25

Research Report

Impacts of Colombia's Current Irrigation Management Transfer Program

Douglas L. Vermillion
and
Carlos Garcés-Restrepo

International Water Management Institute

Research Reports

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Contents

Summary *v*

Introduction *1*

Methodology and Study Sites *2*

Management Transfer Program in Colombia *3*

Transfer Process in Five Districts *5*

Impacts of Transfer *13*

Conclusion *32*

Annex 1. Map of RUT District *35*

Annex 2. Background Information on the Five Sample Districts *35*

Literature Cited *38*

Summary

This report deals with the results of a study conducted by the International Water Management Institute (IWMI) in collaboration with the National Institute for Land Development (INAT) to assess the impacts of the current national irrigation management transfer program in Colombia. In 1990, the Government of Colombia adopted a new national policy to transfer management of its irrigation districts to water users' associations (WUAs). This report examines the context of transfer, the basic transfer strategy, powers and functions devolved, and the impacts of transfer on irrigation management and irrigated agriculture in three sample irrigation districts.

Two districts that were not transferred until 1995 and 1996 were also selected to enable comparison between schemes that had and had not yet been transferred during the period of historical analysis. Impacts measured include costs of irrigation to the government and the farmers, financial solvency of the irrigation districts, quality of irrigation operations and maintenance, and the agricultural and economic productivity of the irrigation systems. Data were collected through interviews with irrigation management staff and farmers, secondary data available from irrigation and agriculture departments, a sample survey of farmers, and direct inspection of irrigation networks.

The national irrigation management transfer program in Colombia adopted in 1990 can be characterized as significant but only as a partial devolution of management to water users. The government maintained considerable advisory influence over the districts for several years, exercising some control over O&M plans and budgets, and resisting district attempts to release large numbers of staff. After adoption of the 1993 Land Development Law, in 1994, this control has been relaxed considerably as districts gained almost complete control over management. However, powers devolved do not include a formal water right or ownership of irrigation scheme infrastructure. Also, the government has not made it clear whose responsibility it will be, and under what terms and conditions to finance possible future costs of rehabilitation.

Management transfer prompted a number of managerial changes aimed at improving management efficiency and accountability of district staff. Transfer resulted in a significant shift in the burden of cost from the government to farmers, which has generally been accepted by farmers. But transfer has not had substantial impacts on the performance of operations and maintenance, or on the agricultural and economic productivity of irrigated land or water, neither improving negative performance nor causing detriment where performance is positive.

This report raises concerns about how lack of a comprehensive devolution policy for the irrigation subsector can discourage farmers from investing in the long-term sustainability of their irrigation schemes. More attention is needed toward using the transfer process to create local management self-reliance and ensuring that needed support systems for local management are in place prior to implementation of irrigation management transfer programs.

Impacts of Colombia's Current Irrigation Management Transfer Program

Douglas L. Vermillion and Carlos Garcés-Restrepo

Introduction

This report deals with results of a study to assess the impacts of the current national irrigation management transfer program in Colombia. The report examines the context of transfer, the basic transfer strategy, and its impacts on selected systems. Impacts measured include costs of irrigation to the government and the farmers, financial solvency of the irrigation districts, quality of irrigation operations and maintenance, and the agricultural and economic productivity of the irrigation systems.

In 1976, the Government of Colombia first transferred management of irrigation districts from the government to WUAs for the Coello and Saldaña irrigation districts in the Tolima valley in central Colombia (Vermillion and Garcés-Restrepo 1996). After a hiatus of a decade and a half, largely due to economic recession and political concerns, in 1990, the government adopted a new national policy to transfer management of all of its irrigation districts to WUAs. In the same year, the government resumed transfer of irrigation districts, beginning with the transfer of the Roldanillo-Unión-Toro (RUT) and Rio Recio districts, in the relatively prosperous Cauca and Tolima valleys.

Global Trend toward Devolution

Largely driven by government fiscal shortages and a common inability to raise sufficient revenues from collection of water charges, since the 1970s, governments around the world have adopted programs one after another to devolve responsibility for irrigation management to WUAs (Johnson, Vermillion, and Sagardoy, eds. 1995). Consistent with overall structural adjustment programs, irrigation management transfer has been supported by the major international development banks (World Bank 1993; EDI 1996; Arriëns et al. 1996). The reforms generally include efforts to organize WUAs, train future managers, make essential structural repairs, and negotiate and formalize agreements between the government and the water users.

As the reforms are normally motivated by financial pressures and driven by donor deadlines, devolution policies tend to be adopted ahead of identification of a practical and integrated strategy for implementation. There is a significant gap of knowledge about actual results of IMT—which strategies do and do not work, and what prerequisites are necessary to sup-

port sustainable local management of irrigation. These questions are global in relevance. To date, there has been a lack of systematic, comparative research to answer these questions (Vermillion 1997) to facilitate policy makers and farmer leaders to make better strategic decisions and investments. This report is part of a comparative research program at the International Water Management Institute to examine the modalities and impacts of IMT in several countries through a common methodology (Vermillion et al. 1996).

The most important research questions related to management transfer are—

1. Under what conditions should transfer be attempted or not?
2. What kinds of external support are necessary to make transfer work?
3. What have been the impacts of transfer in those districts already transferred?

The third issue is the focus of this report, although some of the findings herein contribute partially to the other two questions.

Methodology and Study Sites

This report first describes basic aspects of the agricultural, socioeconomic, and physio-technical context of selected irrigation systems in Colombia. Then it describes the policy and basic arrangements for management transfer. Against this backdrop, impacts are measured and to an extent, explained. Data were collected through interviews with irrigation management staff and farmers, secondary data available from irrigation and agriculture departments, a sample survey of farmers, and direct inspection of irrigation networks.[1] Sample farms were selected by random stratified sampling, in head, middle, and tail locations along canals. Annex 1 is a map of the RUT District showing locations of sample farms that were thus selected (Giraldo 1997).

The report is a comparison of trends in performance in five schemes. Three of the irrigation districts selected for the study (RUT, Rio Recio, and Samacá) were transferred early enough to enable comparisons of performance for 4 or 5 years before and after transfer.[2] The remaining two schemes—San Rafael and Maria La Baja—enable comparison between already transferred and not yet transferred schemes for the period of analysis between 1986 and 1995, as the former was transferred at the end of 1995 and the latter in 1996.

[1]In all cases, sample sizes were more than 5 percent of farmers. Sample sizes were 91 farmers in RUT, 59 in Rio Recio, 88 in Samacá, 56 in San Rafael, and 90 in Maria La Baja.

[2]Some data were unavailable for Rio Recio and Maria la Baja schemes, hence they are not included in some tables and charts.

Management Transfer Program in Colombia

Irrigated Agriculture and Transfer Policy

Approximately 80 percent of Colombia has a humid and tropical, or warm temperate climate. Of an estimated 18.3 million hectares of cultivable land, 3.8 million hectares are actually cultivated at present. Of an estimated 7.4 million hectares of land that is potentially irrigable or could be productive with installation of drainage or flood protection facilities, 750,000 hectares are actually equipped with irrigation or drainage facilities at present (MOA 1990). Colombia still has considerable potential to expand the area under irrigation. Colombia's mountainous terrain, high rainfall, and fertile volcanic soils create conditions conducive to small-scale development of irrigated agriculture. A wide range of crops, from tropical to temperate, can be grown. The most widely cultivated crops are rice, maize, sorghum, soybean, pasture, potato, and vegetables.

The private sector has developed and managed 463,000 hectares (or 62%) of the current functional irrigable land in Colombia. The public sector has developed only 38 percent. Development and operating costs of public irrigation schemes are on average about double those of privately developed schemes (FAO 1994). Colombia's extensive experience with irrigation development in the private sector and the sector's well-known higher levels of economic efficiency have created general expectations that farmers, given the right circumstances and training, are capable of taking over management of public irrigation schemes and managing them more efficiently than the government.

In Colombia, the first impetus for management transfer came from water users themselves, who lobbied the government to take over management of the schemes in the Coello and Saldaña districts in the Tolima valley. In response, the government created HIMAT[3] in 1975 and gave it (among other responsibilities) the dual mandate to first, take over management of all 23 public irrigation districts in Colombia and second, establish and form WUAs in the districts to eventually take over management from HIMAT. Coello and Saldaña districts were transferred to the users in 1976 under an inter-sectoral constitutional principle referred to as "delegation of administration" (Plusquellec 1989). However, the delegation did not include transfer of ownership for scheme assets nor full WUA control over budgets, O&M plans, and personnel. HIMAT retained a strong supervisory role in administering budgets and O&M plans, and strongly resisted early attempts by the WUAs to reduce the number of staff employed by the districts (who were HIMAT staff before the transfer).

Nevertheless, the relatively successful results of this experiment (Vermillion and Garcés-Restrepo 1996) strengthened political resolve to make management transfer a national policy. Toward the end of the economic recession of the 1980s, the government was ready to resume implementation of the devolution policy as part of its overall strategy of economic liberalization and political decentralization.[4] Roldanillo-Unión-Toro (RUT) and Rio Recio were the first irrigation districts to be transferred as part of the "new wave" of transfers, in 1990. Transfer of several other districts fol-

[3]HIMAT is the Institute for Hydrology, Meteorology, and Land Development. In 1994, responsibility for meteorology was removed from the agency and its name was changed to the National Institute for Land Development (INAT) to reflect its narrower focus on development of irrigation, drainage, and flood control facilities.

[4]The strategy included removal of agricultural price supports, input subsidies, and trade barriers.

lowed over the next few years (Garcés-Restrepo and Vermillion 1995).

Recognizing the problems inherent in the partial delegation of administration, and needing to induce greater farmer investment in future expansion efforts, the government passed the Land Development Law No. 41 in 1993 and its associated enabling Decree Nos. 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 WUAs. The new agreements were referred to as "concessional contracts" rather than delegation of administration. This was a significant enlargement of devolution. However, even under the new law, the WUAs were only given use rights, not ownership over irrigation infrastructure.

Program Implementation

Under the transfer process, HIMAT, or, INAT, as it was renamed after 1994, facilitated the formation of a WUA. This included preparation of a constitution, formulation of bylaws, and designation of basic rules and sanctions. Farmers elected representatives to a Board of Directors. This was followed by preparation and signing of a concessional contract between INAT and the WUA. In each scheme, the transfer process may or may not include training, rehabilitation, or changes in O&M procedures, water fees, or personnel. All such issues are resolved on a case-by-case basis through negotiations between the WUA and INAT. At the beginning of 1990, only Coello and Saldaña (with a total irrigable area of 39,603 ha) had been transferred. By the end of 1996, 17 of the 23 public irrigation districts in the country had been transferred to WUAs. This constitutes 115,695 hectares of a total of 241,077 hectares of irrigated area previously under public management (Alvarez and Garcés-Restrepo 1996).

Originally all districts in the country were planned to be transferred by 1997. The government clearly pursued a strategy of transferring management of the "easier" districts first. These tended to be districts that were more prosperous and financially viable, which did not have major infrastructure disrepair and where farmers were more willing to take over management. However, by 1997, after experiencing difficulties in transferring Maria La Baja and other districts, the government temporarily discontinued implementing the program, ostensibly to enable it to conduct more in-depth analyses of what to do about the remaining districts considered to be most problematic. The remaining districts tended to have various problems such as high costs of irrigation, technical problems, facilities in a state of disrepair, lower productivity, lower profitability of irrigated agriculture, social unrest, poverty, and inability to collect adequate irrigation fees from farmers.

Transfer Process in Five Districts

The location of the five sample districts is indicated in figure 1 and basic information on each district is summarized in tables 1 and 2, and annex 2. These are small to medium-size schemes, ranging from an irrigated area of 560 hectares to 10,200 hectares and with design discharges from 0.6 m^3/s to 14 m^3/s. Out of these five schemes, two are river lift pump schemes, two have small reservoirs and the other is a river diversion scheme. Annual rainfall varies from 690 mm in the Samacá scheme in the mountainous Boyaca State to 1,890 mm in the Maria La Baja scheme on the Atlantic coast (table 1). As indicated in table 2, except for the Rio Recio district, the large majority of farm holdings are less than 10 hectares each. In Samacá and San Rafael, 95 percent of farm holdings are less than 5 hectares each in size.

FIGURE 1.
Map of Colombia showing locations of sample irrigation districts.

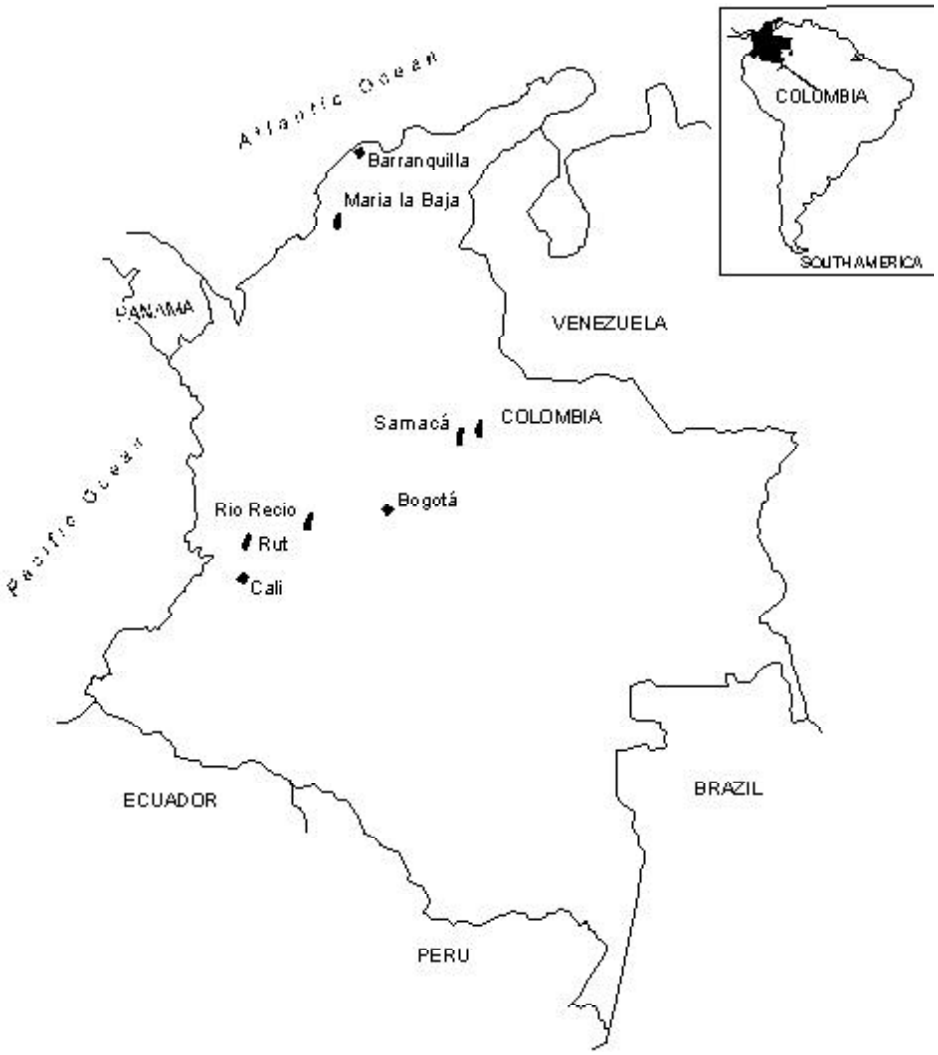


TABLE 1.
Basic characteristics of sample districts.

