing basin organisms and basin councils.

IRRIGATION MANAGEMENT TRANSFER PROGRAM

IMT PROGRAM PROCESS

The IMT program had the following main objectives: 1. Ensure the sustainability of the irrigation districts; 2. Reduce the financial burden of the government, 3. Transfer the responsibility for O&M to the users; 4. Increase water efficiency; 5. Improve and sustain system performance, and 6. Reduce the number of public employees in the irrigation districts.

shows the two stages of IMT: Stage I, transfer of *módulos* to water users associations (WUAs) and, Stage II, transfer of entire irrigation districts to Limited Responsibility Societies (SRL's in Spanish). During the Stage I, IDs were divided into *módulos* and WUA were constituted. Then infrastructure, equipment and machinery (below the main canal level) were officially released to these WUAs in parallel with the emission of the water concession title. In stage II, the SRL were formed grouping *modulos* from the same ID with the main responsibility of distributing water from the head-works to the WUA thereby taking control of the main system level from the agency. The SRLs expenses are covered by the WUA which apportion a percentage of their water fee income, this amount thus being subtracted from the payments going to CNA for that same purpose. In all cases the irrigation agency obtains resources from the central government, although conceivably after the transfer the central funds are to support agency operations that go beyond the services provided to the WUA. With the SRL in place, the agency looses the funds previously allocated for the operation of the main system but continues to perceive funds for the operation of dams and head-works.



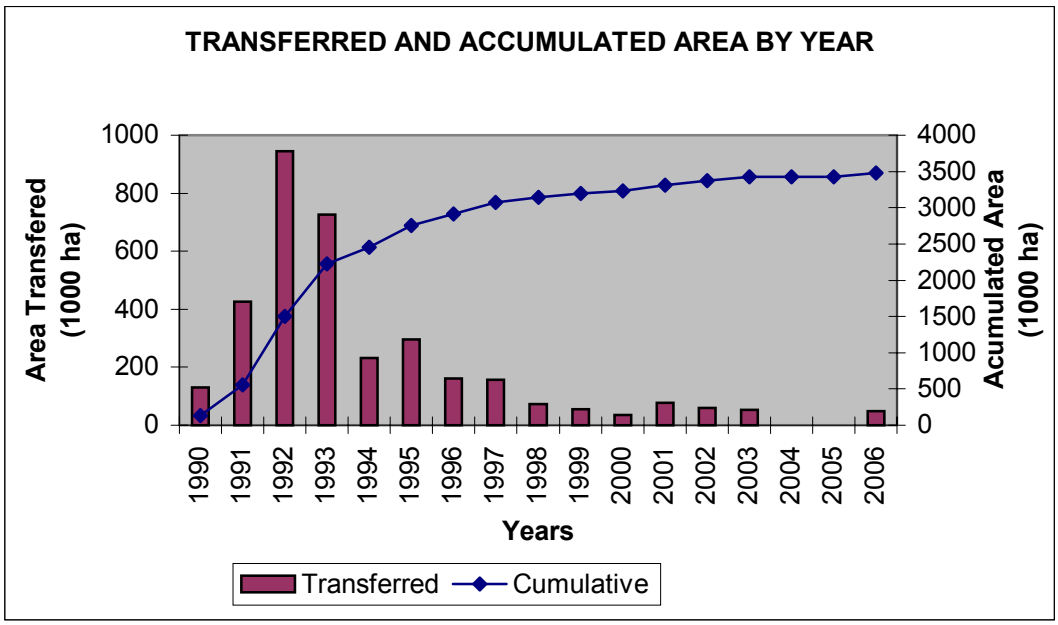
Source: FAO. Garces and Silva, 2004

Figure 6 Structure of O&M services and payments under Mexico IMT program

The WUAs may have four administrative or institutional levels: The General Assembly, the Oversight Committee, the Executive Board and Technical Unit. The General Assembly does not include all the water users but rather consists of the representatives or delegates of both land tenure sectors: *ejidos* and small growers. The main role of the Oversight Committee is to inspect the accounting records, oversee the assets and the inventory, and make sure that a financial auditing takes place yearly or when instructed by the General Assembly. The Executive Board is responsible for general management of affairs and resources, represents the WUA, and executes the resolutions of the General Assembly. Finally, the Technical Unit is composed of a General Manager and his staff that are professionals hired and remunerated under contract, and directly controlled by the Executive Board.

