The Application of External Performance Indicators to Assess Irrigation Management Transfer Impacts in Three Irrigation Districts in Colombia[1]

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INTRODUCTION

Ever since its establishment in 1984, the International Irrigation Management Institute (IIMI) has had the performance evaluation of irrigation systems as one of its core activities. Over the years, a number of IIMI scientists have proposed several approaches and the institute has extensively reviewed the literature on the subject (see for example Murray-Rust and Snellen 1993; Rao 1993; Molden *et al* 1997; Bos *et al* 1994).

Most recently, the institute's performance program has decided towards the use of so-called external and internal performance indicators in order to assess in-depth, the performance of irrigation systems under various situations and conditions and are geared to assess system performance from somewhat different perspectives or purposes.

In general, internal indicators are system specific and evaluate performance by comparing actual results against pre-established goals or targets. An inherent problem relates to the quality of the process by which the goals or targets are established. Another handicap is that given the specificity of the indicators, system manager could not compare where they stand in relation with systems in the region or country. This, of course, may not be of concern to most managers. A major advantage, however, is that system managers are more likely to use this type of indicators which are based on a situation they are most familiar with.

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[1] Paper presented at the International Workshop on Irrigation Performance held in Mendoza, Argentina, November 3-7, 1997.

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External indicators attempt to estimate the interactions between the system and its surroundings; they were conceived by considering the irrigation system as a black box" where inputs like water, labor and financial resources give origin to outputs like crop produce and financial gains. That is, measuring inputs to the system and outputs from it (Perry 1996). These indicators not only allow comparison among different systems, but also within systems at different levels: main, secondary, on-farm, *et cetera*. Furthermore, external indicators are particularly suitable for tracing performance over time.

A major disadvantage, however, is that external indicators while appealing to policy makers and researchers, are less likely to appeal to system managers who could see little immediate gain in their daily operation.

In connection with external indicators, IIMI has developed what it now considers a minimum set that can be used to undertake cross systems performance evaluation within countries and on a global basis with an end-objective of establishing determinants for successful performance of irrigation system under various settings and conditions. This current minimum set of IIMI indicators (Perry 1996) are now being applied on a regular basis in the institute's performance program worldwide.

Purpose of the Study

This paper presents the results of a study undertaken by IIMI as part of its Andean Regional Project, which sought to assess the impact of the Irrigation Management Transfer (IMT) program in Colombia. The program provided an excellent opportunity to apply external indicators over time on three irrigation districts—RUT, Río Recio and Samacá—which were handed over to newly established water users associations in the early 1990s.

The application of the indicators over an 11 years period (1985-1995) allowed performance comparisons of at least 4 years prior to and after the transfer. The indicators are then analyzed over the entire period to try to relate them to possible impacts due to the IMT program. While the usefulness and applicability of the indicators to assess impacts of the IMT program are evaluated, the paper does not attempt to question the way in which IIMI decided on the indicators themselves; but rather takes them for granted. The authors feel that the selection of a minimum set of indicators is an on-going and iterative process under the institutes' current global program on performance assessment.

Irrigated Agriculture in Colombia

Colombia is located in the northwest corner of South America at a latitude of 5° North. Colombia is a mountainous country with an area of 1.1 million km^2 and a population of 31.8 million people. The country has relatively abundant water resources including more than 1,000 perennial rivers. It has both tropical and temperate climates and an average rainfall of 1500 mm per year. A noted bi-modal distribution in April-May and October-November makes the need for irrigation primarily a supplemental one.

Of 6.6 million hectares of land which has been assessed as having high suitability for irrigated agriculture, only 11.4 percent or 750,473 hectares has already been developed, consisting of 525,869 hectares under irrigation and 224,604 hectares under drainage and/or flood protection facilities. (García in Garcés and Vermillion, 1995).

At present, 155,454 hectares of land are irrigated by the public sector under the supervision of INAT and 370,415 hectares are completely under private sector or farmer management. Thus, it is clear that the private sector has played a major role in the development of irrigated agriculture in the country, representing 70 percent of the present total irrigated area (Garcés and Vermillion 1995).

The Colombian government's current irrigation sub-sector policy has three main components:

- an on-going and ambitious ten-year development program (1991-2000) for which irrigation expansion is the cornerstone. With a total cost of US$1.06 billion it aims to develop half a million hectares; an area that represents twice as much as has been developed so far by the public sector in the country's history;
- an on-going nation-wide program to create "mini-districts," which are new, small scale irrigation systems to be located primarily in hillside areas, and
- an irrigation management transfer of all 23 public irrigation districts to water users associations. It is mainly in connection with this latter policy that IIMI has undertaken research activities in the country, leading to this paper.

Methodology

IIMI's Andean Regional Project started in May 95 when an office was established in Cali, Colombia. An integral component of this project was the documentation and evaluation of the government's Irrigation Management Transfer Program. While this particular work covered 9 irrigation districts, the study reported herein selected a sub-set of three districts—RUT, Río Recio and Samacá.

Criteria for the selection of these districts included, among others:

- Represented different types of water source alternatives: RUT by pumping, Río Recio by run o-the-river, and Samacá, as reservoir assisted;
- Transferred in the early 90's thus allowing evaluation at least for 4 years before and after IMT took place;
- Data quality and quantity availability perceived better and more reliable than other districts;
- Better collaboration and interest on the study by the respective WUAs, and
- Accessible locations and good communication facilities.

In Samacá primary data collection took place from 1995 as part of other project activities. For the maintenance survey primary data was obtained from all three districts. As an integral component of the study, a farmer survey was conducted in each district. The sample was stratified both by geographic location (head, middle, tail) and land tenure. Sample size was at least 5% of total plots, as follows: RUT (n = 91), Samacá (n=80), Río Recio (n=58). The survey was intended to assess farmers perceptions before and after transfer on various system matters like: water adequacy, timeliness and equity; maintenance; general administration and quality of operations. The survey was utilized as further cross-check on perceived data quality and reliability.

The study draws secondary data from several sources: the WUAs, the irrigation agency (INAT) at both central and regional levels, IDEAM- the Ministry of the Environment agency, and other local and regional agriculture-related organizations.

Data needed was well known beforehand as those required to assess IIMI's minimum set of performance indicators. Furthermore, other indicators perceived as necessary to support IMT impact assessment provided guidelines as to additional data needs.

Information was gathered on a monthly basis and aggregated by cropping seasons or yearly, as required. These data included, among others, irrigation volumes diverted and delivered at system level, areas, cropping patterns, crop yields, prices, and production costs, general budgets planned and realized, service fees related, climatic data from specific meteorological stations and system's irrigation and drainage network conditions.

Information was thoroughly cleaned and checked for outliers; missing or erratic data were cross-checked from different sources and regular statistical tools were utilized to fill in gaps when appropriate.

Indicators were obtained following the standard methodology used by IIMI and described in detail in various papers (see for example Molden, 1997; Fraiture and Garcés 1997 and Kloezen and Garcés forthcoming). In accordance with this procedure local units and currency were converted to standardized units and constant 1995 US dollars. As equivalent crops potatoes was used in Samacá, rice in Río Recio and sorghum in RUT representing the major crop planted over the entire period of analysis.

Case Studies - Three Irrigation Districts

It is against this backdrop that IIMI decided to assess the IMT program and its impact in Colombia. For reasons already stated, three particular irrigation districts were selected. Their location can be seen in Figure 1. Following is a brief description on each district studied to complement their basic characteristics, as shown in Table 1. Climatic information is given in Annex 1.

Figure 1 Location of Study Sites in Colombia

Table 1 Basic characteristics of sample districts.

Item	RUT	Río Recio	Samacá
State	Valle	Tolima	Boyacá
Position in watershed	Lower	Middle	Middle and Lower
Design area (ha)	13,000	23,600	3,000
Irrigated area (ha)	9,700	10,200	2,893
Water source	river lift	river diver	reservoir
Intake structure	pump	gated weir	vertical gates
Design Q (m^3/s)	14	11	1
Main canal length (km)	87.7	38.7	29.7
Total canal length (km)	170.7	135.8	58
Ha per km of canal	57	74	51
Turnout type	pump	sliding gate	pumps and gates
Control structures (#)	16	234	69
Lowest level water measured	along main canal	farm inlets	main intake
Water delivery efficiency %*	54	74	86
Main soil type	clay, loam	clay, loam	clay, loam
Main crops	cotton, grapes, fruit trees	rice, sorghum, cotton	onion, potato, peas
Year of construction	1958-70	1949-51	1945
Transferred	1990	1990	1992
WUA	Asorut	Asorecio	Asusa
Average annual rainfall (mm)	1,100	1,300	690

* Water delivery efficiency is ratio between volume delivered versus diverted

Source: Alvarez and Garcés 1996

RUT (Roldanillo - La Unión - Toro) Irrigation District

The district is located within the 3 municipalities that give origin to its name, about 170 km north of Cali city. Located in the northern section of the Cauca Valley at approximately 4° latitude North and 76° longitude West. The district lies between the Western Mountain range and the Cauca River, which gives its name to the Valley, and covers a gross area of 13,000 hectares.

The area constitutes the limit between the tropical and sub-tropical climatic division, with an average temperature of 24°C, fluctuating between 17° and 34°C. Precipitation is bimodal with two dry and wet periods. The first rainy season occurs in March, April and May with the second one in September, October and November. The total yearly average rainfall is about 1,100 mm. Average relative humidity is 72 percent, with average yearly evaporation at 2,080 mm. Average wind velocity is 1.30 m/s and its receives 1,936 of sunshine hours per year.

Before construction of the district the area was regularly subject to flooding from both the Cauca River and the streams descending from the Western Mountain range.

Feasibility studies for land reclamation and development of what is now the district were started in 1958. The studies were carried out by CVC, a regional corporation established to manage the Cauca Valley. In 1962, with only 40 percent of construction achieved, lack of funds stopped the work. A flood control and development project started in 1964 under the new land reform institute INCORA and continued until 1970. Construction was concluded in 1976. INCORA handed over the district to HIMAT, a newly created government land development agency. Finally, in 1990 HIMAT (now INAT) transferred the district to the water users association, ASORUT.

There are two cropping sub-seasons per year in the district. The first sub-season starts in February or March, while the second starts in August or September. Two types of crops are grown: seasonal, and semi-perennial or perennial crops. The main seasonal crops are cotton and sorghum rotated with maize and soybean. In addition, a variety of horticultural crops are grown, with tomato as the main one. The main perennial crops are table and wine grapes, fruit trees, passion fruit and pastures.

RUT irrigation district is essentially a flood protection-cum-irrigation and drainage project. The long and narrow bowl-shaped area is enclosed by a protection dike from the Cauca River, running throughout its east side and a flood interceptor canal on the west side. A main drain divides the area almost in half running through the lowest elevation.

The main irrigation canal runs parallel to the dike and is served by 3 pumping stations with a total discharge capacity of $Q = 13.8\ m^3/s$. The interceptor drain serves as an irrigation canal with users utilizing small centrifugal pumps to serve individual needs. The main pumping station (Tierrablanca), located on the Cauca River, has 4 pumps of $Q = 1.7\ m^3/s$ each. These are essentially for irrigation. The two other stations, Cayetana and Candelaria, with $Q = 3.5\ m^3/s$ each, serve a double purpose: irrigation and drainage. The district also has two more small drainage stations strategically located in low-lying areas.

