CHAPTER 4

Impacts Of Irrigation Management Turnover: A Review Of Evidence To Date[1]

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Abstract

Despite the widespread adoption of irrigation management turnover programs, little information is available internationally about impacts of turnover. This paper synthesizes the most significant evidence available to date about the impacts of turnover programs on performance of irrigation operations and maintenance, financial viability, agricultural and economic productivity, government resources and the environment. More data is available in the literature on operational and financial performance, while little data is available on effects of turnover on maintenance and economic performance of irrigated agriculture.

The literature shows a mixture of positive and negative results, while on balance most sources report positive results, especially in operations and finance, although the cost of irrigation to farmers often rises. Agricultural and economic performance tend not to change much with turnover. Turnover often results in reduction in expenditures for irrigation by the government

Introduction

Among the guiding principles of the Earth Summit held in Rio de Janeiro in 1992 were the recommendations that water should be treated as an economic good (with a right attached to it), that water management should be decentralized and that farmers and other stakeholders should play a more important role in the management of natural resources, including water (Keating, 1993). Increasingly, local management solutions are being sought for global problems of food and resource problems (Ostrom, 1990). Irrigation management turnover (or transfer) has become a widespread strategy in more than 25 countries in Asia, Africa and Latin America, where governments are reducing their roles in irrigation management while farmer groups or the private sector are taking them over (Vermillion, 1992). Most often governments pursue irrigation turnover programs in order to reduce their expenditures on irrigation, improve productivity, and stabilize deterioration of irrigation systems (Vermillion, 1994).

The string of logic often used to justify turnover policies is as follows:

> *Government bureaucracies tend to lack the incentives and responsiveness to optimize management performance. Farmers have a direct interest in enhancing and sustaining the quality and cost efficiency of irrigation management. When given the authority and right incentives to act collectively, farmers will tend to optimize and economize water management because it is in their direct interest to do so. However, where management transfer includes a decline in government subsidy to irrigated agriculture, it will involve an increase in the cost to farmers of irrigated agriculture.*
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> *When management transfer occurs in a supportive socio-technical context, it will result in improved quality and cost-efficiency of irrigation management. This (it is assumed) will normally enhance the profitability of irrigated agriculture enough to more than offset the increased costs to farmers of irrigation management.*

Management transfer will also save money for the government, as it divests itself of the responsibility to finance routine costs of operations and maintenance of irrigation systems. The savings can then be used either to reduce government expenditures in the irrigation subsector or to reallocate funds to other functions which can not be handled or financed directly by the private sector.

Following this line of reasoning, we can consider "successful" management turnover as that which saves the government money, improves the cost effectiveness of O&M while improving, or at least not weakening, the productivity of irrigated agriculture.

Irrigation management turnover is occurring in many countries in Asia, Africa, the Americas and the Pacific. Early efforts to transfer management from government to farmer organizations occurred in the USA, France and Taiwan in the 1950s, 1960s and 1970s. IMT, or turnover, became a national strategy in developing countries only in the 1980s and 1990s, with Chile, Peru, Mexico, Brazil, Dominican Republic, Haiti, Senegal, Mauritania, Niger, Zimbabwe, Tanzania, Sudan, Somalia, Madagascar, Turkey, Pakistan, India, Sri Lanka, Bangladesh, Lao, Vietnam, China, Indonesia and the Philippines and other countries adopting transfer programs. This has been referred to as "turnover" in Indonesia and the Philippines, "management transfer" in Mexico and Turkey, "privatization" in Bangladesh, "disengagement" in Senegal, "post responsibility system" in China, "participatory management" in India and Sri Lanka, "commercialization" in Nigeria and "self management" in Niger.

Emerging evidence about impacts

Given the extent to which management turnover is being implemented world wide, it is remarkable how little information is available internationally about the results of turnover programs. Whether or not management turnover can simultaneously save money for the government, result in more cost effective management for the farmers and achieve financial and infrastructural sustainability remains to be seen. Most reports about impacts are qualitative and hard to validate. Over 100 papers were prepared for the International Conference on Irrigation Management Transfer, held in Wuhan, China in September 1994. Of these, only 25 contained any data on performance outcomes of management transfer. Most papers presented post-facto data only, using at most, two or three performance measures. Four papers presented before and after comparison; one paper presented a with and without comparison (Turral, 1995). It is often difficult to distinguish the effects of management transfer from rehabilitation or changes in inputs or technology.

We will provide an overview of the kind of evidence which is emerging about the impacts of irrigation turnover, with reference to performance criteria, measures used, and the strength of evidence. The literature includes the following categories of performance measures:

- O&M performance,
- financing,
- agricultural and economic productivity,
- government resources, and
- the environment.

Evidence in the literature comes in four basic types, listed from the weakest and most frequent type to the strongest and most infrequent type:

- qualitative reports of stakeholders,

- post facto assessment of single cases,
- with and without comparisons, and
- before and after comparisons.

Table 1 displays basic information on the main references in the literature listed below. Most transfer units are sub-sections of irrigation systems which are managed by farmer organizations while the main system continues to be managed by a government agency. These range in size widely from 5 ha pump schemes in Indonesia to the 14,000 ha Paliganj Distributary Canal in Bihar, India. In several cases entire schemes are transferred to farmer organizations (usually federated). These range from small scale 50 ha schemes in Indonesia to the 230,000 ha Columbia Basin Project in the USA (which was transferred to three districts serving an average area of 77,000 ha). Most post-transfer organizations are farmer associations. At larger scales of transfer, such as in the USA, China, or Colombia, post-transfer governance entities tend to be farmer-elected boards of directors while management entities tend to be professional district management staff. The majority of cases cited in the literature involve a transfer of only partial control over irrigation system management functions. Most studies are post facto, with the second most common type being short-term before and after comparisons.

Table 1. Functions, levels and organizations in literature on irrigation transfer

Author	Country	Transfer Unit	Size of Tr. Unit	New Management Entity	Functions Transferred
1. Kloezen, 1996	Sri Lanka	Distributary C.	80-260 ha.	Joint agency/WUA	Partial
2. Uphoff, 1992	Sri Lanka	Field Channels	50-150 ha.	Farmer Associations	Partial
3. Pant, 1994	India	Tubewell Area	84 ha.	Farmer Cooperative	Full
4. Srivastava & Brewer, 1994	India	Distributary C.	14,000 ha.	Village Irr. Comm.	Partial
5. Rao, 1994	India	Minor Canal	359-513 ha.	Farmer Org. Comm.	Partial
6. Shah, 1994	India	Tubewell	50-150 ha.	Farmer Organization	Full
7. Rana, et. al., 1994	Nepal	Irrigation Syst.	500-2000 ha.	Joint Agency & WUA	Partial
8. Olin, 1994	Nepal	Tubewell Area	120 ha.	WUA	Full
9. Mishra & Molden, 1996	Nepal	Entire Scheme	8,700 ha.	WUA	Full
10. Oorthuizen & Kloezen, 1995	Philippines	Entire Scheme	150-200 ha.	WUA	Partial
11. Wijayaratne, et. al., 1994	Philippines	Laterals and Entire Scheme	500-5000 ha.	WUA	Partial/Full
12. Bagadion, 1994	Philippines	Distributary C.	2,500 ha.	Federated WUA	Partial
13. Johnson & Reiss, 1993	Indonesia	Tubewell Area	5 -200 ha.	WUA	Full
14. Nguyen, et. al., 1994	Vietnam	Pump Scheme	ND	Parastatal	Partial
15. Johnson et al., 1995	China	Entire Scheme	5,000 ha.	Irrigation District	Partial
16. Maurya; Musa, 1993	Nigeria	Distributary C.	126-271 ha.	Joint Agency & WUA	Partial
17. Samad, 1995	Sudan	Entire Pump Scheme	80-4000 ha.	Pvt. Co.; Tenant Org.	Partial
18. Wester, 1995	Senegal	River Lift	20 ha.	Farmer Group	Full
19. Azziz, 1994	Egypt	Turnout	20-60 ha.	WUA	Partial
20. Yap-Salinas, 1994	Dominican Republic	Federated	5240 - 9240 ha.	WUA	Full
21. Vermillion & Garces, 1996	Colombia	Irrigation Dist.	14,000 ha.	Irr. District Staff	Partial
22. Johnson, 1996	Mexico	Block	5,000 - 30,000 ha.	WUA	Full
23. Svendsen & Vermillion, 1994	USA	Irrigation Dist.	77,000 ha.	Irr. District Staff	Partial
24. Farley, 1994	New Zealand	Block	2000 ha.	Mutual Irrigation Co.	Full