Item	RUT	Rio Recio	Samacá	San Rafael	Maria La Baja
State	Valle	Tolima	Boyacá	Boyacá	Bolivar
Design area (ha)	13,000	23,600	3,000	590	19,600
Irrigated area (ha)	9,700	10,200	2,893	560	9,260
Water source	River lift	River diversion	Reservoir	River lift	Reservoir
Intake structure	Pump	Gated weir	Vertical gates	Pump	Vertical gates
Designed Q (m^3/s)	14	11	1	0.6	20
Main canal length (km)	87.7	38.7	29.7	Buried pipe	58
Total canal length (km)	170.7	135.8	58	Buried pipe	284.4
Area per km canal (ha)	57	74	51	–	33
Turnout type	Pump	Sliding gate	Pump and sliding gate	Riser	Sliding gate
Control structures (#)	16	234	69	16	na
Lowest level water measured	Along main canal	Farm inlets	Main intake	Main intake	Main intake
Water delivery efficiency (%)*	53.7	74.1	86.1	80.5	54.7
Main soil type	Clay, loam	Clay, loam	Clay, loam	Clay, clay-loam	Loam, clay-loam
Average annual rainfall (mm)	1100	1300	690	783	1890
Main crops	Cotton, grape, fruit trees	Rice, sorghum, cotton	Onion, potato, pea	Pasture, vegetables	Rice, sorghum, pasture
Year of transfer	1958-70	1949-51	1945	1970	1962-65
Period or year of construction	1990	1990	1992	1995	1996
WUA	Asorut	Asorecio	Asusa	Asochicamocha	Asodimar
Heavy equipment (#)	27	20	2	6	26

*Water delivery efficiency is the ratio of volume delivered to volume diverted.

TABLE 2.
Farm size distribution in sample districts.

	Percentage of farm holdings in each size range				
Farm size range (ha)	RUT	Rio Recio	Samacá	San Rafael	Maria La Baja
<5	75	14	95	95	46
5.1—10	11	11	3	2	29
10.1—20	7	23	1	2	15
20.1—50	6	23	1	1	7
>50	1	29	0	0	3

The Five Sample Districts

Roldanillo-La Union-Toro (RUT)

The Roldanillo-La Union-Toro (RUT) irrigation district is located in the prosperous Cauca valley and serves 9,700 hectares. RUT was the first district to be transferred in the national transfer program in January 1990. The WUA was organized at the time of construction of the project, but functioned only in an advisory capacity until transfer, after which it became a governing body (table 3).[5] As part of the government's overall policy to eliminate subsidies to the agriculture sector, the government halted its expenditures for O&M in the scheme after transfer. Before transfer, the subsidy was approximately 60 to 80 percent of total costs. Since the scheme had been rehabilitated before transfer, no arrangements were made for further repairs as part of the transfer process, except for some minor repairs to the main canal. After transfer, farmers began to realize that they had seriously underestimated pumping costs without a subsidy. They have since pressured the government to provide a temporary subsidy of approximately US$800,000 for energy costs. No training was provided as part of the transfer process.

TABLE 3.
Occurrence of transfer activities in sample districts.

Transfer activity	RUT	Rio Recio	Samacá	San Rafael	Maria La Baja
Establish WUA	Yes	Yes	Yes	Yes	Yes
Train stet farmer representatives	No	No	No	Limited	Limited
Train stet management staff	No	No	No	Yes	Limited
Revise O&M procedures and/or plans	No	No	No	Yes	Yes
Revise water charges	Yes	Yes	Yes	Yes	Yes
Reduce or eliminate govt. financing	Fully	Fully	Fully	Partly	Partly
Remove some government staff	Yes	Yes	Yes	Yes	Yes
Repair or improve intake and/or main canals	Yes	Yes (major)	Yes (major)	Yes (after IMT)	Yes
Repair or improvement of subsidiary network	No	Yes (major)	Yes	No	Yes (major)
Did farmers help prioritize improvements?	No	No	No	Limited	Limited
Farmer investment in improvements?	No	No	No	No	No
Future responsibility for rehabilitation known?	No	No	No	Yes	Yes

[5]Information for tables 3, 4, and 5 was obtained from key informants among district board members and management staff, as well as from INAT officials.

Rio Recio

The Rio Recio district is located in the Tolima valley in central Colombia. It irrigates 10,200 hectares of farmland. Rio Recio was transferred to the WUA (ASORECIO) in January 1990, under the principle of delegation of administration wherein the government agency HIMAT continued to exercise guidance over the district for budgets, O&M plans, and personnel.[6] The water users favored transfer mainly because they perceived that some of the funds from the water charge were being diverted to HIMAT budgets at state and central levels. They felt they could manage the system at a cost lower than that of the government. As part of the negotiations for a transfer agreement, the users successfully lobbied to reduce the number of staff after transfer and avoid repaying the cost of rehabilitation done prior to transfer (which cost the government US$3.6 million). Farmers had not participated in the rehabilitation and resisted attempts by the government to recover the costs from them. However, several members of the staff were retained by the WUA after transfer. Consequently, there was no training or change in basic O&M procedures associated with the transfer (table 3).

Samacá

The Samacá irrigation district is located in Boyaca State, northeast of Bogota. It has a service area of 3,000 hectares. In Samacá, negotiations for transfer began in 1991 and culminated in October 1992 with the official transfer. As part of a strategy to make the district financially self-reliant by the time of transfer, in 1991, the government raised the fixed area water fee by 170 percent while abolishing the volumetric fee (mainly due to difficulties of measuring water delivered to the farm level). The farmers' main interests in transfer were to reduce management costs and improve responsiveness of district management staff to the farmers' diverse irrigation needs. Minor repairs were made in the main canal and subsidiary network prior to transfer, but farmers did not participate in the improvements (table 3). Government expenditures for O&M were discontinued after transfer.

San Rafael

San Rafael district is a small river lift scheme built in 1970. It irrigates 560 hectares of land located in the mountainous Boyaca State. Recently, the district has been incorporated into the larger Chicamocha irrigation district that is currently under development. San Rafael is the first, and still the only unit in the larger district to be functional. The WUA for the larger Chicamocha district was organized in 1995, and at the end of the year the district as a whole (including San Rafael) was officially transferred to the WUA. As part of the transfer negotiations, INAT agreed to only gradually discontinue subsidies over 3 to 5 years after transfer. At the request of farmer representatives, INAT also agreed to repair the pump station and to transfer farm and heavy equipment to the WUA at no cost to the water users. The WUA also successfully lobbied for the right to keep revenues obtained from the sale of water to a beer factory and tourist center nearby. Training in pump operation was given to the WUA during the transfer process.

[6] As with RUT, this oversight role continued until after the enactment of the Land Development Law of 1993.

Maria La Baja

The Maria La Baja irrigation district is located 50 km south of Cartagena City near the Atlantic coast. Its current service area is 9,260 hectares. In June 1994, INAT and the WUA for the Maria La Baja district (ASODIMAR) signed a consessional contract. However, due to reluctance by water users and INAT, the actual transfer did not occur until the end of 1996. Farmers complained that many of the structures were dilapidated and should be repaired before the system was handed over to the WUA. INAT had reservations about the perceived weak managerial capacity of the WUA. Hence, it was agreed that INAT would continue to jointly manage the district with the WUA for at least 6 months after the transfer, with a possible extension.

This period of joint management was extended to a full year, and was implemented in 1997, when extensive training was provided to district staff. Following the period of joint management, the WUA would take over full control of water charges, budgeting, and O&M plans. It was also agreed that a modest amount of rehabilitation of broken-down structures would be done after transfer and that the WUA would have a role in prioritizing what should be repaired. However, which party will be responsible to finance the costs of future rehabilitation was not clarified.

Powers Devolved, Functions Transferred

Table 4 summarizes powers devolved and functions transferred to WUAs in the sample districts. In all cases, the WUA is a legally recognized entity with authority to manage water diverted to a defined service area. The WUA is a nonprofit, quasi-municipal entity with legal rights of way for irrigation canals and structures. The association has the right to select its leaders, make rules, and impose sanctions—up to the maximum penalty of fines for damages to property, cessation of the water service, and taking the violator to court.

Each WUA consists of a general assembly of members and an elected board of directors. WUA members are all landowners holding land within the command area, whether irrigated or not. A general assembly of members meets at least once a year to reelect board members and approve policies. The boards have 7 normal members plus alternate members. Board members are elected for a renewable term of 2 years. Before transfer, there was a fixed quota system wherein 4 board members had to be "small holders" whose total farm holdings in the district were less than 20 hectares each, and 3 members had to be "large holders" whose total farm holdings in the district were 20 hectares or more each. Both RUT and Rio Recio districts abolished this rule because farmers felt it was arbitrary and exacerbated rather than lessened tensions among WUA members. Key informants reported no severe social tensions among farmers of differing classes, landholding sizes, and wealth that would restrict farmers to organize collectively. Corruption and misallocation of water occur occasionally, but most farmers interviewed indicated that this was not a pervasive problem and was related to a few individuals rather than classes.

As mentioned, the first transfers did not convey full control over district budgets, O&M plans, water fees, and personnel. However, these powers were finally vested in the WUA after the implementation of the Land Development Law of

TABLE 4.
Powers devolved and functions transferred in sample districts.

Arrangements and functions	RUT	Rio Recio	Samacá	San Rafael	Maria La Baja
Year of transfer	1990	1990	1992	1995	1996
WUA is legal entity	Yes	Yes	Yes	Yes	Yes
WUA leaders selected by farmers	Yes	Yes	Yes	Yes	Yes
WUA has authority to make rules and sanctions	Yes	Yes	Yes	Yes	Yes
Maximum sanction available to WUA	Fine, stop service, take user to court	Fine, stop service, take user to court	Fine, stop service, take user to court	Fine, stop service, take user to court	Fine, stop service, take user to court
Maximum sanction applied since transfer	Take user to court	Stop service	Fine	Stop service	Not yet
Authority to make O&M plan and budget*	Shared with agency	Shared with agency	Shared with agency	Yes	Yes
Authority to set water charges*	Shared with agency	Shared with agency	Shared with agency	Yes	Yes
Authority to hire or release management staff*	Not initially	Not initially	Not initially	Yes	Yes
Legal water right at level of scheme or farmer organization	No	No	No	No	No
Control over intake	Yes	Yes	Yes	Yes	Yes
Control over main canal system	Yes	Yes	Yes	Yes	Not initially
Control over subsidiary canal system	Yes	Yes	Yes	Yes	Yes
Responsibility for future rehabilitation	Not defined	Not defined	Not defined	Not defined	Not defined
Canal rights of way	Yes	Yes	Yes	Yes	Yes
Right to make contracts and raise additional revenue, not for profit	Yes	Yes	Yes	Yes	Yes
WUA has right to make profits**	No	No	No	No	No

* After 1993 requirement for agency oversight was discontinued.

** This issue is currently under consideration.

1993, which was enacted in 1994. Colombia has no distinct water law and there are no water rights or concessions vested in the districts or with individual farmers. Expectations about water entitlements to irrigation districts are based on precedents about maximum seasonal divertable discharges that have been specified by INAT and previous irrigation administrations. In many cases, especially in water-abundant areas, or where there is only one diversion weir along a river, no specified ceilings exist. When a district is transferred to a WUA, it takes over full control of the irrigation network, including the intake. The WUA has the right to make contracts with third parties and raise supplemental revenue apart from water charges. Although the issue is currently under consideration, WUAs are still prohibited from making profits.

Managerial Changes Made by WUAs after Transfer

At the heart of the *theory of management devolution* is the argument that, local users of a resource who are empowered as a group to take over management of the resource have the incentive to manage the resource more efficiently and sustainably than a centrally financed government agency. The vital element between adoption of transfer and realization of impacts is the matter of changes in management by the WUA: What actual managerial changes, if any, are made by the WUA after transfer? What are the primary motivations for the changes—to reduce costs, improve efficiency or reliability of management, or to enhance the productivity or profitability of irrigated agriculture?

Table 5 identifies changes in management practices by WUAs in RUT, Rio Recio, and Samacá districts following management transfer.[7] Enhancement of efficiency (especially cost reduction) was the dominant motivation for changes introduced in the three districts. This concern prompted such actions as streamlining organizational structure, merging or abolishing positions, reducing staff, increasing work hours and service areas, streamlining procedures for fee payment, and introducing computerized management information systems.

Table 6 displays information on district staff deployment before and after transfer in the five districts. Three years after transfer, the WUA management reduced the number of staff in RUT, Rio Recio, and Samacá by 20–60 percent. Post-transfer service area per staff ranged from 124 hectares for RUT (a 2-stage lift system) to 298 hectares in Samacá.

