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Research Report

Assessment of Participatory Management of Irrigation Schemes in Sri Lanka: Partial Reforms, Partial Benefits

M. Samad and Douglas Vermillion

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Research Reports

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The International Irrigation Management Institute, one of sixteen centers supported by the Consultative Group on International Agricultural Research (CGIAR), was incorporated by an Act of Parliament in Sri Lanka. The Act is currently under amendment to read as International Water Management Institute (IWMI).

Contents

Summary

This report presents the results of the application of a standard methodology developed by IWMI to assess the impact of irrigation management transfer on the performance of irrigation schemes. The methodology was applied to assess the impact of the participatory irrigation management program in Sri Lanka. The study was carried out with two objectives in mind: first, to test the proposed methodology and second, to determine what effects participatory management has on the performance of irrigation schemes in Sri Lanka.

The report reviews government policies on irrigation management reforms. The study contends that current policies support limited farmer participation or joint farmer-agency management of irrigation systems, rather than the replacement of agencies with farmer organizations (FOs). Even though the management of subsystems has been officially transferred to farmer organizations government intervention remains strong.

The study analyzes the impact of the partial management reforms on the performance of irrigation management. The analysis is based on data obtained from a sample of 50 large- and medium-sized irrigation schemes in Sri Lanka. Impacts of reforms at the farm level are analyzed with information collected from a sample of farmers in two major schemes.

Piecewise linear regression models are fitted to analyze trends in selected performance indicators during the 5-year periods before and after transfer. The analysis compares performance in four categories of schemes: those rehabilitated and transferred, those turned over but not rehabilitated, those rehabilitated but not transferred, and those without these interventions.

Application of the impact assessment methodology shows that, where the required data are available, the combination of performance measures compared before and after, and with and without the intervention, can yield a comprehensive picture of the impacts of management transfer.

In the Sri Lankan case, the analysis shows that there has been a significant decline in government recurrent expenditure in irrigation beginning before transfer and continuing thereafter. However, data indicate that in the transferred schemes there has been a reversal in the trend in government investments in O&M in the post-IMT period. Irrigation management transfer has not resulted in an appreciable improvement in crop yields, the quality of irrigation services, or the value of agricultural production. Also, rehabilitation alone has not created significant effects. But, where both rehabilitation and management transfer have occurred, significant improvements in agricultural productivity levels and returns to land and have been observed. The infrastructure inspections have revealed underinvestment in maintenance. To eliminate the backlog of deferred maintenance, both the government and the farmers would have to substantially increase investment in maintenance. This raises concerns about sustainability of the schemes under participatory management.

Assessment of Participatory Management of Irrigation Schemes in Sri Lanka: Partial Reforms, Partial Benefits

M. Samad and Douglas Vermillion

Introduction

This report presents the results of a study carried out in Sri Lanka to assess the impact of reforms in the management of government-owned irrigation schemes. The study is part of a broader effort by the International Water Management Institute (IWMI) to systematically document both international experience with irrigation management reforms and their impact on the performance of irrigated agriculture.

The worldwide interest in, and support for, transferring the management of irrigation schemes from public agencies to water user groups and other nongovernmental organizations have prompted considerable research on various aspects of irrigation management reforms and their impacts. This has resulted in a wide range of opinion on the subject.[1] The need for strong political support for the program, clear policy direction, alternate strategies for irrigation management, well-defined water rights and clarity about steps involved in the process of creating farmer organizations, and conditions for successful irrigation management transfer (IMT) are some of the major issues discussed in literature (Johnson, Vermillion, and Sargadoy 1995; Geijer, Svendsen, and Vermillion 1996; Meinzen-Dick et al. 1997; Vermillion 1997). Yet, there is little systematic, comparative evidence to date on the impact of the reforms on irrigation management performance, government finances, and the farming community (Vermillion 1997). With some exceptions (e.g., Svendson and Vermillion 1994; Vermillion and Garcés-Restrepo 1996) most studies that deal with impacts of irrigation management reform, refer to relatively short-term results.

It is important that impacts of management reforms on the performance of irrigation systems are carefully analyzed and understood, in order to set the record straight, and more crucially because of the significance of such analyses for policy decisions pertaining to the irrigation sector. Towards this end, IWMI embarked on a research program to develop and field-test a standard methodology that would generate useful measures of impacts of irrigation management reforms in a variety of settings and permit international comparison of the impacts of irrigation management reforms.[2] This report presents the results of the application of the methodology to assess the impact of irrigation management reforms in Sri Lanka. This study was designed and implemented with two objectives in mind: first, to field-test the proposed methodology and second, to determine what effects management reforms have had on the performance of irrigation management and irrigated agriculture in Sri Lanka.

[1]At the first major international conference on irrigation management transfer held in Wuhan, PR China in September 1994, over 100 papers were submitted on a wide range of issues relating to irrigation management reforms.

[2]The proposed methodology is described in detail in Vermillion et al. 1996.

The report begins with an overview of government policy on irrigation management transfer. The next section outlines the methodology. We then present the results of the analysis. The final section reviews the methodology and concludes with some observations on the irrigation management transfer program in Sri Lanka.

Irrigation Management Transfer Policy

In 1988, following a decade of field experiments, the Government of Sri Lanka formally adopted a policy of transferring full responsibility for the operation and maintenance (O&M) of minor irrigation schemes to farmer organizations (FOs). In the medium and major schemes, farmers and agency personnel were made jointly responsible for the management of the systems: FOs taking charge of O&M of irrigation facilities below the distributary channel head, and the irrigation agency retaining its control of the headworks and the main canal system. This program labeled as “Participatory Irrigation System Management” was implemented in a number of major and medium schemes under three government-sponsored programs: Integrated Management of Irrigation Schemes (INMAS), Management of Irrigation Systems (MANIS) program, and in the systems under the Mahaweli Development Project.[3] The objectives of the program are to:

- relieve the government of the financial burden of funding recurrent expenditures for irrigation
- improve the maintenance of irrigation facilities and the irrigation service
- enhance the productivity of irrigated land and water
- promote a sprit of self-reliance among farmers in irrigation schemes (Abeywickrema 1986; Brewer 1994)

Farmer organizations are fundamental to participatory irrigation system management. Their main function is to deal with irrigation matters, but statutory provisions permit them the right to formulate and implement agricultural programs for their area, market farm produce, and distribute production inputs (GOSL 1991). Owner cultivators and occupiers of land in the designated area are eligible for membership in FOs. Only one person per plot of land is conferred membership. In most localities, cultivating a plot of land irrigated by a particular distributary channel, regardless of the tenure pattern, is a sufficient qualification for membership. FOs can become legal if they register with the Department of Agrarian Services and the Commissioner approves the registration. Once they are registered, FOs get authority under the Irrigation Ordinance to formulate rules on maintenance, conservation, and management of irrigation infrastructure under their jurisdiction, to devise procedures for distributing water within the area under their command, and to impose and levy fees to recover the costs of O&M (IIMI/HKARTI 1997).

[3]The INMAS program was initiated in 1984. There have been thirty five schemes have been under this program, which includes most of the large irrigation schemes in the country. The MANIS program serves the medium-sized schemes. It has been estimated that about 85 percent of the 200 schemes included under these three programs are under participatory management (IIMI/HKARTI 1997).

Transfer of responsibilities from the government to the FOs can take place informally or formally. Informal transfer is a verbal agreement between the agency and the FOs. Once FOs are established and considered capable of handling responsibilities, the irrigation agency formally "hands over" the O&M of distributary channels to FOs (IIMI/HKARTI 1997). An agreement is signed between the FOs and the agency stipulating the responsibilities of each party. Table 1 summarizes management responsibilities assigned to various entities before and after the introduction of participatory management.

TABLE 1.
Assignment of responsibilities before and after participatory management.

Management function	Before participatory management	Participatory management
1. Seasonal planning	Done by agencies and ratified at *kanna* (seasonal) meeting	Done by Project Management Committees
2. Operations planning	Done by agencies; basic plans ratified at kanna meetings	Done by agencies; basic plans ratified by PMCs
3. Operation of headworks and main and branch canals	Managed by the irrigation agency	Managed by the irrigation agency
4. Distributary channel operations	Managed by the irrigation agency	Managed by FOs
5. Field channel operations	Managed by the irrigation agency	Managed by field channel groups (FCGs)
6. Maintenance of headworks and main and branch canals	Planned and managed by the irrigation agency	Managed by the irrigation agency in priority order determined by the PMCs
7. Distributary channel maintenance	Planned and managed by the irrigation agency	Planned and managed by the FOs
8. Field channel maintenance	Done by farmers individually or collectively under the direction of Field Supervisors of the Department of Agrarian Services	Done by the FCGs

Source: IIMI/HKARTI 1997.

The Methodology

This study is based on the standard methodology developed by IWMI to examine the modalities and impacts of IMT in different country settings. By standard methodology we mean a) a uniform set of concepts, b) a common research design and framework of analysis, and c) a standard set of performance indicators.

Key Concepts

In this study, *irrigation management transfer or transfer* is defined as the transfer of responsibility and authority for managing irrigation systems from government agencies to farmers or other local management organizations. The term *management* is used broadly to include the roles of governance, implementation of O&M, mobilization of resources, and resolution of disputes. Irrigation management transfer may include all or only some of these roles in different locations. It may be implemented for entire irrigation systems or only at the level of subsystem units.

The term *impact assessment for irrigation management transfer* refers to the measurement, analysis, and documentation of changes in certain indicators of performance of irrigated agriculture, which are imputed to be affected by irrigation management transfer.

The term *performance* refers to both the quality of management and results derived therefrom, relative to specified criteria and standards. Performance criteria and standards may be *internal,* meaning they are defined by the managing organization itself, or they may be *external*, meaning they are defined by others who are outside of the organization.

Objectives and Hypotheses

The general objective of the impact assessment methodology is to determine what effect irrigation management transfer has on the performance of irrigation management and irrigated agriculture. Performance is measured from several perspectives: the cost of operating and maintaining irrigation systems to the government and the farmers; quality of the irrigation service; maintenance of the irrigation infrastructure and agricultural productivity levels. The principal hypotheses tested are:

- IMT leads to a reduction in government expenditure for O&M.

- IMT will increase the cost of irrigation to farmers.

- IMT will lead to improvements in the quality of irrigation services to farmers.

- IMT will result in improved maintenance of irrigation facilities.

- IMT will result in higher agricultural productivity per unit of land and water.