Table 2 summarizes the extent to which different types of performance data are included in the literature reviewed herein. The most common performance indicators are those about operations, which included 21 of the 24 sources reviewed. Surprisingly little data is contained in the literature on economic impacts of transfer. This is an important deficiency since perhaps the most pertinent concern about management transfer is whether or not incremental benefits to farmers outweigh costs. Also, most sources make no attempts to identify and measure performance indicators which are important to farmers and other stakeholders. We believe it is important to include farmers perspectives in assessments of impacts of management turnover to farmer organizations.

Table 2. Performance measures included in literature on impacts of irrigation management transfer

Author	Country	Operational	Financial	Agricultural	Maintenance	Economic
1. Kloezen, 1996 (SI)**	Sri Lanka	Yes	Yes	Yes		Yes
2. Uphoff, 1992 (SI)	Sri Lanka	Yes		Yes		
3. Pant, 1994 (LI)	India	Yes	Yes	Yes	Yes	
4. Srivastava & Brewer, 1994 (SI)	India	Yes		Yes	Yes	
5. Shah, 1994 (LI)	India		Yes			
6. Rao, 1994 (SI)	India	Yes				
7. Olin, 1994 (LI)	Nepal	Yes	Yes			
8. Rana et al., 1994 (SI)	Nepal	Yes			Yes	
9. Mishra & Molden, 1996 (SI)	Nepal	Yeas	Yes	Yes		Yes
10. Oorthuizen & Kloezen, 1995 (SI)	Philippines	Yes	Yes		Yes	
11. Wijayaratne and Vermillion, 1994 (SI)	Philippines	Yes	Yes	Yes		
12. Bagadion, 1994 (LI)	Philippines					
13. Johnson and Reiss, 1993 (LI)	Indonesia	Yes	Yes		Yes	
14. Nguyen et al., 1994 (LI)	Vietnam	Yes		Yes		
15. Johnson et al., 1995 (SI)	China	Yes	Yes	Yes		Yes
16. Maurya; Musa, 1993 (SI)	Nigeria	Yes	Yes	Yes	Yes	
17. Samad, 1995 (LI)	Sudan	Yes		Yes		Yes
18. Wester, 1995 (LI)	Senegal	Yes		Yes	Yes	Yes
19. Azziz, 1994 (SI)	Egypt	Yes	Yes	Yes		Yes
20. Yap-Salinas, 1994 (SI)	Dominican Republic	Yes	Yes			
21. Vermillion and Garces, 1996 (SI)	Colombia	Yes	Yes	Yes	Yes	Yes
22. Johnson, 1996 (SI)	Mexico	Yes	Yes	Yes		Yes
23. Svendsen and Vermillion. 1994 (SI)	USA	Yes		Yes	Yes	Yes
24. Farley, 1994 (SI)	New Zealand		Yes			

** SI = surface irrigation; LI = lift irrigation.

O&M performance

Much of the literature which supports management turnover asserts that it enhances O&M practices. The most common kind of evidence employed is qualitative statements by project officers, farmers, researchers and rapid appraisal visitors, often based on chance encounters or group interviews with farmers. Project studies in the Philippines, Sri Lanka, Nepal, and India have reported farmer satisfaction with improved water delivery service and equity after turnover (Meinzen-Dick, et al., 1994a; Uphoff, 1992). Table 3 below summarizes key findings of literature on the results of turnover on the performance of irrigation operations and maintenance. Reports of turnover experiences in Mexico (Gorriz, et al. 1994); Colombia (Vermillion & Garces-Restrepo, 1994); and the United States (Svendsen & Vermillion, 1994) indicate farmer perceptions that O&M staff have become more responsive to farmers after turnover. Maintenance is reported to be more responsive to farmers' priorities after turnover in Chile (Meinzen-Dick, et al., 1994b, p. 77). However, assessments of farmer perceptions through participatory appraisal and group interview methods may not be a strong way to make generalizations or assess "external validity"; their value is more in eliciting farmer performance criteria and examining local dynamics (Gosselink & Hoeberichts, n.d.; Pretty, 1995).

Information on post facto change is common. Oorthuizen and Kloezen (1995) report on a case of turnover in Southern Luzon, Philippines where financial autonomy prompted farmers to take cost-cutting measures which negatively effected water distribution and maintenance, as reported by farmers and agency officials. Svendsen and Vermillion (1994) note a similar tendency of farmer boards in the Columbia Basin, USA, to cut costs to the point of infringing upon O&M performance.

In a survey of farmer perceptions about turnover, a study of two systems turned over to farmer management in central Colombia in 1976, Vermillion and Garces-Restrepo (1996) obtained survey data from 93 farmers sampled from upper and lower reaches of the Coello and Saldaña irrigation systems. In Coello system--where relative water supply (Levine, 1982) is normally approximately 1.4 and a variety of crops is planted--45% of farmers interviewed said water delivery was "always enough;" 32% said it was "enough most of the time." Forty percent judged that management in general had "improved" after turnover, 53% said it had "not changed much." In Saldaña (where relative water supply is in the order of 1.75 and only rice is planted), 59% said water delivery was "always enough" and 31% said it was "enough most of the time." Forty-five percent felt management had "improved," 35% said it had "not changed much," but 25% said it had "worsened." Although farmers were asked to compare the situation before and after turnover, their perceptions were obtained post-facto, 19 years after turnover, which constitutes a rather weak and possibly unbalanced before/after comparison.

Contrary to the common notion that farmers generally want to take over complete control, only 29% of farmers in Coello and Saldaña districts wanted the irrigation agency (INAT) to withdraw completely; 48% wanted the agency to remain partially involved in management (mainly to protect against abuses by powerful farmers and help settle disputes); and 21% preferred that the agency should take over management again.

Before and after timeline data on annual irrigation supply per ha in Coello shows a long-term declining trend from 1,300 mm in 1975 (the year before turnover) to 400 mm in 1991. The decline in irrigation supply per ha is partly due to expansion of area and decline in river flows at the source. Under these circumstances, it is notable that management was able to keep farmers relatively satisfied with water adequacy after turnover. Vermillion and Garces-Restrepo (1996) report current water use efficiencies to be 73% in Coello and 57% in Saldaña.

In a pilot turnover project in the Kano River Irrigation Project in Nigeria, newly organized farmers changed water distribution schedules to discontinue night-time irrigation and improve head/tail equity. This led to an additional 12% of water volume reaching middle and tail reaches of distributary canals within the season the changes were introduced (Musa, 1994). On the basis of post-facto farmer interviews and observations of water distribution, Kloezen (forthcoming) reports that turnover of distributary canals to farmer organizations in Sri Lanka did not change water distribution practices at the field channel level, partly because agency staff were still involved in management, canals had been recently rehabilitated and were in good condition, water was abundant and the attention of the farmer organizations was more on agricultural production than irrigation.

Comparisons of performance between systems with versus without turnover is rare in the literature. Most present either post-facto or before and after data. In a post-facto design about turnover of a medium size pump scheme along the Red River in Vietnam, Nguyen, et al. (1994) reports an increase in irrigation efficiency from 50% to 81% and a decrease in water consumption per ha from 8,000 m^3 to 5,120 m^3 (a 36% drop) over a four-year period after turnover. In another post-facto report, water delivery efficiency in the Azua system in the Dominican Republic increased between 25% and 30% after management transfer under the On Farm Water Management Project (NESPAK, 1994).