Other significant actions taken by the WUAs included replacing old "inherited" ditch tenders with new ones (who were expected to be more accountable to the new WUA management). Supervision of operations was decentralized into zones. The districts began making structural repairs at their own expense (reportedly in more pragmatic and cost-efficient ways than had been done by public agencies before transfer). The districts also began to diversify their revenue sources and hired lawyers to collect overdue fee payments. These actions were intended to improve accountability and competence of staff, management efficiency, financial solvency of the district, and reliability of water delivery. There is some question about the willingness of farmers to invest in the long-term sustainability of the irrigation schemes in that, after transfer, no district has yet initiated an infrastructure replacement and improvement fund.[8] Farmers indicated some unease about an accumula-

[7] San Rafael and Maria La Baja are not included here because at the time of this study not enough time had transpired after transfer for managerial changes to be realized.

[8] Among districts transferred in the 1990s, RUT was the only one that established an equipment replacement fund. Coello and Saldaña, transferred in 1976, also set up such funds after transfer. However, no districts in the country have set up a capital-replacement fund for canals and water-control structures.

TABLE 5.
Changes in management made by WUAs after transfer.

Type of change	RUT	Rio Recio	Samacá	Primary motivation
Streamlined organizational structure	Yes	Yes	Yes	Efficiency
General manager and board president positions merged	Yes		Yes	Efficiency
Small/large farmer board quotas eliminated	Yes	Yes		Reduce tensions
Replaced ditch tenders with new recruits			Yes	Accountability
Reduced total number of staff	Yes	Yes	Yes	Efficiency
Staff work hours increased and made flexible	Yes	Yes	Yes	Efficiency
Obtained limited training/consultation from agency	Yes	Yes	Yes	Staff competence
Obtained limited training/consultation from third party	Yes	Yes	Yes	Staff competence
Hired lawyer to recover overdue water fee payments	Yes	Yes	Yes	Financial solvency, accountability
Streamlined fee payment arrangements	Yes	Yes	Yes	Convenience, efficiency
Eliminated volumetric fee			Yes	Efficiency
Diversified revenue sources	Yes	Yes		Financial solvency
Established capital replacement fund for heavy equipment	Yes			Financial solvency
Sponsored improvements in canal network	Yes		Yes	Reliability of water delivery
Established water management zones in scheme			Yes	Accountability, efficiency
Introduced MIS programs for administration and finance	Yes	Yes	Yes	Efficiency, accountability

TABLE 6.
Deployment of district management staff.

	Total district staff		Service area per staff	
District	Before transfer	After transfer	Before transfer	After transfer
RUT	92	78	105.4	124.3
Rio Recio	114	48	88.6	210.4
Samacá	13	10	229.3	298.1
San Rafael	5	5	118.0	118.0
Maria La Baja	94	92	98.5	100.6

Note: 'After transfer data' for RUT, Rio Recio, and Samacá were taken 3 years after transfer. 'After transfer data' for San Rafael were taken 19 months after transfer, and for Maria La Baja only 8 months after transfer.

tion of a large amount of money in a long-term account and many expected the government to finance most, if not all, of the future costs of rehabilitation.

As indicated in figure 2 (charts 2.5 and 2.6), except in Maria La Baja, the majority of farmers interviewed felt that overall administration of the district was good both before and after transfer. In RUT, Samacá, and San Rafael, 25 to 35 percent felt it had improved after transfer. More than half the farmers in Maria La Baja felt district administration was poor before and after transfer. In RUT, farmers were evenly split on whether communication between farmers and district staff was effective or not. In the other districts, most farmers reported a negative perception about farmer/district staff communication both before and after transfer, or that it had worsened (e.g., Rio Recio).

Impacts of Transfer

Financial Impacts

The primary interest of the government for promoting management transfer was to decrease government expenditures for the recurring costs of irrigation. In the short run, management transfer has reduced government expenditures in the sample districts dramatically. As indicated in figure 3, government expenditures per hectare fell from a range of US$20–US$80 per hectare before transfer to zero or near zero after transfer in the RUT, Rio Recio, and Samacá districts.[9] During the same period (1985–95) government expenditures in San Rafael (the lift scheme that was only transferred in 1995) rose during its development stage all the way to US$200–US$250 per hectare and have remained at this high level to date.[10] While expenditures for routine management costs have been eliminated or reduced substantially, it is not yet clear how much money the government might provide to the districts for rehabilitation in the future. If after transfer WUAs begin to defer maintenance in anticipation of future government assistance for rehabilitation, it is possible that government expenditures for rehabilitation could increase over time.

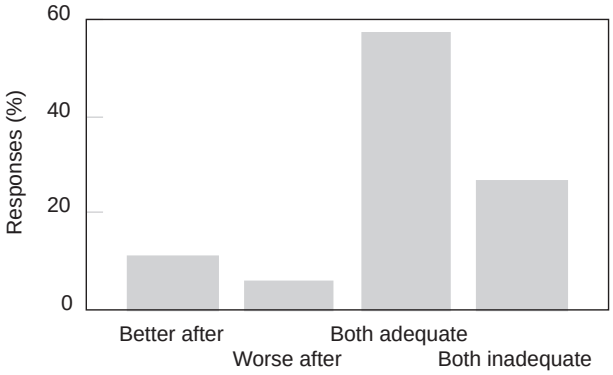
Transfer resulted in variable effects on the cost of irrigation to farmers. In RUT, where the total cost of irrigation was relatively high (due to two-stage pumping), at transfer, farmers exerted pressure on their new board to contain costs. Over 6 years after transfer, total farmer payments declined in real terms by 22 percent, from US$83 to US$65 per hectare by 1995. This was due to both a decline in fee-collection rate, from above 90 percent before transfer to less than 70 percent by 1995 (figure 4 and table 7) and a reduction in the amount of water delivered per hectare (figure 5). Owing to the elimination of the government subsidy and declining farmer payments of water charges, the board was pressured to increase the water charge and reduce the budget in an effort to balance finances. The water charge was increased from US$67 per hectare in 1990 (year of transfer) to US$108 in 1995 (table 8) while the total O&M budget was cut by 42 percent between 1989 and 1995 (table 7). However, these efforts were insufficient due to underfinanced maintenance and lobbying from farmers. By 1995, the government again began paying for some of the cost of repair work.

[9] In Samacá, the government began expenditure reduction before the 1992 transfer, as part of the national policy adopted in 1990 to reduce expenditures and transfer management.

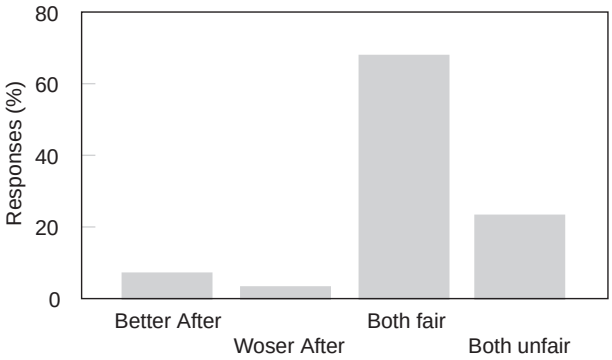
[10] This includes the cost of a hydroelectric energy station in addition to irrigation system costs. It was not possible to split up the two costs in this study.

FIGURE 2.
Farmer perceptions about district performance before and after turnover.

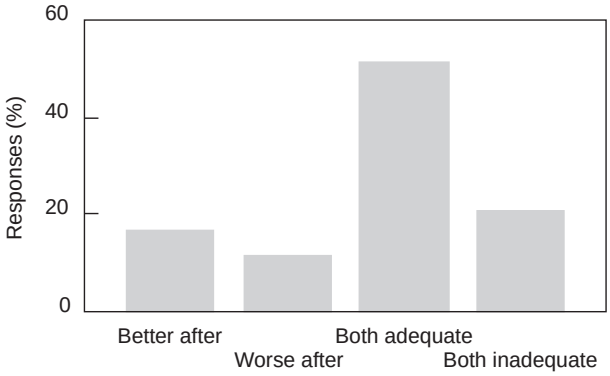
2.1. Adequacy of water delivered.



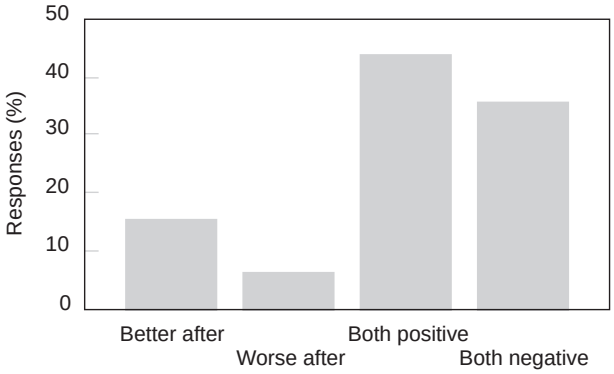
2.2. Fairness of water distribution.



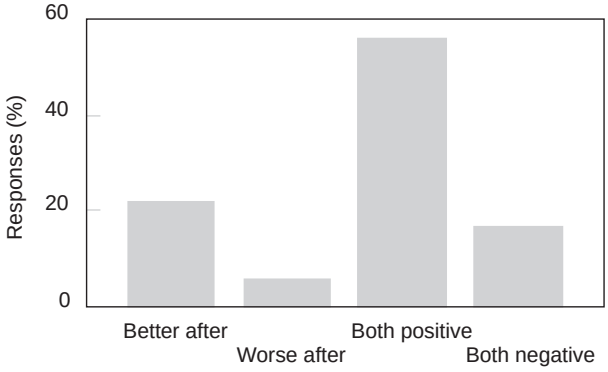
2.3. Adequacy of maintenance.



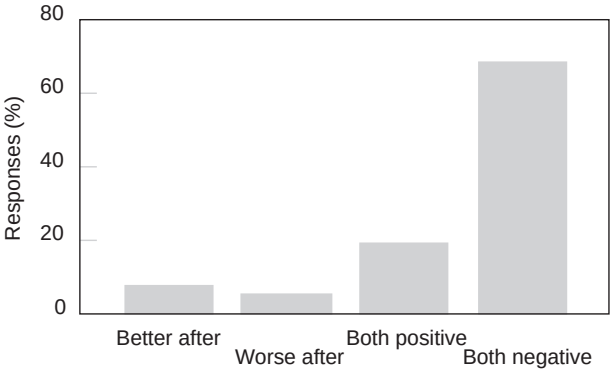
2.4. Financial management.



2.5. Overall administration.

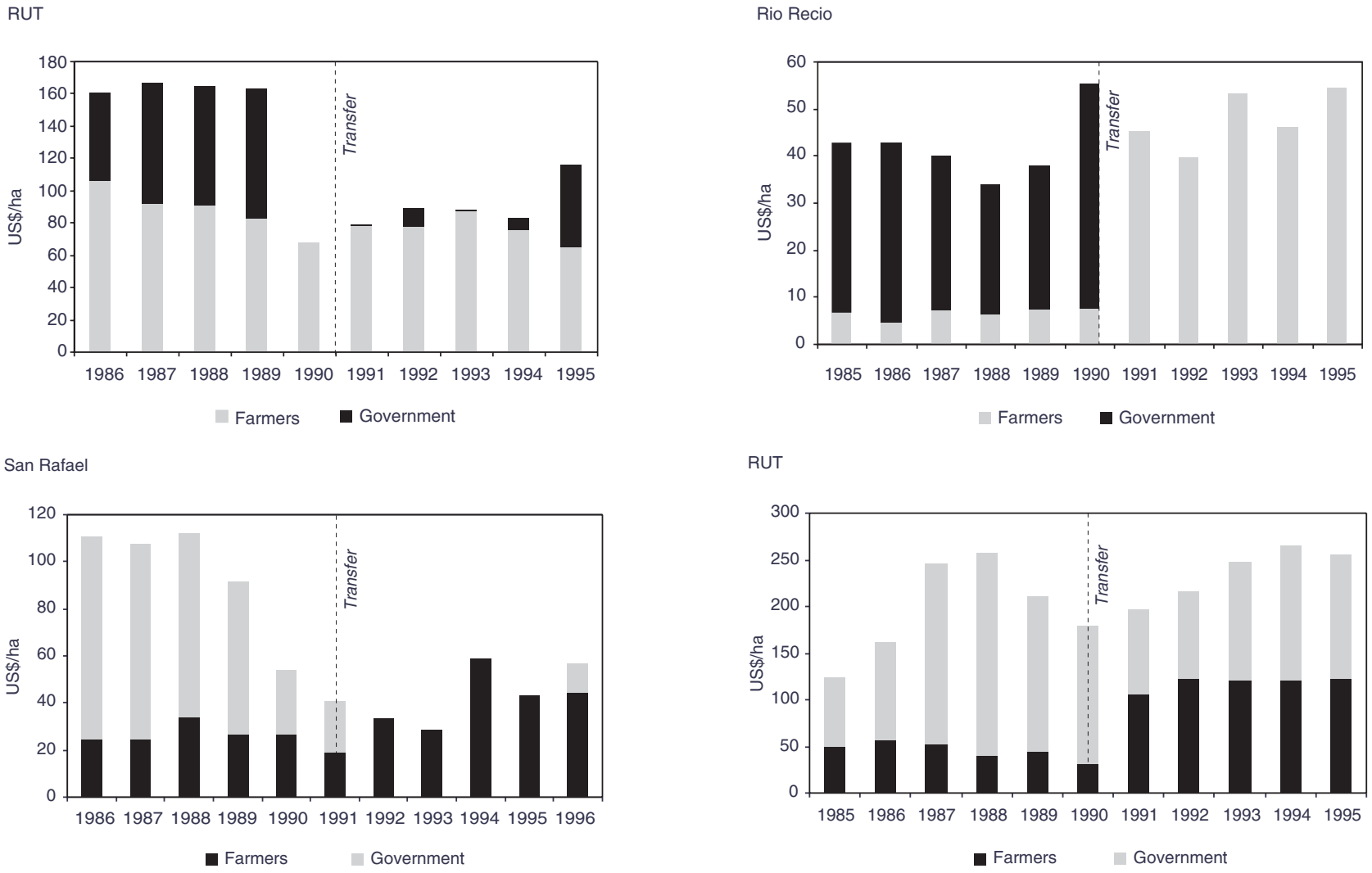


2.6. Effectiveness of communications.



Note: Both=Both before and after (e.g., Both adequate = Adequate, both before and after).