There is a complementary network of both irrigation and drainage canals throughout out the area. The main drain discharges freely into the Cauca River during its low stages and its pumped at the river's high stages. A flap gate allows this operation. In addition to the irrigation and drainage network, RUT has an excellent network of service roads along the canals.

Operation: Users submit in advance to the association information on the areas and the types of crops they want to grow. The administration of the association has established sowing periods for each crop. The administration also establishes an irrigation plan with this information and advises each user when his first pre-planting irrigation date will take place. The user in turn must pay in advance the fixed water fee and keep his own irrigation network in good condition. After the first irrigation, users can request subsequent ones directly to the ditch tender instead of to the central office. This procedure fails often owing to financial constraints to purchasing of seeds as well as for land preparation on the part of users.

The district operates on a pure demand basis, with individual users requesting water when needed. Plans are continuously being modified to adjust to rainfall conditions. Because the district operates on double pumping (from river to canals and from canals to field by individual users) energy costs constitute a major component of total expenditures. Losses in canals are relatively high and the fact that pumping goes on year round—either irrigation or drainage—the financial condition of the district is always in peril. Total operating expenses are now in the order of 55 percent to 60 percent of the total, where the cost of pumping is the lion's share.

Individual users are monitored by ditch tenders who, based on pump characteristics and number of hours of pumping, establish a volumetric water charge which must be paid after the end of the season but before the start of the next cropping season.

Maintenance: The district administration establishes a maintenance plan before the start of each cropping season. It specifies the canals, structures, type of activity, type of equipment to be used, as well as individual and total budgets.

A major activity under maintenance relates to desiltation of the interceptor drain and the main drains as well as the irrigation network. Removal of sediments is in the order of 400,000 m^3 per year. Also conservation of dikes and roads constitutes a major activity.

Maintenance activities in any one season are prioritized based on district administration evaluation of needs and their effect on operations. Funds availability, however, plays a major role. Priorities are re-assessed every season. Maintenance expenses represent about 30 percent of the total O&M expenses.

Monitoring of district performance is not institutionalized. Other than areas irrigated, no other targets are evident, although district management is permanently concerned on volumes pumped given the financial implications. Monitoring concentrates mainly on expenditures vis-à-vis budget and fee collections.

Río Recio Irrigation District

The Río Recio district is located within the Lérida and Ambalema municipalities in Tolima state in Central Colombia. It is on the west margin of the Magdalena river with the Recio river at its south border, the Lagunilla river on the north and the central mountain range constituting its western border.

The precipitation pattern is bimodal, with two rainy periods: from April to June and from September to November. The average yearly precipitation is 1,300 mm. Relative humidity is 72 percent with an average temperature of 28 degrees C. Yearly sunshine is 2,209 hours. Annual evaporation is 1,300 mm.

The Río Recio project was initiated in 1947 by the Ministry of Economics, with the double purpose of generating electricity and providing irrigation to the area. The project, which consisted of a weir, a main conveyance canal, the energy station and the canal network for the Lérida region, was built between 1949 and 1951; with the first irrigation taking place in late 1951. In the late 1950's, Caja Agraria took over responsibility for management of the district and began expanding the service area towards the Ambalema region. This work was completed in 1961. In 1967, the district was handed over to INCORA, the newly created government irrigation agency, which administered the district until 1976, when a new government irrigation agency, HIMAT, was established. In January 1990, HIMAT transferred the management responsibility of the district to ASORECIO, the newly created water users association.

Crops in the Río Recio are planted year round, with rice being the main crop, followed by pasture, cotton and sorghum. Soybean are also grown, but on a much smaller scale.

Waters from the Río Recio are captured high up the mountains. The intake is a diversion weir 32 meters long and 7 meters in height. The lateral canal has a discharge capacity of 10.5 m^3/s and a length of 6 km. The energy station is located 5 km from the intake. It has two turbines, which consume an average of 3.1 m^3/s with a drop of 100 meters. The average discharge available for the irrigation district is 7.4 m^3/s.

The irrigation network consists of two main canals, one for each zone (Lérida and Amabalema) and a secondary and tertiary network totaling 136 km in length. A total of 30 km are lined, mostly along the main canals.

The irrigation district and the energy generation plant are administratively independent of each other with separate budgets and personnel. There are 32 km of natural drains in the form of small streams. In the Ambalema region there are numerous ponds and small lagoons which are interconnected with drains, culminating in the La Joya stream and Lagunilla river.

There is also a road network which totals about 208 km; only a small part of which is paved. The unpaved roads run parallel to the irrigation canals and are generally in fairly good condition.

Operation: During periods of abundant water supply, the district operates on demand. Farmers submit their water request to the district administration at least three days in advance. To be eligible to submit a request, they should have no outstanding debt for water fees. When water becomes scarce, water distribution shifts to a rotation mode, with increasingly short turns with increasing water shortage.

Before the start of the irrigation season farmers submit information about their intended cropping pattern to district management. The information is used to develop the seasonal irrigation plan.

Ditch-tenders are responsible for distributing the water down to farm outlets and hand over water control to users at this point. Water is measured here although not regularly. Area and time are often used as proxies.

Maintenance: A yearly plan that lists activities by priority is prepared. While maintenance needs are utilized to establish the budget requirement, the process is driven more by water fee increases based on inflation than by actual maintenance requirements. Main activities under maintenance include upkeep of the intake structure, desiltation of the main canal, structural repairs and maintenance of equipment over the years. Maintenance expenses represent about 50 percent of total O & M expenses.

Farmers are responsible for field canal level maintenance and are often inspected by ditch-tenders before releasing water.

As in the case of RUT, the system's management does not have a regular evaluation and monitoring program. Areas to be irrigated and volumes to be diverted usually have targets but management concentrates mostly on financial accomplishments: budgets, expenditures and fee collection.

Samacá Irrigation District

The district is located in the eastern part of Boyacá State in central Colombia. Elevations in the command area varies from 2,600 to 3,000 meters above sea level. The command area covers approximately 3,000 hectares, of which 54 percent consists of flat land while 46 percent is hilly area. The district has deep, loamy soils with no salinity problems. Because of the relative proximity to Bogotá, both marketing and transport conditions are excellent.

The mean daily temperature in Samacá district is 13.8°C and it varies only a little over the year. The rainfall pattern is extremely irregular within and between years. Mean annual rainfall is 690 mm, with two pronounced wet periods in October-November and April-May. Occasional hail storms occur in the dryer periods, sometimes damaging crops. Annual potential evapotranspiration is 1,020 mm and varies little through the year. November is the only month in which the mean effective rainfall exceeds evapotranspiration. Irrigation is generally required during other months to meet crop water requirements, although this varies widely in accordance with highly variable rainfall.

Relative humidity is about 78 percent. Evapotranspiration is 1,070 mm per year with sunshine at 5.8 hours per day.

Samacá irrigation district is served by two reservoirs. The oldest and largest was built in 1880 by a textile company to generate its own electricity. In the late 1930s, the reservoir was rehabilitated to provide irrigation by means of two hillside contour canals, finished in 1941.

The district was initially managed by the Water Department and later by the Water and Electricity Institute. In 1996, the Colombian Institute for Agricultural Reform (INCORA) took over responsibility for the district and made technical improvements in the canal and drainage network. Ten years later, the Colombian Institute for Hydrology and Land Improvement (HIMAT) was created and became responsible for the operation, maintenance and overall administration of the district. Under HIMAT the second reservoir was built and numerous improvements were made in the infrastructure, all of which was financed by the government. In 1992, responsibilities for management of the district were transferred to the newly-created water users association, ASUSA.

At present about 2,000 farmers are served by the district. The average landholding is 3.5 hectares in the valley floor and 0.9 hectares in the hilly area. The main crops grown in the district are potato, onion and green peas. About 30 percent of the total command area is currently used for irrigated pasture, mainly on the hill sides. Vegetables, such as beats, cabbage and carrots, wheat, maize, beans and barely are also grown. In the valley agriculture is predominantly commercial, while on the hillsides subsistence farming is common.

Samacá obtains its water from two reservoirs located above 3,000 meters above sea level in Colombia's Central range mountains. Their capacities are 4.7 MCM and 1.5 MCM, respectively and they are built in line of each other. The maximum discharge capacity is controlled by a valve-gate in the lower and smaller reservoir and is 0.90 m^3/s, giving origin to a small river that carries the water down to the valley portion of the district. In this section, the rivers serves a dual purpose of irrigation and drainage.

In the hillside, water is conducted through two lined contour canals of 250 l/s and 400 l/s, respectively. These canals feed 21 tanks, varying in capacity from 12 m^3 to 36 m^3 and known as Irrigation Units. These tanks feed a buried pipe system with risers and valves in individual fields where sprinklers are connected.

In the valley, water is distributed through large drains from which water is pumped either directly into farmers fields or into reservoirs or ponds. From these, sprinklers systems are operated. Through the years, farmers have built more than 600 of these reservoirs throughout the district –in both hill and flat areas. These ponds vary in capacity between 30 m^3 and 4,000 m^3 and constitute an important management tool on the part of the water users. They are of particular importance in the valley, where the ponds are larger and hence provide greater management flexibility.

Operation: The district is divided into 4 zones headed by an irrigation agronomist or technician responsible for water distribution. They report to a Chief of Operations, but are essentially independent in setting their work plans. Given the peculiar geographic configuration of the district, three modes of water distribution are found:

1. in the valley, it is essentially by demand. Users request water to fill their reservoir and then use their sprinkler systems at their convenience;
2. in the hillside, with Irrigation Units. Water is delivered continuously to the tanks, as long as the main reservoir gate is open. Users open or close their risers when needed;
3. in the hillside, without Irrigation Units. Due to design problems some of the tanks are not functional. Water is distributed by rotation based on two or three days advance requests.

Maintenance: Priority and budgets follow the same pattern as in the two districts already discussed. The four zones mentioned under operation above also hold. However, the irrigation technicians are not responsible for maintenance activities, although they report needs to the central office who takes action with district staff or by contract. Every sub-season, each zone submits maintenance priority list and lobbies to the general manager who based on budget availability ranks the work to be executed. The priority list starts from scratch every season.

Performance monitoring and evaluation in Samacá is even less structured than in the previous two cases. Areas and crops are occasional targets. Water diverted or delivered are not, while measuring devices exist they are seldom utilized.

IRRIGATION MANAGEMENT TRANSFER IN COLOMBIA

Background

In 1975, farmers in the Coello and Saldaña irrigation districts in the Tolima Valley petitioned the government for the right to take over management of the districts. They based their argument on the fact that, over the previous 20 years, they had already repaid their agreed 90 percent share of the cost of construction. They were also paying water fees to the government and were dissatisfied with the cost and quality of management that the government was providing. They argued that they could manage the districts more cost-effectively than the government. In 1976, the government agreed to the farmers' demands, expecting that turnover would save money for the government (Vermillion and Garcés 1996).

Soon thereafter, the severe economic problems of "the lost decade" beset Colombia and the government decided to postpone management transfer for other irrigation districts in the country. By the end of the 1980s, however, the government renewed its interest in transferring management of the 21 remaining districts managed by HIMAT, the national irrigation agency (today known as INAT). Since 1990, twelve additional irrigation districts have been transferred to farmer management. Whereas farmers initiated management transfer in the first two districts, the government is promoting transfer of all remaining districts as a national policy. It is expected that the remaining agency-managed districts will all be transferred to farmer management before the turn of the century.

