Privatization and Self Management of Irrigation, Phase II

Draft Final Report

November 1997

Submitted to the

Bundesministerium für Wirtschafliche Zusammenarbeit und Entwicklung (BMZ)

and the

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH

by the

International Irrigation Management Institute
Colombo, Sri Lanka

Project Number:	95.7860.0-001.07
Contract Number:	1-60140402
Contract Date:	15 May 1996
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Privatization and Self Management of Irrigation, Phase II

1. PROJECT SUMMARY

1.1 Title of Funding Request

Privatization and Self Management of Irrigation, Phase II

1.2 Theme

Development and application of a methodology to assess the impacts of irrigation management transfer

1.3 Objectives of Research

The main objectives of this second phase of the Privatization and Self Management of Irrigation Project were:

1. To develop a rigorous methodology for comparative assessment of the impacts of irrigation management transfer;

2. To produce systematic evidence about how irrigation management transfer programs are being implemented in selected countries which have implemented the policy at least three years prior to the study;

3. To document farmer perceptions about and responses to irrigation management transfer programs in sample study irrigation systems;

4. To produce systematic evidence about the effects irrigation management transfer programs have had on irrigation operations, maintenance, financing, agricultural productivity and profitability;

5. To broaden international awareness of emerging key management transfer problems and issues through publication and dissemination of short reports, IIMI research reports, journal articles, and other publications, and presentation of research results at international workshops.

1.4 Abstract

The overall purpose of the Project has been to establish, through systematic comparative research, the appropriateness, contextual pre-conditions and impacts of irrigation management transfer programs being implemented world wide. The investigation has involved obtaining systematic comparative evidence about the nature and results of management transfer programs in four countries -- Sri Lanka, Colombia, Indonesia and India -- largely through the development and application of a rigorous comparative assessment methodology. Selected systems were analyzed for differences in performance before and after management transfer and for differences in performance between systems which had and had not been transferred.

1.5 Mode of Cooperation

The Project was implemented in collaboration with a variety of NARS (both research institutions and water management implementation agencies), national researchers, students, and farmer organizations.

During the methodology development phase, which was conducted mostly in Sri Lanka during 1996, the IIMI research team worked directly with field staff of the Irrigation Department of the Government of Sri Lanka to apply the infrastructure assessment methodology and assemble data on scheme performance. This involved two engineers, two technical assistants and one former training specialist from the Irrigation Department. In addition, ten young recent B.Sc. graduates (from the social and agricultural sciences, geography and management science) were employed and trained to work as field researchers. Four of these were women. About 14 local farmers assisted as key informants or in arranging farmer survey interviews.

In Colombia, IIMI extended research contracts to three recent university graduates (2 engineers, 1 sociologist) and a consulting engineer formerly with the government irrigation agency, INAT. One Associate Expert from the Netherlands was assigned to the IIMI Colombia program and worked on the impact assessment study for part of her work. The sociologist and Associate Expert were women. More than six officers of the farmer-governed irrigation districts acted as key informants and assisted with secondary data collection.

In Indonesia, IIMI had a research contract with Gadjah Mada University in Yogyakarta. Ten faculty members were involved in the study, including five professors or lecturers with Ph.D. degrees and five lecturers with M.Sc. degrees. One of the Ph.D.s was a rural sociologist from Padjadjaran University in Bandung, West Java. Eight recent B.Sc. graduates were hired as field researchers. Two B.Sc. students and one M.Sc. student were hired and used the experience to further their degree programs. More than eight farmers were involved as key informants and in helping arrange farmer interviews for the sample surveys.

The study in India was conducted in collaboration with the Indian Institute of Management (IIM) in Ahmedabad. Two senior faculty members of IIM (an agricultural economist and an economist) supervised field research activities. A woman engineer (with a Ph.D. from the Center for Water Resources, Anna University, Madras, India) supervised the field work for the infrastructure maintenance component of the study. Four recent M.Sc. graduates (in agricultural sciences), one recent B.Sc. graduate (a data management specialist) and two M.Sc. students (in engineering) were employed to work on the field research program. More than six farmers were involved as key informants and in helping arrange sample survey interviews.

1.6 IARC Program and Unit

Policy, Institutions and Management Program, International Irrigation Management Institute

1.7 IARC Project Coordinator

Dr. Douglas L. Vermillion, Senior Social Scientist and Irrigation Management Specialist, International Irrigation Management Institute

1.8 Collaborating Institutions

Sri Lanka

Department of Irrigation, Government of Sri Lanka
Distributary canal organizations in Nachchaduwa and Hakwatuna Oya irrigation systems

Colombia

INAT (National Institute of Land Development), Government of Colombia
Water users associations in Samaca, RUT, Recio, San Rafael, San Alfonso and Maria la Baja irrigation districts