Before and after comparisons are stronger than post-facto data because they help rule out the possibility of trends having begun before turnover and continuing into the post-facto period. These tend to be simple, short-term comparisons however, without enough of a time line to confirm a pattern interrupt at the time of turnover. In a simple before and after comparison, Pant (1994) reports that the turnover of a public tubewell in Uttar Pradesh, India increased water and electricity use efficiencies by reducing average pumping time per irrigation from 42.4 and 39.3 hours per ha in kharif season for two years before turnover to 13.4 and 22.8 hours per ha in kharif season during the first two years after turnover (1992-94). Azziz (1994) reports a dramatic and consistent reduction in average irrigation time after management transfer in a sample of mesqa's small storage/shallow lift pump turnouts in Egypt from an average of 15-17.5 hours per ha before turnover to 5 to 7.5 hours per ha. However, no comparisons with non-Mesqa or non-turned over turnout groups is given, so it is not clear whether similar improvements occurred in other areas over time as well.

Regarding impacts on equity, Rao (1994) compares water delivered per ha between three minor commands in the Sreeramsagar Project in Andhra Pradesh, India. In one year after management transfer he recorded an improvement in equity between the three blocks from 2,186 m^3/ha, 4,387 m'/ha and 12,065 m^3/ha before transfer to 7,416 m^3/ha, 7,307 m^3/ha and 10,329 m^3/ha respectively, afterwards. However, this was in a system where total irrigation supply exceeds gross demand by more than 200%.

Turnover of the 12,000 ha Paliganj Distributary Canal in the Sone Command in Bihar, India to a federated farmers' organization in 1989 resulted in a new rotational arrangement in the dry season, policing of breaches and new use of farmer canal repair parties. The impact on equity of water distribution was reported in a simple, short-term before and after comparison. Before turnover in 1988, 16.7% of water entering the distributary reached gate 10, which was two-thirds of the distance to the tail end of the canal. By 1990, after farmers had taken over O&M for the canal, 21.2% of water entering the canal reached gate 10 and for the first time in known history, water reached to tail end of the canal (Vermillion, 1992). Before turnover, 30.7% of the canal command area which is located in the tail end received an average of 10 to 12% of total canal water. During 3 years after turnover, 18% of canal water reached the tail area (Srivastava & Brewer, 1994).

Long-term time series data on irrigation efficiencies before and after management devolution or turnover is available from case studies in the medium scale Nanyao and Bayi irrigation districts in the north China plain (Vermillion, et al., forthcoming). In Nanyao district, the rise in annual cost of irrigation water from US$ 4.68 per ha in 1972 to US$ 31.84 per ha in 1993 (in 1991 dollars) helped bring about a decline in water duty from 11,000 m^3 per ha in 1973 to only 4,500 m^3 per in 1993. Seen alone, this trend appears to continue unaffected by the reforms which occurred in the mid 1980s.

However, annual discharge into the system increased from 28 million m^3 in 1972 to about 60 million m in 1982 (at the collapse of the commune system) and then steadily declined thereafter to 20 million m^3 in 1993. The same peak and decline trend occurred in the Bayi system, where total annual discharge (from surface and groundwater) went from 6 million m^3 in 1972 to 34 million m^3 in 1980, then declining to 17 million m^3 in 1993. The average annual number of surface irrigations decreased from 3 in 1973 to 2 in 1992 in Nanyao and from 6 in 1973 to 4 in 1992 in Bayi--after peaking in 1982 in both systems. Introduction of the "pay for service" system at main canal, village and farmer levels undoubtedly influenced the decline in water diverted and delivered per ha after reforms in the mid 1980s.

Two studies which employ extended before and after comparisons report constant or slight temporary drops in irrigation performance for 2 to 5 years after transfer. In a study of the large-scale Columbia Basin Project in the USA, Svendsen & Vermillion (1994) report a relatively constant overall irrigation efficiency (system-wide PET/aggregate net supply) of about .46 to .48 after turnover in 1969. Conveyance efficiency dropped slightly at turnover from .70 to .65 in 2 years and then rose to pre-turnover levels for several years until a long-term decline to .62 by 1989 (attributed to deterioration due to the cost containment policy of the farmer board). Total system irrigation supply per ha. rose substantially for two years after turnover and then dropped 10% over 15 years, from a high point of .77 hectare-meters in 1971. The rise in total irrigation supply per acre after turnover occurred despite declining water delivery per acre at farm turnouts during the same time (due to rising use of sprinklers and shift to lower water consuming crops)--indicating a temporary lapse in main system management. Over the long-term since turnover, farmers generally reported no change in the quality or timeliness of irrigation delivery.

Garces-Restrepo & Vermillion (1994) report a three-year leveling off of long-term increases in irrigated area at the time of management transfer in the Coello district, which they attribute to temporary inefficiencies during adjustment to new management.

In their study of the Columbia Basin Project, Svendsen and Vermillion (1994) developed an equity index for comparing relative water supply between three branches in the system, each managed by a different farmer irrigation district. The study showed no change in equity for 6 years after turnover, followed by a steady decline, possibly due to system deterioration brought on by cost cutting measures. The index was 1.15 (i.e., 15% difference between branches with the highest and lowest RWS) for the period 1969-75 and then declined to 1.03-1.10 in the latter 1970's and early 1980's.

Regarding system maintenance, studies on lift irrigation in Senegal (Wester, et al., 1995) and Indonesia (Johnson and Reiss, 1993) report an acceleration in deterioration of pump set equipment for lift irrigation after turnover of equipment and networks to management by farmer organizations. In Indonesia this was attributed to lack of local knowledge, skills and spare parts. In Senegal, farmers continued to maintain the network while pump set equipment deteriorated, indicating a constraint in skills rather than farmer motivation. While the Indonesia study substantiated the finding with data on pump operating hours and ratios of irrigated versus design area, the Senegal study relied only on reports of breakdowns.

In a post-facto case study of a system in the Terai of Nepal, Rana, et al. (1994) report that irrigation discharge increased four fold after substantial turnover-related de-silting and repair work was conducted by farmers. Without comparisons with other systems which did not have physical repair work or which did not have turnover, it is impossible to distinguish the effect of physical repair versus turnover. The study by Mishra and Molden (1996) on the West Gandak scheme in Nepal found that inflow increased from 2.2 cumecs to 7.9 cumecs after turnover, relative to a design capacity of 8.5 cumecs. However, this result is primarily explained by the effects of a major de-siltation which was part of the turnover program. Without a long-term comparison before and after transfer, it is difficult to know whether similar levels of discharge might have been achieved before turnover. In the Bhairawa-Lumbini groundwater irrigation project in Nepal, it is reported that farmers became cost conscious after turnover and reduced waste of water, resulting in a 50% drop in water consumption per ha even at the same time the price of water was reduced by 40 to 50% (Olin, 1994).

In a study in Colombia, Vermillion and Garces-Restrepo (1996) conducted a detailed post-facto maintenance survey of the Coello and Saldaña irrigation systems in 1994. The study found that 68% of all irrigation structures (for conveyance and division) in Coello were fully functional and 30% were partially functional. In Saldaña, 48% of all structures were fully functional and 44% were partially functional. In Coello, 80% of farmers interviewed in a stratified random sample stated that maintenance of irrigation structures was the same after turnover as before; 15% said it was better afterwards. In Saldaña, 70% said it was the same; 10% said it was better. The post-facto study design, provides evidence that satisfactory performance can be sustained after transfer, but it does not show whether performance levels rose or fell as a result of transfer.