The transfer process employed a legal rule in the country's constitution, referred to as the "delegation of administration", by which a public good (in this case an irrigation district) could be turned over to a private corporate entity (a water users association) for administration on behalf of the state. The delegation of administration created continuing labor related conflicts between the districts and the government, which resulted in numerous legal debates and proceedings until the 1990s (Vermillion and Garcés 1996).

Recognizing the problems inherent in the partial "delegation of administration", and needing to induce greater farmer investment in future transfer efforts, the government passed the Land Development Law No. 41 in 1993 and its associated enabling Decrees 1278 and 2135. Together, the new law and decrees determined that transfer would thereafter place full control over irrigation district finances, O&M procedures and personnel in the hands of the water users association. The new agreements were referred to as "concessional contracts" rather than agreements for "delegation of administration". This, indeed, was a major concession. However, even under the new law the WUAs were only given use rights, not ownership over the irrigation infrastructure.

IMT in Sample Districts

Before applying the external performance indicators in order to evaluate the impact of IMT in the districts, it is felt pertinent to describe briefly where the sample districts stand with respect to the transfer process. What led to the transfer; what kind of negotiations took place and what where the conditions under which IMT occurred? Table 2 summarizes these related issues in the 3 sample districts.

Table 2 Conditions, arrangements and changes due to the IMT process

Conditions and changes	RUT	Rio Recio	Samacá
• Year of transfer	1990	1990	1992
• Type of transfer	Full district	Full district	Full district
• Mode of transfer	By delegation	By delegation	By delegation
• WUA pre-established as legal entity	Yes	Yes	Yes
• WUA has authority to make O&M plans and budgets	Initially shared with agency	Initially shared with agency	Initially shared with agency
• WUA board constituted by major and minor members	Exists but not enforced	No	Yes
• WUA can make profit	Under study	Under study	Under study
• Water rights are clearly defined	In process	In process	In process
• Government subsidies exist	Only recently	No	Indirectly
• Maximum sanction applied since IMT	Fines	Stop services	Take user to court
• Rehabilitation prior to IMT	Pumps only	Major	No
• Responsibility for future rehabilitation	Not defined	Not defined	Not defined
• Changes in water fees structure after IMT	No	No	Volumetric discarded
• Reorganization of personnel structure since transfer	Yes	Yes	Yes
• Districts have diversified reserves since IMT	Yes	No	Minor changes

RUT Irrigation District

The district was the first one to be transferred after the freeze of the IMT program during the 1980s. Although the program was being promoted by the government, RUT's water users where familiar with the transfer success that had taken place in Coello and Saldaña district in 1976 (Vermillion and Garcés 1996). Thus, IMT negotiations occurred under a favorable climate on both sides of the fence.

During the RUT transfer process, farmers agreed to take over management and to forgo government subsidies, which at the time could be of the order of 60 to 80 percent.

The major portion of the subsidy was associated with the relatively high cost of pumping, as already mentioned in an earlier section.

Four years before the transfer the main pumping stations underwent a full overhaul, during the negotiations users were convinced by government negotiators that the district had been 'rehabilitated' and there was no need to have this item included in the IMT agenda. In retrospect, it would appear that farmers grossly miscalculated the future cost of energy and allowed themselves to be deprived of the subsides in one single step during negotiations.

Another element of the transfer negotiation dealt with the future of the agency's staff. Farmers agreed to keep most of them although a reduction of about 15 to 20 percent did take place. Only 10 of the initial 13 staff remained. Finally the negotiations dealt with personnel training prior or immediately after the transfer. However, since most of the district personnel could continue their jobs, the training issue did not carry much weight and very little training, if any, was provided during the transfer process.

Parallel to the above events, the transfer of the districts coincided with a government policy of general privatization of the country which included among others the elimination of all agricultural subsidies.

Over the years, WUAs throughout the country claimed that this "opening" of the economy, coupled with the subsidies policy, has resulted in a sharp reduction on crops profitability. In general, the agricultural sector in Colombia is in disarray and users claim they can no longer be self-sufficient in management of the districts. High operation costs have resulted in higher water fees and low or no profitability.

The fact that the government has backed away from its zero subsidies policy on IMT has also created discomfort at RUT. Some of the nearly transferred districts (in 1995 and 1996) have managed to keep their current subsidy levels which in some districts can be as high as 80 percent. Under the new IMT agreements, these subsidies will be reduced over 5 years period. As can be expected, RUT WUA has requested the restoration of subsidies for them. While the government has not complied directly with this request it has allocated some funds (in the order of US$800,000 over a period of 2 to 3 years) to ease the district's burden on energy costs. During 1996, an amount of roughly US$200,000 was actually disbursed by the government to RUT which was used to off-set energy bills.

Outstanding bills are increasing. From $60,000 at time of transfer it has risen to $608,000 as of December 1996 while a significant component of the increase is due to the high interest rates in Colombia (45 percent in 1995, but lower in 1996 and 1997). Many users who are paying their debts on time keep falling behind because of the unpaid interest fees of years past. This difficult financial situation faced by the district is the one driving the users to request the government to re-assume the management of RUT.

It would be unfair to district management not to say that they have been trying hard to cut down costs. Old energy subsidies have also been eliminated and irrigation districts no longer get special rates. There are, however, some differential energy rates depending on the time of the day. This low-rates seldom coincide with the pumping needs of the district. This is a further element that introduces complexity into the district's water management. It appears that the RUT irrigation district is currently undergoing a painful post-transfer adjustment process

Río Recio Irrigation District

The district was always perceived by both the government and water users as a financially viable system. In December 1989 an agreement on "administration by delegation" between HIMAT and the water users association ASORECIO was reached. Official transfer took place in January 1990. This process was facilitated by the earlier experience of management transfer in the Coello and Saldaña districts and the influence of the newly-created Federriego, the national Federation of water users associations.

Initially, the water users generally felt that they could manage the district at a lower cost than could HIMAT. They felt that some funds from the water charge were being used to subsidize HIMAT employees at both the state and central levels. Among the more significant issues negotiated in the process of reaching an agreement were the following:

- Disposition of existing government staff. Water users managed to have the government agree to releasing some staff, which the users felt were not needed. Río Recio was one of the districts that managed to make substantial cuts in staff;
- The amount of training provided by the government. Very little training of staff was done either prior to or after transfer. Since some of the O&M staff continued with the district, the WUA saw this as a small issue. Limited training other than informal training on the job was provided for new staff;
- Rehabilitation. Prior to transfer, Río Recio was already part of a government effort to rehabilitate a number of irrigation districts. In the period 1982 to 1989, a total of US$3.6 million (about $ 353 per hectare irrigated) was invested in Río Recio's rehabilitation. This included civil works, farm and field equipment, some technical assistance via training and extension. Farmers who had obtained these funds under the old system—mainly fully subsidized by the government—managed to side step the issue of repayment, both for original construction costs and rehabilitation;
- O&M procedures. O&M procedures did not change much after transfer because they had been developed over time by the respective managing agencies, with farmer concurrence prior to transfer. HIMAT continued to play a role of advice and consent to the WUA regarding irrigation plans, budgets and water fees for several years after transfer. Water distribution, rules and sanctions continued to be the same as had been established under the government;
- Ownership of irrigation infrastructure. Some farmers suggested that the WUA should have a right to take over ownership of district assets, but this was not allowed by the government and there was no consensus about this among farmers.

In short, the IMT process at Río Recio has evolved in a much smoother way than in RUT. The fact that Río Recio is a run-of-the-river system is an advantage to water users who did not have extra costs related to O&M as a result of taking over management.

Samacá Irrigation District

The transfer of management from HIMAT to the water users association of Samaca in October 1992 was done as part of a national program, which had as its aims reduction of government subsidies and expenditures in the irrigation sector through turning over management and full responsibility for financing recurring costs of irrigation of the beneficiaries. Samacá was the fifth district in the country that was transferred to the water users.

In 1991, the government raised the fixed area water fees 170 percent after the volumetric fee was removed in order to achieve financial self-sufficiency for the district and remove the need for government expenditure on the district. In the same year negotiations began between the government and the water users association over terms and conditions for management transfer. While some farmers were interested in taking over management with the expectation that they could better contain costs and ensure a more responsive management than could the government, the great majority were fearful of the IMT process and considered it a risk taking over management responsibilities. As a result, negotiations were not friendly. These negotiations took one year. The transfer agreement was signed in October 1992 and the water users association ASUSA took over management responsibilities in January 1993. Among the more significant issues negotiated in the process of IMT were:

- Disposition of equipment. This was a major issue since the WUA board could not agree whether it was prudent or convenient to receive maintenance equipment which they would have to upkeep. At the time it was difficult to obtain spare parts or repair services (Garces and Rymshaw 1997).
- Continuation of government staff. The association agreed, under some pressure from the agency, to keep most of the staff and assume their salaries and benefits;
- Training. This issue was hardly discussed since the continuation of the staff already in place made it seem as unnecessary;
- Outstanding debts. It was agreed that ASUSA would collect post debts to be used for district improvements to be identify later.

Unlike in Río Recio, it seems that the IMT process in Samacá did not go smoothly and the users were, in general, not entirely pleased with having to take over management of their own district.

EXTERNAL PERFORMANCE INDICATORS

Rationale

To pursue IIMI's broad objective of increasing and sustaining the productivity of the water resource —in order to secure the food requirements for the poor and disadvantaged people of the world— there is an urgent need to understand better the dynamics of irrigated agriculture. Irrigation districts constitute the main agent through which food security can be achieved.

While recognizing that it is important to know how individual irrigation districts are performing, at any point in time, from IIMI's research point of view it is even more important to be able to identify on a country, regional or global level what are the determinants for success or failure of the districts. In this sense, IIMI is more interested in comparing across districts or within a district over time in order to identify strength and weaknesses that can lead to broad improvements, and not just the problem or solution of an individual case. Thus, the use of external rather than internal performance indicators seems to be rational and justified.

Through time, and as a result of many studies under multiple environments and conditions, IIMI's scientists and their collaborators have identified a minimum set of external performance indicators which the institute now believes can be applied under a wide range of irrigation settings in order to evaluate their performance.

This set of core external indicators are described briefly in the following paragraphs and the reader is referred to the other publications in the references of this paper for an in-depth description and discussion on their rationale and use. In order to meet particular circumstances of the districts or their environments, four additional external indicators are included. These help to reinforce or clarify results derived from the application of the minimum set.

IIMI's Minimum Set of Indicators

Relative Water Supply (RWS). This indicator is defined as the ratio of total water supply (total rainfall plus irrigation) and the total water demand (crop water requirement, non-beneficial ET, losses to drains and net flow to groundwater). It is non-dimensional. It can be obtained at various system levels (main, secondary or on-farm) and applied for any particular periods (daily, weekly , per season or per year).

Relative Irrigation Supply (RIS). This is also a non-dimensional indicator. It makes a correction over the previous one by taking into consideration the effective rainfall. It is defined as the ratio of the irrigation supply and the irrigation demand (crop water requirement minus effective rainfall). For the effective rainfall, both the USBR and the AGWL/FAO methods were utilized to look for the best fit. For calculation of the crop water requirement the FAO CROPWAT software was used.