CURRENT SITUATION AND EVOLUTION

The IMT of the secondary network (Stage I) is practically finished; since 2001, close to 98% of the total large-scale irrigation area is already being managed by its corresponding WUA (See). According to CNA, in 2004 there were only 47,878 ha remaining to be transferred to the users and in 2006 the National Association of Water Users (ANUR) reports only 20,427 ha remaining for transfer.



Source: Adapted from CNA, 1999 for years 1990-2000; Adopted from Unified System of Water Basic Information, (SUIBA,CNA) for years 2000-2002; ANUR (2003; 2006)

Figure 8. Mexico Irrigation Management Transfer program (1990-2006)

The second stage of the IMT program is almost at a standstill since the year 2000. The 13 SRL formed so far, currently managing the main network correspond to the more profitable agriculture zones or to the largest irrigation areas. The rest of the WUAs have difficulties in forming a SRL for the following reasons:

- Modules with very low capabilities for managing the main network, which are in marginal or conflict zones,
- Individual modules that do not have a main network, and thus do not need the establishment of a SRL,
- Modules that already manage the main network by a different type of arrangement (like on a rotation basis) and they are not interested in the establishment of a SRL.
- There is some resistance from fear to loose their power and influence on the maintenance investment projects. The percentage of the water fee that is paid to the CNA without the mayor network transfer (i.e. before the establishment of a SRL) is 15 to 20%, while for those transferred is 6 to 10%.
- Finally, the official concession for the management of the main network has a long process within the CNA after the SRL is established, which discourages its formation.

During the last few years, the role of users has gain relevance due to the impact that the National Association of Irrigation Users (in Spanish, ANUR (Associacion Nacional de.Usuarios de Riego, ANUR) is having on promoting and organizing the farmers into WUAs and SRLs. The ANUR was established in 1994 with the aim of representing the

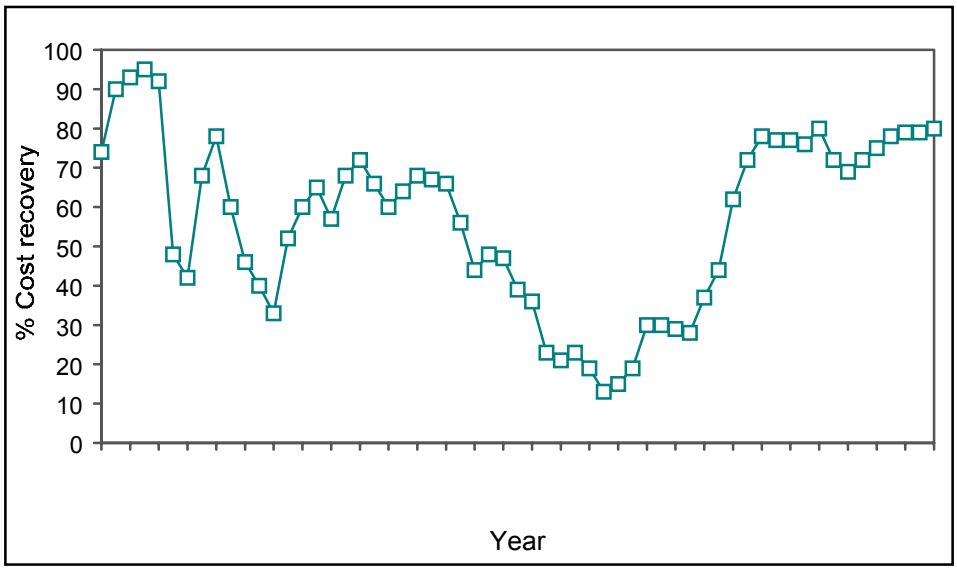
interests of water users in their negotiations with the government institutions, to provide support services in order to improve efficiency and water management, and to instruct and carry out technology transfer among its affiliates. Currently, it gathers 474 WUAs, which is 100% of the transferred ID associations and comprises 557,381 water users - 75% are *ejidatarios* and 25% from the private sector-. For financing ANUR´s expenses each member pays an annual fee of $1.5 pesos per hectare (around 15 USD cents), plus some subsidies from the CNA and other institutions. Currently, ANUR is working on the establishment of new SRLs.