The Research Design

The study bases key evidence about impacts on the comparison of performance before and after management transfer, and with and without IMT. The rationale for this approach is:

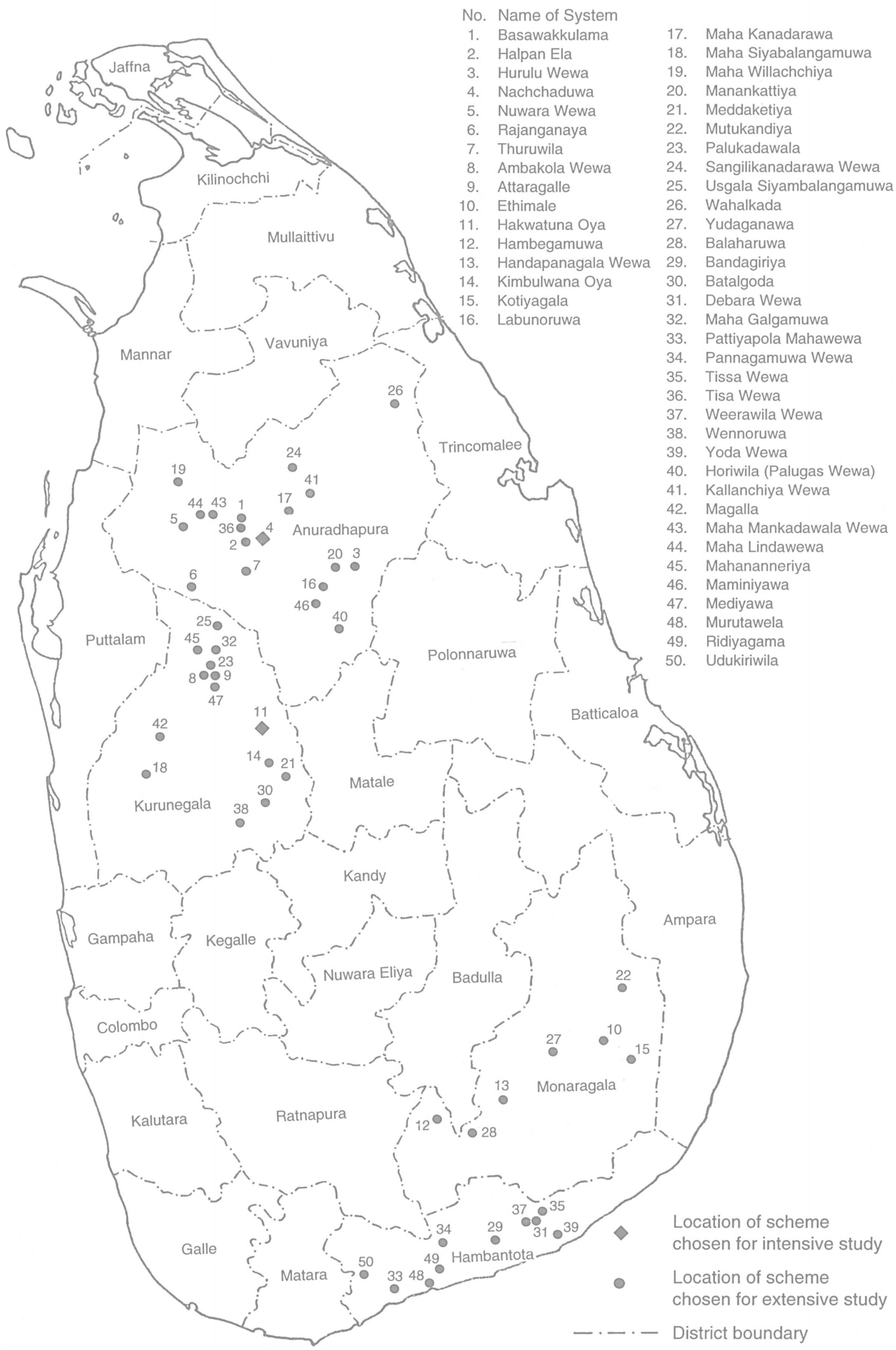
- Variability among irrigation schemes (which also causes differences in performance) is controlled through comparing performance before and after transfer in the same irrigation system.

- Where governments implement IMT selectively, differences in performance may be introduced between schemes in the selection process itself. This could make “with” and “without” comparisons misleading.

- The performance of transferred systems is compared with that of non-transferred systems to control against the possible effects of other time-related factors such as economic trends, which could cause changes in performance over time.

The assessment is based on two sets of data. The first set is from an intensive study of two irrigation schemes (Nachchaduwa and Hakwatuna Oya) and the other is from an extensive survey of 50 randomly selected schemes from four districts, Anuradhapura, Kurunegala, Moneragala, and Hambantota where major and medium irrigation systems are concentrated (figure 1). The annex gives the salient characteristics of the schemes selected for the study.

FIGURE 1.
Map of Sri Lanka, showing location of sample schemes.



The intensive component consists of a rigorous and detailed analysis of changes in performance in the two irrigation schemes before and after management transfer, and validation of a set of performance indicators that could be used in the extensive component. The extensive component analyzes performance according to a small subset of indicators to enable generalizations about the impacts of transfer.

Two common intervening variables that could confound assessment of the impacts of management transfer are rehabilitation and rainfall. Where rehabilitation occurs along with transfer, it is nearly impossible to distinguish between the effects of transfer and rehabilitation. Similarly, abnormal rainfall in the chosen reference years could affect agricultural production and mask the effects of management change.

To minimize such confounding effects, schemes selected for the extensive survey were first stratified into two groups: rehabilitated and un-rehabilitated.[4] Each group is subdivided into IMT and non-IMT groups, as illustrated in figure 2, and analyzed separately. The confounding effects due to rehabilitation would be the same in groups 1 and 2. It is assumed that differences in performance between these two groups would be due to IMT and stochastic factors.

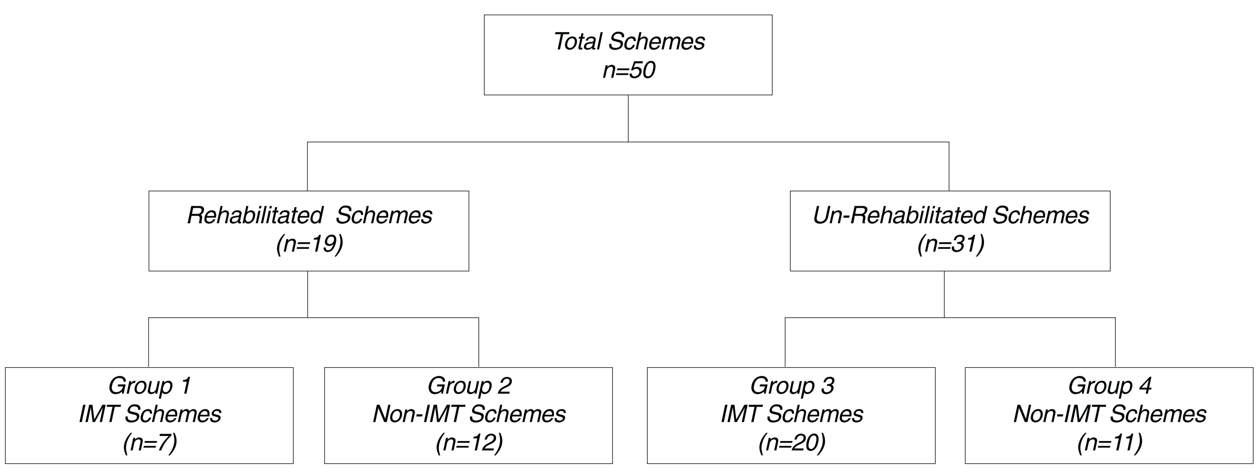
Differences in performance in the schemes in the un-rehabilitated schemes (groups 3 and 4) are assumed to be due to IMT and other factors. For the intensive component, two schemes were selected: one that had been rehabilitated and transferred and the other, transferred but not rehabilitated.

As for rainfall, the reference year was selected only if the annual rainfall did not differ by more than 25 percent (above or below) of the long-term average annual rainfall for the area in which the scheme is located. If this condition was not met, the "normal" rainfall year closest to the reference year was selected.

Data Sources

The analysis is based on both time series and cross-sectional data. Time series covering a period of 10 years (5 years before transfer and 5 years after) were collected to measure changes in performance over time at the scheme level. Information was collected on a number of performance measures, including finance, O&M, agricultural productivity, and economic productivity.

FIGURE 2.
Stratification of sample schemes—extensive component.



[4]For sampling purposes, we define rehabilitation as being restoration or improvement of irrigation scheme infrastructure (i.e., canals and water control structures) where the annual expenditure levels exceed the average annual O&M budget by at least 50 percent. Where expenditure in a scheme was less than 50 percent, it was not considered as rehabilitation.

The main source of information comprised records maintained by various government agencies.

Cross-sectional data were collected through a questionnaire survey of a sample of farmers from the two schemes selected for the intensive study to measure impacts at the farm level. The objective of the survey was to obtain information from farmers about their perceptions of changes in selected performance attributes before and after turnover. Ninety farmers from each of the two schemes were selected as samples by stratified random sampling. The sampling unit was a selected parcel of land in the irrigation scheme. The agricultural year immediately preceding the year of transfer was taken as the "before" period (pre-IMT reference year) and the latest complete agricultural year after transfer was taken as the "after" situation (post-IMT reference year), provided it was at least 4 to 5 years after the year of transfer. Key informant interviews were conducted primarily amongst FO leaders to obtain information about post-IMT changes in the organization, operations, maintenance, and financing of irrigation management.

An assessment survey was done to document the overall functional condition of irrigation system infrastructure after transfer and to provide evidence on the capacity of post-transfer management to sustain the functionality of irrigation infrastructure. The capacity to sustain functionality of this infrastructure was assessed by comparing the level of investment required to repair dysfunctional and nearly dysfunctional structures with the recent average annual level of investment for maintenance after transfer. Through direct inspection of irrigation system infrastructure, structures are classified according to their ability to perform designed functions. Recent average levels of investment are indicated by annual volume of work or expenditure levels for routine maintenance.

Performance Indicators

In this study, performance is measured in qualitative and quantitative terms. The qualitative assessment is based on farmer perceptions of changes in selected performance indicators before and after turnover. The quantitative analysis is based primarily on the standard set of indicators formulated by IWMI to assess the performance of irrigation schemes (see Molden et al. 1998). The indicators relate to financial, agricultural, hydrological, and economic performance across irrigation systems. The indicators require limited amount of data, and their computation is straightforward. The specific indicators used to assess performance and the level at which they were measured are set out in table 2.

Analyzing Trends in Performance

A major aim of the analysis was to determine the annual trends in selected performance indicators during the period 1985-1995, which covered 5 years before turnover (1985-90) and 5 years after (1991-1995). A set of regression equations was estimated based on data obtained from the 50 schemes selected for the extensive survey. The following performance indicators were used as dependent variables:

- government expenditure for O&M for 1985–1995
- paddy yields (yield/ha), 1985–1995
- cropping intensity (CI), 1985–1995
- standardized gross value of output per hectare (GVO/ha), 1985–1995
- GVO per cubic meter of water diverted (GVO/m^3), 1985–1995

Cropping intensities, paddy yields, and GVO per unit of land and water were adjusted for seasonal and locational variations and analyzed as annual values.

Piece-wise linear regression models were fitted to analyze trends in performance in the two

TABLE 2.
Performance indicators and the level at which they are measured.

Performance indicators	Scheme level	Farm level	Data source
Financial performance indicators			
Annual operations and maintenance cost per hectare to the government	X		Secondary data (Irrigation Department)
Irrigation cash costs per hectare to the farmers		X	Farmer survey
Value of family labor contributions for canal maintenance		X	Farmer survey
Total irrigation costs per hectare to the farmers		X	Farmer survey
Operational performance indicators			
Farmer perceptions about adequacy, timelines, and equity of water supply		X	Farmer survey
Maintenance performance indicators			
Percentage of sample canal lengths with critical and noticeable defects after transfer	X		Field inspection
Percentage of structures that are fully functional, partly functional, and dysfunctional after transfer	X		Field inspection
Cost to repair dysfunctional structures relative to the annual average budget	X		Estimated
Farmer perceptions about canal conditions before and after transfer		X	Farmer survey
Agricultural performance indicators			
Cropping intensities by season		X	Secondary data (Department of Agriculture)
Yield of major crops by season		X	Secondary data (Department of Agriculture)
Farmer perceptions about changes in agricultural production		X	Farmer survey
Economic performance indicators			
Standardized gross value of output per hectare[5]	X		Estimated
Standardized gross value of output per unit of water diverted	X		Estimated

[5]Standardized Gross Value of Output (SGVO) = $\left(\sum_{crops} A_i Y_i \frac{P_i}{P_b}\right) P_{world}$

where, Y_i is the yield of crop i; P_i is the local price of crop i; P_{world} is the international price of the base crop; A_i is the area cropped with crop i; P_b is the local price of the base crop. For a detailed explanation of SGVO see Molden et al. 1998.

time periods: the period before IMT (1985-90) and the period after IMT (1991-95). The aim was to determine whether a performance indicator showed a particular linear trend from 1985 up to 1990, the year of transfer, but followed a different trend thereafter. This involved testing whether there was a statistically significant difference in the slopes of the regression lines for the two time periods.