FIGURE 3.
Cost of irrigation to the government and the farmers.



* Cost to the government = Funds spent, which originated from government sources other than the district.
Cost to the farmer = Total water charges actually collected from farmers.

FIGURE 4.
Irrigation fee collection rates.

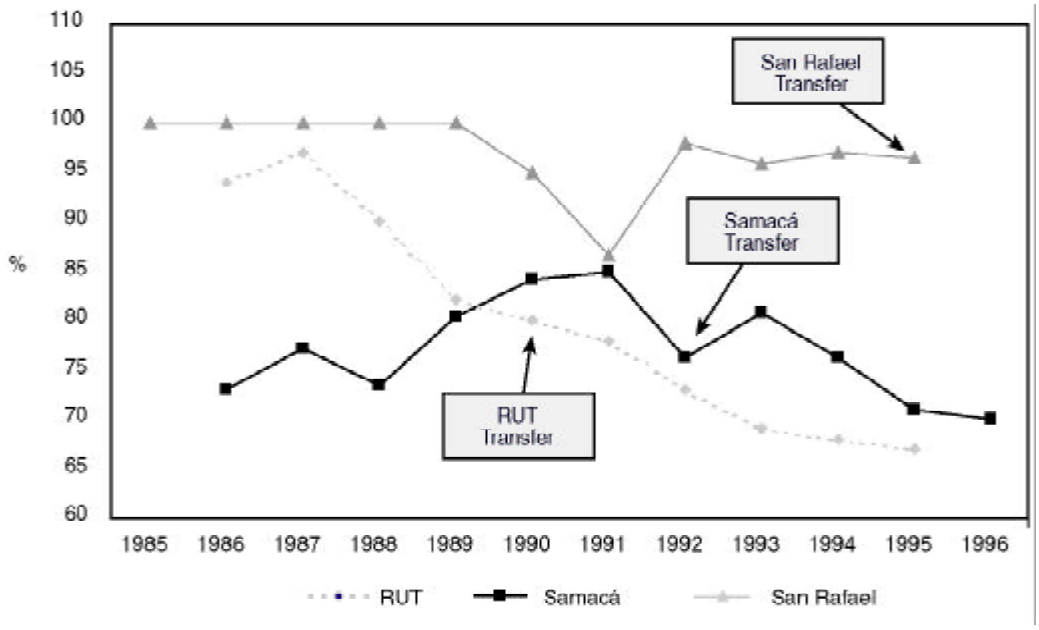


TABLE 7.
Key performance indicators for sample districts, before and after management transfer.

		RUT		Rio Recio		Samacá		San Rafael	
		1989	1995	1989	1995	1989	1995	1989	1995
Relative water supply*	ratio	2.1	1.9	2.3	2.1	1.4	1.6	1	1.1
Relative irrigation supply	ratio	2	1.1	3.3	3.7	1.5	1.8	0.6	0.9
Water delivery capacity	ratio	1.6	2.5	2.3	2.2	1.2	1.7	na	na
Capacity utilization rate	ratio	0.6	0.4	0.4	0.5	0.8	0.6	na	na
Irrigation intensity	%	154	153	142	114	106	149	197	190
GVO/Unit land*	US$/ha	2,013	2,060 (1994)	2,155	2,112 (1994)	10,394	9,060	1,568 (1991)	1,808
GVO/Unit water*	US$/m^3	0.54	0.91	0.17	0.17	1.2	2.06	1.08	1.56
Fee collection rate	%	82	67	na	na	80	72	94	95
Financial self-sufficiency*	%	51	69	19.4	114.9	29	107	21.2	52.8
Return on investment*	%	25	33	31	29	12	22	24	28
O&M/Unit land	US$/ha	163	95	38	54	111	61	180	256
O&M/Unit water	US$/1,000m^3	23	29	2	2	7	8	62	176

* These belong to IWMI's standard minimum set of performance indicators (IIMI 1996).

FIGURE 5.
Relative water supply (RWS) and relative irrigation supply (RIS) in sample districts.

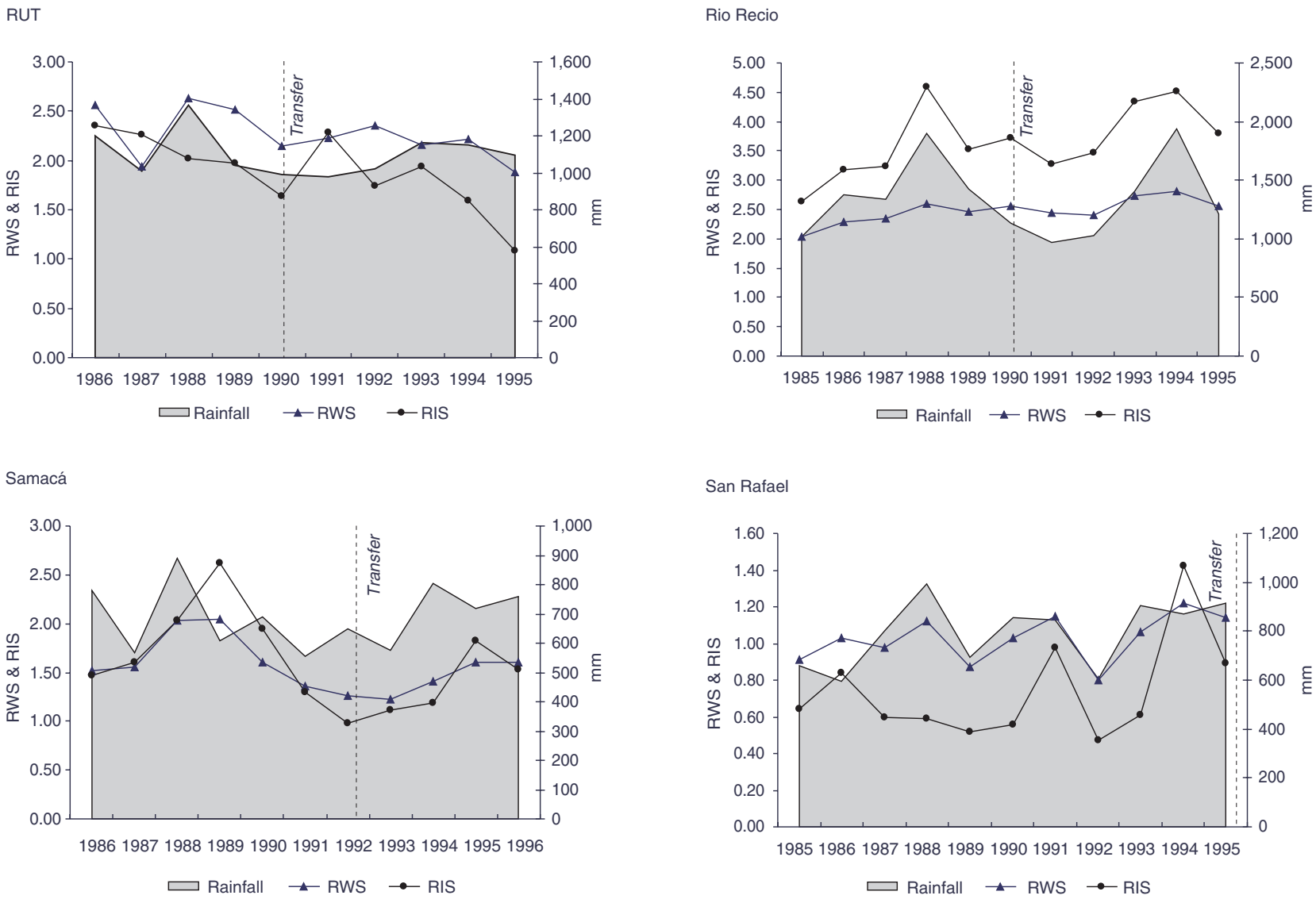


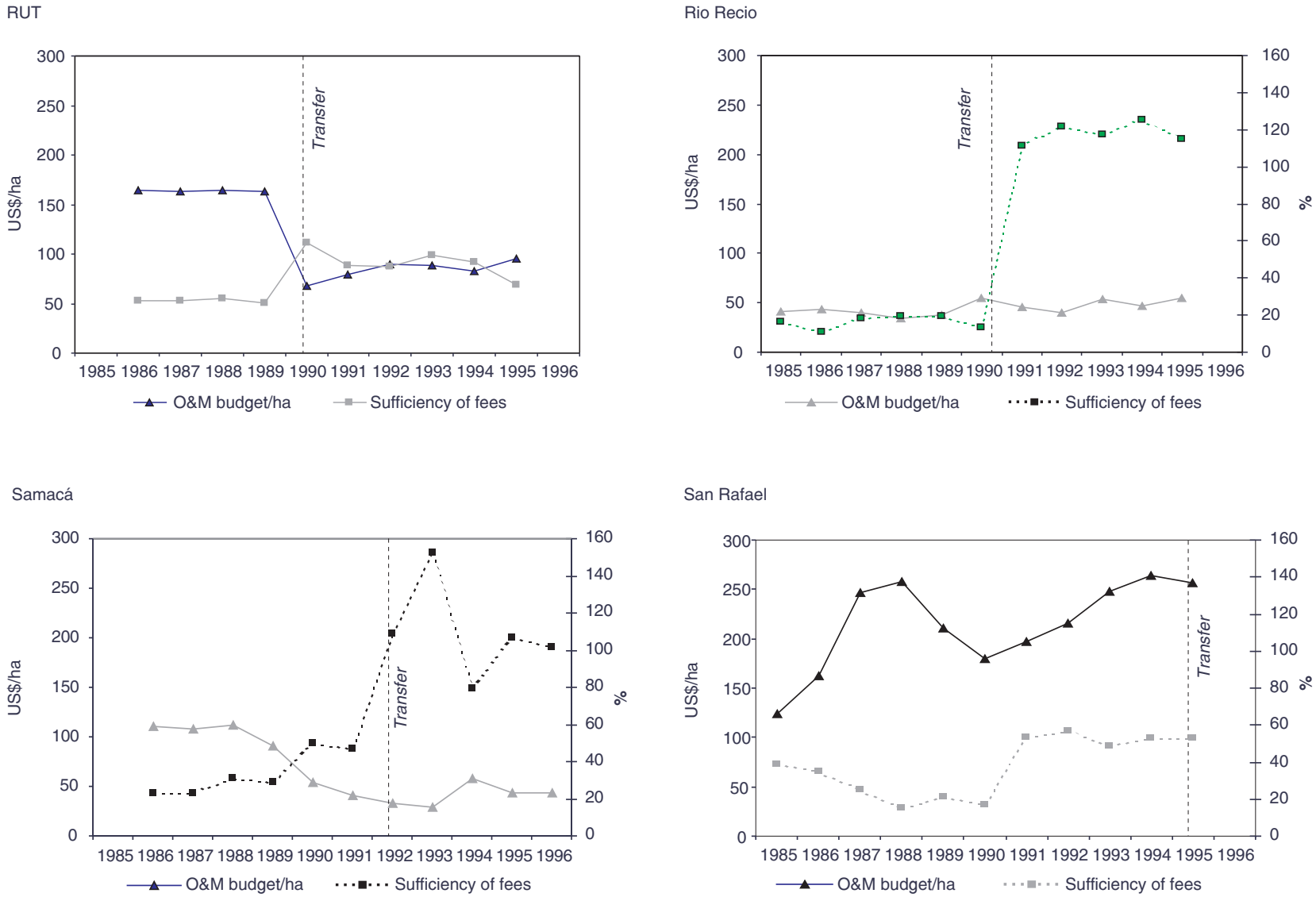
TABLE 8.
Water charges in sample districts before and after transfer.

District	Area water charge (US$/ha)		Volumetric water charge (US$/1,000m^3)		Total water charge (US$/ha)	
	1990	1995	1990	1995	1990	1995
Samacá	14.8	35.5	2.3	**	23	36
Rio Recio	12.9	12.6	1.3	1.3	66	Pending
RUT	40.7	65.7	6.8	9.3	67	108
San Rafael	18.1	26.6	10.4	17.5	48	53
Maria La Baja	14.3	16.4	2.7	2.2	53	55

In Samacá, where total O&M costs were at the modest level of about US$20–US$25 per hectare, and where government subsidies were eliminated completely, the cost of irrigation to farmers rose substantially after transfer. However, the new board kept total O&M budgets at about the same level after transfer. In Rio Recio, the district was able to achieve financial self-sufficiency rapidly after transfer without raising its fees (which were nearly as high as in RUT, although it had no pumping costs). The district achieved this through increasing fee collections dramatically and avoiding increases in the O&M budget after transfer. Although San Rafael was not transferred until 1995, a trend of declining government expenditures and rising costs to farmers occurred from the late 1980s to the early 1990s. The district has not had trouble with fee collections from farmers, despite their extraordinarily high levels. This is largely because it is a pump scheme and water is not delivered to individual farms if payments by the respective farmer are in arrears.

The total cost of irrigation, or the total annual O&M budget, did not increase significantly during the first few years after transfer in any of the schemes in the study. Figure 6 shows that the self-sufficiency of fee levels (relative to O&M budgets) rose to approximately 100 percent at transfer in RUT and Samacá, mainly due to drops in the O&M budgets (which were followed by slight rising trends after transfer). This was followed by worrisome declines in irrigation fee collection rates over several years after transfer (figure 4). By 1995, fees collected had dropped back down to only 69 percent of the O&M budget (table 7). In Rio Recio, the O&M budget remained at virtually the same level for several years after transfer, although the fee level adequacy rose abruptly after transfer. This suggests that most of the additional revenues were not being applied to O&M.

FIGURE 6.
O&M budgets and financial self-sufficiency.



In the high-cost RUT district, the budget dropped abruptly in the year of transfer from about US$163 per hectare in 1989 to US$95 per hectare in 1995. The abrupt budget cut was apparently not sustainable; as is also indicated by the just one-time rise in self-sufficiency of fees collected. After this, the budget again began to rise and self-sufficiency to fall. By 1995, only 69 percent of RUT's budget was mobilized from fees, while the government again began providing financial assistance to the district.