Water Delivery Capacity (WDC). This third non-dimensional indicator can also be applied at different systems levels, and is defined as a ratio of a canal capacity and the peak consumptive demand that needs to be carried in a particular period. Thus, it is a measure of whether the canal infrastructure can provide the irrigation service required by the districts, and how much it is being utilized.

Standardized Gross Value of Output/Unit of Cropped Land ($/ha). The GVO is standardized for all districts utilizing an equivalent yield which is normally taken as the major traded crop over the period evaluated. The equivalent yield is multiplied by the world market price for the base crop. All values are taken to a constant year; in this study 1995. The cultivated area in this study is equivalent to the irrigated area.

Standardize Gross Value of Output/Unit of Irrigation Applied ($/m^3). This indicator follows the same rationale discussed above but related to irrigation water applied rather than to area. It is intended as a measure of the productivity of the water resource.

Financial Self-sufficiency (FSS). Defined as total water charges collected (fixed, volumetric, interest and outstanding debts) divided by the O&M expenditures (operation, maintenance and administration). It is a measure of what percentage of expenses can be covered by district revenues due to water service fee collection; that is the adequacy of fees.

Gross Return on Investment (GRI). It is a financial indicator that relates the GVO per hectare and the capital investment per hectare. The cost of the investment is normally viewed as how much it would take to build a similar irrigation district at a base year price. In the study these belong to 1995 prices and were obtained from current irrigation agency construction costs per hectare (given in percentages).
Two other IIMI indicators were dropped because of incomplete or unreliable information: GVO/unit of water consumed ($/m^3) and GVO/unit of command area ($/ha). On the other hand four non-IIMI indicators were added to reinforce the performance evaluation of the districts studied. These are briefly described in the following section.

Non-IIMI External Performance Indicators

Irrigation Intensity (II). Defined as the ratio of the irrigated area and the command area. It is a yearly value given in percentage. In theory, since there are two cropping seasons in the districts the maximum value that can be obtained is 200 percent, indicating that the entire area was cropped and irrigated during each season. In reality, more than two crops per year is common in many countries, including Colombia.

Fee Collection Rate (FCR). That portion of planned water service charges that is actually collected during a particular year. If interest on the debt and outstanding collection are included in the target collection then the corresponding values actually collected are included. Otherwise they are excluded from both sides of the ratio (given in percentage).

O&M Costs per hectare of Irrigated Area ($/ha). All costs are taken to a base year (1995) and corrected for inflation. It includes all costs incurred by operation, maintenance and administration.

O&M Costs per unit of Irrigation Supplied ($/m³). A financial indicator that relates to the use of water. This indicator and its counterpart above can show financial management trends over time.

Two other interventions executed within the districts as part of the evaluation, helped to provide an insight on district management. These were done by way of a farmer survey and a direct inspection of the physical conditions of the districts. The methodology on the survey has already been explained. The maintenance inspection of the irrigation and drainage network (the structures included) was done on selected reaches chosen at random (see Vermillion 1995).

APPLICATION OF INDICATORS TO ASSESS IMT IMPACT

The on-going irrigation management transfer program in Colombia, coupled with the selection and definition of a minimum set of external performance indicators to evaluate the performance of irrigation districts, provided an unique opportunity to IIMI. It was now possible to apply the indicators over a 10 to 12 years period on three irrigation districts that had some very distinct characteristics.

Water-based Indicators

RWS. In figure 2 values of the the indicator are shown for all three districts, organized around their respective transfer year. The RUT district presents steady RWS values overtime, with a small declining trend since transfer took place. For a pump system, values above 2 in eight out of ten years evaluated suggests that the district has been operated under conditions of moderate abundance of water supply.

Río Recio shows values on a steady increase over the period studied with no particular changes that could be attributed to the transfer. It presents the highest values of the set—all above 2--which also suggests relatively abundant water supplies. The values can be explained both because of the inundated rice (with farmers perception that it requires large amount of water) and its water source (run-of-the-river) which offers relatively less control.

The values for Samacá points towards a district that operates with less water but with some fluctuations over the period evaluated. It does show a steady, albeit small, increase in RWS in the district as a result of transfer. If anything, the graph seems to suggest that there have been no changes as a result of transfer in the supply-demand relationship for irrigation in three districts.

RIS. This indicator provides a better insight into how the irrigation water is managed by considering only the effective rainfall. In Figure 3, RUT shows an steady decline in RIS values, a trend that seems to have accelerated after transfer took place. Since RUT is a pump system the trend shows that management has made a genuine effort to cut down unnecessary pumping and hence operating costs.

On the other hand, Rio Recio presents an opposite trend, with steady RIS increases after turnover. This trend was seen earlier under the RWS values. The RIS values are high and suggests very little water control in a run-of-the-river system that grows paddy rice.

For its part, Samacá shows fluctuations in the RIS values but perhaps with an overall downward trend. But again, it shows less water available than for the other districts.

It is difficult to derive any firm conclusion from the indicator vis-à-vis IMT, although RUT and Samacá show both an improvement. This can be explained by having better water control over pumping or on reservoir operation, respectively.

WDC. This indicator is useful because it not only provides information on the appropriateness of the design or actual physical conditions of the irrigation network, but also, about the degree of utilization of the physical infrastructure. Figure 4 provides WDC values for two districts as it was not possible to obtain the information required for Río Recio. The figure shows that for both RUT and Samacá there has been a considerable increase in the degree of utilization of the infrastructure (in both cases values correspond to the main canal). In both cases, however, the decline in values (which suggest improvement) seems to have occurred prior to the transfer. Less fluctuations in WDC values have occurred in the post-IMT period.

In the case of Samacá, improvements have been traced to occur as a result of the introduction of onions in 1989, as will be presented in this seminar in the Samacá paper (fraiture and Garces 1997). For RUT it can be argued that is due to the more rational pumping plan introduced by the WUA after taking over management

Farmer Perception. In Figure 5a and 5b the results of the farmer survey on their perception around water-related parameters, are summarized. In the Figure 5a, the questions on adequacy of water supply and timeliness of water delivery were made in the context of the IMT impact. It is clear from the graph that the great majority of the farmers in all three districts are satisfied with the service but do not think there has been any change as a result of the transfer. They indicated that both water supply and timeliness of water delivery were satisfactory before and after. In Figure 5b, where the perception from farmers on the operation of the district was stratified geographically (head, middle, tail), again a high percentage of farmers are pleased with the operation before and after turnover.

The graph also shows that some degree of dissatisfaction is present, particularly in Samacá and Río Recio.

The complacency with the service before and after, as shown in Figures 5a and 5b is associated to the relatively high water supply available in these districts over the 1985-1995 period .

Agricultural-based Indicators

Irrigation Intensity. This indicator provides interesting results, as shown in Figure 6. RUT and Samacá show a rising trend which flattens after transfer. On the other hand, Río Recio presents an steady decline over the evaluation period which coupled with the water supply increases shown earlier gives rise to quality of management concerns.

In the case of Samacá, the indicator values are probably underestimated as there is plenty of evidence that farmers often grow more than two crops per year; but these extra crops are not accounted for in the district records. As mentioned, the rapid increase was traced to the change in cropping pattern, mostly to onion.

Río Recio is also presenting a crop shift from rice to cotton and pastures, but without adjustments in water management or volumes diverted to reflect changing conditions. In RUT, the increases can be explained by the rapid expansion of sugar cane, a semi-perennial crop.

GVO/unit land. This indicator is shown in Figure 7 for all three districts. The flat values obtained throughout the study period for both RUT and Río Recio are noticeable smaller than the much higher and flucutating type found in Samacá. The high value crops grown coupled with the excellent marketing and transport conditions in Samacá contribute to the high values. The trend, however, gives no room to indicate that IMT has played a role. This is certainly true for RUT and Río Recio, which show no variation over time. The values are consistent with those reported for other Colombian district during the period (Vermillion and Garcés 1996), or in Mexico (Kloezen, Garcés and Johnson forthcoming). The values for Samacá are much higher.

GVO/unit water. The productivity for water for the three districts is presented in Figure 8. Results are consistent with previous indicators; higher for Samacá and smaller for the other two. RUT and Samacá show improvement after the transfer although in both cases the upward trend seems to have started a year before turnover. The values shown are considerably higher than those reported for districts in Colombia and Mexico (Vermillion and Garcés 1996; Kloezen and Garcés forthcoming) but in line with values reported worldwide (Molden *et al* forthcoming). These results reflect efforts on the part of districts management to control water deliveries.

On the other hand, Río Recio shows a flat response throughout the period, consistent with a similar trend of previous indicators that suggest high water deliveries, diminishing irrigation intensities and changing cropping patterns. The values however, although low, fall within those reported for other districts mentioned.

Financial-based Indicators

FSS. The application of this indicator can be seen in Figure 9. In all three districts there is a observable improvement after turnover took place. Here, IMT seems to have had a real impact. The figure shows that fee collections are fully covering the districts O&M expenditures. This is consistent with the IMT hypothesis that once farmers take over they are more responsible in managing their own affairs then the government agency, and hence more willing to pay their fees. Also, in all three districts farmers have to pay their previous water fees before getting the next service. In order to support what is being said above, it was decided to add another related indicator that could shed some light on the status of fee collection in the three districts. This is given below.

FCR. Information on the fee collection rate is included in Figure 9. Unfortunately, data for Río Recio were not only incomplete but were inconsistent and hence were dropped. The results shown for RUT and Samacá are surprising. In both cases, fee collection rates showed a steady decline, somewhat more pronounced in the former. The fact that adequacy percentages are higher than those of the collection rates suggests that O&M expenditure levels are below what they should be. In other words, maintenance is deferred to keep expenditures down. Only this way can declining fee collection rates continue to cover adequately all expenditures.

This peculiar situation also reinforces the comment made earlier about the quality of the process by which the targets are established. Even though the values of financial self-sufficiency suggest a very healthy district, in reality the indicator masks a deteriorating maintenance condition. Below an attempt is made to addressed this in more detail .

Table 3 presents both water charges (including fixed and volumetric where appropriate) and the cost of irrigation before (1989) and after (1995) transfer (in constant 1995 US dollars). The ratio of cost of irrigation as a percentage of the GVO is provided in the last column. The table shows significant increases in RUT in both fees and total costs and for Samacá with respect to the fixed water charges. This case is well explained by the fact that Samacá dropped its volumetric water fee and merged it with the fixed fee.

Table 3 Water charges and costs of irrigation before and after transfer

	Fixed Charges (US$/ha)		Volumetric Charges (US$/1000m³)		Total Charges (US$/ha)		Cost of Irrigation (US$/ha)		Gross Value of Output (US$/ha)		COI/GVO %	
District	1989	1995	1989	1995	1989	1995	1989	1995	1989	1995	1989	1995
RUT	41	66	7	9	67	108	95	106	4,541	3,016	2.09	3.51
Río Recio	13	13	1	1	66	25	40	52	2,230	2,112	1.75	2.16
Samacá	15	36	2	**	23	36	16	35	10,256	11,714	0.16	0.33

** Volumetric fee dropped in 1990

Constant 1995 US dollars

Table 3 also shows that costs of irrigation as a ratio of GVO are fairly small in all cases, but particularly in Samacá. These results are not consistent with farmers' general perception that the cost of water is "high" in the production chain. All values are consistent with those reported for other Colombian irrigation districts (Vermillion and Garcés 1996).