A common set of explanatory variables was specified in all equations. These included a *time* variable (T) to capture the effect of time (in years) on the dependent variable, and a *dummy* variable (D_1) to indicate the periods before and after turnover.

The basic regression equation estimated was as follows:

$$Y_t = \beta_0 + \beta_1 T + \beta_2 (T - T^*) D_1 + e \text{ .... } (1)$$

where, Y_t = Performance measure (O&M costs/ha, yield/ha, CI, GVO/ha, GVO/ m^3) in year t

T = Time in years (1985............1995)

T* = Threshold period (i.e., 1990, the year of transfer)

D_1 = 1 if T, >1990

0 if T<=1990

e = Error term

$\beta_{0......}\beta_2$ = Parameters to be estimated

Assuming E(e) = 0, parameter β_1 gives the slope of the regression line or the trend during the pre-IMT period (1985–90) and ($\beta_1 + \beta_2$) the trend in the post-IMT period (1991–95). A test of the hypothesis that *there is a change in the trend between the two periods* was conducted by noting the statistical significance of the estimated differential slope coefficient $\beta_{2.}$

Results

Impact on Government Expenditures for O&M

The main interest of the government in transferring irrigation management at the subsystem level to FOs was to reduce its own costs for irrigation. This section examines the trend in government expenditure for O&M during the period 1985-1995. The hypothesis advanced is that *with the transfer of O&M responsibilities to FOs, government's recurrent cost for irrigation will be lower in the transferred schemes than in the non-transferred schemes.*

The regression model (equation 1) was used to analyze trends in government investment with the annual O&M costs/ha (in 1995 constant US$/ ha) during the period 1985-95 as the dependent variable. The estimated regression coefficients are given in table 3. Figures 3A to 3D illustrate the trend in government's O&M expenditure in the four groups of schemes during the period 1985–1995. The results indicate that in all four groups, there is a statistically significant declining trend ($-\beta_1$) in government expenditure for O&M during the pre-IMT period. In the post-IMT period, there is a slight reversal in the trend ($+\beta_2$) in all categories of schemes except the rehabilitated schemes without IMT and the rehabilitated group. However, the change in the trend is not statistically significant.

The results suggest that there has been a decline in government's recurrent costs for irrigation during the period 1985–95 across all categories of schemes irrespective of whether IMT programs have been introduced or not, but

TABLE 3.
Estimated regression coefficients for trends in government expenditure for O&M 1985–1995.

Variable description	Regression coefficients			
	Rehabilitated schemes		Un-rehabilitated schemes	
	With IMT	Without IMT	With IMT	Without IMT
Constant (β_0)	87.04	80.11	86.80	96.72
Trend in government's O&M cost/ha in the pre-IMT period (β_1)	- 0.879 (-5.684)*	-0.794 (-4.269)*	-0.885 (-8.271)*	- 0.983 (-5.023)*
The change in trend in government's O&M costs in the post-IMT period (β_2)	0.424 (1.373)	-0.2867 (-0.761)	0.346 (1.603)	0.428 (1.078)
Adjusted R^2	0.534	0.4439	0.487	0.390
F. statistic	43.42*	52.18*	102.47*	37.265*

*Statistically significant at the 5 percent level.
Figures in parentheses are t values.

FIGURE 3A.
Trend in government O&M expenditure in the rehabilitated schemes with IMT.

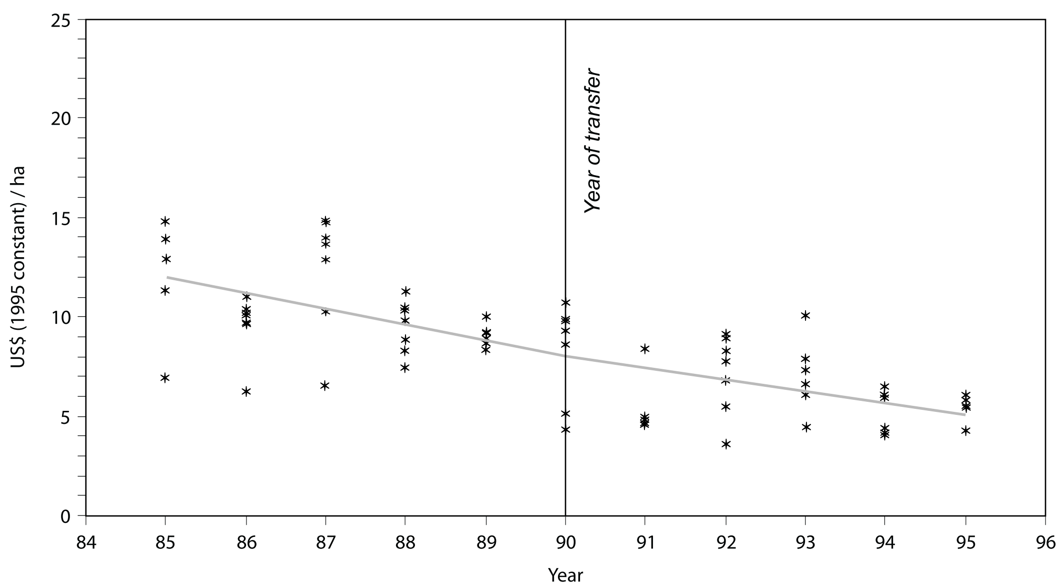


FIGURE 3B.
Trend in government O&M expenditure in the rehabilitated schemes without IMT.

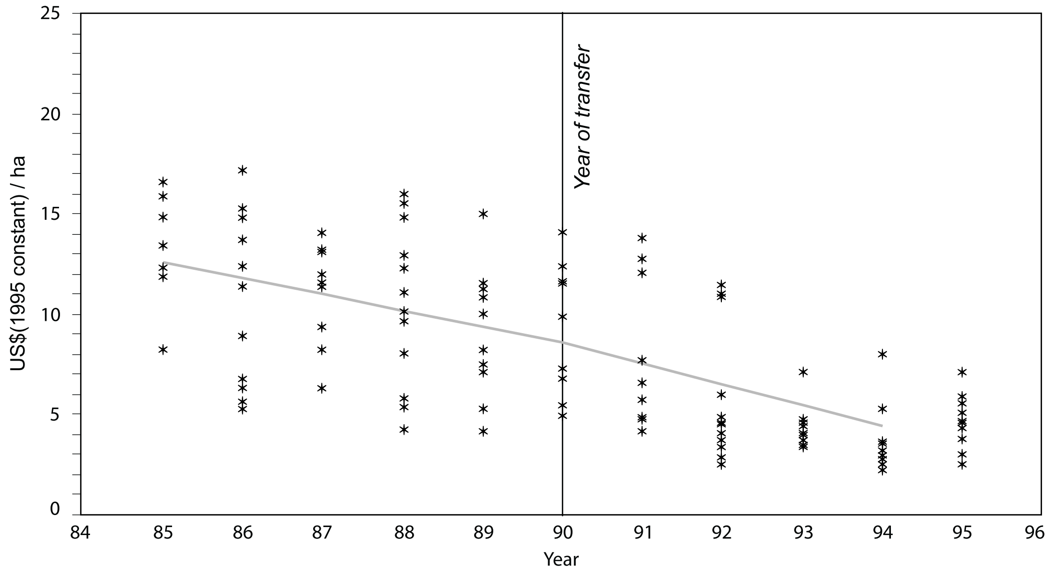


FIGURE 3C.
Trend in government O&M expenditure in the un-rehabilitated schemes with IMT.

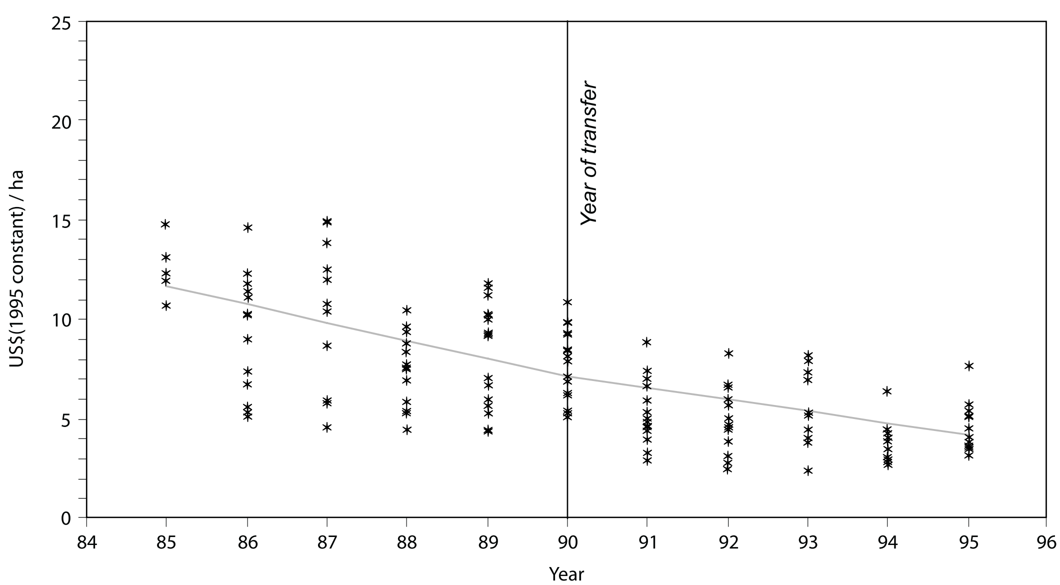
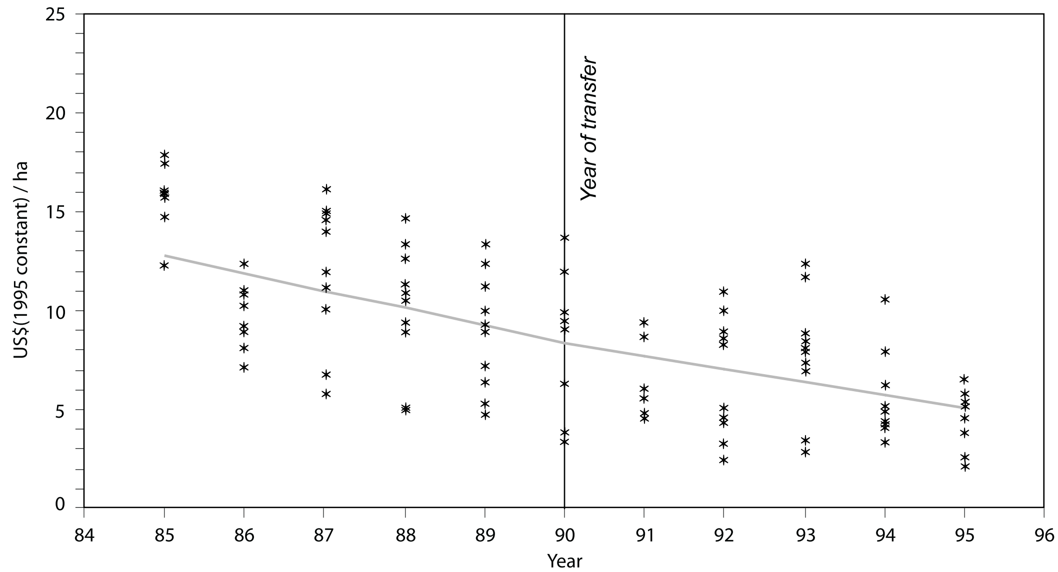