Indonesia

Faculty of Agricultural Technology, Gadjah Mada University, Yogyakarta
West and Central Java Provincial Irrigation Services,
Sukabumi and Sumedang District Irrigation Services, West Java
Bogowonto District Irrigation Service, Central Java
Water users associations in Cipanumbangan and Cinangka II schemes, West Java
Water users associations in Planditan and Kaliduren schemes, Central Java

India

Indian Institute of Management, Ahmedabad
Water user associations in Right Bank minor canals 6 and 7, Mula irrigation scheme and Left Bank minor canals 10 and 10J, Bhima irrigation scheme, Maharashtra

1.9 Project Scientists

IIMI Staff Members

Dr. Douglas L. Vermillion, Rural Sociologist
Dr. M. Samad, Agricultural Economist
Dr. Carlos Garces-Restrepo, Agricultural Engineer
Dr. R. Sakthivadivel, Irrigation Engineer
Dr. Upali Amerasinghe, Statistician

Consultants

Dr. S. G. Naranyanamurthi, Systems Analyst
Dr. S. K. Raheja, Statistician
Dr. F. Marikar, Agricultural Economist

1.10 Project Duration

1 January 1996 through 31 March 1998 (period of implementation)
1 January 1996 through 31 December 1997 (period of funding)

1.11 Summary of Expenditures (in US $)

Item	PSM2 (BMZ)		Other sources		TOTAL	
	1996 actual	1997 projected	1996* actual	1997** projected	BMZ projected	Other projected
1. BMZ-supported PSM2						
Personnel	185,691	163,107	24,000	5,000	348,798	29,000
Supplies, Operations	10,790	15,181	-	-	25,971	-
Travel	23,141	22,139	-	-	45,280	-
Publications	159	-	-	-	159	-
Contract research	-	5,000	15,000	39,000	5,000	54,000
Subtotal-Project	**219,781**	**205,427**	**39,000**	**44,000**	**425,208**	**83,000**
2. IIMI Policy, Institutions and Management Program,* of which BMZ Project**	**1,603,338**	**2,042,171**	not applicable	not applicable	**3,645,509**	not applicable
%	**14%**	**10%**			**12%**	

* Includes direct support funds from Performance Program
** Includes direct support from Design and Operations Program
*** Includes all Program costs: senior staff, consultants, travel, operational expenditures, indirect costs; and also includes $45,000 over the two years provided as direct support to this Project from the Policy, Institutions and Management Program.
Not included in the table: program funds from partners, $ 83,000.

1.12 Status

Field work began in Sri Lanka in January 1996 and in Colombia in September 1996. Field work in Indonesia and India began in early 1997. By November 1997 field work was completed in all four countries. As of November 1997, data analysis has been completed for the Sri Lanka and Colombia studies and is still underway for the Indonesia and India studies, which experienced delays in data collection. This work will be completed by the end of December 1997, and a number of publications will be completed before the end of March 1998.

2. ANALYTICAL SUMMARY

Project number	95.7860.0-001.07
Dates	1 January 1996 to 31 March 1998
Title	Privatization and Self Management of Irrigation, Phase II
Reporting period	1 January 1996 to 30 November, 1997
Reporter	Douglas Vermillion
Address	IIMI, P O Box 2075, Colombo, Sri Lanka

2.1 Project Characterization

Characteristics of Research	Increase in Productivity	Environmental Protection	Safeguarding of Biodiversity	Policy, Socio-economic Research	Consolidation of National Programs
Basic/strategic		15%		20%	
Applied				20%	20%
Adaptive/on farm					
Networking				5%	
Information				10%	10%
Other					

2.2 Background and Research Outputs

Irrigation management transfer (IMT) or devolution is a widespread strategy, being pursued in more than 25 countries in Asia, Africa and Latin America. IIMI defines management transfer as the movement of management authority and responsibility for irrigation systems from a government agency to a non-governmental organization, such as a farmer or water users association. Governments around the world are attempting to reduce their recurring expenditures on irrigation and stabilize deterioration of scheme infrastructure without sacrificing the productivity of irrigated agriculture. Many governments assume that the transfer of management responsibility to farmer organizations will improve the accountability of the irrigation service to farmers, will make the service more cost efficient, will motivate farmers to invest more in maintaining irrigation systems and ultimately, will make irrigation systems and irrigated agriculture more sustainable.

There are substantial differences in strategies, contexts and results among countries. Although IMT is a widespread phenomenon and has the potential to have a large impact on the sustainability of irrigation systems and the productivity of irrigated agriculture, until very recently there has been little knowledge at the international level about what approaches work and do not work in different contexts.

The Privatization and Self Management of Irrigation (PSM) Program was started at IIMI in 1992, with substantial funding from the German Government. Its primary objective was to apply research to generate knowledge at the international level about:

1. What are the main strategies for IMT which are being implemented worldwide?
2. What are the impacts of IMT strategies?, and
3. How should IMT be organized and implemented to produce successful results?