RESULTS AND IMPACTS

COST OF IRRIGATION

The cost of irrigation can be measured in terms of operation, maintenance and administrative expenses (O&M&A). The assessment of IMT impact in this aspect can be portrait by the financial self-sufficiency (fss) indicator before and after the program. Financial self-sufficient can be defined as the percentage of total annual cost of irrigation O&M&A that is financed locally by water users. In the irrigation districts' fss has increase from pre-transfer levels (1989) of 43 percent to an estimated 80 percent reached in 2005 (ANUR, 2006). See .

ANUR reports that the average irrigation fee is 450 pesos/ha and varies depending on the ID area, from fees of up to $ 1,500 pesos/ha in small to only $ 400/ha in large ones. The distribution of this fee is: 50% in maintenance, 25% in operation and 25% in administration expenses. There is an average of 2.5 million hectares that are currently irrigated therefore the total income from water fees can be estimated in around 112.5 million USD.



Sources: Period 1947-1990: Johnson, 1997: figure 3, page 8; period 1989-2000: ANUR (2001); period 2002-2005: ANUR (2006). Data for other years was extrapolated.

Figure 10. Percentage Cost Recovery (or self-sufficiency) of Irrigation Districts in Mexico; 1947-2005

EFFICIENCY OF FEE COLLECTION

A major goal of IMT was for WUAs to gain financial autonomy for O&M&A needs. However, the mean 72% fss reported for the period 2000-2005 (see) was exceeded only by around 40% of the IDs; the range went from 20% to 100%. These numbers suggest that while a few districts are doing very well the large majority are not. This notwithstanding, ANUR indicates that in most districts the revenue-collection performance is around 85% since the water fee payment is a requirement for water deliver. Hence, the problem seems to concentrate in the existing gap between the required fss and the actual fee that is approved and paid by users. As expected, users try to keep the fee as low as possible even in detriment of the long-term life of the infrastructure.

The program of "*permiso único de siembra*" (in English, "sole planting authorization permit (in Spanish, Permiso Único de Siembra") was implemented in order to increase the efficiency of fee collection. This permit is granted once the users have completed their payment and it is a requirement to access other governmental support programs. Therefore, paying on time is aNormally, all users need these government support programs and therefore there is an incentive to pay the water fee on time.

QUALITY OF MAINTENANCE

The country-wide deterioration of the irrigation and drainage infrastructure was one of the leading reasons that gave birth to the IMT program. Before transfer, maintenance responsibility was entirely in the hands of the irrigation agency and was done at the district level, rather than at *módulo*-equivalent level. This created a bias towards maintenance of main canals and head-works in detriment of secondary (and below) levels. Both maintenance budgets and programs were dictated from CNA's central office and users had little influence in the works.

At the moment, WUAs pay a negotiable percentage of total fees to CNA that has kept responsibility for maintenance of dams and head-works. The percentage has been a function of amount of worked involved in terms of kilometers of canals and roads, and type of head-works. But also, on the particular negotiations undertaken between the agency and individual *módulos*. The percentages reported varies from 5 to 25%, with a diminishing tendency as the SRLs are created and take over management of the main canals. Today, the agency has a supervisory role as maintenance plans have to be submitted to them for approval. At least 60% of fee collections should be allocated to maintenance, but ANUR reports an average of only 50%.