FIGURE 3D.
Trend in government O&M expenditure in the un-rehabilitated schemes without IMT.



does not fully support the hypothesis that *IMT leads to a reduction in government expenditure for O&M.*

Cost of Irrigation to Farmers

Traditionally, irrigation water has been supplied free to farmers in Sri Lanka. Attempts made by the government in the past to levy a fee from farmers were largely unsuccessful. The "costs" of irrigation to farmers are primarily the contribution of voluntary labor for canal maintenance and in some instances, the payment made in kind to the *yaya palaka* (field supervisor) employed by the Irrigation Department to oversee the distribution of irrigation water. With the introduction of participatory management, the government expected FOs to recover the cost of O&M from farmers (Ratnayake 1995). This section examines the implications of participatory management for the cost of irrigation to farmers. The hypothesis advanced is that, *the adoption of participatory management will increase farmers' cash costs and labor contribution for irrigation.*

The analysis is based on data obtained from a sample survey of farmers in Nachchaduwa and Hakwatuna Oya schemes. Three kinds of irrigation costs were assessed: cash payments, payments made in kind, and the number of person-days of family labor contributed to canal maintenance. Farmers were also asked about any "unofficial" payments made to obtain irrigation water. Table 4 gives the actual irrigation costs reported by farmers in the post-transfer reference year (1994-95). The total cost of irrigation is about the same (approximately US$15–16/ha) for both schemes. Data show that after transfer farmers generally contributed more in the form of unpaid family labor (56% in Nachchaduwa and 58% in Hakwatuna Oya) than in cash or kind for canal maintenance.

In the survey, farmers were asked to compare irrigation costs in the post-transfer reference year with costs of irrigation before transfer. About 90 percent of farmers in both schemes claimed that there was no cash fee on irrigation before turnover. After the transfer of O&M functions to FOs, some organizations charged a modest fee (Rs 50/acre/season or US$2.5/ha/season) for canal maintenance. The survey results showed

TABLE 4.
Annual irrigation costs to farmers after IMT (1994–95).

Cost components	Units	Nachchaduwa scheme	Hakwatuna Oya scheme
Cash costs per hectare [a]	US$/ha	6.34 (36) [b]	6.58 (50)
Value of unpaid family labor contributions for canal maintenance	US$/ha	8.18 (67)	9.00 (74)
Total irrigation costs [c]	US$/ha	14.52 (47)	15.58 (54)

Source: Farm Survey (July and November, 1996)

[a]Irrigation cash costs include cash payments plus the monetary value of payments made in kind.

[b]Figures in parentheses are the coefficients of variation in percentage terms.

[c]Total irrigation cost = Irrigation cash costs + the value of family labor.

that only a minority of farmers (23% in Hakwatuna Oya and 16% in Nachchaduwa) paid the maintenance fee.

Figure 4 gives farmers' perception of changes in irrigation cost components before and after turnover. A majority of farmers in both schemes claimed that payments in kind and unpaid family labor contributions for canal maintenance had remained about the same before and after turnover. In both locations well-defined procedures for cost recovery have not been established as yet. Data from the two schemes do not provide sufficient evidence to suggest an increase in the cost of irrigation to farmers following the introduction of participatory management.

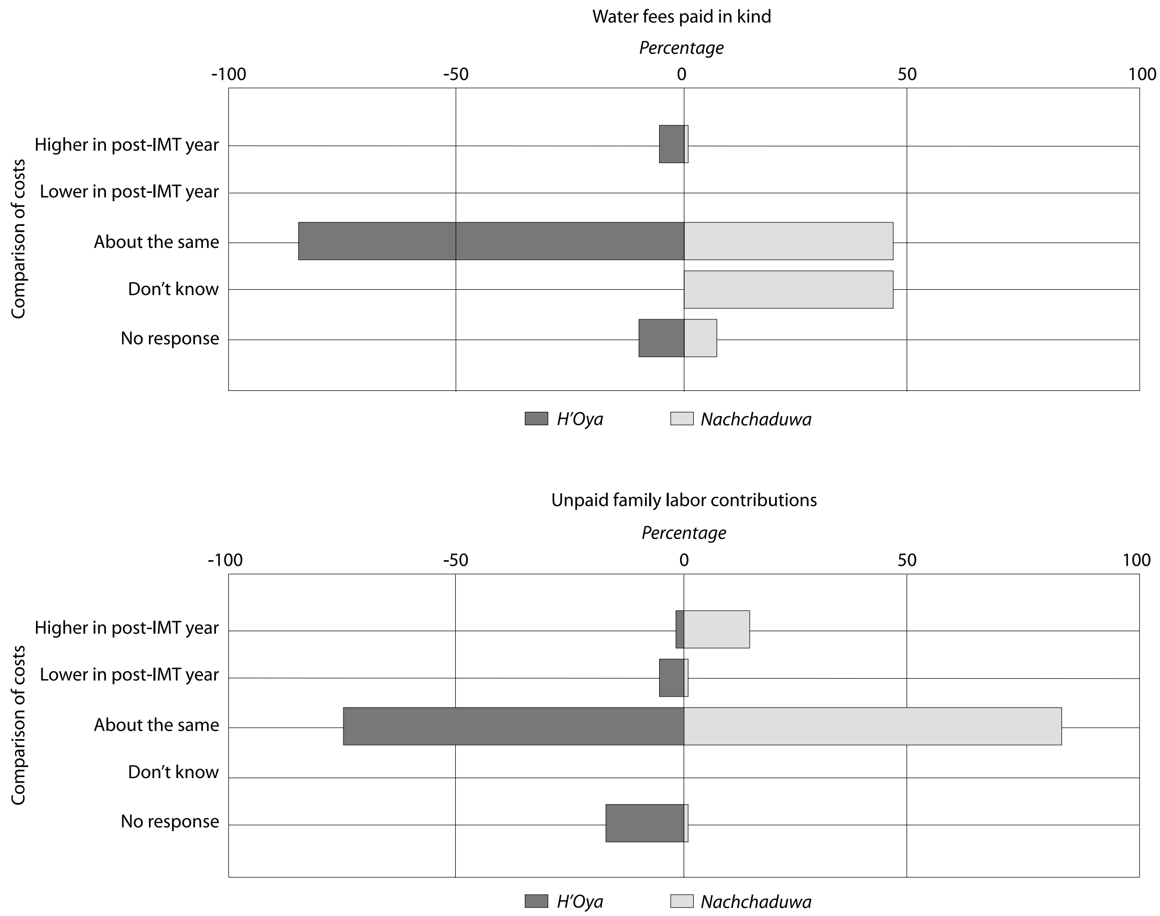
Quality of Irrigation Service

This section examines whether the introduction of participatory irrigation management has resulted in an improvement in the irrigation service. The hypothesis advanced is: *as farmers have a vested interest in the irrigation service, involving them directly in irrigation management would lead to improvements in the quality of the irrigation service.* Changes in the quality of irrigation service were assessed in terms of farmer perceptions, adequacy, timeliness and fairness of water distribution, and the incidence of irrigation-related conflicts among farmers before and after transfer.[6]

Figure 5 displays farmers' perceptions about the quality of irrigation service before and after transfer. A majority of farmers in both schemes claimed that water supply in both the wet and dry seasons was adequate before and after transfer. However, in Nachchaduwa, about one-third of the farmers in the head-reach and about 25 percent in the middle and tail-end areas reported that water supply had worsened after transfer. Farmers attributed the worsening of water supply to the poor quality of work done during rehabilitation prior to management transfer. The responses of a majority of farmers in both schemes were similar with regard to the timeliness of water supply, fairness of distribution, and the frequency of conflicts over water distribution, namely, that these had not changed significantly after transfer.

[6]The indicators specified by IWMI to measure water supply conditions in irrigation schemes are: Relative Irrigation Supply (RIS) and Relative Water Supply (RWS). These indicators relate water supply to demand and indicate how tightly supply and demand are matched (see Molden et al. 1998). Water supply data were not available at the level of the transfer unit (distributary channel).

FIGURE 4.
Farmers' perception of changes in irrigation costs.



What was negative or positive before remained so afterwards (figure 5).

Impact on Maintenance

To assess the outcomes of maintenance investment after transfer, the study team conducted a detailed field inspection of the full length of main canals, a sample of six distributary channels in each scheme and all structures along these canal reaches. Canal reaches and structures were classified as 'functional' (F), 'nearly dysfunctional' (ND), and 'dysfunctional' (D).[7] Canal lengths were considered 'defective' if one of the following problems existed and if it interfered with the desired hydraulic operation:

- constriction or enlargement of the canal cross section
- visible siltation and/or encroachment of freeboard or adjacent road

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

- visible seepage
- slippage, scouring, or other defect in embankment
- cracks or other damage to canal lining

Main canals and distributary channels were divided into quartile reaches. Table 5 shows (for both schemes) the percentage of total canal length in each quartile that was defective for main canals and distributary channels. Despite rehabilitation in Nachchaduwa, the average percentage of main canal length that was defective was about 15 percent in both schemes (which would be considered relatively high for a main canal). However, at the level of farmer investment, the condition of the distributary channels in Nachchaduwa was significantly better (only 3.2% defective) than that in Hakwatuna Oya (about 15% defective).

Table 6 gives the functional condition of irrigation structures that were inspected. Control, conveyance, measurement, or ancillary structures were considered defective (D or ND) if one of the following conditions was present:

FIGURE 5.
Farmers' perceptions about the quality of irrigation service before and after IMT.