The study by Svendsen and Vermillion (ibid) relied on secondary data about maintenance from technical audits conducted every two years by the US Bureau of Reclamation.[3] For the 222,582 ha. Colombia Basin Project, between 1973-77 there were only 5 "category 2" recommendations by auditors which stated "important preventative maintenance needed". By the period 1980-84 there were 20 such recommendations. During the entire post-transfer period, no "category 1" recommendations were received ("urgent remedial maintenance required"). This suggests that cost cutting measures may be compromising the quality of maintenance over time, while still holding the line against breakdowns.

Most evidence on impacts on the performance of irrigation O&M is based on either qualitative reports or post-facto data for normally only 3 to 5 years. However, what limited data exists to date mostly indicates either positive or no effects on O&M performance, with the exception of some evidence that a temporary downturn in performance sometimes occurs immediately after turnover.

Table 3. Reported performance impacts on operations and maintenance

Author/Country	Operations	Maintenance
1. Kloezen/Sri Lanka, 1996 (SI)**	Quality of water distribution did not change.	
2. Uphoff/Sri Lanka, 1992 (SI)	Improved equity of water distribution.	Maintenance activity and investment increased.
3. Pant/India, 1994 (LI)	Reduced average irrigation time.	Maintenance work increased.
4. Srivastava & Brewer/ India, 1994 (SI)	Improved equity. 27% more water to tail end; 20% increase in irrigated area in dry season.	More maintenance activity.
5. Rao/India, 1994 (SI)	Improved equity of water distribution.	
6. Rana et al./Nepal, 1994 (SI)	Irrigation discharge increased four fold.	
7. Olin/Nepal, 1994 (LI)	50% drop in water consumption.	
8. Mishra & Molden, 1996/ Nepal (SI)	Inflow increased from 2.2 to 7.9 cumecs (26% to 93% of design capacity)	
9. Oorthuizen & Kloezen/Philippines, 1995 (SI)	Water distribution became less equitable.	Maintenance worsened.
10. Wijayaratne and Vermillion/Philippines, 1994 (SI)	Improved water distribution equity; expansion of dry season irrigated area.	
11. Johnson and Reiss/Indonesia, 1993 (LI)		Deterioration of pump sets accelerated.
12. Nguyen et al./Vietnam, 1994 (LI)	Irrigation efficiency improved 31%. Water consumption per ha. dropped 36%. Area irrigated increased 71%.	
13. Johnson and Vermillion/China, 1995 (SI)	Reduction in water duty from 11,000 m^3 to 4,500 m^3	
14. Maurya; Musa/Nigeria, 1993 (SI)	Improved equity. 12% more water reached middle and tail reaches.	Increased maintenance activity.
15. Samad/Sudan, 1995 (LI)	Average number irrigations higher in government than farmer managed schemes. Timeliness and water adequacy worse in schemes turned over.	
16. Wester/Senegal, 1995 (LI)	Expansion of areas irrigated.	Deterioration of pumpsets accelerated.
17. Azziz/Egypt, 1994 (SI)	Reduced average irrigation time; better water adequacy.	
18. Johnson, Mexico, 1996 (SI)	No change in water delivered per ha. in case study	
19. Yap-Salinas/Dominican Republic, 1994 (SI)	Delivery efficiency improved 25-30%	
20. Vermillion and Garces/Colombia, 1996 (SI)	More responsive operations. Water adequacy satisfactory. 40% to 45% farmers say operations improved. Temporary inefficiencies after turnover.	Good maintenance; 92% to 98% of state quality of maintenance has stayed same.
21. Svendsen and Vermillion/USA, 1994 (SI)	More responsive operations. Efficiency did not change. Equity worsened slightly.	Good but slight declining trend detected.

** SI = surface irrigation; LI = lift irrigation.

Irrigation finance

The five aspects of irrigation financing most related to management turnover are: staff, O&M costs and fees, fee collection rates, revenue sources and budget solvency. Table 4 below summarizes the key findings of the literature on the impacts of turnover on the financial performance of irrigation systems and organizations.

Staff In countries where transfer is aimed at reducing the size of government, reports generally indicate a reduction in numbers of irrigation agency staff follow transfer, either at system or administrative levels. This is often a gradual process however, while governments wait for staff to retire. In the Philippines, staff of the National Irrigation Administration, at regional and system levels throughout the country, decreased from 2.6 staff per 100 ha service area 1976 to 1 staff per 100 ha by 1985 as a result of management transfer. Oorthuizen & Kloezen (1995) report that turnover of a system in Southern Luzon led to a decrease in staff from 24 in 1982 to only 6 in 1987, or a drop from a service area of approximately 75 ha. per staff in 1982 to 300 ha. per staff in 1987. This led to a 60% reduction in annual operating expenses.

In the Columbia Basin Project in the USA, there were 612 US Bureau of Reclamation (USBR) staff in 1969--the year of transfer. By 1985 only 83 USBR staff remained. Staff declines were even steeper in the Irrigation and Land Management Division, dropping from 297 in 1969 to only 22 in 1985 (Svendsen & Vermillion, ibid). Staff were either re-hired by the districts, transferred to other systems, or retired.

Johnson (1996) reported a slight reduction in total irrigation system staff after transfer in Mexico but a substantial reduction of government staff from 7,742 before transfer to 4,450 by 1993. In Colombia the 10 irrigation systems transferred to farmer management between 1990 and 1994 had an average decline in the number of staff of 43.7%, which produced an average increase in area served per district-level staff by 211%. In Coello and Saldaña, which were transferred in 1976, there were 300 total district staff in 1975 and 189 staff in 1993. In 1975, an average of 62 ha was served per staff, whereas in 1993, 147 ha was served per staff (Garces-Restrepo & Vermillion, 1994).

O&M costs and fees The literature to date suggests that where significant subsidies exist before transfer and are dropped afterwards that transfer can result in significant increases in the cost of irrigation to farmers. Where there is little or no change in subsidies, transfer may lead to a decrease in irrigation costs for farmers. High cost systems, such as pump irrigation, are especially susceptible to significant increases in the cost of water to farmers. Lift irrigation systems seem to have the most problems with financial viability after transfer (Johnson & Reiss, 1993).

In Senegal, project reports indicate that irrigation turnover improved supervision of pump management and reduced over pumping, leading to an average increase in water charges of 200 to 400%, due to loss of government subsidies--despite a decrease in the cost of electricity for pumping by about 50% (Meinzen-Dick, 1994b). More broadly, privatization of irrigated agriculture in the Senegal River (irrigated by river lift pump schemes) valley led to a 78% increase in the cost of rice production for farmers between 1980 and 1993 (in constant 1980 prices), due primarily to discontinuance of subsidies for credit, input provision and irrigation. The price of rice rose by 65% during the same time period, from approximately $ .11 per hg. in 1980 to $ .19 per kg. in 1993 (in 1980 dollars; Wester, et al., 1995; Meinzen-Dick, 1994b).

Turnover of pump schemes to farmer groups in Indonesia caused 5 to 7 fold increases in the level of water charges to farmers, due to a reduction in government subsidies (Johnson and Reiss, 1993). In India, where the cost of electricity for pump irrigation is heavily subsidized, Pant (1995) notes that turnover of a public tubewell to farmer management in Uttar Pradesh led to more efficient pump use which brought about a reduction in water costs from US $2.70 to $1.20 per ha in kharif (summer) season and a reduction from US

$6.20 to $3.20 per ha for the rabi (winter) season. The number of irrigations increased from 2 to 3. However, since data was only available for 2 years, it was impossible to confirm a trend. In a post-facto comparison of tubewell system performance for 30 sample tubewells, Shah, et al. (1994) report that turnover of public tubewells in Gujarat caused an increase in irrigated area between 30 and 400% in sample systems and a reduction in the price of water by 40 to 50.