GRI. This value was obtained for the respective year before transfer and for 1995. The results are shown in Table 4. The returns are high for both RUT and Río Recio, with values above 20% and with a slight decrease in the latter district. Samacá districts shows smaller values, but these are underestimated since the cost of constructing a similar district today could be much smaller given technological advances in buried pipe systems. Vermillion and Garcés (1996) report similar values for other districts in Colombia and Kloezen, Garcés and Johnson (forthcoming) report higher values for Mexico.

Table 4 Gross return on investment, before and after IMT

District	Year of transfer	Construction cost (1995 US$/ha)	1 year before IMT GVO (US$/ha)	1 year before IMT GRI (%)	In 1995 GVO (US$/ha)	In 1995 GRI (%)
RUT	1990	7,500	1,908	25	2,500	33
Río Recio	1990	7,200	2,230	31	2,112	29
Samacá	1992	7,000	950	14	1,500	22

Constant 1995 US dollars

O&M costs / ha. This indicator was added in trying to further understand the behavior of the water fees. Figure 10 shows diminishing values in the pre-transfer period for all districts and a reversing trend in the post- transfer period.

In the case of RUT, the increase is explained by the rising pumping costs,. That is, the operation which now stands at about 50 percent of the total budget. In this case, it can still be argued that maintenance costs are still lower than in pre-transfer times. The increases in Samacá are related to maintenance, with managers trying to keep a viable infrastructure. The fluctuations in Río Recio are small over time with the O&M levels similar for the transfer and the 1995 year. Figure 10 does not support our earlier assertions that maintenance efforts have declined

O&M costs / m³. This financial indicator related to the productivity of water was also added to shed some light into the effect of the water source technology and expenses. The results presented in Figure 11 are consistent with the technology of supplying the water. Pumping costs are highest and run of the river lowest.

In RUT, the very high pre-transfer values are explained by the poor conditions of the pumping units which were finally rehabilitated a few years before IMT. They explain the drop in values after transfer. Now costs are again increasing owing primarily to energy costs and are heading towards pre-rehabilitation levels. In Samacá, the increase after transfer is related to the purchase of maintenance equipment to replace the old units handed over to the association, as part of the transfer negotiations. Río Recio shows a very flat behavior throughout the period, suggesting that IMT has had no impact.

Maintenance Conditions. The results of the maintenance survey undertaken to assess the potential impact of IMT on infrastructure conditions are shown in Table 5. The term dysfunctional indicates that the canal reach or structure, so labeled, no longer can provide the service for which it was intended. Nearly dysfunctional indicates that a major repair or rehabilitation is needed within a year. The table also provides information on the coverage of the survey. With respect to the canals, the conditions found can be described as worrisome although in both RUT and Río Recio no dysfunctional canal reaches were observed. However, results indicate that rehabilitation of the canals is badly needed in Samacá (25%), RUT (17%) and Río Recio (10%). The situation found for the structures was fairly good in the case of Río Recio (only 3% of those surveyed need repair), but again critical for Samacá (39%) and RUT (18%).

Table 5 Functional conditions of irrigation infrastructure after IMT.

	Canals			Structures		
District	Length inspected (%)	Dys-functional (%)	Nearly dys-functional (%)	Number inspected (%)	Dys-functional (%)	Nearly dys-functional (%)
RUT	10	0	17	50	4	14
Río Recio	12	0	10	17	0	3
Samacá	28	6	19	60	11	28

The overall survey results suggest that the districts need to upgrade their maintenance, which will require budget increases for this purpose. Given that no pre-transfer maintenance conditions information were available in any of the districts, no before and after comparisons can be made. However, this should not take away from the importance of the surveys conducted. They indeed shed a light on where the districts are heading in this connection.

Figure 12 summarizes farmers perceptions on the maintenance conditions of the district before and after the transfer, in accordance to their geographical location within the district: head, middle and tail. The graph indicates that in general, farmers perceive no changes before and after IMT. However, negative perceptions do occur for all districts and for all locations. Thirty percent of the tail-end farmers in RUT and 25 percent of the middle farmers in Río Recio think that maintenance has deteriorated. Interestingly, 38 percent of tail-enders and 22 percent at middle reaches in Samacá think that maintenance has improved after transfer; these perceptions contradict the relatively poor conditions of the irrigation network as found by direct inspection.

The foregoing concludes the application of the external performance indicators in order to assess the impact of irrigation management transfer at RUT, Río Recio and Samacá. Table 6 summarizes the values of indicators applied in all three districts during the study. For simplicity, one value before transfer (1989 as base year) and one valve after transfer (1995 as base year) for each district is given. The trends and implications have already been discussed.

Table 6 External performance indicators, before and after IMT

		RUT		Rio Recio		Samacá	
Indicator	Units	1989	1995	1989	1995	1989	1995
RWS**	Ratio	2.1	1.9	2.3	2.1	1.4	1.6
RIS**	Ratio	2.0	1.1	3.3	3.7	1.5	1.8
WDC**	Ratio	1.6	2.5	2.3	2.2	1.7	1.7
II	%	154	153	142	114	106	149
GVO/ha**	US$/ha	954	1,269	2,230	2,112	3,870	4,530
GVO/m^3 **	US$/$m^3$	0.54	0.91	0.17	0.17	0.63	1.16
O&M/ha	US$/ha	163	95	38	54	111	61
O&M/m^3	US$ /1,000 m^3	27	30	1.5	1.9	7.0	8.0
FSS**	%	110	68	21	115	50	102
FCR	%	82	67	na	na	80	72
GRI**	%	25	33	31	29	14	22

** Belonging to IIMI's minimum set of external performance indicators

CONCLUSIONS

The main objective of the study was to evaluate the impact of irrigation management transfer in three Colombian irrigation districts by using external indicators. The impact was to be determined not only through comparisons across districts but also by analysis of time series (12 years) within districts. The following are general conclusions that can be derived from the study.

- The application of three water-related external indicators showed that two of the districts RUT and Río Recio—operated under moderate to high water supply conditions. Samacá is a district with less water availability but was still able to meet adequately its crop water requirements. The impact that IMT had on the districts in terms of the water-related indicators is less clear. RUT and Samacá were able to improve the adequacy of water deliveries as well as the use of their infrastructure. Río Recio, on the other hand, shows rather flat responses and even some slight deterioration in their water management. This view is supported by farmer perceptions on the issue.

  The RWS indicator is not a good choice to evaluate IMT Impact since the inclusion of total rainfall tends to mask actions taken by management in controlling the irrigation supply. For this reason, the application of RIS provides a better way evaluate changes in district management. While WDC does suggest improvements in RUT and Samacá there is no clear evidence that the positive impact observed can be ascribed to IMT.
- The application of agricultural-based indicators shows mixed results. In terms of irrigation intensities it shows a downward trend after turnover in all districts, with an steady decline in Río Recio. However, in the latter the decline began long before IMT. On the positive side, the productivity of water shows marked improvement in Samacá and RUT and constant and flat for Río Recio. The productivity of land appears flat, in RUT and Río Recio, and increasing in Samacá after turnover. However, the historical trend in the latter district precludes us from being able to state that the rise is a result of IMT.

  Given that GVO values are influenced by many factors beyond crop prices, for example marketing, transport and even climatic conditions —which all have varied since transfer— it is impossible to separate the effects due to IMT from those resulting from parallel policies and economic interventions taken by the government.
- Financial indicators suggest relatively high and stable returns to investment before and after transfer. There has been a clear positive impact related to farmers contributions being able to cover districts expenses. This effect is counter weighted by declining fee collection rates. This dichotomy raises questions as to the impact of IMT on physical system sustainability. The information collected provides a disturbing picture that suggests that the practice of deferred system maintenance has increased. The cost of districts O&M per unit of land and water

are both on the rise for RUT and Samacá, which seems to add weight to the negative effects of IMT upon systems maintenance.

- In terms of the technologies used to supply water to the district and farmers, the indicators provide consistent information: O&M costs decline as one moves from pumping (RUT), to reservoir assisted (Samacá), to run-of-the-river (Río Recio) districts. The financial indicators were able to capture well the particular system condition. The GVO per unit of water is higher in RUT and Samacá, which deal with higher value crops grown to off-set the higher operating costs.
- Comparison of the districts indicates that in both RUT and Samacá efforts are being made—through better water management—to off-set increasing costs. Río Recio on the contrary shows very flat responses through the years indicating very little changes as a result, of the transfer. Adjustments are being made based more on changing cropping patterns than on water management per se.

In summary, the evaluation revealed that IMT has had little impact on the operation of the districts. While some changes have been introduced in order to improve water deliveries and distribution, in general, districts management has mostly continued applying the procedures that existed prior to the turnover. In terms of maintenance, the indicators suggest an increase in deferred maintenance over time that could eventually affect the physical stability of the districts. On the other hand, agricultural-related indicators show stagnation or decline in irrigation intensities after turnover, GVO per unit of land and water show moderate to high increases in all districts after transfer but it is nor clear that the observed trends can be attributed only to the IMT process. Finally, financial indicators showed that while fee collections seem to be covering O&M expenses in all districts, fee collection rates show a steady decline. On the other hand, O&M expenses in terms of unit area or unit water are on the rise in all three districts evaluated after transfer occurred.

Particularly disappointing was the fact that Rio Recio which was found to have the smoothest irrigation management transition process, from agency to water users, shows the poorest results, in terms of the indicators applied. Rio Recio has the highest water availability and lowest O&M expenses creating maybe a combination that does not provide incentives to the users in pursuing the beneficial effects of the transfer.

REFERENCES

Alvarez, Claudia Elena. 1997. *Transferencia del manejo del riego en el distrito Roldanillo-La Unión-Toro (RUT)*. Trabajo presentado en el taller sobre Transferencia del Manejo del Riego, Villa de Leiva, Colombia, Mayo 26-28.

Alvarez, Claudia Elena and Carlos Garcés-Restrepo. 1996. *Perfil de Riego de la República de Colombia*. Cali, Colombia: Instituto Internacional del Manejo de la Irrigación. (IIMI).

Bos, M.G., D.H.Murray-Rust, D.J.Merrey, H.G.Johnson and W.B.Snellen. 1994. Methodologies for assessing performance of irrigation and drainage management. Irrigation and Drainage Systems 7:231-261.

de Fraiture, Charlotte and Carlos Garcés-Restrepo. 1997. *Assessing trends and changes in irrigation performance: The case of Samacá irrigation scheme, Colombia*. Paper presented at the International Workshop on Irrigation Performance, November 3-7. Mendoza, Argentina: IIMI, ILRI, IHE and INCYTH - CRA.

Food and Agricultural Organization of the United Nations. 1994. Colombia: Agricultural Sector Review, *Irrigation and Drainage Studies*. Rome. FAO and World Bank Cooperative Program.

Garces-Restrepo, Carlos and Ellen P. Rymshaw. 1997. Memorias del seminario sobre el desempeño de sistemas de riego transferidos a los usuarios. Villa de Leiva, Colombia. Instituto Internacional del Manejo de la Irrigacion (IIMI).

Garcés-Restrepo, Carlos and Douglas L. Vermillion. 1995. Irrigation Management Transfer in Colombia: assessment of seven transferred districts in *Irrigation Management Transfer*. Water Report No.5. Rome. FAO and IIMI.

Kloezen, Wim. H. and Carlos Garcés-Restrepo. (forthcoming). Assessing performance with external indicators: the case of the Alto Río Lerma Irrigation District, Mexico. *Research Report*. Colombo, Sri Lanka: International Irrigation Management Institute. (IIMI).