Phase I of the PSM Program produced detailed case studies in five countries where management of irrigation systems had been turned over to farmer organizations. Also during the first phase a large international conference was organized and IIMI participated in several other international meetings about IMT to present research results and promote comprehensive discussions about IMT issues. The case studies identified key issues, specified hypotheses and promoted exchange of concepts and information about irrigation privatization and management turnover.

Phase II of the PSM Program has enabled IIMI, in collaboration with its research partners, to develop a multi-disciplinary research methodology for comparative assessment of the impacts of IMT. This impact assessment methodology was developed and field tested in Sri Lanka and

Colombia. This involved extensive discussions and inputs from numerous IIMI and non-IIMI experts and collaboration with national researchers, as described in section 1.5 above. A draft research paper describing the methodology was produced in mid-1996, entitled, "A Standard Methodology to Assess the Impacts of Irrigation Management Transfer."

The standard methodology for IMT impact assessment includes the following key methodological elements: an intensive and non-intensive component, statistical tests of significance of differences in performance before and after transfer and between schemes which had and had not been transferred, a stratified random sample survey of farmers, and a field inspection of the functional condition of irrigation canals and structures.

The impact assessment has intensive and non-intensive components. In the *intensive component* three or four irrigation systems are selected for a detailed assessment of the extent to which transfer has occurred, and the immediate outcomes and impacts. Systems selected are those where:

- transfer actually occurred (i.e., prior government staff had been removed from scheme management and prior expenditures for operations and maintenance [O&M] had been cut off or reduced significantly),
- transfer occurred at least four or five years before the study (to enable adequate before/after comparison), and
- a reasonable amount of reliable annual data related to performance was available to enable time series analysis.

The purposes of the intensive component are:

1. to enable identification of apparent causal linkages between transfer and impacts, and
2. to validate indicators of performance for local contexts.

In the *non-intensive component*, approximately 50 irrigation systems are selected from within a region in order to enable generalization about the impacts of transfer. (This was done in Sri Lanka and Indonesia.) The sample is stratified to enable comparison of performance between systems which have and have not been transferred, and between systems which have and have not been rehabilitated before transfer. Rehabilitation is often a confounding variable which tends to occur at the time of transfer and have its own effect on performance, apart from that of management transfer. Performance indicators included cost of O&M per ha and per unit of water diverted, irrigation intensity, crop yields, and gross economic value of agricultural production. Analysis of 50 cases enables statistical tests of significance of differences. This was done by comparing average levels of performance between each of the above four categories of systems (i.e., transferred or not, and rehabilitated or not) for a single year and analyzing time series data based on average annual values for each category of systems. For time series analysis, researchers compared changes in slope of trend lines before and after IMT.

In the *intensive component*, seasonal or annual data were collected for at least five years before and five years after transfer. Data on O&M budgets, cost of irrigation to government, irrigation intensity, relative irrigation water supply, crop yields and intensity and gross value of agricultural production or output were collected from official data. Data on cost of irrigation to farmers, crop yields, gross value of output, roles of men and women in irrigation management, and perceptions of farmers about irrigation performance and management transfer were collected from individual

interviews with farmers, both informal key informant interviews and survey sample structured interviews. Intentional duplication between secondary and interview data collected on key indicators enabled cross-checking for validity. It was found that trends in agricultural productivity recorded in secondary data were generally consistent with reports by a majority of farmers interviewed.

The farmer sample was selected by stratifying according to location (generally, the upper, middle, and lower and right and left side portions, of the service area) and by selecting at least 15 farmers from within each cell, for a minimum total of 90 farmers. The research team conducted a pre-test to determine the degree of variation in responses among farmers to key questions, such as cost of irrigation and yields. The degree of variation, indicated by standard errors in responses, determined the final sample size needed. Pre-tests in both Sri Lanka and Colombia determined that farmers could not accurately recall quantitative estimates of crop yields, fertilizer application rates or payments and labor inputs for irrigation. Quantitative data on these variables was obtained for only the most recent year and farmers were asked to make qualitative comparisons between the current situation and before IMT.

Data on the functional condition of irrigation system canals and control structures and cost of repairing dysfunctional structures were collected from direct inspection of system infrastructure. Standard criteria were developed for categorizing structures as functional, nearly dysfunctional and dysfunctional. Estimates were made of the cost to eliminate any accumulation of preventive and essential maintenance problems and these were compared with the average annual investment in maintenance made by farmers after IMT. This method enabled researchers to determine whether farmers were deferring maintenance after IMT and to what extent management was moving toward or away from sustainability of infrastructure after IMT.