Maintenance after transfer continues to be a problem given that many WUAs still can not collect enough fees to off-set full costs; the results is an increase in deferred maintenance in many *módulos*. According to a study by the Colegio de Postgraduados (1998), direct investment in maintenance has been decreasing in constant peso terms. CNA's contribution have diminished from 100 million pesos in 1989 to 10 million in 1997; while WUA contributions have increased from essentially zero in 1991 to 70 millions in 1997 (all in 1993 pesos).

In the Alto Rio Lerma district, the number of employees assigned to maintenance activities decreased from 81 to 65 after transfer, suggesting that the same level of effort was obtained with fewer staff, hence efficiency improved. Also, the volume of work

executed increased after IMT. In the pre-IMT period from 1982 to 1992, an annual average of 438,550 m^3 of silt was removed, compared to 1.26 Mm^3 after IMT. The results show that not only there has been an increase in the amount of work done, but also that maintenance work has shifted to the lower system levels, and away from main canals (Kloezen *et al*, 1997

QUALITY OF WATER DELIVERY

Another reason for IMT was that users would improve the O&M of their systems given greater incentives to do so once it belonged to them. Several attempts to determine whether the quality of the water services, by the new WUAs have been made is shown in Table 1. The studies relate to research and field-based oriented activities carried on by the International Water Management Institute (IWMI) and others, in several districts throughout the country. Results indicate that improvements in the quality of water services after transfer have not been quite as dramatic as those reported through farmers' perceptions. The studies do show however improvements in some areas and, perhaps more importantly, that there has been no deterioration of the O&M service since transfer.

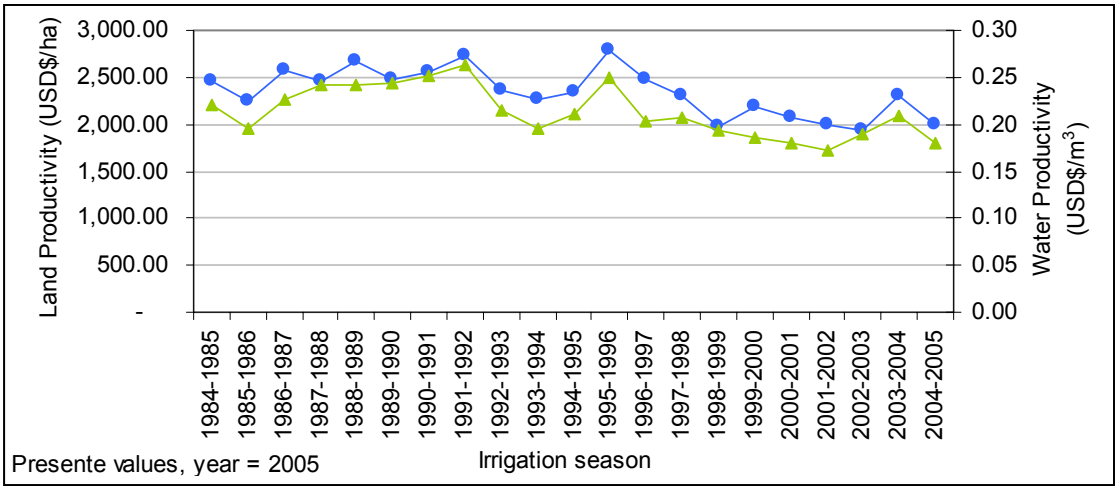
Table 1. Water delivery improvement in slected IDs