Samacá had no trouble collecting enough fees to cover its total budget after transfer. In this sample, the gravity flow schemes were able to sustain financial solvency for the first 5 years after transfer, even where substantial increases in fees were required. But neither of the high-cost pump schemes (RUT and San Rafael) was financially solvent either before or after transfer.

Figure 2 (chart 2.4) shows data on farmer perceptions about financial management of the districts before and after transfer. Except for Maria La Baja, the most common view among farmers was that financial management of the district was handled satisfactorily both before and after transfer. However, a significant minority of 10–25 percent had negative views. In all cases, the majority perception was that transfer has not brought about a significant change in the quality of financial management of the districts. Data in figure 4 indicate declining irrigation fee collection rates in RUT and Samacá, which is an unexpected cause for concern. It suggests that the new farmer organizations lack adequate support from farmers.

Table 7 summarizes data on these financial and other performance indicators, before and after transfer. The financial self-sufficiency of fees collected to cover O&M budgets increased dramatically in all cases (even San Rafael which was not turned over), except RUT, which declined by almost 40 percent. The decline in RUT is apparently attributable to its high cost and sudden loss of substantial subsidies from the government. Following transfer, expenditures for O&M in high-cost RUT and Samacá were cut substantially while, for low-cost Rio Recio they increased significantly. O&M expenditures (by the government) in high-cost San Rafael increased further even before it was transferred to the users.

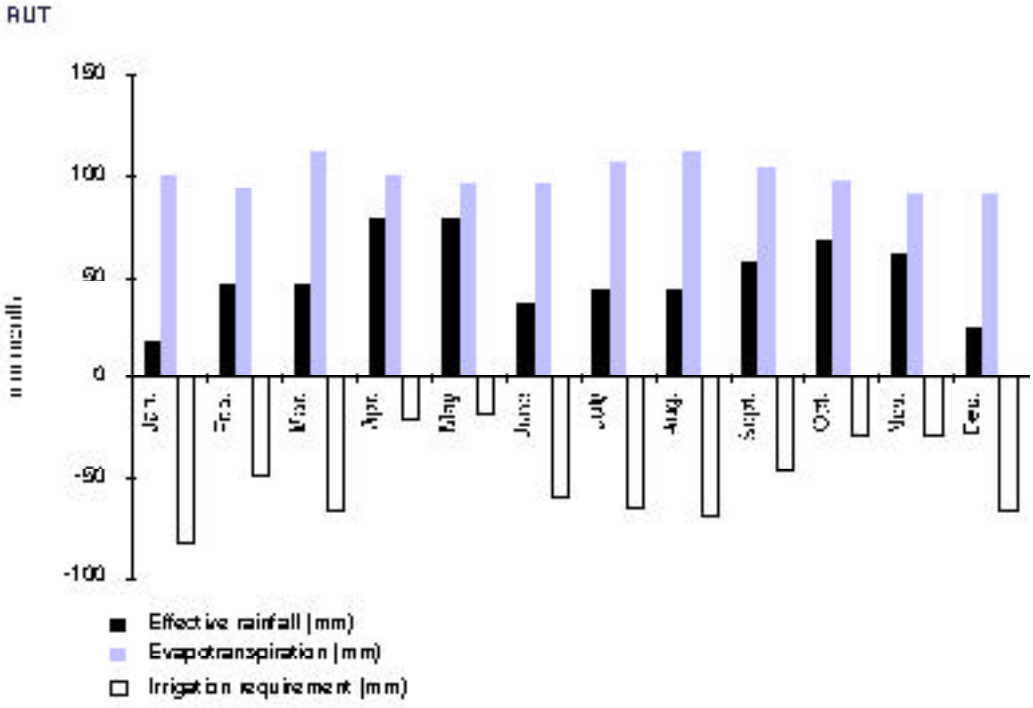
Quality of Operations

Monthly water balance data for the four sample schemes are presented in figure 7. The irrigation requirement (shown as hanging bars) is the difference between effective rainfall and evapotranspiration. In all the four sample districts there are two marked rainfall periods during the year. In RUT and Samacá, irrigation is required to supplement effective rainfall in nearly every month of the year (except November in Samacá). In Rio Recio, irrigation is required only 8 months of the year. No irrigation is required during the rainy periods of April–May and October–November. In all districts, irrigation is supplemental to cover frequent and sometimes lengthy dry periods.

Figure 5 and table 7 present annual data on Relative Water Supply (RWS), Relative Irrigation Supply (RIS), and total precipitation.[11] RUT and Rio Recio have relatively abundant water supplies in relation to crop water requirements. Since RUT is a pump scheme, RWS and RIS values which are above 2.0 suggest poor management in that they are pumping more than what is required for irrigation. Prior to

[11] RWS is the sum of irrigation supply (IS) and total rainfall (TR) divided by crop water requirement (CWR), i.e., RWS = (IS + TR)/CWR. RIS is irrigation supply (IS) divided by the difference between crop water requirement (CWR) and effective rainfall (ER), i.e., RIS = IS/(CWR-ER).

FIGURE 7.
Average monthly water balance in sample districts.



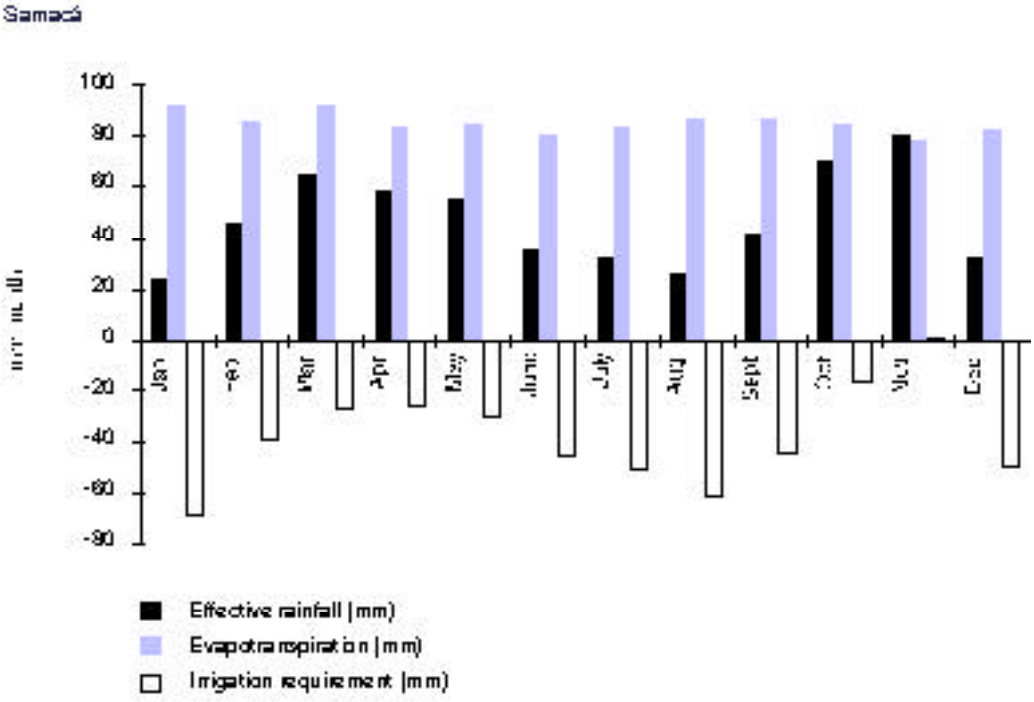


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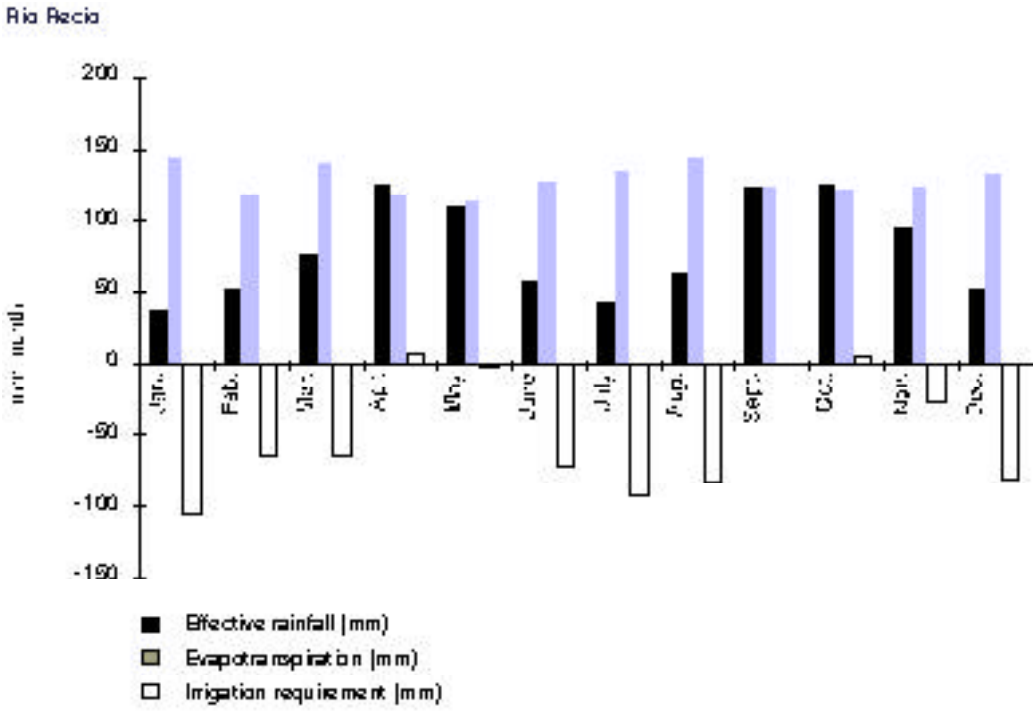
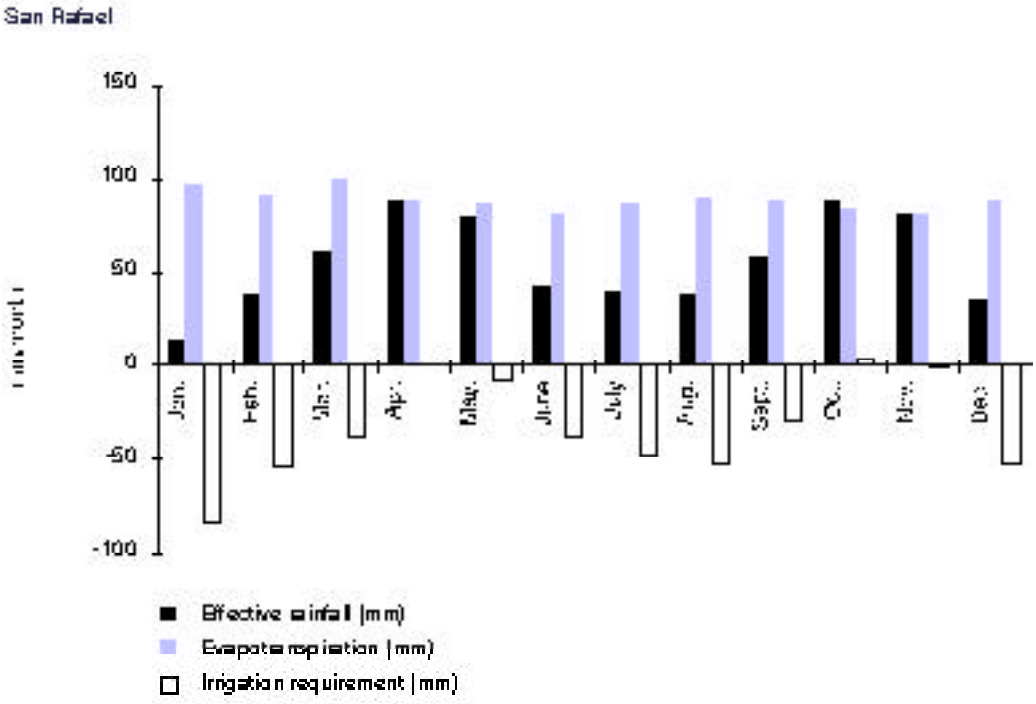
FIGURE 7. *(Continued)*





transfer, farmers had got used to an on-demand system of ordering water and this continued after transfer, despite the high costs involved and the inefficiencies of this delivery system. However, after transfer, RIS has been on a declining trend as the new management has attempted to reduce the amount of water pumped.

In Rio Recio, RWS and RIS values above 3.0 also indicate that the management is diverting water far above crop water requirements, leading to greater inefficiencies. However, since it is a run-of-the-river scheme and there are no other users downstream, there is little incentive for the district to divert less water. But, given that Rio Recio has the opportunity to sell water for energy generation, the high RWS and RIS values are indications of high opportunity costs. RWS and RIS have continued to rise even after transfer.

From just before transfer in 1992 until 1996, RWS and RIS values for Samacá have been roughly within what can be considered an ideal level of approximately 1.5. This did not change after transfer. The low values for RWS and RIS for San Rafael indicate that farmers have been unwilling to pump unless it was absolutely necessary, given the high costs. Also, the predominant crop is pasture, which is more resistant to dry periods than crops grown in the other districts. However, values less than one indicate that the crops are being grown under stress and yields could be affected. While it makes good sense of management to keep pumping costs down, this should not be done at the cost of crop yields.

No significant changes in RWS or RIS were observed in Samacá or San Rafael after transfer. The significant decline in RIS in RUT after transfer is explained mainly by the high cost of pumping and the declining financial situation due to elimination of government subsidies and declining revenues from water charges. Increase in RWS in Rio Recio after transfer is apparently more related to above-average levels of rainfall after transfer than to the transfer itself.