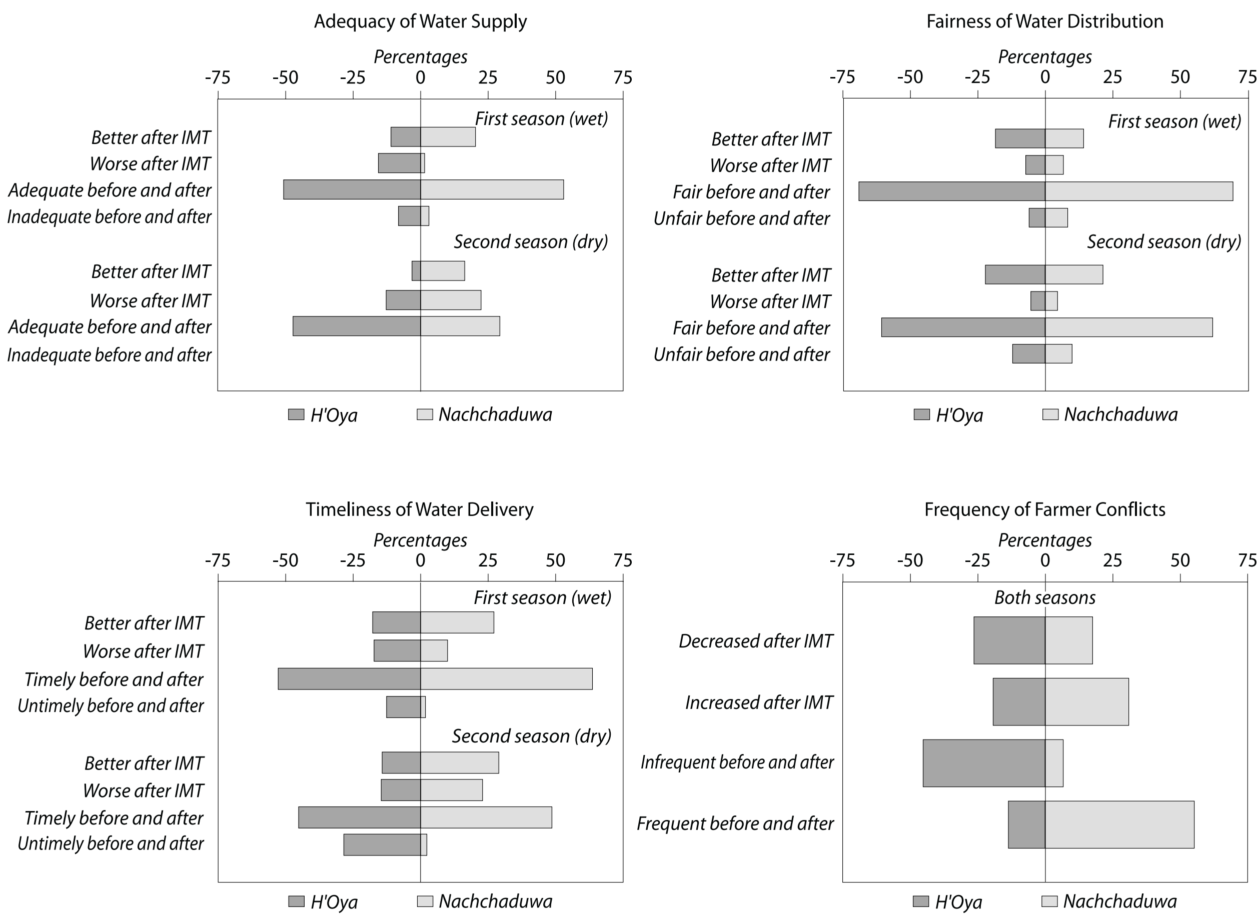


TABLE 5.
Functional condition of canal (channel) legths inspected.

Canal (channel) type	Quartile reaches	Nachchaduwa		Hakwatuna Oya	
		Length (meters)	Percent defective	Length (meters)	Percent defective
Main canals	Q 1*	10,007	20.5	4,686	5.4
	Q 2	10,007	13.5	4,686	14.9
	Q 3	10,007	5.7	4,686	39.1
	Q 4	10,007	23.7	4,686	2.1
	Total	40,027	15.9	18,745	15.4
Distributary channels	Q 1	2,453	11.4	8,164	23.7
	Q 2	2,453	0	8,164	19.5
	Q 3	2,453	1.4	8,164	9.6
	Q 4	2,453	0.2	8,164	6.6
	Total	9,812	3.2	32,657	14.9

*Listed from head (Q1) to tail-end (Q4) of canals.

TABLE 6.
Functional condition of structures inspected.

Type of structure	Total structures	Number dysfunctional inspected	Percentage dysfunctional
Nachchaduwa			
Water control	191	44	18.7
Water conveyance	67	1	1.5
Water measurement	0	0	0
Ancillary	267	1	0.4
Total	525	25	5
Hakwatuna Oya			
Water control	164	4	2.4
Water conveyance	180	18	9.1
Water measurement	3	0	0
Ancillary	177	3	1.7
Total	524	25	5

- Scouring of canal around structures.

- Approach section, rubble pack, and wings of structures are breaking apart.

- 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).

- Water measurement structure cannot be used to measure flow due to damaged or missing gauge, recorder, or other component.

- Civil works of ancillary structures damaged or poorly constructed.

Only 5 percent of all structures in both schemes were dysfunctional. In both Nachchaduwa and Hakwatuna Oya more than 60 percent of all dysfunctional structures observed at the distributary level had been dysfunctional for less than 1 year. In Nachchaduwa 72 percent had been dysfunctional for less than 2 years; in Hakwatuna Oya this ratio was 94 percent. There is no indication of significant long-term deferral of maintenance by farmers in Hakwatuna Oya. However, in Nachchaduwa 5 of the 18 dysfunctional structures (28%) had been dysfunctional for 3 to 4 years. This is probably because of the extended rehabilitation program and the expectation that the government would eventually repair the dysfunctional structures.

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 tables 7 and 8, the cost estimate for repairing all dysfunctional canal lengths and structures is referred to as the Essential Maintenance Requirement (row 3). The cost estimate for repairing all nearly dysfunctional canal lengths and structures is referred to as the Preventive Maintenance Requirement (row 4). The combination of the two is termed the Total Accumulated Maintenance Requirement (row 5), which means maintenance problems that have been deferred from routine maintenance.

The Maintenance Investment Capacity Ratio (MIC ratio, row 6) compares the level of average annual maintenance budget (row 2), after transfer,

TABLE 7.
Maintenance investment capacity in the Nachchaduwa scheme (in 1995 US$/ha).

Maintenance expenditures and requirements per ha	Main system level	Distributary canal level	Entire scheme
Average annual maintenance budget	1.98	1.71	3.69
Essential maintenance requirement	3.83	0.35	4.18
Preventive maintenance requirement	1.0	0.51	0.61
Total accumulated maintenance requirement*	3.93	0.86	4.79
MIC ratio [Row 2/Row 5]	0.5	2.0	0.8
Annual requirement for routine + accumulated maintenance**	6.15	2.23	8.08
Required budget increase $\left[\frac{\text{Row 7 – Row 2}}{\text{Row 1}}\right]$	211%	30%	119 %

*Accumulated maintenance is a total of essential plus preventive maintenance. ** Assumes essential maintenance is completed in 1 year and preventive maintenance is completed over 3 years.

with the total Accumulated Maintenance Requirement. This is an indicator of the extent to which scheme management is capable of taking care of the backlog of accumulated maintenance needs at the average level of routine maintenance expenditure. If we add routine and accumulated maintenance requirements together (row 7) and compare this to routine expenditure, we have a value which is the percentage by which routine expenditure would have to increase in order to take care of all routine, essential, and preventive maintenance requirements within 3 years (row 8).

For Nachchaduwa, table 7 shows an MIC ratio of 2 at the distributary channel level, which means that the average annual expenditure for maintenance is twice the size of the relatively small accumulated maintenance requirement. The FOs are in a relatively good position to handle maintenance. The organizations would only have to increase their annual maintenance budget by about 30 percent in order to eliminate the backlog. The situation is quite different in Hakwatuna Oya (table 8), where the MIC ratio is 0.2, which indicates that the average annual maintenance investment is only one-fifth the size of the cost of eliminating the deferred maintenance requirement. It would take an increase in the annual budget of 275 percent to handle routine maintenance and eliminate the backlog within 3 years. The MIC ratios at the main system level (for which the government remains responsible) are similar, at 0.5 and 0.4 for Nachchaduwa and Hakwatuna Oya, respectively. In Nachchaduwa, despite the rehabilitation, the government is less capable of handling maintenance requirements at its level of responsibility than are the farmers at their level. The reverse is true in Hakwatuna Oya.

Finally, on the whole, farmer perceptions of the quality of maintenance are more negative in Nachchaduwa than in Hakwatuna Oya (figure 6). In Nachchaduwa, nearly 60 percent of all farmers interviewed felt that the functional condition of the canal system was worse after management transfer. This implies extensive farmer dissatisfaction with the rehabilitation, which was done without farmer participation. In Hakwatuna Oya, farmers were more evenly split in their views about whether the functional condition of canal infrastructure was better or worse after management transfer.

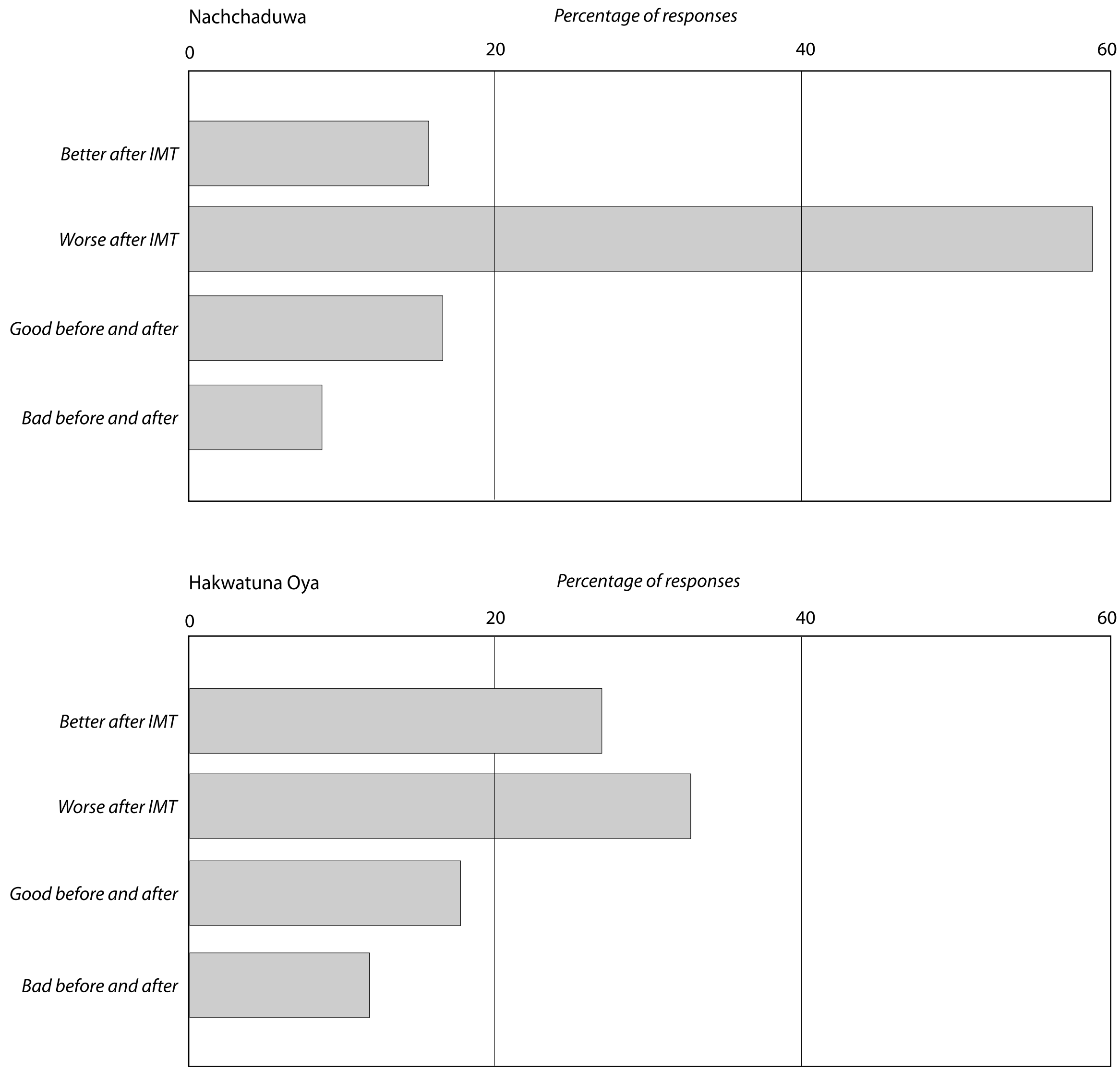
TABLE 8.