Study	Author	Year	ID studied	Type	Results	Comments
Colegio de Postgraduados	Enrique Palacios	1997	Alto Rio Lerma, Lagunera, Culiacan, Bajo Rio Bravo and La Begoña	700 users survey	84% water distribution had improved, 79% water received in timely fashion, and 64% water received in appropriate amount	Survey conducted shortly after the ID IMT and co-management with agency not yet in place
CNA		1999	229 modulos in 36 ID	Survey	Average irrigation application depth diminished by 1%	
IWMI	Kloezen *et al*	1997	Alto Rio Lerma	Field measu-rements	RWS reduction from a 2.1 pre-IMT level to 1.9 after transfer	RWS=relative water supply
IWMI		2000	Alto Rio Lerma	125 farmers survey	36% service of water distribution improved and 23% dropped. 30% timeliness water improved and 34% no improvement 40% improvement on ditch tenders performance	These results are in great contrast to those reported by Colegio de Postgraduados
IWMI	Rym-Shaw	1998	Rio Bravo and Bajo Rio San Juan	Estima-tion with second-ary data	Average RWS values, for period (1982-96), down by 0.4 in Bajo Rio Bravo and by 1.0, in Bajo Rio San Juan	Results affected by strong dry period that hit both districts in the 1990s.
IWMI	Levine, et al	1998	Lagunera		RWS values before and after IMT have remained constant, at around 1.5	

Source: Prepared based on Garcés and Silva, 2004

PRODUCTIVITY OF IRRIGATED AGRICULTURE

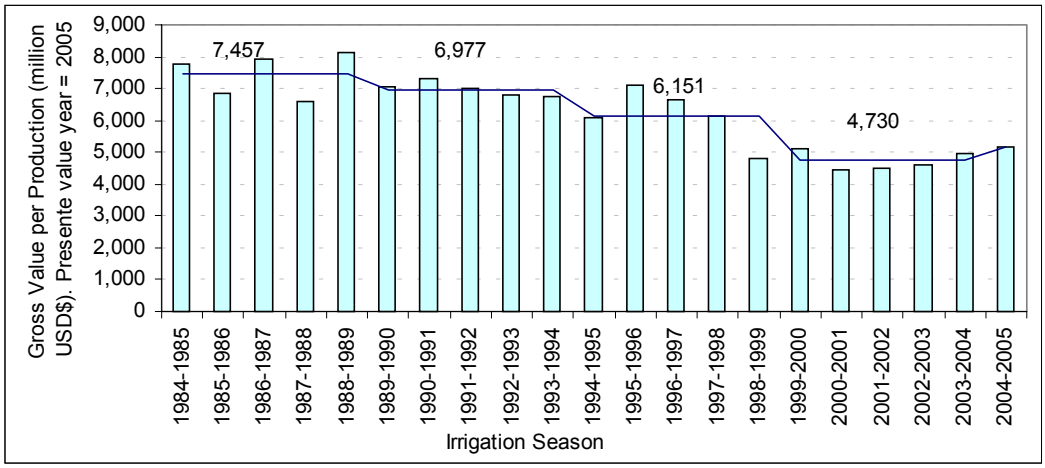
To measure land and water agricultural productivity before and after transfer indicators as changes in crop yield in ton/ha, gross value of production per unit of water supplied ($/m^3) and gross value of production per unit land ($/ha) are used. In a recent nation-wide survey done by the irrigation agency trough a contractor (CNA, 1999) it was reported that over the period 1991-1998 the productivity of land (in terms of crop yields) increased 1.85 % per year on the average. Likewise, the productivity of water (in terms of yields per unit water) increased 2.2 % per year on the average, in the all irrigation districts. In a sub-sample of 36 transferred districts, they reported increases of 2.5 and 2.8 % per year, for productivity of land and water respectively, over the same period. However, in terms of Gross Value per Production (GVP) the productivity of land and water has remained almost stable as is presented in elaborated from the official CNA statistics (1998; 1999; 2000; 2001; 2002; 2003; 2004; 2005).