In a before and after comparison case study in a 180-ha block of a medium-size system in Southern Luzon, Philippines, Oorthuizen and Kloezen (1995) found that average total annual expenditures for O&M were $ 31,196 during the four-year period before turnover and were only $ 7,696 per year (in 1982 dollars) on the average during the four years following turnover--a 75% reduction in budget. Studies in the US (Svendsen & Vermillion, 1994), Colombia (Vermillion & Garces-Restrepo, 1994) and the Philippines (Lauraya & Sala, 1994) report a concern by engineers that the tendency for farmers to push cost cutting to the extreme after turnover may accelerate deterioration.

Reforms toward local financial and managerial self-reliance in the Bayi and Nanyao irrigation districts in Hebei, China led to increases in surface water costs from $ 13 ha/yr in 1984 to $ 36/ha/yr in 1992 in Bayi and from $ 24 ha/yr in 1984 to $ 60 ha/yr in 1992 in Nanyao (in 1991 dollars; Johnson, et al., 1994).

From a sample study of six irrigation districts in Mexico, Gorriz, et. al. (1995) report a consistent increase in water fees after transfer of between 45% and 180%, at a range of $ 2.25 to $ 7.79 per $1000m^3$ in 1994. Fees also increased modestly relative to the cost of production but remained in the moderate range of 3% to 8% (Johnson, 1996).

Transfer of the Coello and Saldaña systems in Colombia was accompanied by significant reduction in government subsidies. The area-based water fee rose from $ 1.50 per ha. in 1967 to $ 8.68 per ha. at transfer in 1976 and then declined to US$ 5.54 per ha. in 1993 (all in constant 1988 dollars). Conversely, the volumetric water fee was on a downward trend before turnover (from $ .22/$100m^3$ in 1967 to $ .13/$100m^3$ at turnover in 1976), which reversed to a modest rising trend afterwards--reaching $ .16/$100m^3$ in 1993. The overall cost of water rose modestly after transfer with a policy to raise the proportion of the cost of water which is charged volumetrically. From a broader perspective, the total cost of water relative to the cost of rice production is low anyway and fell still further from before to after transfer, from an already relatively low 4.4% in the 1950's to 3.3% in Coello and 3.1% in Saldaña in 1993 (Vermillion & Garces-Restrepo, 1996).

Comparative post-facto evidence about reduced costs of irrigation as a result of transfer also comes from New Zealand where the government privatized 49 irrigation schemes through outright sale of the districts in the early 1990's. Forty-seven were sold to farmer groups. Farley (1994) reports that water charges on privatized schemes are 2 to 4 times lower than on government "pre-privatized" schemes, despite the fact that government schemes still retained subsidies for O&M costs while privatized schemes paid the full cost of operations. This is attributed to privatized schemes on the average cutting operational costs by 66%, reducing overhead costs and designing simpler repair and maintenance work. In the Hawea system, annual water charges were US $23.90 per ha before privatization and US $10 per ha afterwards. The Greenstreet system was privatized in 1990 and by 1994 had an annual water fee of US$ 2.10 per ha and cash reserves of US $3.30 per ha, compared with average water fees exceeding US $7.00/ha and average debt loads of US $30 per ha for government schemes in the same region. The Bannockburn system, privatized in 1990, had an annual water charge of US $10.80 per ha with no debts, while government schemes in the same region had water charges ranging from US $25 to $47 per ha with large debts.

In the Columbia Basin Project farmers were already paying close to the full cost of O&M before turnover (except for subsidized electricity for pumping water out of the Columbia Basin, which continued after transfer). In this case turnover also prompted a reversal in trends in water charges, beginning with a rising trend followed by a downward trend after transfer. Water charges rose from $ 64.44 per acre in 1961 to an annual average of $ 80.33 per acre in 1969-73 and then gradually fell (in real terms) to $ 49.42 per acre by 1989, constituting an average decline in assessment rates of 21.9% and a decline of 15.9% in volumetric charges (from $ .83 to $ .70 per hectare-meter water) between pre- and post-turnover periods (Svendsen & Vermillion, ibid).

Collection rates Evidence on impacts of transfer on fee collection rates is generally in the form of post-facto or simple before and after comparisons. We are not aware of any time series trend analyses or with and without comparative samples. Bagadion (1994) reports average irrigation fee collection rates in the Libmanan-Cabusao pump irrigation system in the Philippines to have been an annual average of 27% for the period 1982-88 and 60% for the post-turnover period 1990-92. In another study in a system in southern Luzon, Philippines, fee collection increased from 20% under the National Irrigation Administration before turnover to 81% in 1989, after turnover (Oorthuizen & Kloezen, 1995). Mishra and Molden (1996) also report in Nepal a substantial rise in collection rates and overall labor and cash raised by farmers after turnover.

In the On Farm Water Management Project in the Dominican Republic, fee collection rates rose from 12% before turnover to 80% afterwards, reportedly due to significant improvements in the reliability of water delivery--despite the fact that water fees increased by 1,500% between 1985 and 1993 as a result of management transfer (Yap-Salinas, 1994; Hanrahan, et al, 1990). In Mexico, water fee collection rates rose from only 15% before transfer to 80% to 100% afterwards. Cost recovery is reported to be virtually 100% in all systems which have been transferred to farmer organizations for at least one year. Collection rates are generally 60 to 70% during the first transitional year and 100% by the second year (Gorriz, et al., 1995, p. 32). This high rate is largely due to the requirement by districts that farmers pay fees before water is delivered (Johnson, 1996).

In China, total water fee collection throughout the country increased from US$ 50.70 million in 1984, when reforms were just starting, to $ 415.12 million in 1992 (in 1994 dollars), partly due to an increase in collection rates from 30% in 1984 to 70% in 1991 (Turner and Nickum, 1994). In conjunction with organizing farmers and turning over management responsibility in the Kano River Irrigation Project in northern Nigeria, water fee collection rates rose from only 50% before turnover in 1989 to more than 90% in 1990 after farmers became involved for the first time in collecting the fee. Following the approach of NIA in the Philippines, farmer organizations are granted rebates for 10 to 15% of fees collected if the total collection rate exceeds 80% (Maurya, 1993). Aside from the common rise in fee collection rates, what the above cases of turnover have in common is that farmer organizations became involved in collecting the fees, received bonus incentives for collecting above a certain rate, and gained more voice in determining how the fees were spent.

Diversity of revenue sources Another common tendency after transfer is for farmer organizations to begin to diversify their sources of revenue beyond water charges and management functions beyond irrigation O&M. This has been so in cases of turnover in the Philippines (Wijayaratna, 1993), Sri Lanka, Colombia, China, and the USA. In the Coello system in Colombia, irrigation district revenue from sources other than water charges increased from 10% of revenue in 1983 to 20% by 1992 (Vermillion & Garces-Restrepo, 1994). In the 5,000 ha Kaudulla scheme in Sri Lanka, farmer organizations took over management of distributary canals in 1992 and quickly federated to the main system level, diversifying revenue sources, including collection of membership, seasonal and shareholder fees, provision of fertilizers and agro-chemicals, paddy marketing, tractor rental, and interest from small loans. Within two years the organization had raised US $8,335 from profits on input sales valuing $200,000, with a net profit rate of 4%.[4] Through group rice marketing the organization also obtained a selling price of approximately one US cent more per kg. than the market rate (Kloezen, forthcoming).

The reforms in China during the 1980's promoted formation of sideline enterprises to cross-subsidize local government budgets after the demise of line agency funding from central government sources (Gitomer, 1994). Today, sideline enterprises are a common source of financing for irrigation districts. For example, the Bayi district in Hebei province developed 9 sideline enterprises between 1984 and 1992 after it became financially autonomous. The enterprises produced approximately US $60,000 in profits during this period, of which 65% was allocated to the district for water management costs and the rest went to salaries and bonuses of enterprise workers, most of whom were family members of irrigation district staff. By 1994, 30% of the Bayi district revenue was from its sideline enterprises (Vermillion, et al., 1994).