After the methodology development stage was completed, the methodology was applied in other systems in Sri Lanka and Colombia and in two more countries, Indonesia and India. This has resulted in findings and recommendations of an international or generic nature. The impact assessment tested the following hypotheses:

1. *Irrigation management transfer (IMT) causes or occurs together with a reduction in government expenditure for operation and maintenance.*
2. *Where farmers did not pay for O&M prior to IMT, the reform will significantly increase the cost of irrigation to farmers.*
3. *IMT results in improved quality of irrigation service to farmers, defined in terms of adequacy and equity of water distribution.*
4. *IMT supports the objective of more sustainable maintenance of irrigation infrastructure.*
5. *IMT gradually results in higher agricultural productivity per unit of land and water (depending on which is the more scarce resource in a given context).*
6. *IMT gradually results in higher economic productivity per unit of land and water (depending on which is the more scarce resource in a given context).*
7. *Due to more cost efficient management and improving economic productivity after IMT, the cost of irrigation to farmers relative to gross value of output of irrigated agriculture will decline over time after IMT.*

During the period of PSM Phase II, from January 1996 through November 1997, papers from the project have been prepared and presented at international meetings in Turkey, Mexico, Colombia, South Africa, Egypt (ICID Congress), Germany (Berlin), Niger and Sri Lanka. On December 16-18,

1997 a synthesis paper of comparative results of the PSM Phase II Project will be presented at the FAO/World Bank Technical Consultation on Decentralization, to be held at FAO in Rome.

These papers include findings from the case studies and recommendations for policies, planning, implementation and research for irrigation management devolution programs. The methodology paper is available as a guide to researchers and program evaluators. It is currently being revised and is expected to be published as an IIMI research report in the near future. The paper entitled "Analytical Framework for Irrigation Management Reform" was developed out of IIMI's comparative analysis of management reform. It provides a tool for policy makers and planners involved in strategic planning for management devolution. It encourages a comprehensive analysis of options and decision criteria based on an integrated assessment of all dimensions of management reform--technical, managerial and organizational. This paper is currently being finalized for expected publication as an IIMI research report during the first quarter of 1998.

2.3 General Conclusions

2.3.1 Recommendations on policy and management issues

This section briefly reviews results of hypothesis testing about impacts of IMT and then discusses the implications of the study for research and development. Because of space limitations only summary comments are provided. Annex 1 provides a methodological note about how hypothesis testing was carried out.

1. *Irrigation management transfer (IMT) causes or helps sustain a reduction in government expenditure for operation and maintenance.* The hypothesis was confirmed in all cases, with the qualification that IMT did not cause the reduction but supported a broader policy of reduction. IMT was part of an overall policy of reducing government expenditure on recurring costs of irrigation in Sri Lanka, Colombia, Indonesia and India. In each of these cases IMT has been part of a declining trend in government expenditures, though it did not cause the decline.

2. *Where farmers did not pay for O&M prior to IMT, the reform significantly increases the cost of irrigation to farmers.* This hypothesis was not confirmed. The only two cases where farmers did not pay for O&M prior to IMT were Sri Lanka and Indonesia. Cost of irrigation to farmers in these countries did not increase significantly in either case, although the amount of unpaid family labor contribution for irrigation maintenance did increase slightly in Sri Lanka.

3. *IMT results in improved quality of irrigation service to farmers, defined in terms of irrigation intensity and adequacy and equity of water distribution.* This hypothesis was disconfirmed in all cases. Findings indicate no significant difference in irrigation intensity and most farmers report no change in adequacy or equity of water distribution. However, there is evidence from Colombia that irrigation management effectiveness rose after IMT in pump schemes.

4. *IMT supports the objective of more sustainable maintenance of irrigation infrastructure.* This hypothesis is supported in India and run-of-river schemes in Colombia but not in Sri Lanka, Indonesia or expensive lift schemes in Colombia.

5. *IMT results in higher agricultural productivity per unit of land or water (depending on which of the two is the more scarce resource in a given context).* The results are so mixed between and within countries, that the hypothesis can not be confirmed or disconfirmed on the basis of comparative evidence. In general, where changes do occur, they are not dramatic.

6. *IMT results in higher economic productivity per unit of land and water (depending on which of the two is the more scarce resource in a given context).* Again, results are so mixed between and within countries, that the hypothesis cannot be confirmed or disconfirmed on the basis of comparative evidence, but in general, where changes do occur they are apparently more related to changes in crop prices or amount of water delivered, than to IMT.

7. *Due to more cost efficient management and improving economic productivity after IMT, the cost of irrigation to farmers relative to gross value of output of irrigated agriculture declines over time after IMT.* There is evidence in each of the four countries studied of efforts by farmers and their elected representatives or hired staff to improve the cost efficiency of irrigation management. However, within the five-year post-IMT time frame permitted by this study and in the four countries studied, such improvements did not result in enough gains in efficiency relative to economic productivity to bring about a significant decline in cost of irrigation relative to gross value of output.