SOURCE: Elaborated based on data bases from Subgerencia General de Operación, Gerencia de Distritos y Unidades de Riego, Comisión Nacional del Agua (CNA). NOTE: The irrigation season comprises from October 1st to next year September 30th

Figure 12. Land and Water Productivity in Irrigation Districts: 1984-2005

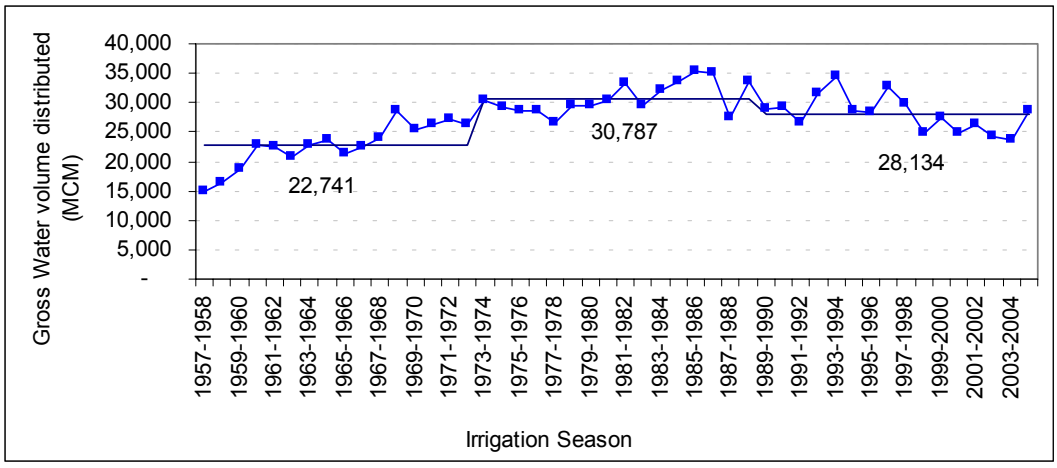
The most influential aspect on water and land productivity is the GVP. As can be observed in , the productivity indicators follow a similar trend and, can be said that, in those cases where the decrement on productivity is not proportional to the GVP decrement, is because irrigation has been more efficient or yields have increased.



SOURCE: Elaborated based on data bases from Subgerencia General de Operación, Gerencia de Distritos y Unidades de Riego, Comisión Nacional del Agua (CNA). NOTE: The irrigation season comprises from October 1st to next year September 30th

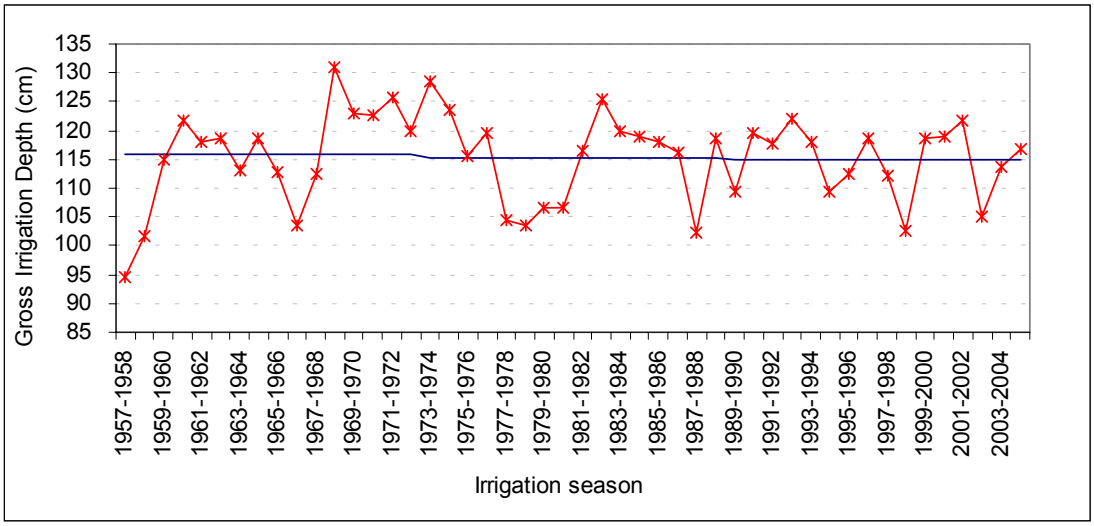
Figure 14. Gross Value per Production in Irrigation Districts: 1985-2005 and, Gross Value per Production Average, periods: 1984-1989, 1989-1994, 1994-1999 and 1999-2004

The water volume consumed by the ID has been reduced in the order of 9% after 1989 when the IMT program started. Previously, a significant increased (31%) of water volume consumption for ID took place from the period of 1957-1973 to period 1973-1989 mainly do to the construction of new reservoirs. As can be observed in , the reduction water allocated to ID is a consequence of an irrigated area reduction since the variation on the irrigation depth applied is rather small (see) and the IMT impact on this aspect is hardly observed.