As a result of pressures from farmers, irrigation district boards in the Columbia Basin Project have promoted diversification of revenue sources after transfer in an effort to keep water charges as low as possible. Before transfer in 1976, the water charge was 80% of revenue. It fell to 67% of revenue by 1989 as the districts developed 7 mini-hydropower stations and engaged in water selling contracts and other income generating activities.

Budget solvency Financial solvency after turnover depends partly on the level of subsidy which is removed as well as the potential of the post-transfer managing organization to cut costs and raise additional revenue. In their case study in southern Luzon, Philippines, Oorthuizen and Kloezen (1995) report that within 4 years the system's budget deficit declined from an annual average during 1982-85 of US$ 19,178 to an average of $ 553.57 during 1986-89, the first four years after turnover. This largely occurred because farmers cut annual expenditures by one fourth and increased fee collection from 20% to above 80% (as mentioned above). Pant (ibid) reported annual losses of US $876 before transfer of a public tubewell in Uttar Pradesh changed to consistent surpluses after turnover. Bagadion (1994) reported that the Libmanan-Cabusao pump system, Philippines, was able to convert annual average losses of US 42,218, for the period 1981-89, into an annual average surplus of $42,880 after turnover, during 1990-92.

In the large-scale transfer of 3.3 million ha. served by large-scale irrigation systems in Mexico, the shortfall in meeting required levels of financing irrigation fell from an annual national deficit of $ 66 million in 1989 to $ 41 million in 1993, when transfer was 80% completed. Local self reliance in financing irrigation O&M rose from 43% in 1989 to 78% in 1993, at the national level. However, the absence of district reserve funds, a fixed base fee and government subsidies means that the districts are extremely financially vulnerable in the event of drought (when there is no water to sell) or when major repairs or rehabilitation will be needed in the future (Johnson, 1996).

Coello and Saldaña districts, Colombia, had budget deficits in most years prior to turnover in 1976. During 16 years after turnover Coello had a balanced or surplus budget, whereas Saldaña (which had higher costs due to a substantial amount of necessary dredging and de-silting) had deficits during 8 of the 16 post-turnover years measured (Vermillion & Garces-Restrepo, forthcoming). Garces-Restrepo and Vermillion (1994) report that all irrigation districts transferred to farmer organizations in Colombia between 1990 and 1994 had budget deficits for 2 to 4 years before transfer and had surpluses during the first 2 to 4 years measured afterwards. This was due to both decreases in expenditures (mainly due to staff lay offs) and increases in revenue (primarily from increases in water charges).

Data on the effect of turnover programs on government subsidies to irrigation systems is lacking in the literature. This is needed in order to assess the extent of real financial autonomy after transfer and to interpret changes in cost of water. Also, there is almost no data provided in the literature with a long enough time frame to assess financial sustainability of management after turnover.

Table 4. Reported performance impacts on irrigation finance

Author/Country	
1. Kloezen/Sri Lanka, 1996 (SI)**	Government subsidies for O&M continued after turnover. Farmer organizations invested mainly in input provisions and marketing, not O&M. Annual government costs decreased 33%.
2. Pant/India, 1994 (LI)	50% reduction in cost of water. Budget deficits converted to surplus.
3. Shah/India, 1994 (LI)	50% reduction in cost of water.
4. Olin/Nepal, 1994 (LI)	Cost of water decreased 40% to 50%.
5. Mishra & Molden/Nepal, 1996 (SI)	Cash and labor value raised from farmers increased to $6.77/ha. 7% of farmers paid water charges.
6. Oorthuizen & Kloezen/ Philippines, 1995 (SI)	Reduced cost to farmers. 75% drop in budget. Fee collection rates rose from 20% to 81%.
7. Wijayaratne and Vermillion/Philippines, 1994 (SI)	Revenue from water charges increased from 24% in 1979 to 60% in 1990. Reduction in agency field staff.
8. Bagadion/Philippines, 1994 (LI)	Budget losses converted to surpluses. Fee collection rate rose from 27% to 60%.
9. Johnson and Reiss/ Indonesia, 1993 (LI)	Cost of water pumped increased 5-7 times.
10. Johnson and Vermillion/ China, 1995 (SI)	Cost of water to farmer per ha. rose 2.5 times. Growing importance of sideline revenue enterprises after reform.
11. Maurya/Nigeria, 1993 (SI)	Water fee collection rates rose from 50% to 90% after turnover.
12. Azziz/Egypt, 1994 (SI)	Dramatic decline in maintenance costs. Per ha. pumping costs declined from $ 68 - $ 79 to $ 45 - $ 50 after rehabilitation and turnover.
13. Yap-Salinas/Dominican Republic, 1994 (SI)	Water fees increased 1,500% in 8 years. Fee collection rates increased from 12% to 80%.
14. Vermillion and Garces/Colombia, 1996 (SI)	44% average decline in total staff. Farmer emphasis on cost cutting. No long term major change in cost of irrigation. Cost of water relative to production fell 27%. Diversification of revenue sources, from 10% to 20% of revenue other than fees. Budget deficits converted to surpluses.
15. Johnson, 1996 and Gorriz, et al., 1995/ Mexico (SI)	Increase in water charges between 45% and 180%. Increase in fee collection rates from 15% to 80%-100%. Shortfall in financing declined nationally from $66 to $41 million annually. Local self reliance increased from 43% to 78%.
16. Svendsen and Vermillion/USA, 1994 (SI)	86% decrease in government staff. Farmer emphasis on cost cutting. Volumetric charges reduced 16%. Diversification of revenue sources. Water charge was 80% of revenue before and 67%, after turnover.
17. Farley/New Zealand, 1994 (SI)	Farmer emphasis on cost cutting. Average operational costs declined 66%. After turnover, water charges was 1/4 to 1/2 of the pre-turnover level.

** SI = surface irrigation; LI = lift irrigation

Agricultural and economic productivity

The relationship between management transfer, agricultural productivity and economic output is less direct than the relationship between transfer and O&M performance or financial viability. Of the 25 papers presented at the International Conference on Irrigation Management Transfer in Wuhan, China in 1994 which contained data on performance, only 14 reported increases in cropping intensity (of up to 97% in Andra Pradesh) and 10 reported increases in crop yields (Turral, 1995). Most reported improvements in both performance measures, although the studies provide no control comparisons to enable exclusion of other causes of improvements. The most common agricultural productivity measures referred to in the literature on management transfer are area cultivated, cropping intensity and yield. The most common economic measures referred to are gross value of output, net farm income per hectare, economic returns to irrigation. Less data is available on economic than agricultural productivity. Table 5 below summarizes the key findings of the literature of the impacts of turnover on the agricultural and economic productivity of irrigation systems.

Research in Mexico has shown no significant increase in area irrigated, cropping intensity or yields before and after management transfer (Johnson, 1996). Gross economic returns have remained similar or have declined after transfer, being in the range of $ 1,500 to $ 1,900 per ha. (Ibid).

The Dominican Republic's On Farmer Water Management Project reported yield increases of 40%. But it is not possible from the data to distinguish the effects of transfer from other factors, such as improved irrigation infrastructure and cultivation practices (Sagardoy, 1994). In the Coello and Saldaña systems in Colombia, net income rose from US $124.32 per ha in 1984 to $153.15 per ha in 1994 (in 1988 peso equivalents), with net income varying dramatically during the period, however. Economic return to irrigation was US $12 per 100m^3 in the Coello system in 1993 (with water use efficiency of 73%) and $11 per 100m^3 in Saldaña in 1993 (with water use efficiency of 57%). However, no data on economic productivity before transfer was available. While this type of evidence supports the view that farmer organizations can sustain relatively high levels of productivity after transfer, it does not confirm that the levels were primarily achieved or sustained because of management transfer.