Another measure of operational performance is the Capacity Utilization Ratio (CUR), expressed as a ratio of the annual peak demand for irrigation to the maximum canal carrying capacity. It is an indicator of the extent to which canal delivery capacity is being availed. Data for RUT (shown in figure 8 and table 7) show a gradual improvement from 1986 through 1993, at which time the CUR reached 1.25.[12] The rise was related to shifts to crops with higher water requirements. The decline after 1993 was apparently due to the decline in RIS in recent years, brought about the financial crisis mentioned above. Samacá also had a rising trend (figure 8) over time that reversed at transfer and stabilized at a moderate level of about 0.6.[13]

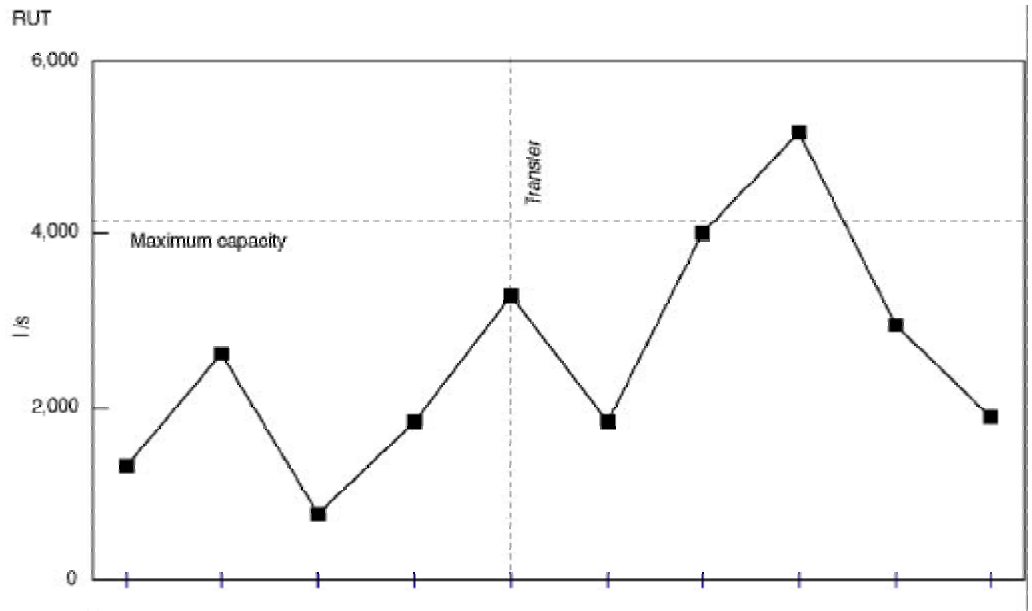
Figure 9 shows the data on trends in irrigation intensity in the sample districts. San Rafael has the consistently highest intensity due to its production of pasture that has grown through both cultivation seasons. Intensities increased to the range of 150–170 percent in both RUT (mainly because of increasing the area planted with sugarcane) and Samacá (mainly due to increasing the area planted with multiple crops of onion). But in both cases, the increases began before transfer and cannot, therefore be attributed primarily to management changes brought about by transfer. Rio Recio has had a steady decline in irrigation intensity over the entire period, from 160 percent to 115 percent. This is related to a general shift from flooded rice to cotton, sorghum, and other crops. The decline in irrigation intensity

[12]Peak demand exceeded maximum capacity in 1993 (with a CUR of 1.25). This happens when farmers establish a cropping pattern over an area such that the irrigation requirement exceeds what can adequately be served with the available canal capacity. In this situation rotational deliveries could be arranged and/or the delivered flow may temporarily encroach on canal freeboard.

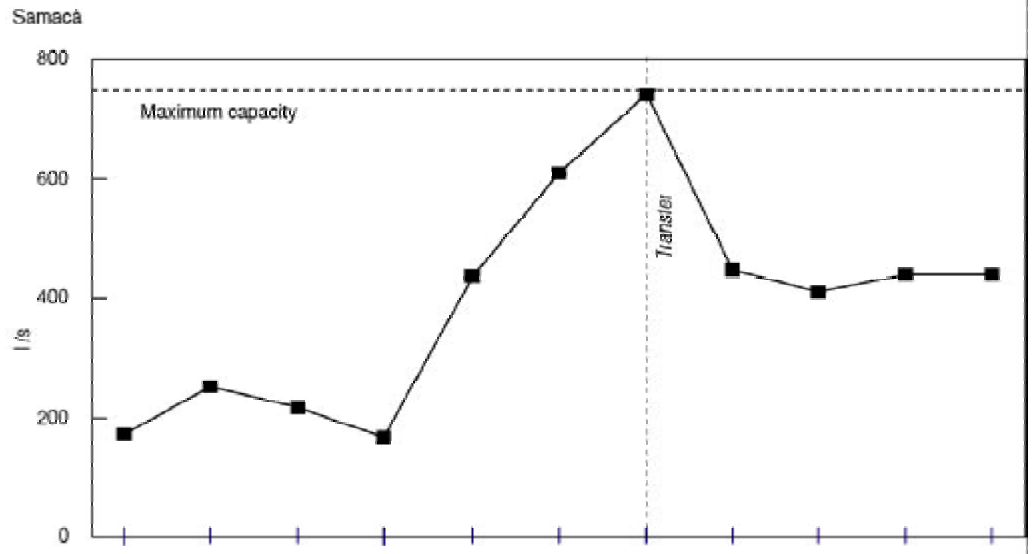
[13]This was also apparently related to shifts in crop choices as noted in the section entitled "Impacts on Productivity" p28.

despite high RWS and RIS is an indication of poor water management, which has continued to worsen after transfer. This statement is supported by the trend in values of both water- and agriculture-related indicators, for this system.

FIGURE 8.
Capacity utilization ratio in sample districts.

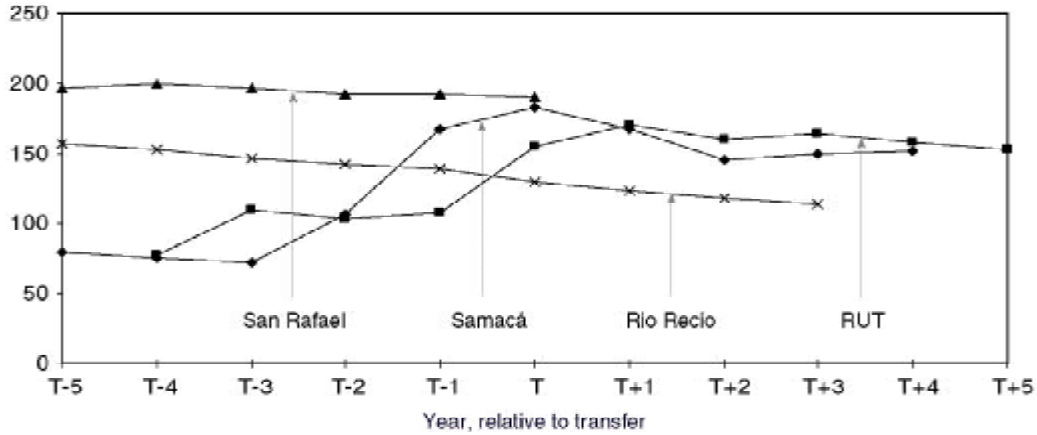


Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Peak demand	1322	2605	764	1826	3266	1841	4002	5163	2947	1895
Max. capacity	4134	4134	4134	4134	4134	4134	4134	4134	4134	4134
Cap. util. ratio	0.32	0.63	0.18	0.44	0.79	0.45	0.97	1.25	0.71	0.46



Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Peak demand	173	253	218	166	435	609	743	448	409	439	439
Max. capacity	750	750	750	750	750	750	750	750	750	750	750
Cap. util. ratio	0.23	0.34	0.29	0.22	0.58	0.81	0.99	0.6	0.55	0.59	0.59

FIGURE 9.
Annual irrigation intensity in sample districts.



Note: T-5 is 5 years before transfer. T is the year of transfer. T+5 is 5 years after transfer.

Figure 2 (charts 2.1 and 2.2) shows that the majority of farmers interviewed in RUT, Rio Recio, and San Rafael felt that water delivered was both adequate and fairly distributed before and after transfer. Farmers in Samacá are divided between the positive and negative views of water adequacy and fairness of distribution. This is mainly due to the bifurcated and elongated structure of the system between the hillsides and valley floor and water-scarce conditions in Samacá.

We hypothesized that the proportion of farmers who perceive change in performance before and after IMT (or the reference year for nontransferred schemes) would be different between transferred and nontransferred districts. This was disconfirmed at the 95 percent level of probability with the Pearson Chi-square test (X^2), for the three indicators of:

1. Farmer perceptions about adequacy of water delivered to the farm (X^2=0.0003),
2. Adequacy of system maintenance (X^2=3.65), and
3. Fairness of water distribution (X^2=3.76).

Our conclusion is that management transfer by itself did not bring about any clear and significant changes in the quality of irrigation operations in the study schemes.

Impacts on Sustainability of Infrastructure

A detailed field inspection was made of canal lengths and structures in the RUT, Rio Recio, Samacá, San Rafael, and Maria La Baja schemes. The study team inspected sample canal lengths randomly selected within upper, lower, and tail strata along main, branch, and distributary canals. All control and measurement structures along the sample lengths were inspected. Canal reaches and structures were classified as 'functional' (F), 'nearly dysfunctional' (ND), and 'dysfunctional' (D).[14] Canal lengths were considered 'defective' if one of the following problems existed and if it interfered with the desired hydraulic operation—

[14] A *functional* structure is defined as one that can currently perform its basic design function and shows no signs of losing this capacity within about a year. A *nearly dysfunctional* structure is one that is considered to be likely to become unable to perform its basic function within about one year's time. A *dysfunctional* structure is one that was unable to perform its basic function at the time of the inspection. For canal reaches, *dysfunctional* means it is unable to convey at least 70 percent of the desired flow capacity. *Nearly dysfunctional* means it is likely to become *dysfunctional* within about one year's time.

- constriction or enlargement of the canal cross section
- visible siltation and/or encroachment of freeboard or adjacent road
- visible seepage
- slippage, scouring, or other defects in the embankment
- cracks or other damage to canal lining

Table 9 displays the percentage of total canal length inspected in each scheme that was observed to be dysfunctional, nearly dysfunctional, and functional. Except for Maria La Baja (which had numerous design and construction problems and was undergoing rehabilitation at the time of the study), dysfunctional canal lengths were rare. Nearly dysfunctional sections were found along 10 percent to 19 percent of observed canal lengths.

TABLE 9.
Functional condition of structures inspected.

District	Total structures in scheme	Structures inspected (%)	Dysfnctional (%)	Nearly dys-functional (%)	Functional (%)
RUT	80	50	4	14	82
Rio Recio	234	17	0	3	97
Samacá	525	60	11	28	62
San Rafael*	40	25	0	12	88
Maria La Baja**	250	22	52	30	18

* Network inspected was drainage network. San Rafael has no surface irrigation canals.

** Some canals inspected are already under rehabilitation as part of the IMT process.

Control, conveyance, measurement, and ancillary structures were considered defective (i.e., dysfunctional or nearly dysfunctional), if one of the following conditions was present:·

- Scouring of canal adjacent to the structure.
- The approach section, rubble pack, or wings of structures are breaking apart.
- The water control structure cannot control flow as intended (due to gates or sills missing, eroded, or damaged; significant leakage at gates; or damaged mechanism of movable structures).
- The water measurement structure cannot be used to measure flow due to a damaged or missing gauge, recorder, or other component.
- The civil works of ancillary structures are damaged or poorly constructed.

Table 10 shows the number of structures inspected that were found to be dysfunctional, nearly dysfunctional, and functional. Again, Maria La Baja was in poor condition with 82 percent of observed structures being either dysfunctional or nearly so. This clarifies why the farmers have resisted transfer and insisted that the scheme be rehabilitated before transfer. Samacá is problematic with only 62 percent of observed structures being fully functional. Figure 10 shows that most of the dysfunctional structures in Samacá are adjustable gates (many are missing or damaged) and division boxes (many with broken sills or walls).

TABLE 10.
Functional condition of canal lengths inspected.

District	Total canal network length	Length inspected (%)	Length dysfunctional (%)	Length nearly dysfunctional (%)	Length functional (%)
RUT	170.7	10	0	17	83
Rio Recio	135.8	12	0	10	90
Samacá	58.0	28	6	19	75
San Rafael*	30.0	15	3	12	85
Maria La Baja**	284.7	13	19	19	62

* Network inspected was drainage network. San Rafael has no surface irrigation canals.

** Some canals inspected are already under rehabilitation, as part of the IMT process.

The study team working together with maintenance staff of the Irrigation Department also estimated the cost using local materials and labor to repair all canal lengths and structures that were identified as dysfunctional or nearly dysfunctional. In table 11, the cost estimate for repairing all dysfunctional canal lengths and structures is referred to as the *accumulated essential maintenance requirement* (row 2). The cost estimate for repairing all defective canal lengths and structures is referred to as the *accumulated preventive maintenance requirement* (row 3). The combination of the two is termed the total accumulated or *deferred maintenance requirement* (row 4), which means maintenance problems that have been deferred from routine maintenance.

If we add routine and accumulated maintenance requirements together (row 5) and compare this to routine expenditure, we have a value which is the percentage by which routine expenditure would have to increase to take care of all routine, essential, and preventive maintenance requirements within 3 years (row 6). Clearly, the lower the value, the greater the organization's ability to handle current maintenance requirements without external subsidies.

FIGURE 10.
Distribution of dysfunctional structures by type, Samaca irrigation system.

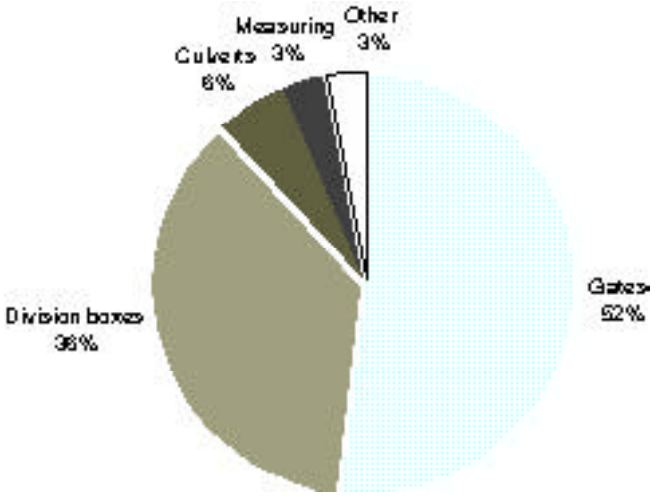


TABLE 11.
Maintenance investment capacity in transferred districts.