Maintenance investment capacity in the Hakwatuna Oya scheme (in 1995 US$/ha).

Maintenance expenditures and requirements per ha	Main system level	Distributary canal level	Entire scheme
Average annual maintenance budget	1.26	1.36	2.62
Essential maintenance requirement	2.69	2.54	5.23
Preventive maintenance requirement	0.27	3.58	3.85
Total accumulated maintenance requirement*	2.96	6.12	9.08
MIC ratio [R2/R6]	0.4	0.2	0.3
Annual requirement for routine + accumulated maintenance**	4.04	5.10	9.14
Required budget increase $\left[\frac{\text{Row 6} - \text{Row 1}}{\text{Row 1}}\right]$	221%	275%	249%

*Accumulated maintenance is a total of essential plus preventive maintenance. ** Assumes essential maintenance is completed in 1 year and preventive maintenance is completed over 3 years.

FIGURE 6.
Farmers' perceptions of functional condition of canals.



Impact on Agricultural Production

Although irrigation schemes contribute about two-thirds of the national rice output, there is growing concern about low cropping intensities and stagnation of the rice yield level in the schemes. Problems related to irrigation are considered to be a major reason for the stagnation of yield levels in the schemes (National Development Council 1996). If the shift of primary responsibility for water distribution to FO leads to an improvement in the quality of irrigation service, one could expect cropping intensities to improve and farmers to use more inputs due to greater confidence in the irrigation service, which in turn would lead to higher yields. This proposition is tested by examining the trend in paddy yields and cropping intensities in 50 schemes over the 10-year period 1985-95. The analysis was done separately for rehabilitated and un-rehabilitated schemes with and without IMT.

Trends in Paddy Yields

The trend in paddy yields during the period 1985–95 is estimated using regression equation (1). The results are given in table 9. Figures 7A to 7D give the yield trends for each group.

The results indicate that in the pre-IMT period, paddy yields in the rehabilitated schemes, irrespective of whether they were transferred or not, show a declining trend ($-\beta_1$). The decline is statistically significant in the schemes with IMT and rehabilitation. During the same period, yields in the un-rehabilitated scheme show a statistically significant upward trend ($+\beta_1$). In the post-IMT period, there is a statistically significant upward shift in paddy yields in the group showing the effects of both rehabilitation and management transfer ($\beta_2 = 245.54$). There is no statistically significant change in trends in the schemes that had been rehabilitated but not transferred and those that had been transferred but not rehabilitated. In the post-IMT period, paddy yields in the group without the two forms of intervention show a statistically significant declining trend when compared to the pre-IMT period. The conclusion that emerges from the analysis is that there has been a significant improvement in yields in the schemes that have undergone both management transfer and rehabilitation. There is no statistically significant change in yield trends in schemes with only one type of intervention, and those without any of the two forms of intervention show a significant decline in yields. These findings are consistent results from the Gal Oya scheme in Sri Lanka (Amerasinghe et al. 1998).

Cropping Intensities[8]

The regression model 1 was used to analyze trends in cropping intensities in the different groups of schemes. The estimated regression coefficients are given in table 10. The analysis indicates that there are no significant differences in the trends in cropping intensities in any of the four groups of schemes in the periods before and after transfer.

TABLE 9.
Estimated regression coefficients explaining trends in paddy yield in the selected schemes, 1985-95.

Variable description	Regression coefficients			
	Rehabilitated schemes		Un-rehabilitated schemes	
	With IMT	Without IMT	With IMT	Without IMT
Constant	12941	5163	- 1761.38	-3558.15
Trend in paddy yields in the pre-IMT period (β_1)	-98.79 61.14	(-2.875)* (2.338)*	-6.32 89.83	(-2.219) (3.088)*
The change in trend in paddy yields in the post-IMT period (β_2)	245.54 -52.09	(3.799)* (-1.06)	-0.70 -93.66	(-0.219) (- 1.728)*
Adjusted R^2	0.11	0.01	0.04	0.08
F. statistic	7.81*	0.124	5.18*	7.72*

*Statistically significant at the 10 percent level.
Figures in parentheses are t values.

[8]Cropping intensity = $\frac{\text{Area cultivated in first (maha) season + area cultivated in second (yala) season x 100}}{\text{Cultivable area}}$

FIGURE 7A.
Trend in paddy yields in rehabilitated schemes with IMT.

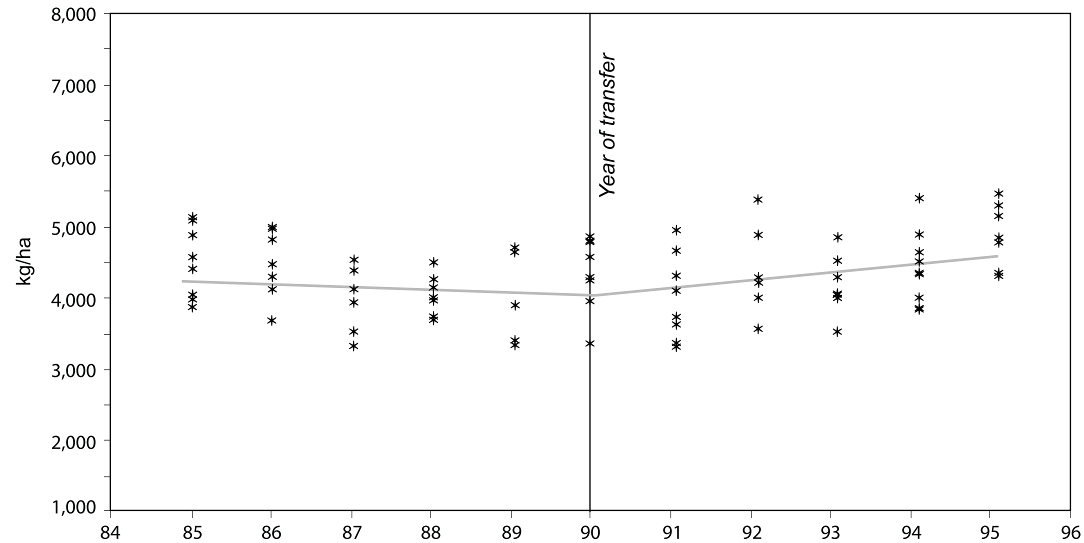


FIGURE 7B.
Trend in paddy yields in rehabilitated schemes without IMT.

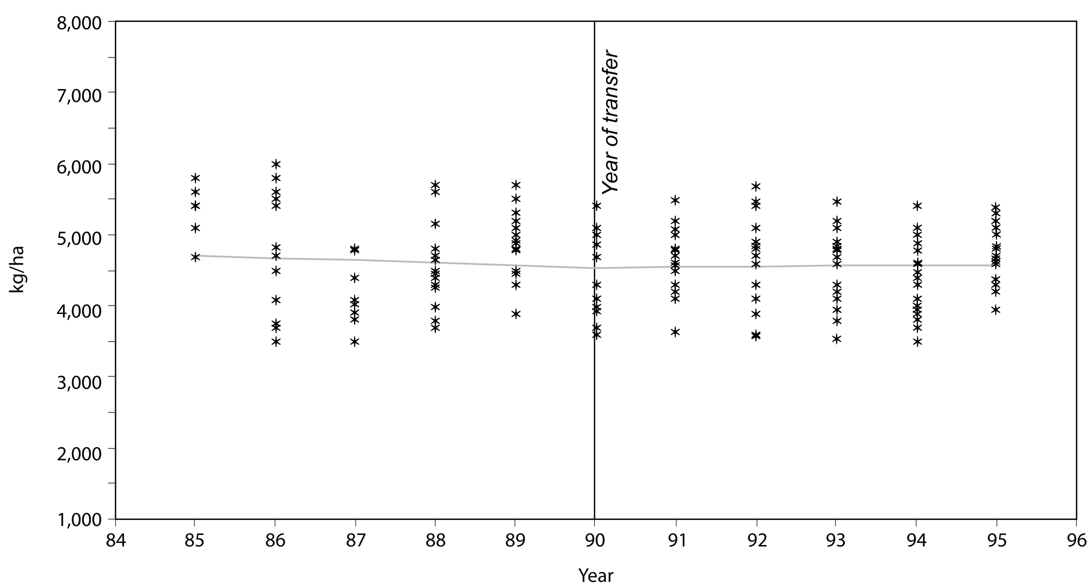


FIGURE 7C.
Trend in paddy yields in un-rehabilitated schemes with IMT.

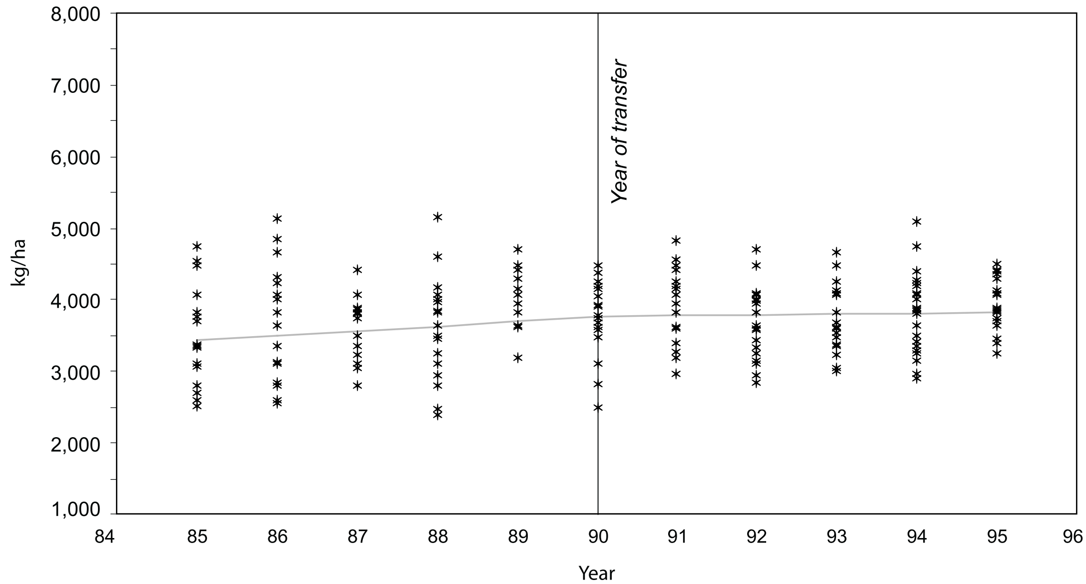
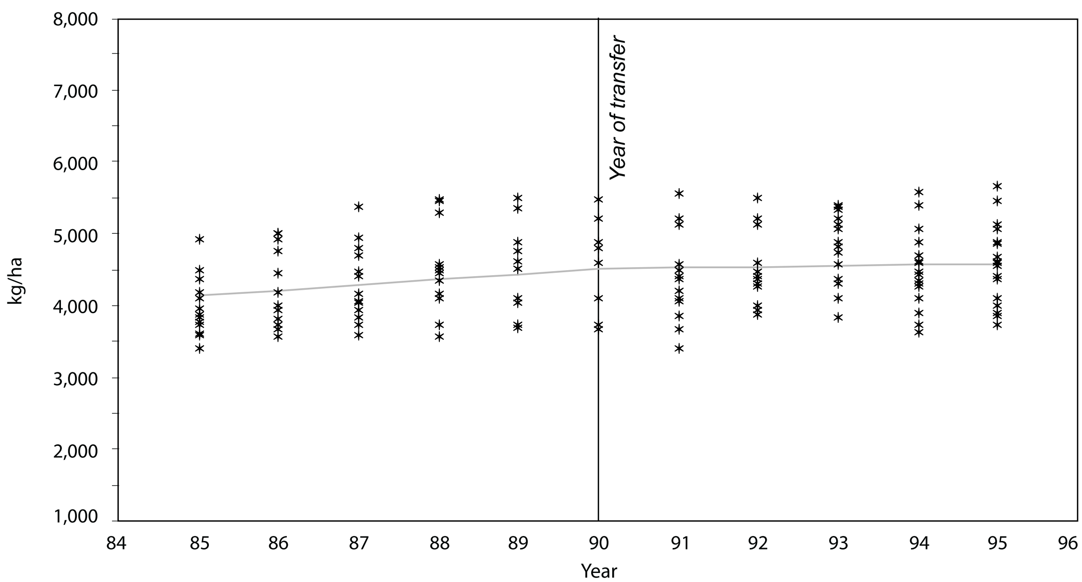


FIGURE 7D.
Trend in paddy yields in un-rehabilitated schemes without IMT.