In addition to testing these hypotheses, the study also developed a simple typology of irrigation management devolution with three categories: comprehensive, partial and minimal. The study defined irrigation management transfer or devolution as replacement of a government entity with a non-governmental user-based organization in the management of irrigation. *Replacement* rather than *augmentation* of government management is what distinguishes management transfer or devolution from *participatory irrigation management*. Comprehensive devolution is management transfer which includes the following five elements:

1. *a sustainable water right vested in a legally recognized WUA,*
2. *an agreed irrigation service fully under the control of the post-transfer entity,*
3. *balance between responsibility and authority devolved to post-transfer entity,*
4. *devolution of integrated management responsibility (i.e., control over finance & O&M integrated in post-transfer entity), and*
5. adequate *incentives and sanctions to ensure accountability.*

Two additional important hypotheses emerged during the latter part of this study. The first is that the above-listed five elements are essential parts of an irrigation management devolution program, if the objective is to produce locally sustainable irrigation management. Where any of the characteristics are missing, the results will be correspondingly sacrificed. Findings from the four cases and reference to other studies provide modest support for this hypothesis. However, rigorous testing would require comparative analysis of at least 30 to 40 irrigation schemes which differ in terms of comprehensiveness of devolution. Comprehensive irrigation management devolution is rare in developing countries. One of the surprising findings of this study was that none of the cases contained the first element and all of the cases had at least three of the elements missing or in only partial realization. We conclude therefore, that management devolution in all four cases was at best only partial. We hypothesize that the partial reforms were, as structured, relatively ineffective and that the findings of limited or no impacts on performance were more the result of lack of devolution (i.e., partial transfer) than the result of full or comprehensive devolution.

The second hypothesis which emerged is that management transfer by itself can have measurable impacts on management procedures, cost of irrigation to government and farmers, cost efficiency and financial viability of irrigation management and quality of O&M. However, IMT by itself tends to have little direct impact on agricultural and economic productivity, which are more

affected by other factors (such as use of inputs, labor constraints and soil and water conditions). A more comprehensive study including these other factors and with a much longer time series than five years (e.g., 10 to 20 years) would be required to establish impacts of IMT on agricultural and economic productivity.

2.3.2 Messages for research policy and the CGIAR

The study indicated that it is feasible to develop and apply a systematic and comparative methodology to assess the impacts of a type of policy or management reform which is replicated across countries. Despite local differences, a common methodology can be used both to evaluate the local situation and to produce generalizations at the international level. Donors or international development agencies which promote policy, institutional or management reform in developing countries normally have a paucity of knowledge based on comparative research. The CGIAR has a comparative advantage to supply such research knowledge.

One example of such a demand is for research knowledge on how to structure management devolution effectively for natural resources management in developing countries. Both decentralization and devolution are trends which are becoming more widespread not only in water but in forestry, fishery, soil, rangeland and watershed management. Since management devolution tends to be a policy, institutional and managerial frontier in many developing countries, there is more need for experimental or action research than observational studies. Research and information exchange over the last several years has created general awareness among professionals about various strategies for irrigation management devolution. IIMI has been the only source of comparative research information about IMT. More adaptive research is needed about the impacts of different kinds of devolution strategies, but this can be done mainly by NARS (national agricultural research system) organizations. CGIAR centers which conduct research on devolution of natural resource management, such as IIMI, IFPRI, ICRAF, ICLARM, and ICARDA, could productively share methodologies and theoretical concepts and hypotheses about devolution, especially through the System-Wide Initiative on Property Rights and Collective Action. Individually, CGIAR centers can work closely with NARS to do action research on management devolution, building on the international pool of theoretical and methodological knowledge.

Future research, stemming out of recent studies on impacts of IMT, is needed on the following emerging issues:

- What is the appropriate mix of sector and scheme level policies and arrangements that need to be put in place in addition to devolution to optimize adequate local investment in the long-term sustainability of irrigation infrastructure?
- What kinds of management models are appropriate for IMT at large scales of management (exceeding, say, 10,000 ha service area)?
- What kinds of organizational models work best for river basin or aquifer management where IMT has occurred at the scheme level and where competition for water exists between sectors?

2.3.3 Messages for program conception and research management

As mentioned above, the PSM2 Project was implemented with collaborating research partners in all of the countries except Sri Lanka (where local scientists and field workers were hired directly by IIMI during the methodology development stage). The main constraints to more effective collaboration were inadequate time and funds for more on-site visits by IIMI staff for joint planning workshops, joint methodology adaptation and joint analysis, writing and technical editing. Research involving methodology development and adaptation in three or four countries requires at least three years to enable interactive learning processes to evolve.

Collaboration with NARS organizations is essential for conducting field studies in multiple countries. This study has demonstrated that NARS organizations are quite willing to not only collaborate with IIMI but also to invest some of their own resources in the study. In Indonesia, the Gadjah Mada University was able to obtain additional research funds from the Indonesian Government to complement funds from IIMI. It was eligible to receive national research funds by virtue of its memorandum of agreement with an international research organization. Gadjah Mada University is now doing its own study of the impacts of IMT in the outer islands of Indonesia adapting research methods from IIMI and using funds from the Government of Indonesia. We have also found the NARS we worked with in Indonesia, Colombia and India to be quite interested in doing action research. We have recently been invited by a major agency in Sri Lanka to collaborate on action research on irrigation management reform.