Kloezen, Wim H., Carlos Garcés-Restrepo and Sam H. Johnson III. (forthcoming). Impact assessment of irrigation management transfer in the Alto Río Lerma Irrigation District, Mexico. *Research Report*. Colombo, Sri Lanka: International Irrigation Management Institute. (IIMI).

Ministry of Agriculture, Government of Colombia. *1990. El Desarrollo Agropecuario en Colombia*. Bogotá, Colombia.

Molden, David., R. Sakthivadivel, and C.Perry. (forthcoming). External indicators for comparative irrigation performance. Colombo, Sri Lanka. International Irrigation Management Institute (IIMI).

Mora, Luis A. y Claudia Elena Alvarez. 1997. *Análisis del desempeño de los distritos de riego de Samacá (Boyacá) y RUT (Valle del Cauca),* Trabajo presentado en el VII Congreso Nacional de Ingeniería Agrícola. Chinchiná, Colombia. Oct 8-11.

Murray-Rust, Hammond and Bart Snellen. 1993. *Irrigation system performance assessment and diagnosis.* Colombo, Sri Lanka: International Irrigation Management Institute. (IIMI).

Perry, Chris, 1996. *Quantification and measurement of a minimum set of indicators of the performance of irrigation systems.* Internal Memorandum (unpublished). Colombo, Sri Lanka: International Irrigation Management Institute. (IIMI).

Vermillion, Douglas L. and Carlos Garcés-Restrepo, 1996. Results of management turnover in two irrigation districts in Colombia. *Research Report* 4. Colombo, Sri Lanka: International Irrigation Management Institute. (IIMI).

Vermillion, Douglas. 1995. *Methodology for assessing the impact of irrigation management turnover.* Draft (unpublished). Colombo, Sri Lanka: International Irrigation Management Institute. (IIMI).

FIGURES

Figure 2. Relative water supply

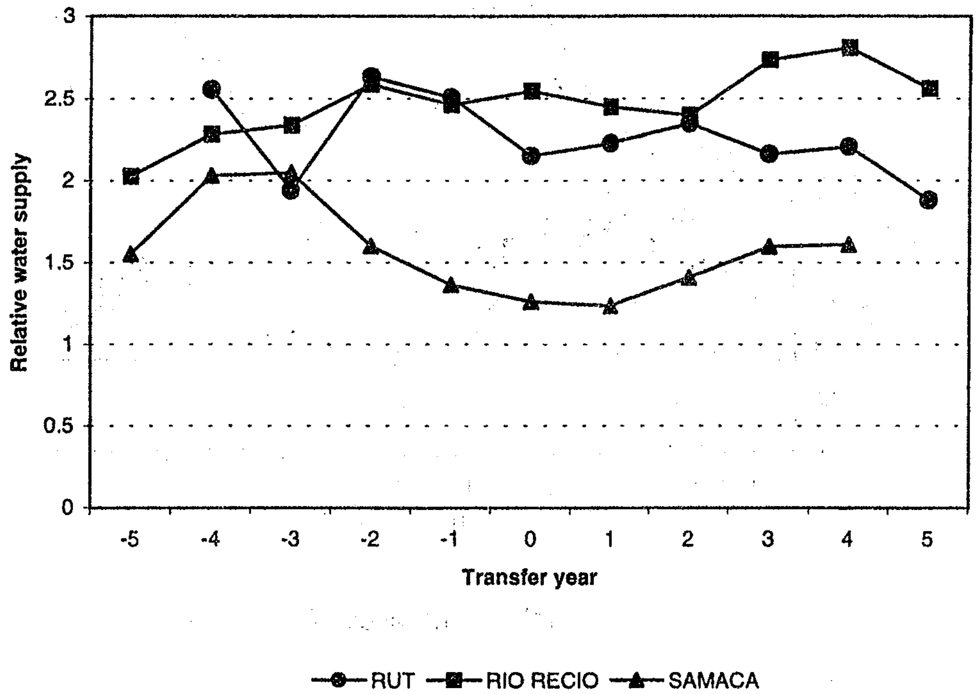


Figure 3. Relative irrigation supply

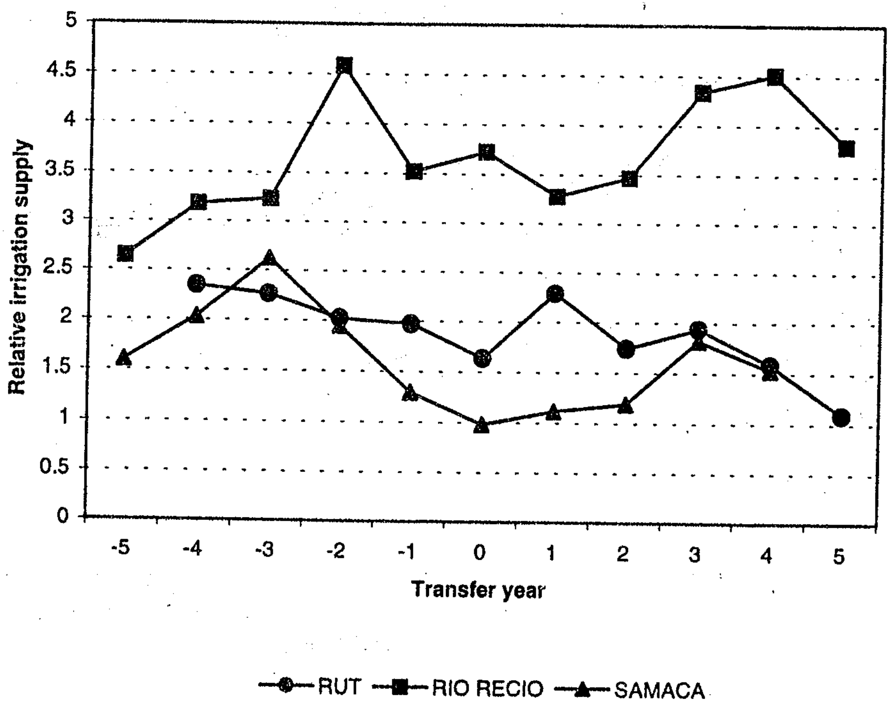


Figure 4. Water delivery capacity

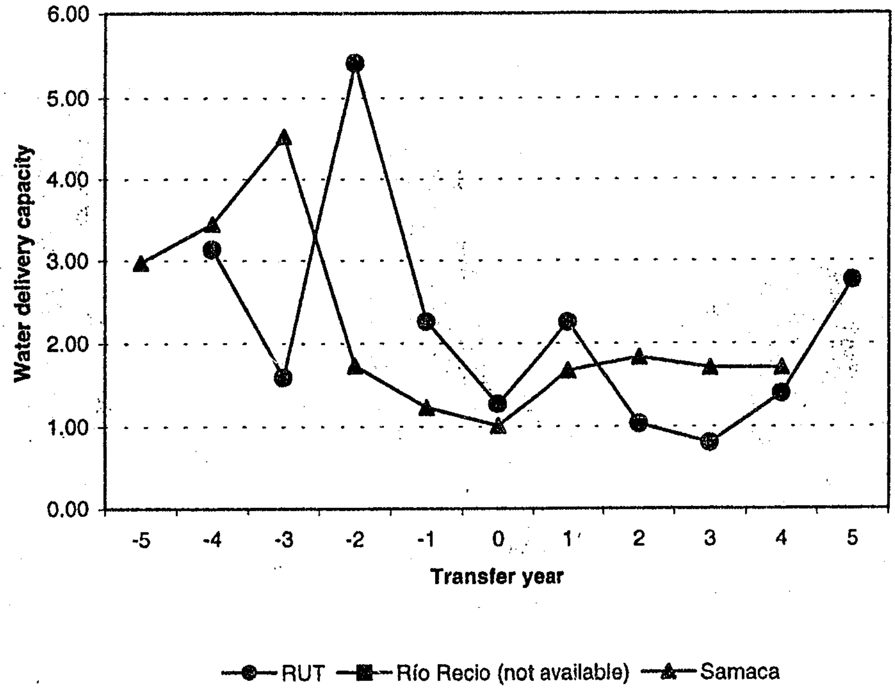
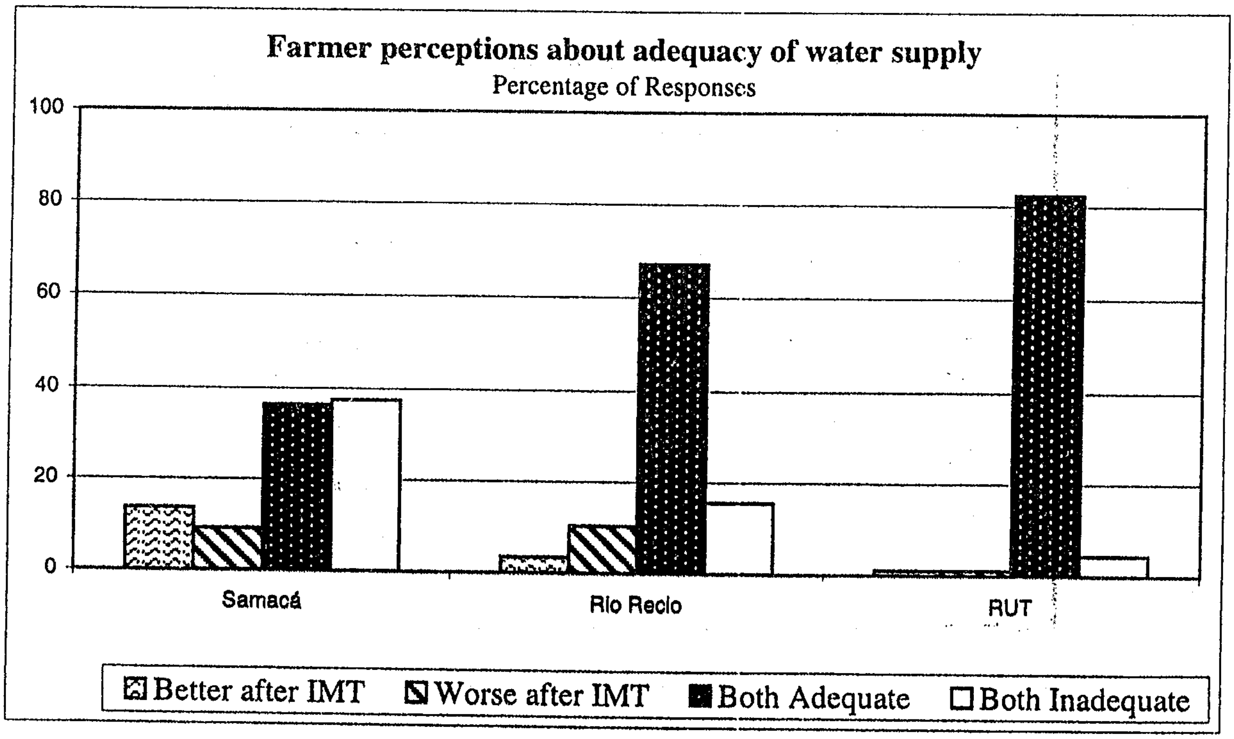