In a comparison of two localities in the Senegal River Valley, researchers found that in the Doue Region of the Senegal River Valley, privatization of irrigated agriculture support services was accompanied by a decline in cropping intensities but an expansion in irrigated area, from 620 ha in 1985 to 1,070 ha by 1991. Farmers shifted to growing more of their crops only in the wet season, partly due to rapidly rising input prices and greater complexities of dry season irrigation after management transfer. Similarly, in the Ile a Morphil in the Senegal River, privatization led to a near doubling of irrigated area between 1985 and 1993 and an increase in cropping intensity from 86% during 1985-88 to 93% during 1990-93 (Wester, et al., 1995).

In a case study of a pilot turnover project in the Kano River Irrigation Project in Northern Nigeria, researchers found that organizing farmers to take over management of distributary canals led to 12% increases in water volume reaching middle and tail ends of pilot canals, which resulted in an 80% increase in dry season cropped area. Turnover was introduced to the system largely because of lack of government funds for irrigation O&M and the consequent rapid deterioration of the system due to lack of maintenance. In the 1992/93 season following turnover, 70% of distributary canals and 60% of field channel lengths were cleaned by farmer groups. As a result 10% more wheat and 8% more maize was grown in the dry season than in previous years. However, absence of data for multiple years prevents us from generalizing about trends in productivity and the sustainability of farmer investments in maintenance (Maurya, 1993; Musa, 1994).

Samad and Dingle (1995) compared the performance of six pump schemes along the White Nile in Sudan which were managed by three types of organizations: farmer groups (which had recently taken over management), the White Nile Agricultural Corporation (a parastatal), and a contracting private holding company. Wheat yields per unit of water delivered were 11 kgs/100 m^3 in schemes managed by farmers and by the private company. They were 17 kgs/100 m^3 in schemes managed by the parastatal. This difference was attributed to better access to agricultural inputs by the parastatal.

Gross margin/100m^3 of water delivered for the 1993/94 wheat crop was $0.34/100m^3 in the turned over schemes, $1.09/100m^3 in the parastatal schemes, and only $0.09/100m^3 in schemes managed by the private company. Average net farm income was $17.68/ha in the turned over scheme, $42.26/ha in the parastatal scheme, and only $6.90/ha in the scheme managed by the private company. The differences were attributed to higher cost of inputs and difficulty of obtaining timely inputs for the private sector entities. 1993/94 was the first year after transfer and the farmers and private company had little, if any, experience in management before this time.

Azziz (1994) reports comparative post-facto data that the transfer of mesqa's in Egypt led to an increase in average annual farm income of US $300 per hectare. Pant's study of transfer of a public tubewell in Uttar Pradesh, India documented a decrease in irrigated area but increases in cropping intensity and yields after the transfer. The average irrigated area in rabi (winter) season was 103 ha during 1990-92 (before turnover) and 59.5 ha during 1992-94 (after turnover). Cropping intensities were an average of 143% during two years before turnover and 162% afterwards. Yields for wheat, rice and sugarcane increased about 10%, indicating that farmers preferred to intensify rather than extensify production after turnover. Because of a limited study time period (2 years before and 2 years after) it is impossible to generalize about trends. In the case of turnover in the Paliganj Canal in Bihar, India, management improvements due to turnover (mentioned above) led to an increase in irrigated area in the dry season from 3,613 ha in 1990 before turnover to 4,350 ha after turnover in both 1992 and 1993 (Srivastava & Brewer, 1994).

Uphoff reports the results of management transfer in the Gal Oya system in Sri Lanka as improved equity of water distribution between head and tail areas, improved maintenance, increased cropping intensity and higher yields. However, the study does not present system-wide quantitative data about these results and only refers to agricultural productivity changes in a partial, anecdotal way. Attendance of farmers at meetings is characterized as a good in itself (Uphoff, 1992).

In a paper on turnover in several systems in the Philippines, Wijayaratna and Vermillion (1994) report on improvements in water distribution, expansion of irrigated area, and increases in cropping intensities in all study sites. The Banurbur system irrigated 486 ha in the dry season before turnover and 750 ha after turnover. The increase continued for several years. The Maramag system irrigated 524 ha in the dry season before turnover and 719 ha afterwards. The MNOH system in Bicol added an additional 390 ha to wet season irrigation after turnover and a third crop was planted in several blocks for the first time. Again, the data has a short time line and incomplete coverage of key agricultural performance data.

In Vietnam, four years after the turnover of a medium scale river lift pump system in the Red River delta, area irrigated increased from 934 ha to 1600 ha., while leading to an increased cropping intensity from 170% to 250% after turnover. (Nguyen, et al., 1994). Management turnover of the West Gandak scheme in Nepal led to yield increases for rice from 2.2 to 3.4 tons per ha. and for wheat from 1.6 to 2.4 tons per ha. This was apparently due to a combination of de-siltation and management changes related to turnover. Incremental economic benefits as a result of turnover were estimated to be $ 193 per ha. per year or $ 182 per ha. per year after accounting for an increase in O&M costs to farmers (Mishra and Molden, 1996).

Johnson, et al. (1994) report that annual grain yield (wheat and maize) per unit of water in two systems in the north China plain increased steadily between 1973 and 1992 and the rate of increase accelerated after the reforms in the mid 1980's. Annual grain yield (kg) per unit of water (100 m^3) in Nanyao was 66 kgs/100m^3 in 1973, 70 kgs/100m^3 in 1982 and 135 kgs/100 m^3 in 1992. Similarly in Bayi, yields increased from 28 kgs/100m^3 in 1973 to 65 kgs/100m^3 in 1982 to 150 kgs/100m^3. Turnover impact data over such a long time period is rare and suggests that turnover had a positive effect on yield returns to water, given the parallel upturn in trend in both systems at the time of turnover. However, measures of input use rates or other factors were not documented.

Table 5. Reported performance impacts on agricultural and economic productivity

Author/Country	Agricultural	Economic
1. Kloezen/Sri Lanka, 1996 (SI)**	Cropping intensities increased from 138% to 200%.	Gross value of output between $ 944 and $ 1,136 per ha. per year after turnover.
2. Pant/India , 1994 (LI)	Increase in cropping intensity from 143% to 162%. Yields increased 10%.	
3. Srivastava & Brewer/India, 1994 (SI)	20% increase in area irrigated in dry season.	
4. Mishra & Molden/Nepal, 1196 (SI)	Rice yields increased from 2.2 to 3.4 t/ha. Wheat yields increased from 1.6 to 2.4 t/ha.	
5. Wijayaratne and Vermillion/Philippines, 1994 (SI)	Increases in cropping intensity and area irrigated.	
6. Nguyen et al./Vietnam, 1994 (LI)	Cropping intensity increased from 170% to 250%. 14% increase in area cropped. Yield increased 13%.	Incremental benefits per ha. per year increased by $ 193 or by $ 182, net of increased O&M cost.
7. Johnson and Vermillion/China, 1995 (SI)	Grain yields increased modestly.	Cases of both increase and decrease in net income.
8. Maurya; Musa/Nigeria, 1993 (SI)	80% increase in dry season cropped area.	
9. Samad/Sudan, 1995 (LI)	High yields per 100m^3 water in parastatal vs. turned over schemes (17 kgs. vs. 11 kgs.)	Gross margin 3 times higher in parastatal than turned over schemes. Productivity of land and water higher in parastatal than turned over schemes.
10. Wester/Senegal, 1995 (LI)	Increase in irrigated area by 72%, with cropping intensity rising and falling in different locations.	Cost of irrigated rice production increased 78%.
11. Azziz/Egypt, 1994 (SI)	Increase in main crop yields 10% - 16%.	Increase in farm incomes by $ 60 per ha.
12. Johnson/Mexico, 1995 (SI)	No change in area irrigated, cropping intensity or yields.	Gross economic returns have remained same or declined ($ 1500 - $ 1900 after turnover)
13. Vermillion and Garces/Colombia, 1996 (SI)	Rice yields of 6.5 tons, sustained after turnover. Irrigated and crop area continued to expand after turnover.	Net farm income rose 23%. Economic return to irrigation was $ 11 - $ 12 per 100 m^3 water. Gross value of output increased 400%, 1983-1991.
14. Svendsen and Vermillion/USA, 1994 (SI)	Shift to less water intensive crops.	Average farm incomes rose approximately 15% due to reduction in water cost.