One way to improve the partnership between CGIAR centers like IIMI and NARS counterparts is for counterparts to receive parallel grants from donors to manage their research activity with partial financial independence from IIMI, so that they become more motivated to take initiative in research and feel like equal partners with the IARC. Developing governments should be encouraged to create research funds for which NARS organizations can apply, with additional incentives if they are collaborating with an IARC (as in the case of Indonesia). IIMI should always work with both the NARS research organization and the relevant government agency in formulating and carrying out research studies, to ensure studies have the support of implementing agencies. IIMI's country-level coordinating committees have generally been effective in generating guidance and support from multiple government agencies which are related to the policy implications of the study -- not just the irrigation agency. The line department tends to be more resistant to reform than planning or finance departments, which often support reform. So these latter agencies should be involved in research planning as well.

2.4 Validation of Study Results

2.4.1 Messages for researchers

We have found that impact assessment must have four components to enable interpretation of impacts. These are:

- documenting the actual nature and extent of IMT implemented (strategies differ substantially and some are IMT in name only),
- documenting key socio-economic and physio-technical parameters in the context,
- documenting managerial changes occurring after IMT (the crucial causal link between institutional reform and impacts), and
- documenting impacts.

Often, impact studies assume homogeneity in the independent variable and focus on measuring impact, to the neglect of the mediating linkage of changes in managerial practices. IMT is not a homogeneous concept and cannot be measured as a standard factor for causal analysis across countries and even between irrigation systems within countries. Assessment must include careful documentation of the key roles, responsibilities and authority actually devolved and the nature of supporting policies, programs and institutions. Documentation of key socio-economic and physio-technical parameters is essential for comparative analysis and for interpreting social and managerial responses to devolution.

Impact assessment research design should be based on comparison of management performance before and after IMT, or with and without IMT, and should involve both in-depth analysis of a few cases (to validate indicators and track causal linkages) and extensive analysis of 20 to 40 cases to permit generalization. In data-rich environments time series analysis and use of secondary data for a large number of cases is possible. This enables such statistical tools as interrupted time series regression analysis (to test significance of change in trends before and after or with and without IMT) and analysis of variance. In data-poor environments, qualitative data from farmer surveys and key informants becomes more important. Remote sensing of performance indicators such as irrigation intensity and crop yields can also provide historical data. It is now apparent that the methodology developed in PSM Phase 2 assumes a relatively data-rich environment, which is too stringent an assumption for many developing countries. Further methodology development in such areas as participatory rural appraisal and remote sensing is needed for data-poor environments.

Our experience has shown that household surveys are more time efficient, data quality is better, and morale of field researchers is better, if interviews involve two researchers, one to speak and one to record responses. Pre-testing for variability in responses to key questions was useful in estimating an approximate sample size. We found that samples of irrigation systems or sub-systems involving approximately 90 farmers can be stratified into no more than six cells, so that each cell has enough respondents to measure standard error within and between cells. We also found that farmers could not recall yields, fertilizer rates or expenditures on irrigation more than two years in the past. Hence, for the farmer survey, we were forced to substitute qualitative for quantitative recall questions about the situation before IMT.

2.4.2 Messages for NARS and national development agencies

The following messages have arisen both from IIMI's research as well as from its information exchange activities. They are not all directly supported by research findings but several have arisen repeatedly in workshops involving participants in IMT programs or among farmers and agency field operational staff during field work in different countries, so there is reason to assume that these issues cut across countries and should be matters for serious consideration by policy makers and planners as well as NARS researchers and M&E specialists.

1. Management devolution is essentially about authority and can be defined and measured in terms of the core set of potential elements listed in section 2.3 above, each of which describes a measure of authority. IMT can be considered comprehensive, partial or minimal in relation to this core set of elements. Preliminary evidence suggests that the comprehensive type of devolution may produce better outcomes and impacts on management efficiency and financial viability of irrigation and quality of operations and maintenance than partial or minimal devolution (see paper 5, section 3.2, below). Partial reforms (such as those in Sri Lanka and

India) produce little if any change in performance and should not be considered IMT. Evidence from case studies suggests that the structure and comprehensiveness of devolution is more important than the process of change itself. Case studies done by IIMI during phases 1 and 2 of the PSM Project generally exhibit similar change processes but have widely different powers which are devolved and impacts which occur.

2. Management transfer is often only partial because of resistance of line agencies or lack of comprehensive strategic planning. Governments not fully committed to reform often attempt to transfer responsibility but not full authority for management. Where agency staff continue to exercise partial control over water distribution or O&M budgets after transfer, farmer organizations lack the incentives or ability to optimize management for the long term. This can create a false sense of failure about IMT, which can encourage further resistance.