Figure 5a. Perceptions on water



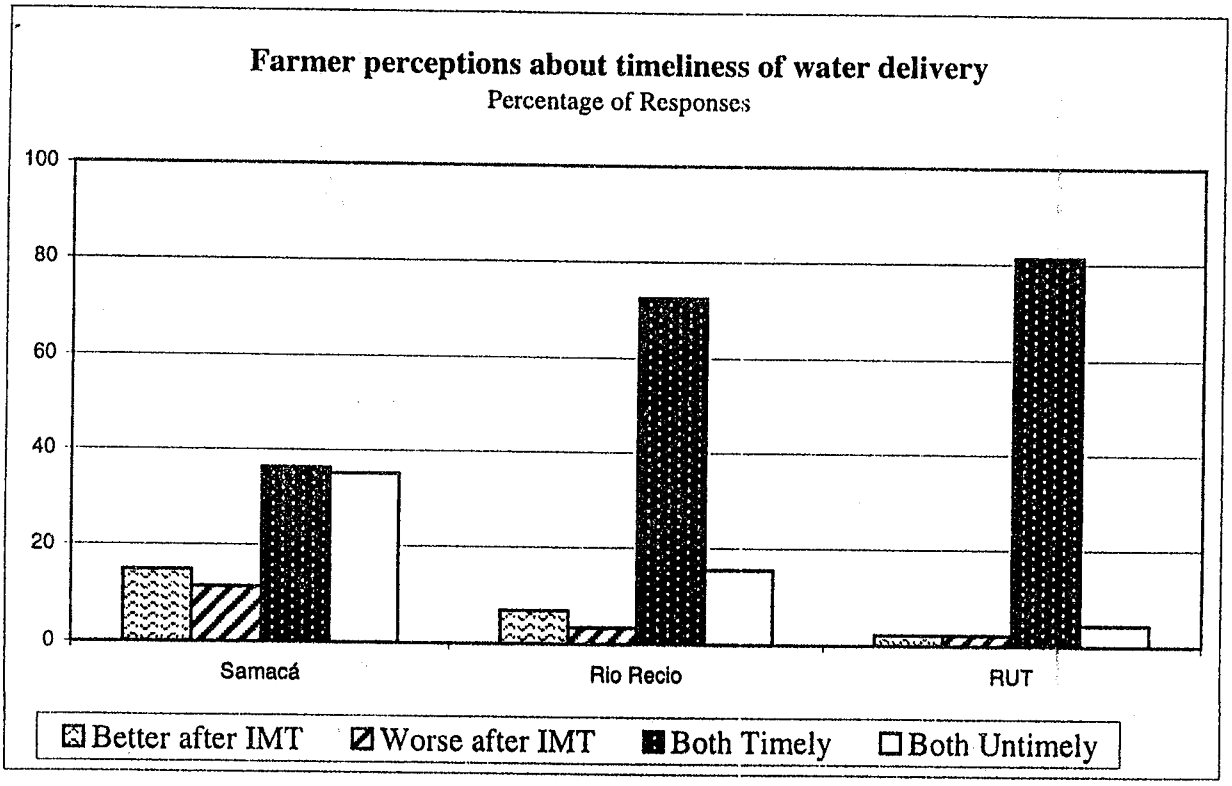
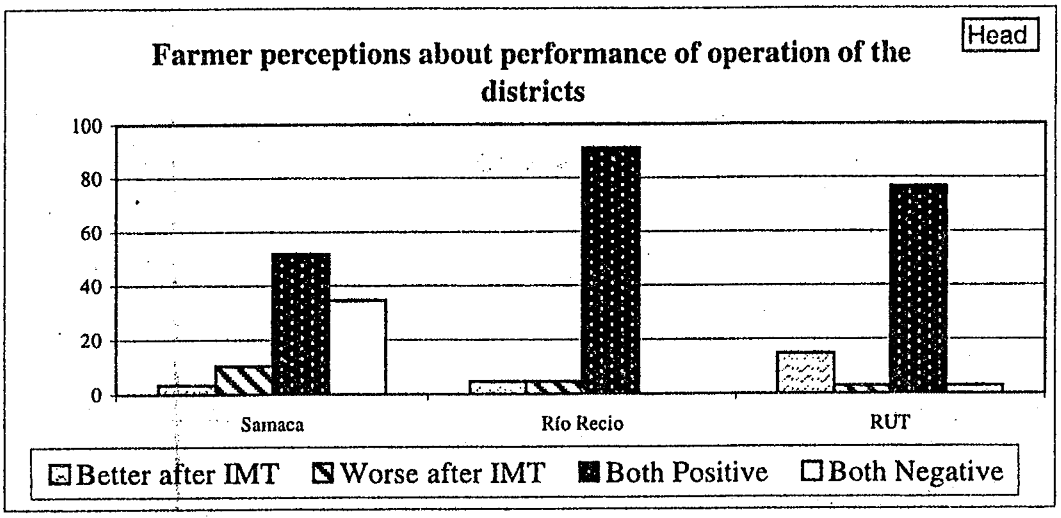
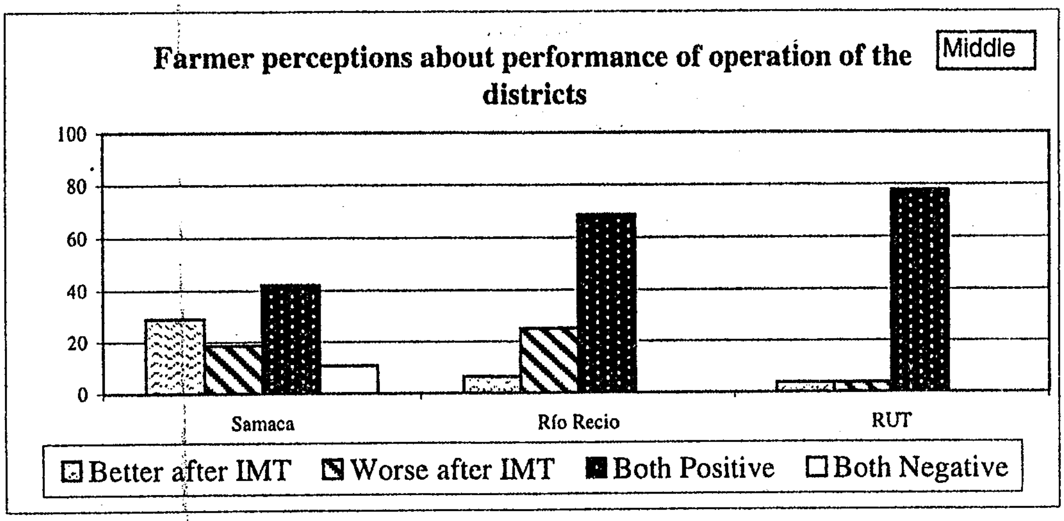