	Maintenance expenditures and requirements (1995 US$ per ha)	RUT	Rio Recio	Samacá
1	Current average annual maintenance expenditure (US$ per ha)	38.18	25.45	19.12
2	Accumulated essential maintenance requirement (US$ per ha)	0.46	0	3.01
3	Accumulated preventive maintenance requirement (US$ per ha)	0.91	1.01	3.42
4	Total accumulated or deferred maintenance requirement (US$ per ha)	1.36	1.01	6.43
5	MIC Index (item 1/item 4)	28.10	24.95	2.97
6	Total annual maintenance expenditure required to do routine maintenance plus complete essential maintenance in 1 year and preventive maintenance in 3 years (US$ per ha)	38.95	27.97	23.27
7	Increase of item 6 over item 1 (%)	2.0	1.3	21.7

To eliminate deferred maintenance requirements within 3 years RUT and Rio Recio would only have to raise the average maintenance budget by 2 percent and 1.3 percent, respectively. This is quite reasonable and we conclude that maintenance appears to be sustainable in these schemes from the aspect of resource mobilization.[15]

However, in Samacá, the situation is more problematic. The district would have to increase its maintenance budget by 21.7 percent to eliminate the accumulated maintenance requirement within 3 years. In theory, this could be achieved either by increasing the fee collection rate above its current level of 70 percent, or by increasing the fee per hectare, or both. The district had already increased its water charges by 56 percent between 1990 and 1995. Even with an additional increase in the water fee, the fee will still be significantly lower than in the other districts. However, there is cause for concern about whether the district will be able to raise the budget by a further 21.7 percent to eliminate the backlog since the fee collection rate has been on a declining trend after transfer—from 80 percent in 1993 to 70 percent in 1996 (figure 4). An increase in the fee collection rate could lead to a further decline in the collection rate.

Figure 2 (chart 2.3) shows that most farmers in RUT and Rio Recio perceived maintenance to be adequate before and after transfer. Positive farmer perceptions in RUT and Rio Recio, and more divided perceptions in Samacá, correspond generally with the results of the scheme inspections. Farmers in Maria La Baja are very dissatisfied with canal maintenance for reasons mentioned above. With the exception of Maria La Baja, and some concern about Samacá, we can conclude that most of the schemes transferred appear to be physically sustainable, assuming moderate increases in maintenance investment can be made.[16]

Impacts on Productivity

Changes in management practices and financial status of irrigation districts can be considered as direct outcomes of management transfer. These, in turn, could be expected to have effects on the quality of operations and maintenance. Changes in the quality of operations and maintenance

[15]However, in RUT the inspection did not include the condition of pump stations, which could represent a significant additional cost requirement.

[16]Since no inspections were conducted before transfer, it is impossible to directly compare functional conditions of infrastructure before and after transfer.

could, in turn, effect the agricultural and economic productivity of irrigation schemes.

We have seen that, with the apparent exception of RUT, transfer did not result in significant changes in the quality of operations and it appears doubtful that it had much effect on maintenance, as levels of maintenance investment have not deteriorated (according to farmer reports). Hence, except for RUT, we would not expect to find significant changes in agricultural or economic productivity that could be attributed to management transfer.

Figure 9 shows that only one scheme (RUT) had significant improvement in cropping intensity at the time of transfer and afterwards. The cropping intensity rose from 110 percent to 160–170 percent after transfer. The increase is attributable to a shift to sugarcane production (which is in the ground year-round), perennial grape, and tree crops. However, soybean yields (one of the major crops) remained constant before and after transfer (figure 11). Also in RUT, gross value of output (GVO) per unit of land did not change significantly after transfer (figure 12). The post-transfer improvement in value of output per unit of water in RUT is attributable to the decline in RIS (as referred to above) and it appears that the decline in RIS is related to financial pressures induced by transfer.

In Samacá, irrigation intensity and potato yields (figures 9 and 11) were on the rise before transfer and reversed to a slight downward trend afterwards. But this is apparently more related to temporary disturbances caused by significant shifts in crop choices among farmers, rather than to effects of management transfer. Substantial drops in GVO per hectare and per cubic meter followed by improvements after transfer (figures 12 and 13) are apparently attributable to temporary water balance disturbances related to shifts by farmers to higher-value commercial crops such as potato and onion. After the volumetric fee was discarded in Samacá in 1991, more pasture and vegetable crops were grown and there was a slight increase in the amount of water diverted per hectare (figure 5). With the shift to higher value crops which occurred just before management transfer, the GVO per unit of land and water reversed to a rising trend after transfer. The discarding of the volumetric fee can be linked to management transfer (in that, it was the decision of the farmer assembly), but changes in crop patterns towards more onion and potato cannot be linked.

FIGURE 11.
Yields of major crops in sample districts.

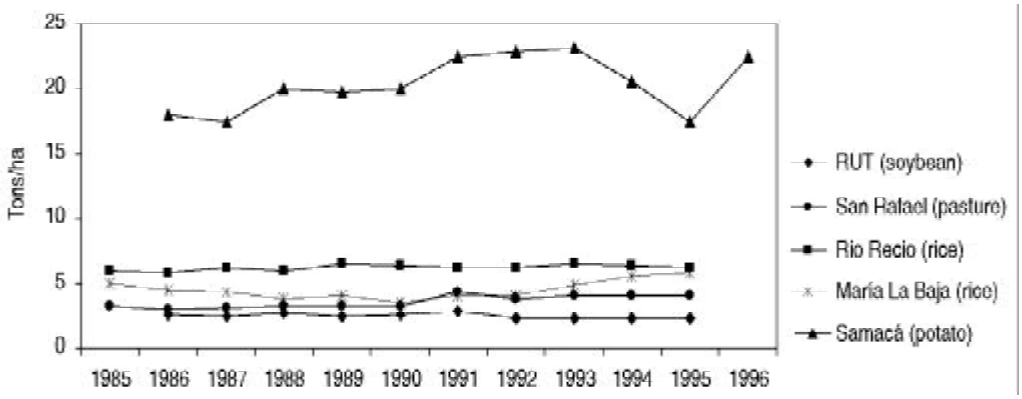


FIGURE 12.
Annual gross value of output per unit of land.

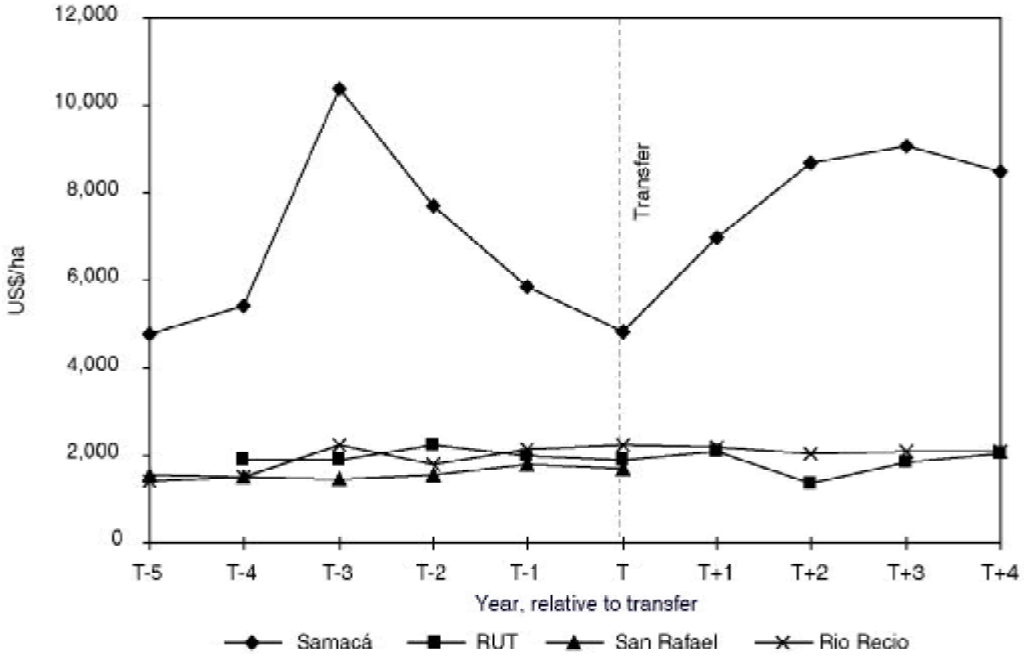
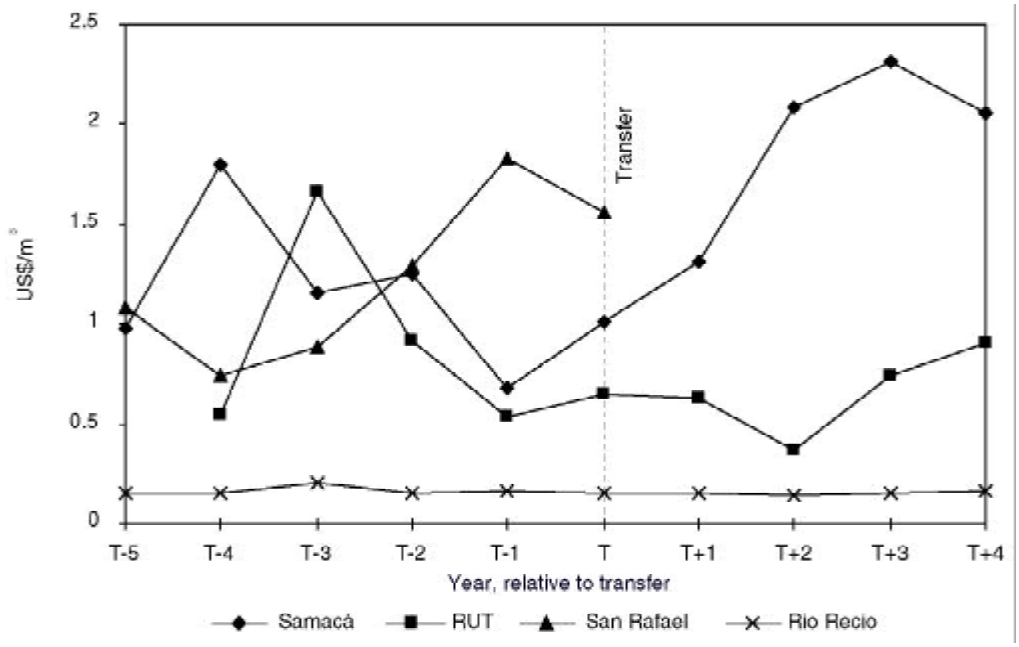


FIGURE 13.
Annual gross value of output per unit of water.



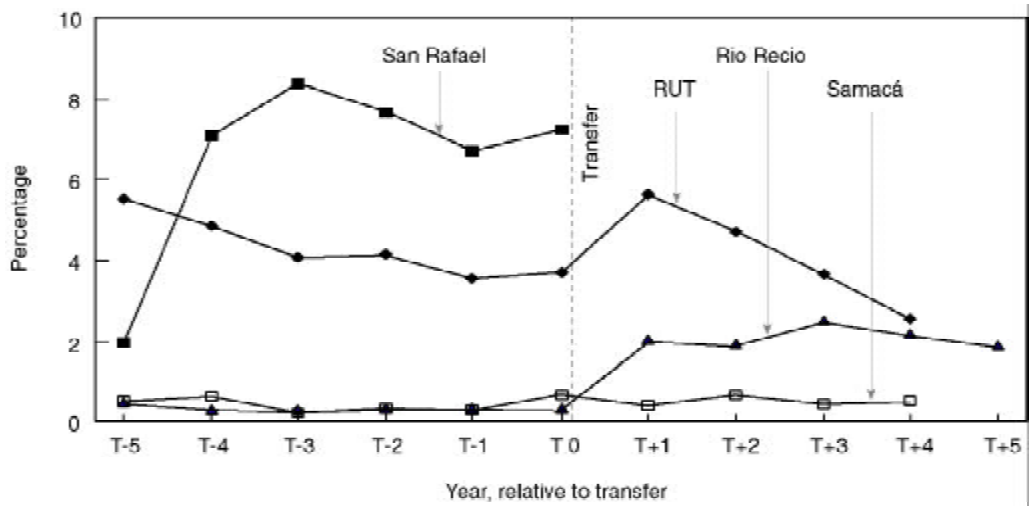
Changes in the crop pattern in the other districts do not appear to be related to management transfer. Irrigation intensities have been on a long gradual decline in Rio Recio since before transfer, but have remained stable in San Rafael (which was not transferred during the same period). Between 1985 and 1995, main crop yields (rice) in Rio Recio, which had been transferred, and San Rafael (pasture) and Maria la Baja (rice), which were not transferred, have all remained fairly stable (figure 11).

Figure 12 shows that GVO per unit of land remained relatively stable after transfer in RUT, Rio Recio, and San Rafael. Samacá was the exception. Figure 13 shows that the GVO per unit of water increased significantly in three of the transferred schemes, including non- transferred San Rafael. In Rio Recio, although rice has been gradually replaced by cotton and other grains after transfer, the amount of water diverted has not declined; hence, GVO per unit of water has not improved.

As mentioned above, the increase in GVO per unit of water in RUT after transfer is due to a shift to higher value crops such as sugarcane and smaller water orders due to higher pumping costs. Mainly due to financial pressures created by the loss of government subsidies in RUT, and reductions in volume of water delivered per hectare after transfer, the district significantly reduced its RIS ratio as well as its GVO per unit of water pumped into the main canals. In San Rafael, high pumping costs similarly resulted in higher GVO per unit of water delivered, but this cannot be attributed to management transfer, since it did not occur until 1995. So we conclude that, except for RUT, management transfer itself did not have significant impacts, either positive or negative, on the agricultural or economic productivity of the study schemes.

Data are available on cost of irrigationas a percentage of gross value of output for RUT, Rio Recio, and Samacá. In RUT, the declining trend in this indicator is related to a decline in the RIS (as noted above) and a decline in water fee collection rates after transfer. Cost of irrigation relative to GVO rose gradually after transfer in Rio Recio and Samacá (figure 14).

FIGURE 14.
Cost of irrigation as percentage of gross value of output.



Note: Based on per ha farmer costs and output, in 1995 US dollar equivalents.