Economic Returns per Unit of Land and Water

Economic returns per unit of land and water are measured in terms of the gross value of output (GVO) per hectare of cultivated land and per cubic meter of water respectively. Rice is the major crop grown in the major irrigation schemes in Sri Lanka. In recent years there has been an increase in cultivation of non-rice crops particularly in the dry season. But, as there is no reliable data on the extents cultivated and yields of non-rice crops in the schemes, the valuation of output is based solely in terms of the amount of paddy (rough rice) produced. GVOs for the various schemes were first computed on the basis of the average price of paddy in the district in which they were located. The value was then "standardized" using the international price of rice and expressed in terms of constant 1995 US dollars.[9]

Returns per Unit of Land

The trend in the economic returns per unit of land during the period 1985-95 was estimated using equation 1. The standardized GVO/ha was specified as the dependent variable with the same set of explanatory variables specified in the equation. The estimated regression coefficients are given in table 11.

TABLE 10.
Estimated regression coefficients explaining trends in cropping intensities in the selected schemes, 1985-95.

Variable description	Regression coefficients			
	Rehabilitated schemes		Un-rehabilitated schemes	
	With IMT	Without IMT	With IMT	Without IMT
Constant	-34.16	242.63	372.87	-27.21
Trend in cropping intensities in the pre-IMT period (β_1)	1.797 -2.49	(0.578) (-1.158)	-1.356 1.57	(0.551) (0.496)
The change in trend in cropping intensities in the post-IMT period (β_2)	5.878 7.026	(0.937) (1.645)	5.545 -0.375	(1.133) (0.058)
Adjusted R^2	0.11	0.01	0.01	0.01
F. statistic	4.31	1.041	1.511	0.424

Numbers within parentheses are t values.

TABLE 11.
Estimated regression coefficients explaining trends in the gross value of output (GVO)/ha in the selected schemes, 1985–95.

Variable description	Regression coefficients			
	Rehabilitated schemes		Un-rehabilitated schemes	
	With IMT	Without IMT	With IMT	Without IMT
Constant	3689	2223.62	877.06	728.60
Trend in GVO/ha in the pre-IMT period (β_1)	- 32.10 (- 4.09)**	- 14.52 (- 2.373)	- 1.50 (-0.258)	1.88 (0.296)
The change in trend in GVO/ha in the post-IMT period (β_2)	68.07 (4.587)**	21.79* (1.914)	10.29 (0.950)	- 0.055 (- 0.005)
Adjusted R^2	0.17	0.02	0.012	0.01
F. statistic	10.522**	2.899*	1.234	0.227

Figures in parentheses are t values.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.

[9]The method of estimating the standardized gross value of output is explained in Molden et al. 1998.

The results show that in the pre-IMT period three of the four groups of schemes show a decline in the GVO/ha ($-\beta_1$). The decline is statistically significant only in the group where both rehabilitation and IMT had occurred. In the post-IMT period there is a statistically significant upward shift in the GVO/ha in the rehabilitated schemes. The rate of increase of GVO/ha in schemes, with the effects of management transfer and rehabilitation, is higher than in those which have been rehabilitated only. There is no statistically significant difference in the trend in GVO/ha in un-rehabilitated schemes during the reference period.

Returns per Unit of Water

Returns per unit of water were estimated in terms of gross value of output (GVO) per unit of water diverted. As most of the un-rehabilitated schemes did not have accurate time-series on irrigation releases, the analysis is confined to the schemes that had undergone rehabilitation. Table 12 gives the estimated regression coefficients of the parameters used to estimate trends in the GVO per unit of water diverted (GVO/m^3). Figures 8A and 8B display the trend in GVO/m^3 during the period 1985–95. In the pre-IMT period, both categories of schemes show a slight (statistically not significant) declining trend in the productivity of water. In the post-IMT period, there is a statistically significant reversal in the trend, irrespective of whether the schemes had been transferred or not. These results suggest that rehabilitation rather than IMT may be the major contributing factor for the improvements in the productivity of water experienced in the post-IMT period.

TABLE 12.
Estimated regression coefficients explaining trends in the productivity of water in the selected schemes, 1985–95.

Variable description	Regression coefficients			
	Rehabilitated schemes		Un-rehabilitated schemes	
	With IMT	Without IMT	With IMT	Without IMT
Constant	0.181	0.135	–	–
Trend in GVO/m^3 in the pre-IMT period (β_1)	-0.001 (-1.323)	-.001 -(0.400)	–	–
The change in trend GVO/m^3 in the post-IMT period (β_2)	0.003 (1.710)*	0.005 (1.693)*	–	–
Adjusted R^2	0.014	0.11	–	–
F. statistic	1.54	0.011*	–	–

Figures in parentheses are t values.

* Statistically significant at the 10 percent level.

FIGURE 8A.
Trend in the productivity of water in the rehabilitated schemes with IMT.

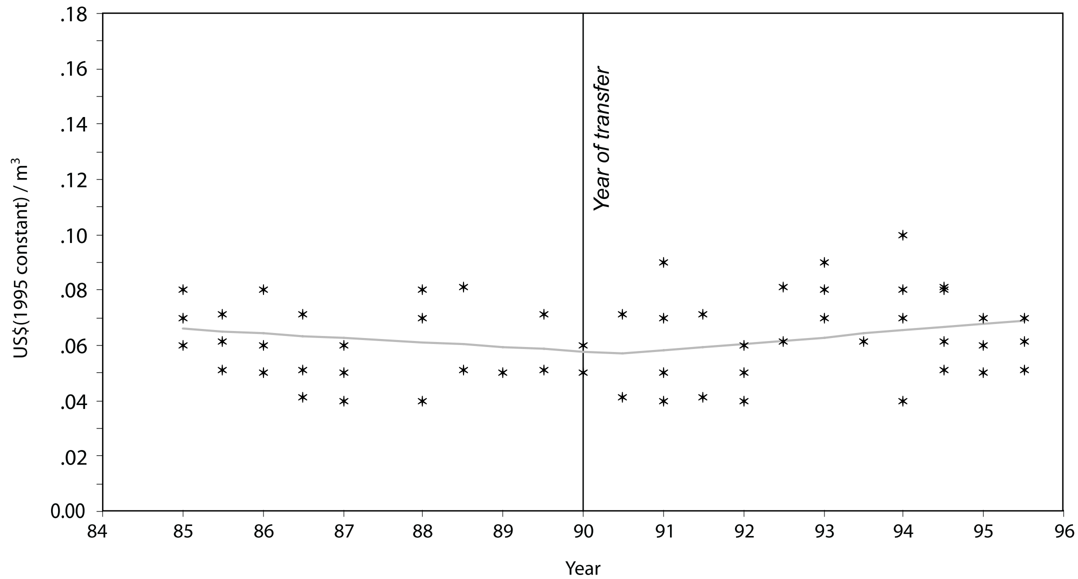
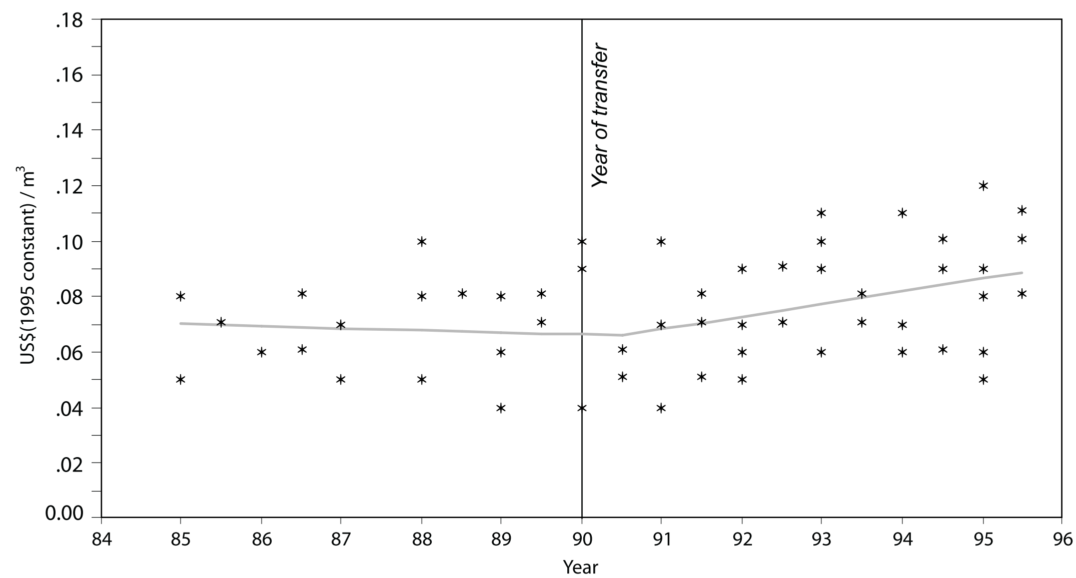


FIGURE 8B.
Trend in the productivity of water in the rehabilitated schemes with without IMT.



Conclusions

This study was undertaken with two objectives in mind: first, to validate empirically the methodology developed by IWMI to assess the impacts of management devolution and second, to document the effects of the participatory irrigation management program on the performance of irrigation schemes in Sri Lanka. Based on the case study, this section reflects on the methodology and summarizes the results of the analysis of the impacts of the participatory irrigation management program in Sri Lanka.

Review of the Methodology

The principal aim of the methodology advocated in this text is to gauge the extent to which IMT has resulted in some movement or change in selected measures of performance of irrigation systems. The aim was to measure the direction of change, rather than changes in the absolute value of the performance indicators. The application of the impact assessment methodology to the irrigation systems in Sri Lanka has shown that, where the required data are available, the combination of performance measures, compared before and after, and with and without the intervention, can yield a comprehensive picture of the impacts of management transfer. The selected performance measures cover financial, hydrological, agricultural, and economic aspects.