Figure 5b. Perceptions on operation





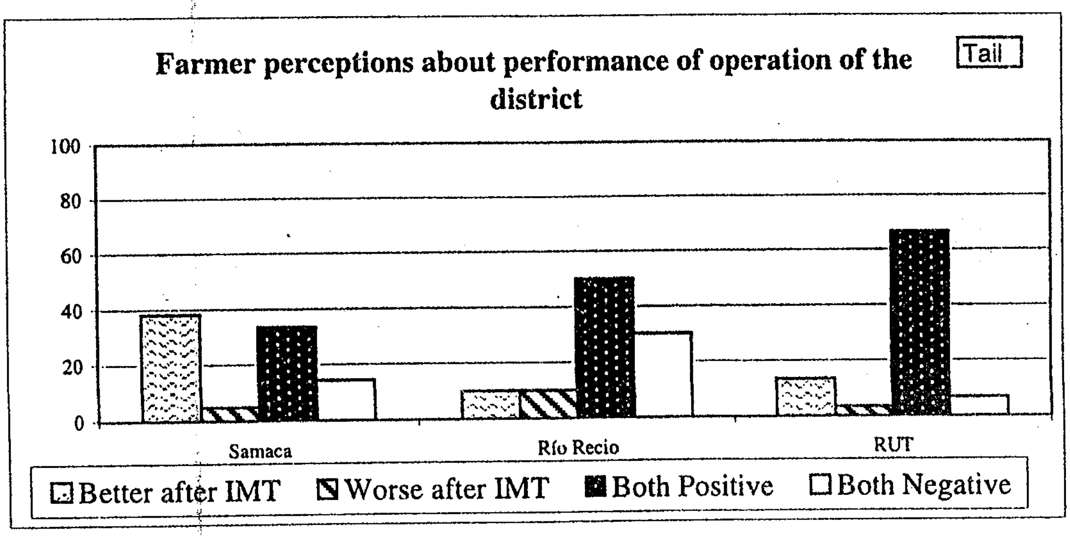


Figure 6. Irrigation intensity

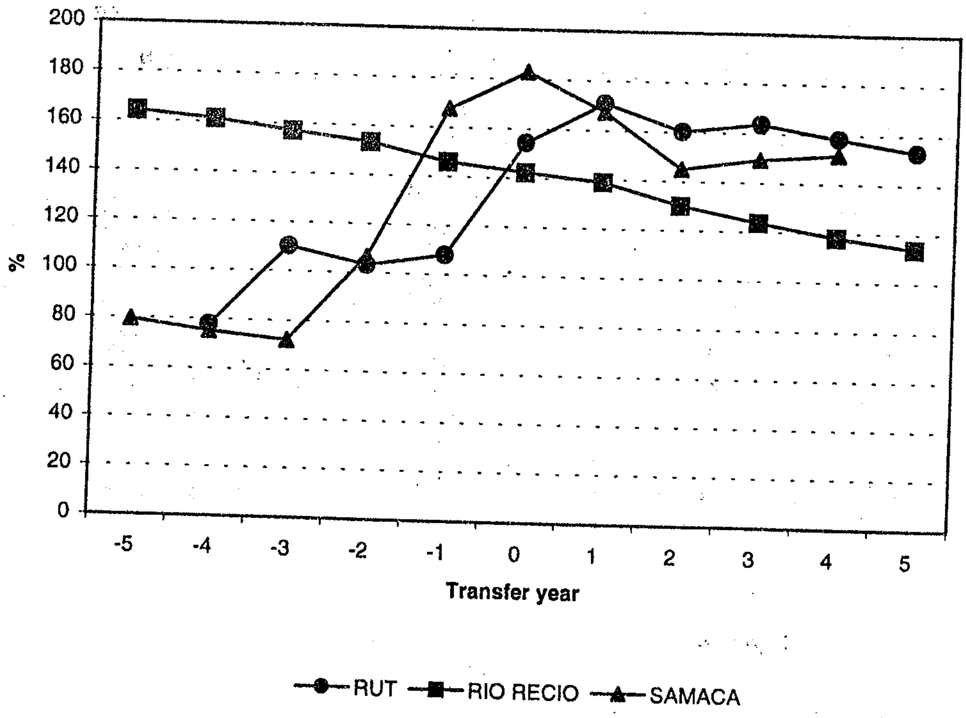
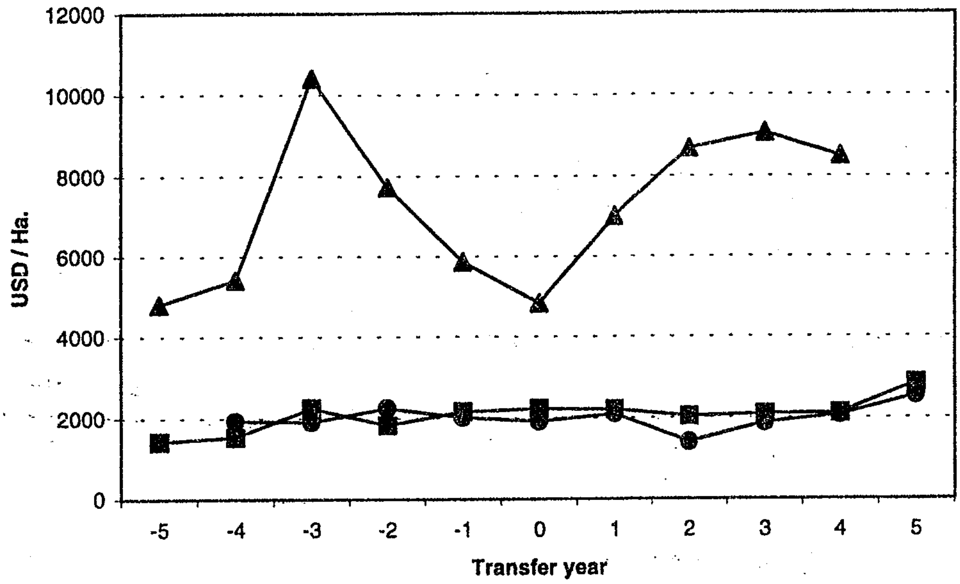
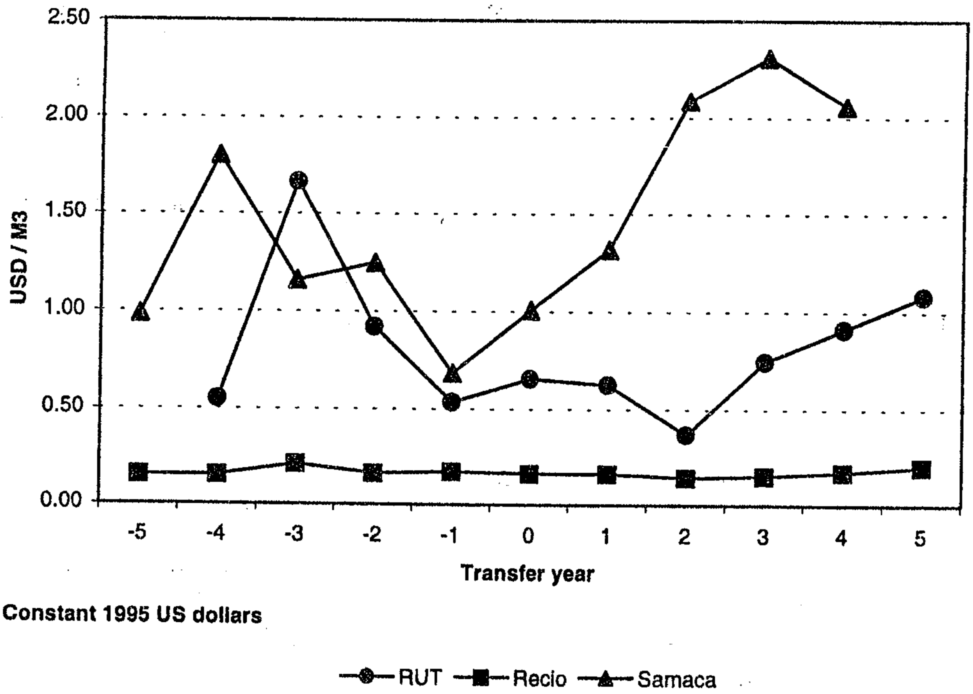


Figure 7. Annual gross value of output per unit of land



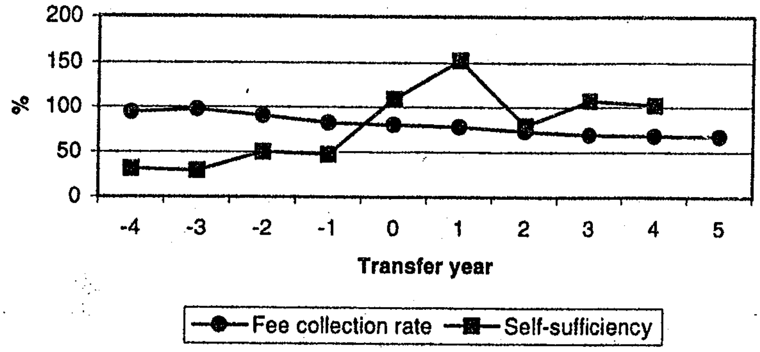
Constant 1995 US dollars

Figure 8. Annual gross value of output per unit of water

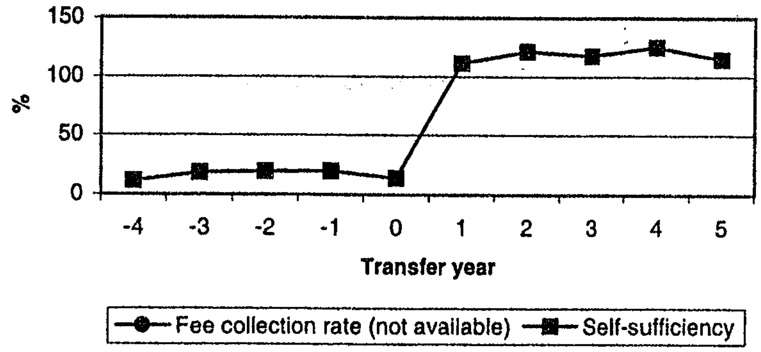


Constant 1995 US dollars

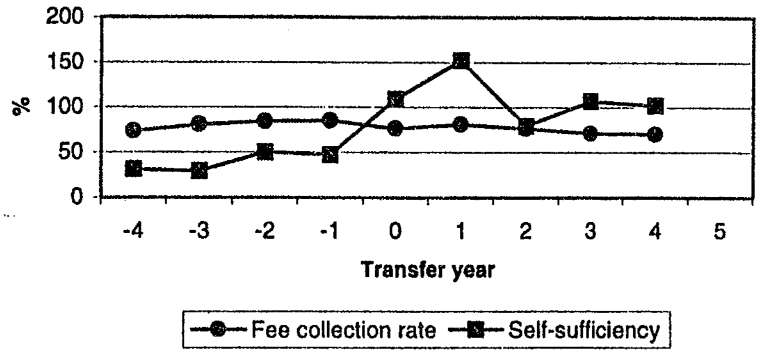
Figure 9. Irrigation fee collection rate and financial self-sufficiency



RUT

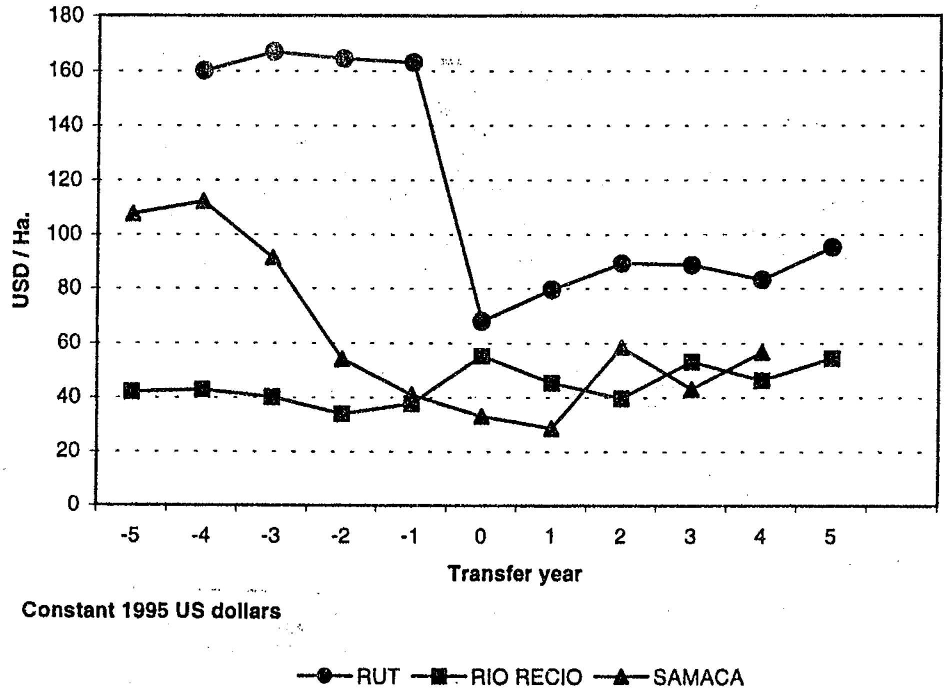


RIO RECIO



SAMACA

Figure 10. Operation and maintenance cost per unit of land

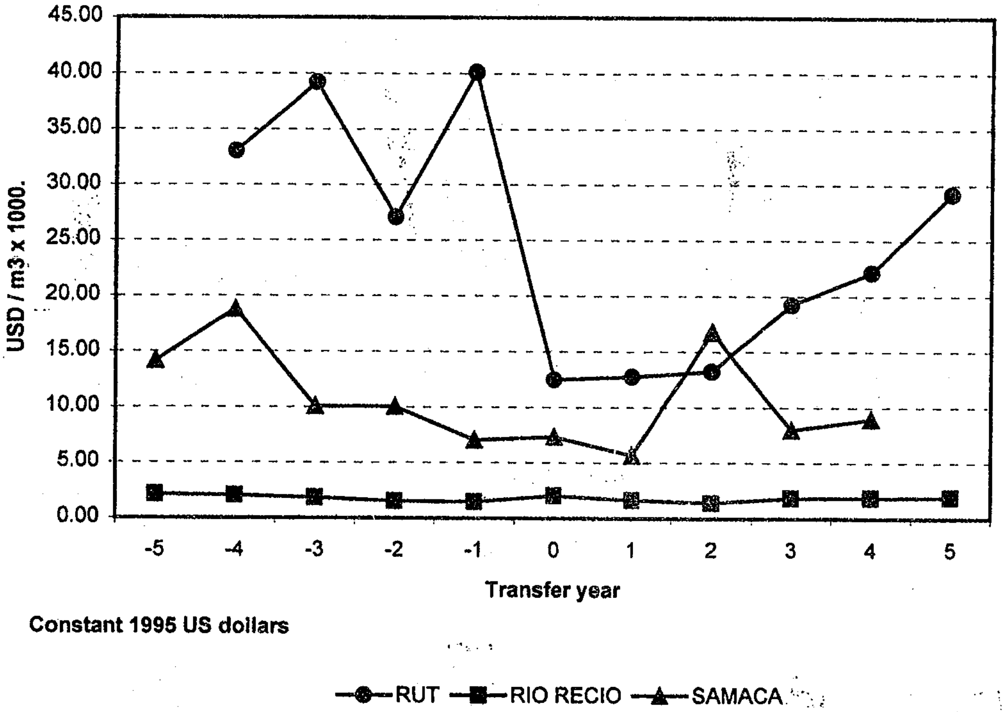


Annex Climatic information of sample districts

District	Temperature mean daily °C	Rainfall mm / year	Evapotranspiration mm / year	Relative humidity %	Sunshine hours / day	Wind speed m / seg
RUT	25.0	1101	1198	71	5.3	1.3
Samaca	13.8	689	1020	78	5.8	2.2
Rio Recio	29.2	1341	1536	67	5.7	1.1

Source: INAT and IDEAM

Figure 11. Operation and maintenance cost per unit of water



Constant 1995 US dollars

Figure 12. Perceptions on maintenance