Conclusion

The national irrigation management transfer program in Colombia adopted in 1990 can be characterized as a significant but only partial devolution of management to water users. The government maintained considerable advisory influence over the districts for several years, exercising some control over O&M plans and budgets, and resisting district attempts to release large numbers of staff. After adoption of the 1993 Land Development Law, this control was relaxed considerably and districts gained almost complete control over O&M, financial management, and disposition of staff. However, powers devolved do not include a formal water right or ownership of irrigation scheme infrastructure. Also, the government has not made it clear as to whose responsibility it will be, and under what terms and conditions, to finance possible future costs of rehabilitation.

The findings of this study support the hypothesis that management transfer leads to efforts by the WUA to improve management efficiency, such as reducing the number of management staff and taking measures to cut costs (see table 12 for a summary of impacts).

TABLE 12.
Summary of impacts.

Measures to improve cost efficiency	High priority after transfer, several measures adopted
Measures to improve administration and communications	Majority of farmers report no change
Cost of irrigation to the government	Significant reduction
Cost of irrigation to the farmers	Upward trend, especially for pump schemes
Total cost of irrigation	Mixed results, no clear pattern
Local financial self-sufficiency for O&M budget	Increasing trend after transfer
Water distribution	Mixed results. Planned improvements in relative irrigation supply in 2 schemes. Majority of farmers report no changes in adequacy or fairness of water distribution
Financial sustainability of infrastructure	Three sample schemes OK. Two others have significant deferred maintenance or construction problems. Costly pump schemes are in doubt. No capital replacement funds set up
Functional condition of infrastructure	Good in 3 schemes, problematic in 2 others
Agricultural productivity	No significant changes
Economic productivity	Mostly no change in GVO/ha. Improving trend in GVO/m^3 water in 3 schemes (partly related to managerial improvements in RIS in 2 schemes)
Ratio of cost of irrigation to gross value of agricultural output	Mixed results

In the short term, the government has achieved its objectives of significant reduction of government expenditures for irrigation management. In most cases, this has resulted in a significant but not severe increase to farmers in the cost of irrigation. In most cases, total costs of O&M did not change much after transfer. The general conclusion regarding operations and maintenance is that management transfer did not appear to bring about significant changes in the quality of operations or maintenance, that the transfer did not settle problems, and that it did not interfere with favorable management. Results of the maintenance survey suggest that most gravity flow, river diversion schemes that were transferred in the early wave of the reform appear to have the capacity to finance and carry out a sustainable maintenance program.

Schemes transferred more recently tend to have high management costs (such as San Rafael) or dilapidated infrastructure with high costs for repair (such as Maria La Baja). This makes the prospect of local sustainability for these schemes much more problematic than those transferred in the early wave of transfers. The financial sustainability of pump schemes is in doubt after the government abolished all energy subsidies and farmers were forced to pay the full cost of pumping water. Of the five districts, only RUT established an equipment-replacement fund. No district has set up a capital-replacement fund for basic infrastructure. So there is cause for concern about the willingness of the farmer-governed districts to invest in the long-term sustainability of scheme infrastructure.

The sample districts did not show any significant improvements in agricultural or economic productivity that could be attributed to management transfer. In summary, management transfer prompted a number of managerial changes aimed at improving management efficiency and staff accountability in the districts. Transfer resulted in a significant shift in the burden of cost from the government to farmers, which has generally been accepted by farmers. But transfer has not had substantial impacts on the performance of operations and maintenance, or on the agricultural and economic productivity of irrigated land or water—neither improving negative performance nor causing detriment where performance is positive.

The assumption is commonly made that management devolution will lead to improved performance of irrigation systems. But irrigation management transfer is not a singular concept. There are a variety of strategies worldwide that vary in degree of authority transferred. In the case of Colombia, management transfer was significant but not complete. In the early years, the government maintained considerable authority over O&M plans, budgets, and district staff. The government retains ownership of infrastructure and is also responsible for financing future rehabilitation and modernization of the schemes. No water rights have been granted to the districts or water users. Further comparative research is needed to test the hypothesis that a more integrated and comprehensive devolution policy would lead to more positive impacts on performance.

This study provides evidence that irrigation management transfer does lead to improve the efficiency and contain the cost of management. This study suggests that to be viable, local management should be given full authority over O&M plans and budgets, financial management, disposition of staff, and enforcement of sanctions. The study lends credence to the argument that consistent and integrated policy support is needed to induce farmers to invest

in the long-term financial and physical sustainability of irrigation systems. Examples of such kinds of support, which are often lacking in management transfer programs in many countries, are the following:

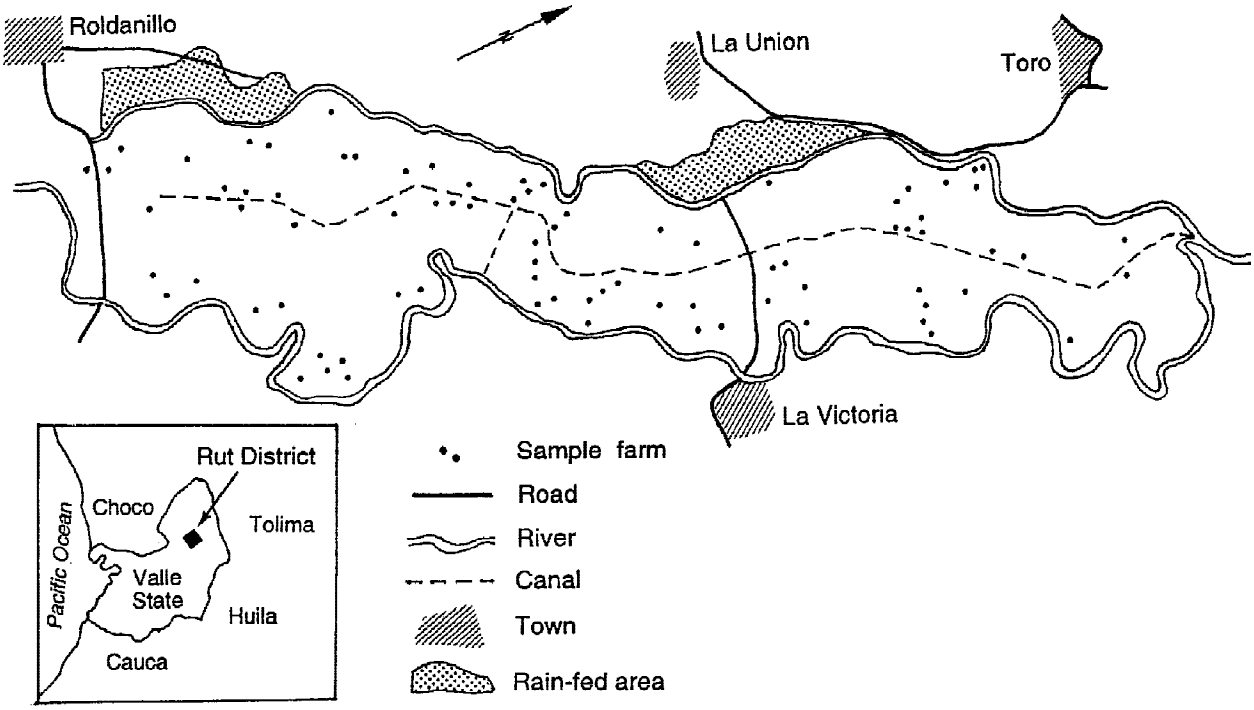
- Clear policy about terms and conditions whereby future subsidy or financial assistance for rehabilitation, or modernization of irrigation systems will be provided.
- Linkage of such a policy to some degree of matching local investment, development of a long-term capital replacement fund by local management, and implementation of maintenance according to agreed technical standards.
- Arrangements whereby the government conducts technical audits of maintenance and helps guarantee the financial integrity of capital replacement funds.
- Involvement of farmer equity and decision making in pre-transfer repairs to engender a sense of local ownership in the irrigation system.
- Adequate on-the-job training provided to new staff through at least one or two full seasons prior to transfer.
- Special arrangements to provide extra, but well-specified subsidies (which phase out gradually) to lift schemes which have high energy costs.
- A program to develop a post-transfer arrangement for provision of support services to locally managed irrigation systems for technical and financial consultation, dispute resolution, and political lobbying. Experience in Colombia and elsewhere suggests that such services are needed after transfer to help local management be viable in the long run.

Regarding this last point, in order to minimize costs and ensure a demand-driven approach, it may be worthwhile for governments to facilitate development of provincial or national-level water user network organizations, such as the Federriego in Colombia (García-Betancourt 1995), to provide such services after devolution.

Despite the last point above, it appears likely that governments will still need to play roles in technical auditing or consultation, and dispute mediation, providing partial subsidies designed to stimulate (not discourage) local investment, providing financial security for long-term capital-replacement funds raised by WUAs, water allocation, and water quality regulation upstream. Perhaps the most fundamental recommendation that could be made at this point is that governments that have adopted devolution policies but are still designing programs to implement them should develop integrated, comprehensive devolution strategies that are internally consistent and that promote the self-reliance of local management. Adequate investments should be made in monitoring and evaluation of management transfer and, where necessary in action research, so as to ensure that the change process is also an effective learning process.

ANNEX 1

Map of RUT District



ANNEX 2

Background Information on the Five Sample Districts

RUT

The Roldanillo-La Union-Toro (RUT) irrigation district is located in the prosperous Cauca valley and serves 9,700 hectares. It was built between 1958 and 1971. Water is pumped from the Cauca river through three pumping stations for both irrigation and drainage. The district has predominantly smallholdings, with 75 percent of holdings being less than 5 hectares each. The main crops are cotton, grape, fruit trees, and sugarcane. As can be seen in figure 7, rainfall is bimodal. The irrigation requirement alternates with rainfall but is spread throughout the year. Water is delivered on demand and is pumped a second time from the canal stet to farmers' fields. Hence, pumping constitutes a major cost to farmers.

Rio Recio

The Rio Recio district is located in the Tolima valley in central Colombia, which is one of the most productive agricultural areas of the country. Constructed in 1951, it is a river diversion gravity flow scheme

with open canals serving 10,200 hectares of steep to undulating terrain. Average landholding sizes are the largest of the five schemes, with 75 percent of landholdings being more than 10 hectares each. Main crops are rice, sorghum and cotton, which are irrigated on demand during periods of water abundance or on rotation during water shortages. The demand-based delivery system, 234 control structures, and water measurement structures down to farm inlets constitute a highly flexible and management intensive system.

Samacá

The Samacá irrigation district is located in Boyaca state, northeast of Bogota, in a narrow valley rimmed with steep hills. It is at an elevation between 2,600 and 3,000 meters. Water is supplied by two reservoirs with a combined total storage capacity of 6.2 million cubic meters. Water is delivered along hillsides on both sides of the valley and onto the valley floor. Irrigation is used almost year-round and is supplemental during the two rainy periods of the year, in March–May and October–November (figure 7). The district was constructed in 1941 and presently serves 3,000 hectares, of which 46 percent is on hillsides and 54 percent on the valley floor. Of all farm holdings in the scheme 95 percent is less than 5 hectares each. The main crops are onion, potato, pea, pasture, and vegetables. Water delivery to farms is scheduled weekly on the basis of written requests from farmers submitted to ditch tenders. On the hillsides, water is delivered to small temporary storage tanks, each serving 10–20 hectares, from which water is directed to individual fields through buried plastic pipes that use gravity pressure. In the valley, water is normally directed to small temporary storage ponds at farm intakes, out of which water is pumped onto each field. Significant differences in the socioeconomic status exist between poorer smallholders on the hillsides and more wealthy and influential large holders in the valley. However, regarding water, these tensions have been partly offset by the distribution of small farms upstream and a considerable amount of return flow from the hillsides being reused on larger farms in the valley and at the tail end of the system.

San Rafael

San Rafael district is a small river lift scheme built in 1970. It irrigates 560 hectares of land located in the mountainous Boyaca State. Water is pumped from the Chicamocha river (through a pump with a capacity of 0.60 m^3/s) and delivered to individual farms via a buried pipe system. Pasture and vegetables are the main crops grown. Soils and water have a high salinity content and much of the area is poorly drained during rainy times of the year. Irrigation is virtually unnecessary during the peak rainy periods in April–May and October–November (figure 7). On the basis of farmer requests, which must be submitted at least 2 days in advance, district staff make water delivery schedules. Before water can be delivered to a farm the area fee should be paid up to date. Recently, the district has been incorporated into the larger Chicamocha irrigation district that is currently under development. San Rafael is the first, and still the only unit in the larger district to be functional.

Maria La Baja

The Maria La Baja irrigation district is located 50 km south of Cartagena City near the Atlantic coast. Its water supply comes from two reservoirs fed by two rivers.

Together, the reservoirs have a total storage capacity of 235.5 million cubic meters and a combined discharge capacity of 20 m^3/s. The original design area was projected to be 19,600 hectares, but 32 years after construction in 1965, the actual irrigated area is only 9,260 hectares. Siltation in the reservoirs, fed by deforestation in the watershed, is cause for rising concern. The irrigated area has been shrinking in recent years. The shortfall in expectations and shrinkage has mainly been due to design errors, flooding, poor drainage, and waterlogging. There are also socioeconomic constraints such as extreme poverty. Bolivar State is in one of the poorer regions of the country and small farmers are often undercapitalized. Seventy-five percent of landholdings in the irrigated area is less than 10 hectares each. Sometimes, farmers cannot afford to purchase seeds or other inputs or obtain credit. Also, a considerable amount of the potentially irrigable land in the scheme is used for cattle ranching by wealthy farmers.

Topography in the irrigated area ranges from a slope of 12 percent near the mountains to flat land in swampy, flooded areas at the tail end of the system. By the end of the rainy season, the water table depth is within 0.50 of a meter over 80 percent of the area. On average, rainfall is relatively high (1,890 mm per year) but it is highly irregular. The most important crop is rice. Sorghum, pasture, plantains, cassava, and maize are also grown. As in other districts in Colombia, water deliveries are based on requests received from farmers, with the precondition that fee payments are up to date. It is reported that there are many problems with the design and construction of the scheme and many structures are in disrepair.

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