SOURCE: Elaborated based on data bases from Subgerencia General de Operación, Gerencia de Distritos y Unidades de Riego, Comisión Nacional del Agua (CNA). NOTE: The irrigation season comprises from October 1st to next year September 30th

Figure 16. Gross Water volume allocated in Irrigation Districts: 1957-2005 and, Gross Water volume allocated average, periods: 1957-1973, 1973-1989 and 1989-2005



SOURCE: Elaborated based on data bases from Subgerencia General de Operación, Gerencia de Distritos y Unidades de Riego, Comisión Nacional del Agua (CNA).

Figure 18. Irrigated depth in Irrigation Districts: 1957-2005 and, Irrigation depth average periods: 1957-1973, 1973-1989 and 1989'2005

In Table 2, the productivity values for land and water for four irrigation districts that have been studied by IWMI are summarized. These studies conclude that the productivity of both land and water is relatively high in some districts, but that the values can not be related directly to the transfer program but have to be viewed in the context of other economic changes that have taken place in parallel. Those districts with better irrigation water availability (Alto Rio Lerma and Lagunera) produce higher–values crops, than those that rely more on rainfall. The combination of higher-value crops and better water availability produced higher GVPs/ha, almost double. However, the GVP per unit of water are higher in those districts with supplementary irrigation. But, as discussed above, the differences can not be attributed necessarily to IMT.

Table 2. Gross Values of Production for Land and Water in selected Districts (aveg. 1982-1996)

Irrigation District-number	GVP/ha irrigated (US $ of 1994)	GVP/m3 supplied (US $ of 1994)	Main Crops
Alto Rio Lerma -011	1422	0.10	Wheat, Maize, Veg.
Lagunera-017	1654	0.13	Alfalfa, Cotton
Bajo Rio Bravo-025	769	0.19	Maize, Sorghum
Bajo San Juan-026	728	0.14	Maize, Sorghum

Source: Levine and Garces, 2000; page 19

GENERAL CONCLUSIONS

- The IMT has produced a dramatic impact in bringing down government public expenditures in O&M&A of irrigation districts. However, government investments in modernization of the districts still represents an important share of public expenditures.
- The size of the *módulos* is a key factor in the financial self-sufficiency of the WUA on O & M. It seems that economies of scale play a role, larger *módulos* seem to cope much better
- The irrigation service has improved but perhaps not as much as it was expected
- The fact that cost recovery in most Irrigation Districts is based on the actual irrigated surface makes their financial self-sufficiency vulnerable when water availability is diminish, i.e. droughts or water reallocation. Around 75% of the Irrigation Districts costs are fixed (50% maintenance and 25% administration) which need to be covered even when the irrigation service is not fully provided.
- The agriculture production has decreased as a consequence of a reduction in water availability.
- There is still a long way to be walked by the WUA in terms of agricultural productivity. A lot could be done for further improving both land and water management efficiencies, but the real incentive for conservation, modernization and rehabilitation investments will only come through the increases in farmers' income.
- The IMT process in Mexico is almost completed; now it is necessary to monitor and evaluate the impact of IMT in the irrigation districts in particular and in the irrigated agriculture sector in general.
- There is a need to strengthen the Support Services that have been generated by IMT: water providers, technical assistance, irrigation cooperatives etc.
- There is no evidence that IMT has had a negative impact on the environment, however the process appears not to have addressed the problems related to salinity which are in fact an environmental problem on their own.

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