3. Where the comprehensive elements of devolution are in place, less emphasis will be needed by the government on efforts to persuade, motivate and raise the consciousness of farmers to "participate." Primary emphasis should be placed on introducing the above elements where they do not yet exist. This may require dramatic change at the policy level. However at the field level, since these are demanding requirements and since great variation often exists among schemes and regions, management transfer should be dealt with as an institutional evolution, often requiring negotiation and experimentation, rather than as a project or structural adjustment, with rigid short-term requirements to meet quotas.

4. Frequently, there is a lack of clarity about who will be responsible for rehabilitation after turnover and under what terms and conditions. It is often assumed that the government will be primarily, if not totally, responsible for financing future major repairs and rehabilitation. This can create an attitude of speculation among farmers and a tendency to defer maintenance.

5. Rehabilitation is often done just before turnover of management. Where this is implemented without meaningful participation and investment by farmers, it can reinforce a perception among farmers that the irrigation system belongs to the government. This can weaken the incentive of farmers to invest in the system in the future. By contrast, having farmers take the lead in setting priorities for repairs and improvements, while investing a significant amount of their own labor and materials, can be an effective means of changing farmer perceptions about who is and who will be primarily responsible for the system after turnover.

6. Irrigation systems which were originally designed to be managed by engineers or trained technicians, to maximize water use efficiency and flexibility of operation, may need to have some alterations in design to make the infrastructure more compatible with the sometimes constrained management capacities of farmers. Examples of how designs can be simplified are the replacement of adjustable sluice gates with fixed proportional division structures or fixed diameter pipe outlets, or the replacement of gated intakes with a fixed size intake and a flood prevention wall. Such changes may result in less flexibility but more predictability in water distribution, and a lower level of management intensity required to operate the system.

7. Where farmers did not pay for the full cost of irrigation before IMT, and where IMT involves a decrease in, or elimination of, government subsidy for O&M costs, IMT may result in a net increase in the cost of agricultural production for farmers. In this situation, farmers may be reluctant to take over management of irrigation schemes, unless they perceive that they will be able to improve system performance enough that increases in productivity will more than compensate for increases in the cost of irrigation.

8. After IMT, farmer organizations often seek to replace former government subsidies with income from sideline enterprises (such as renting out of equipment, sale of excess water, bulk purchase or sale of agricultural inputs, marketing services, etc.). This is done in response to farmer pressures to contain the rise in cost of irrigation. Some experts see this as a threat to management performance, in that it dissipates the attention of the organization from its original primary function of irrigation management. Others see it as a means to increase farmer group support for their organization, to strengthen the organization's ability to apply sanctions against erring members and as a necessary means to replace lost subsidies. Nevertheless, farmer organizations often spontaneously diversify their functions after turnover, regardless of government policy or views of experts on the matter, as has been the case in many countries, including the Philippines, Sri Lanka, Indonesia, China, Colombia and the USA.

9. Internationally, it is apparent that farmer organizations rarely raise long-term capital replacement funds. There is evidence that they tend to emphasize cost containment to the point of neglecting preventive, and sometimes corrective, maintenance of infrastructure. Taken together, these two trends constitute an emerging threat to the sustainability of irrigation systems, particularly where the ability of governments to finance rehabilitation in the future is in question.

10. Proponents of "participation" often promote maximum participation of farmers in all aspects of irrigation management. When one distinguishes among governance, management and ownership, it is apparent that farmers do not always want to maximize their participation in all ways. Fearing the possibility of future civil liabilities, taxation and financial obligation to rehabilitate their system, farmers sometimes do not want to take over ownership of irrigation system infrastructure. Recognizing their technical limitations and fearing the possibility of partisanship by local factions or elites, farmers often prefer to have governments remain partly involved in regulating management to help regulate conflict, guard against abuses by factions or powerful individuals, audit finances and provide technical support. Where there are labor shortages and farmers are involved in multiple livelihood activities, farmers may not want to takeover the direct management tasks of the system. They are often reluctant to attend regular meetings to discuss matters of implementation. From the farmers' perspective, their desire for participation appears to be focused on participating in the benefits of irrigation and participating in approving basic policies and leaders.

11. Experience to date suggests that the widespread water users' association model of direct management of irrigation schemes is often unable to ensure accountability for finances and management performance. It seems unsuited for management of irrigation systems or sub-systems above the scale of roughly 50 to 100 farmers. Federations of associations have similar weaknesses for larger service areas. Since there are also pressures in developing countries to extend management transfer to medium and large-scale irrigation systems, it is necessary for these countries to learn about, and experiment with, alternative management models which appear to have stronger capacity to deal with problems of accountability, such as semi-municipal districts (governed by farmer representatives), public utilities and farmer-constituted mutual companies.

12. Generally, strong high-level political commitment and support for reform is essential in order for turnover programs to succeed. Clear messages from high levels of government to agencies and farmers are generally needed in order to overcome resistance and confusion.

13. There is a frequent lack of strategic planning which involves all stakeholders of transfer programs. Strategic planning, when used, has the potential to enable identification of new agency mandates and minimize disruptive issues such as staff displacement. Identification of new roles for irrigation agencies after turnover, such as water basin management and environmental regulation, can help limit agency resistance to transfer programs.