Early attempts to obtain farmer estimates of crop yields and expenditures on maintenance before transfer showed that farmers could not recall data as far back as 5 to 6 years in the past. Historical data on crop yields and irrigation costs were available only as aggregates for the scheme as a whole. This limited the possibility of assessing quantitatively changes in performance over time. Farmer comparisons of performance indicators before and after transfer could only be qualitative in nature. It proved effective, however, to first obtain quantitative estimates by farmers of recent yields, input usage and expenditures on maintenance, and then ask qualitative questions about the direction of change that had occurred since transfer.

As for assessing the impacts of management transfer on the physical infrastructure, it was not possible to have inspections of the canal networks before transfer, to enable a direct comparison. However, infrastructure assessment as carried out in this study proved to be a reasonably effective way to assess: 1) the functional condition of the schemes after transfer and 2) the capacity of FOs to ensure the physical sustainability of the schemes after transfer.

One limitation of the methodology is that data collection can be very demanding, particularly when attempts are made to measure changes in performance over time. In many developing countries reliable time series will not be available. Under such circumstances comparisons of schemes which have and have not yet been transferred may be important, as may be the use of remote sensing, qualitative historical assessments by key informants, and the use of participatory rural appraisal techniques.

Impacts of Participatory Irrigation Management in Sri Lanka

The evidence provided in this report suggests that participatory irrigation management entails a partial devolution of decision making authority to farmers. The main concern of the government has been on setting up of farmer organizations. This initiative and the creation of farmer-agency joint project management committees, have apparently improved communication between farmers and agency personnel, and have fostered greater farmer participation in decision making. Yet, government intervention at the level of the transfer unit remains strong.

The evidence from this study leads to the following conclusions on the impact of the participatory irrigation management program on the performance of irrigation schemes:

- There has been a substantial decline in government expenditure on irrigation, beginning before transfer. The declining trend is not confined to schemes where IMT had occurred but, is common to non-IMT schemes as well. However, the analysis suggests that in schemes where participatory management has been introduced, government investments have increased in the 5-year period after transfer. The rate of change in government expenditure is statistically significant in the case of schemes that have been rehabilitated and transferred.

- The reforms have not generated an appreciable increase in the costs of irrigation to farmers. Farmers generally make fewer direct payments (in cash and kind), but contribute more labor for canal maintenance.

- Management transfer alone did not bring about significant changes in the quality of irrigation services.

- Management transfer alone did not result in significant improvements in agricultural production levels or the gross value of agricultural production per unit of land or per unit of water diverted. Neither did rehabilitation alone create significant effects. However, in schemes where both management transfer and rehabilitation have occurred, significant effects on agricultural productivity levels and economic returns were observed.

- The infrastructure inspections revealed a serious underinvestment in maintenance. To eliminate the backlog of deferred maintenance, both the government and the farmers would have to increase investments in maintenance substantially. This raises concerns about sustainability of the schemes under participatory management.

ANNEX

Study Locations

A. Intensive Component

Nachchaduwa and Hakwatuna Oya irrigation schemes were selected for the intensive study (see figure 1). Both are ancient irrigation systems. Nachchaduwa was restored in 1906. It was last rehabilitated between 1984 and 1991 under the Major Irrigation Rehabilitation Project without significant participation of farmers. Although management transfer and rehabilitation were two separate and uncoordinated events, they both overlapped in time. By 1990, the year of transfer, all major repair works had been done and only repairs in the lower part of the scheme remained. For the propose of this study, Nachchaduwa is considered as a scheme showing the effects of both management transfer and rehabilitation.

Hakwatuna Oya scheme was restored in the early 1960s. Substantial investments in physical improvements were made in the early 1980s under a World Bank-sponsored integrated district development program. Since then, there has not been a significant investment in the physical infrastructure. Hakwatuna Oya is considered as a case of management transfer without the effects of rehabilitation. Table A1 gives the key physical and socioeconomic characteristics of the two schemes.

TABLE A1.
Basic characteristics of Hakwatuna Oya and Nachchaduwa irrigation schemes.

	Hakwatuna Oya	Nachchaduwa
Administrative location/district	Kurunegala	Anuradhapura
Agro-ecological zone	North Central Intermediate Zone	North Central Dry Zone
Average annual rainfall	1,610mm	1,473mm
Period of establishment	Ancient; restored in 1960s	Ancient; restored in 1906
Design command area	1,740 ha	2,383 ha
Functional irrigated area	2,407 ha	2,833 ha
Capacity of main reservoir	23.43 Mm^3	55.69 Mm^3
Canal lengths (main)	Right Bank - 11.36 km Left Bank - 4.54 km	High Level - 28.18 km Low Level - 11.89 km
No. of distributaty channels	28	23
Soil type	Reddish Brown Earths	Reddish Brown Earths
No. of farm families	2,178	3,027
Farm sizes	2 ha (average)	0.5 - 6 ha
Cropping pattern in irrigated area: Maha (wet) season Yala (dry) season	 Paddy Paddy + Other Field Crops	 Paddy Paddy + Other Field Crops
Field channel groups	96	187
Distributary channel organizations (DCOs)	13	16
DCOs officially registered	12	16

Both schemes were brought under the Integrated Management of Irrigation Schemes program launched in 1984. Initiatives to form FOs were made in 1988 and by 1990 in Hakwatuna Oya and Nachchaduwa there were 13 and 16 FOs, respectively, at the distributary channel level. Table A2 summarizes the key activities during the transfer process and the institutional arrangements while table A3 summarizes the functions vested with FOs after transfer in the two schemes.

TABLE A2.
Transfer activities in Hakwatuna Oya and Nachchaduwa.

Transfer activities	Hakwatuna Oya	Nachchaduwa
Period of establishment of water user associations	1988–1990	1986–1990
Training farmer representatives	Yes	Yes
Training management staff	Yes	Yes
Revising O&M procedures and/or plans	Yes	Yes
Revising water charges	No	No
Reducing/eliminating govt. financing	Yes	Yes
Retrenching of government staff	No	No
Repairing/improving intake and/or main canals	No	No
Repairing/improving subsidiary canals and structures	Yes	Yes
Farmer participation in prioritizing improvements	Yes	Yes
Farmer investment in improvements	Minor	Minor
Agreeing about future responsibility for rehabilitation	No	No

TABLE A3.
Responsibilities vested with the FO.

Agreements and functions	Hakwatuna Oya	Nachchaduwa
Year of transfer	1990–1995	1990–1991
Legal water right at level of scheme or FO	No	No
FO is legal entity?	Partial	Partial
FO leaders selected by farmers?	Yes	Yes
FO has authority to make rules and sanctions?	Partial	Partial
Authority to make O&M plans and budgets	Partial	Partial
Authority to set water charges	Yes	Yes
Authority to hire staff	Yes	Yes
Release management staff	No	No
Maximum sanction available to FO	Levy fines	Levy fines
Maximum sanction applied since transfer	None	None
Control over intake	No	No
Control over subsidiary canal system	Yes	Yes
Responsibility for future rehabilitation	No	No
Canal rights of way	Partial	Partial
Right to make contracts and raise additional revenue	Yes	Yes
FO has rights to make profits?	Yes	Yes

Source: Scheme level data records
Interview of FO leaders (July, December 1996).

B. Schemes Selected for the Extensive Component

	Name	Location/ District	Type of intervention	Design area (ha)	Functional irrig. area (ha)
1	Basawakkulama	A'pura	IMT + Rehab	156	186
2	Halpan Ela	A'pura	IMT + Rehab	239	240
3	Hurulu Wewa	A'pura	IMT + Rehab	3,866	7,668
4	Nachchaduwa Tank	A'pura	IMT + Rehab	2,382	2,747
5	Nuwara Wewa	A'pura	IMT + Rehab	971	971
6	Rajanganaya Tank	A'pura	IMT + Rehab	6,616	6,223
7	Turuwila Tank	A'pura	IMT + Rehab	187	600
8	Ambakola Wewa	Kurunegala	IMT + No Rehab	340	340
9	Attaragalle Tank	Kurunegala	IMT + No Rehab	419	419
10	Ethimale Tank	Monaragala	IMT + No Rehab	406	340
11	Hakwatuna Oya Tank	Kurunegala	IMT + No Rehab	1,546	2,093
12	Hambegamuwa Tank	Monaragala	IMT + No Rehab	271	283
13	Handapanagala Wewa	Monaragala	IMT + No Rehab	648	648
14	Kimbulwana Oya Tank	Kurunegala	IMT + No Rehab	558	674
15	Kotiyagala Tank	Monaragala	IMT + No Rehab	450	242
16	Labunoruwa Tank	A'pura	IMT + No Rehab	167	258
17	Maha Kanadarawa Tank	A'pura	IMT + No Rehab	2,468	2,469
18	Maha Siyabalangamuwa Tank	Kurunegala	IMT + No Rehab	165	197
19	Maha Willachchiya Tank	A'pura	IMT + No Rehab	1,078	1,390
20	Manankattiya Tank	A'pura	IMT + No Rehab	607	615
21	Meddaketiya Tank	Kurunegala	IMT + No Rehab	208	208
22	Mutukandiya Tank	Monaragala	IMT + No Rehab	810	900
23	Palukadawala	Kurunegala	IMT + No Rehab	820	820
24	Sangilikanadarawa Wewa	A'pura	IMT + No Rehab	263	340
25	Usgala Siyambalangamuwa	Kurunegala	IMT + No Rehab	850	850
26	Wahalkada	A'pura	IMT + No Rehab	810	2,000
27	Yudaganawa Tank	Monaragala	IMT + No Rehab	102	182
28	Balaharuwa Tank	Monaragala	No IMT + Rehab	102	102
29	Bandagiriya Tank	Hambantota	No IMT + Rehab	660	660
30	Batalgoda Tank	Kurunegala	No IMT + Rehab	2,549	3,238
31	Debara Wewa	Hambantota	No IMT + Rehab	382	385
32	Maha Galgamuwa Tank	Kurunegala	No IMT + Rehab	163	163
33	Pattiyapola Mahawewa	Hambantota	No IMT + Rehab	190	230
34	Pannagamuwa Wewa	Hambantota	No IMT + Rehab	191	191
35	Tissa Wewa	Hambantota	No IMT + Rehab	1,112	1,280
36	Tisa Wewa	A'pura	No IMT + Rehab	434	902
37	Weerawila Wewa	Hambantota	No IMT + Rehab	1,100	1,100
38	Wennoruwa Tank	Kurunegala	No IMT + Rehab	190	190
39	Yoda Wewa	Hambantota	No IMT + Rehab	1,322	1,416
40	Horiwila Tank (Palugas Wewa)	A'pura	No IMT + No Rehab	231	209
41	Kallanchiya Wewa	A'pura	No IMT + No Rehab	243	243
42	Magalla Tank	Kurunegala	No IMT + No Rehab	5,654	5,654
43	Maha Mankadawala Wewa	A'pura	No IMT + No Rehab	157	400
44	Maha Lindawewa Tank	A'pura	No IMT + No Rehab	179	442
45	Mahananneriya	Kurunegala	No IMT + No Rehab	172	172
46	Maminiyawa Tank	A'pura	No IMT + No Rehab	204	204
47	Mediyawa Tank	Kurunegala	No IMT + No Rehab	485	486
48	Murutawela Tank	Hambantota	No IMT + No Rehab	1,306	1,711
49	Ridiyagama Tank	Hambantota	No IMT + No Rehab	2,738	3,026
50	Udukiriwila Tank	Hambantota	No IMT + No Rehab	298	316

Note: A'pura = Anuradhapura; Rehab = Rehabilitation.

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