** SI = surface irrigation; LI - lift irrigation.

Svendsen and Vermillion (1994) report that the reduction in per area water costs after transfer enhanced average annual profitability of irrigated farming by about 15% of average family incomes, assuming real net income remained the same in the 1980's as in 1978. They note that this would increase the gross margin on a typical 65 hectare farm by about $1,600 per year. In general, the literature to date most often reports positive impacts of management transfer on agricultural and economic productivity.

Government resources

One of the main reasons governments promote transfer programs is to reduce the cost burden of irrigation management on the government. Therefore it is curious that there is not very much information available on impacts of transfer on the government. Potentially, transfer could reduce government expenditures for

O&M and allow reallocation of central revenues to construction or other costs within the irrigation or agricultural sector. Or it could cause a total reduction in budget for the sector itself. Much depends on size of budgets, financial policy and political will.

The move to make the National Irrigation Administration (NIA) in the Philippines financially autonomous and to turn over irrigation system management by 1990 produced an annual savings to the Philippine Government of US $12 per ha from cash and in-kind contributions in systems where transfer was partially or fully implemented (Bagadion & Korten, 1991). Revenues from irrigation fees collected by water users associations which partially or fully took over irrigation management constituted 24% of NIA's total revenue in 1979 but 60% by 1990 (Wijayaratna & Vermillion, 1994). Kloezen (1996) shows that the rise of "participatory management" policy in Sri Lanka supported a reduction in irrigation O&M expenditures by the government from approximately $ 14.80 per ha in 1985 to $ 6.50 per ha in 1994. Pant (1994) showed that the transfer of a typical public tubewell to farmer management in Uttar Pradesh, India reduced government subsidies to the tubewell system from US $876 before turnover to $656 afterwards, or a reduction of 25%. In the case of the turnover of the West Gandak scheme in Nepal, government expenditures for maintenance declined from $ 6.65/ha. to $ 4.06/ha. after turnover (Mishra and Molden, 1996).

The small scale irrigation turnover program in Indonesia includes about 70% of all public irrigation systems and 21% of the total irrigation design area. It has been estimated that by the time the program has been fully implemented it will save the government approximately US $13.5 million in annual O&M costs (Johnson, 1995). Vermillion (1989) calculated the budgetary effect the policy would have at the district level assuming a policy of reallocating funds from small scale systems to underfunded medium large scale systems. In the Sumedang Section of the West Java Provincial Irrigation Service, which has numerous small scale systems and only a few medium or large scale ones (i.e., over 500 ha in service area), turnover would permit transfer of all O&M funds for small scale systems to medium or large systems, which would allow an increase in O&M expenditures on the larger systems from a pre-turnover level of about US $10 per ha to a post-turnover goal of $15 per ha, to prevent deterioration of larger systems.

As a result of Mexico's large scale management transfer program, annual government subsidies for irrigation O&M fell from $ 40 million in 1989 to zero by 1993, at which time approximately 2.4 million ha. of service area had been transferred to farmer management. Gazmuri (1994) asserts that at a macro level in Chile, irrigation management transfer had a positive effect on redistribution of wealth from the wealthier (those who had water) to the poorer. After transfer, public funds previously spent on irrigation were diverted to poverty alleviation programs. However, no data is provided.

The environment

Only a few studies refer to impacts of turnover on the environment; these are mostly qualitative. In Chile, water users associations, which took over control of irrigation systems, reportedly became empowered by transfer and the 1981 Water Law Code and successfully pressured paper factories to invest in pollution reducing equipment, at the threat of cutting off water to industrial users (Meinzen-Dick, 1994b, p. 81).

Yap-Salinas (1994) reports that irrigation transfer in the Dominican Republic, through establishment of local organizations to regulate land and water use, has halted and reversed land degradation and loss of soil, which in turn has reduced health risks associated with water logging due to poor drainage previously. However, due to lack of comparative data it is difficult to know how much of this was due to installation of new drainage facilities versus the institutional reform.

In Senegal it is reported that irrigation management transfer has increased water logging and salinization due to poor management practices by new and inexperienced managers hired by farmer associations (Agsieve, 1994). Because of the short time frame reported, it is difficult to assess whether this is a long term problem or only a learning adjustment.

Impacts of transfer reported in the literature to date are mostly positive. This may be partly a result of a bias in sites selected or the possibility that many authors are promoters of the reforms. Evidence about impacts includes changes in O&M practices and performance, financial strategy and viability, agricultural and economic productivity, and limited reports about effects on government finances and the environment. The weakest areas to be documented, which are of potential importance, are effects on government subsidies, maintenance of irrigation infrastructure, and the cost of irrigation to farmers (relative to changes in economic productivity). Another weakness in the evidence is that most reports only mention two or three indicators of performance, so it is impossible to judge tradeoffs between key performance measures, such as changes in finance versus maintenance.

Future priorities

In our view the following are the three main priorities for research and development about irrigation management transfer.

Priority 1: Systematic assessment of impacts More systematic research is needed on the impacts of management transfer. Each study should include a balanced set of performance indicators which includes quality of operations and maintenance, financial viability, agricultural productivity, economic impacts, and impacts on government resources and the environment. The International Irrigation Management Institute is currently developing and field testing a methodological guide for impact assessment of irrigation management transfer, which will soon be disseminated to researchers and professionals involved in management transfer around the world.

Priority 2: Research on essential conditions Research to date and reports from practitioners in international meetings favor the notion that certain pre-requisites are needed before countries can expect to achieve success with turnover programs (Vermillion, 1994). The most common are:

- A clearly recognized and sustainable water right,
- Appropriate infrastructure relative to local management capacities,
- Clear designation of responsibility and authority for essential management functions,
- Effective accountability and incentive mechanisms, and
- Adequate resources (financial, human) for sustainable irrigation management

The components which tend to be most commonly lacking in many Asian countries are: clear water rights, clearly designated lines of authority between farmers and agencies, and effective accountability and incentive systems. Research is needed on what common characteristics occur in more successful cases of management transfer. Such characteristics include institutional arrangements of transfer, the socio-economic context, the agro-technical context, and support services for irrigated agriculture. Action research is needed which includes all five of the above hypothesized essential elements in locations where they do not yet normally occur.

Priority 3: Action research on turnover at a larger scale For several years the water user association has been promoted as both a governing and a management body for irrigation systems. Community organizers have helped WUA's to develop constitutions and by-laws, select leaders, approve plans and budgets and apply sanctions. WUA's then directly manage operations, maintenance and finances. This model is not well suited for management at higher levels of larger scale systems or in more complex environments because all functions are integrated into the same body, which causes an overload at larger scales of management. Accountability between farmers and leaders, especially in finances, is often weak and WUA's generally do not have professional staff. This has led many to conclude that transfer can only occur at small scales of management.

And yet, the problems of poor performance, high costs to government and deterioration are equally, if not more, severe in large scale irrigation. Action research is needed on experiments to turnover medium or large scale irrigation systems to financially self-reliant local organizations. In an experiment to improve accountability and professionalism in local organizations, we suggest testing a tripartite organizational model where the governance entity (general assembly of farmers and elected board of directors) forms and supervises a professional management entity (recruited technicians or a contracted company). In turn, a separate body (perhaps a parastatal) performs independent financial and technical audits of management. Research is also needed to determine under what conditions turnover of management of the water source can and should be attempted.

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END NOTES

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[3] The US Bureau of Reclamation regional offices conducted technical audits of systems after transfer. These involved on site inspection of all physical structures and examination of finances and management practices. Maintenance assessments were rated according to degree of urgency of need for repairs.

[4] The 4% net profit rate is overshadowed by an agricultural credit interest rate of 9% and an annual rate of inflation of approximately 11%..