14. Competition for water is rising dramatically between irrigation schemes and between agriculture, manufacturing and industry and domestic water users at the level of water basins. There is a widespread lack of adequate management of water allocation and environmental protection at the level of water basins in many developing areas. Irrigation management transfer may not convey important benefits to farmers where it occurs in under-managed water basins -- where local management problems are being overwhelmed by competition for water and environmental degradation at the level of the resource base. Environmental problems may include salinization, rising sodicity, declining water quality, waterlogging, soil erosion and subsequent siltation of irrigation canals, loss of soil water retention capacity due to elimination of trees and foliage in the catchment area and water-related health problems. It is apparent that formation of strong water basin management organizations, which represent all stakeholders, is of urgent importance and should be promoted concurrently with the formation of farmer-based management entities at the level of irrigation systems.

2.4.3 Messages for ultimate clients

1. From the four case studies, the most common ways in which farmer respondents in the sample survey said that IMT had changed management performance was in improving communications between farmers and management staff, in making staff more responsive to farmers and in reducing the hassles of arranging water deliveries and making payments of water charges.

2. Farmers in general did not see a relationship between IMT and changes in agricultural or economic productivity of irrigated agriculture.

3. In cases where more complete control over irrigation financing was devolved to the farmer organization (such as in Colombia) farmer representatives tend to make a concerted effort to improve the cost efficiency of irrigation management, through reductions in staff and other means.

4. If farmers have paid for nearly the full cost of routine O&M before transfer, IMT is likely to lead to a decrease in the cost of irrigation to farmers.

5. In order to motivate farmers to invest in the long-term maintenance of their irrigation scheme, farmers may need to have the security of strong legal recognition of their organization, a water right, and agreed irrigation service between the agency and farmers and between the farmer organization and individual farmers.

6. IMT may result in more flexible management of water and an enhanced capacity of farmers to change their cropping patterns (as has been found in Colombia and the Columbia Basin in the USA). Where this is so, to take full advantage of the opportunities to increase the economic value of irrigated agriculture, farmers will need to be able to move into new, higher value crops. As an alternative to conventional agricultural extension (which has become less and less effective and less relevant to farmers in the new era of crop diversification), farmers may find it worthwhile for their organizations to hire their own agricultural expert or networker to obtain information

about production practices of new crops, markets and prices, etc., and to facilitate group business transactions such as bulk purchasing and cooperative marketing.

3. SCIENTIFIC SUMMARY

3.1 Publications to Date

1. Vermillion, D. 1996. Irrigation Management Transfer: A Review of Ideas and Evidence. *Zeitschrift für Bewässerungswirtschaft* 31. Jhg. (H.1), 3-27.

2. Vermillion, D. and C. Garces-Restrepo. 1996. Impacts of Irrigation Management Transfer in Two Irrigation Districts in Colombia. *Zeitschrift für Bewässerungswirtschaft* 31. Jhg. (H.1), 28-50.

3. Vermillion, Douglas L. and Carlos Garces-Restrepo. 1996. Impacts of Management Transfer in Two Irrigation Districts in Colombia. IIMI Research Paper No. 4. Colombo, Sri Lanka: IIMI.

4. Vermillion, Douglas L. 1996. Impacts of Irrigation Management Transfer: A Review of Evidence to Date. IIMI Research Report No. 11. Colombo, Sri Lanka: IIMI.

5. Kloezen, Wim H., Carlos Garces-Restrepo, and Sam H. Johnson III. 1997 (forthcoming). Impact Assessment of Irrigation Management Transfer in the Alto Rio Lerma Irrigation District, Mexico. IIMI Research Report No. 15. Colombo, Sri Lanka: IIMI.

3.2 Workshop Papers and Draft Publications

1. Vermillion, D., M. Samad, U. Amerasinghe, M. Svendsen. 1996. A Standard Methodology to Assess the Impacts of Irrigation Management Transfer. Discussion paper. Colombo, Sri Lanka: IIMI.

2. Vermillion, Douglas L. 1996. Analytical Framework for Irrigation Management Reform. Paper presented at the 16th International Congress on Irrigation and Drainage, Cairo, Egypt, September 15-22, 1996.

3. Svendsen, Mark and Douglas Vermillion. 1996. Performance Impacts of Transfer to Farmer Management in the Columbia Basin Project, USA. Paper presented at the 16th International Congress on Irrigation and Drainage, Cairo, Egypt, September 15-22, 1996.

4. Vermillion, Douglas L. 1997. Does Management Devolution Increase the Local Sustainability of Irrigation? In Deregulation, Decentralization and Privatization in Irrigation. DVWK Bulletin No. 20. Bonn, Germany: DVWK [German Association for Water Resources and Land Improvement].

5. Vermillion, Douglas L. 1997. Management Devolution and the Sustainability of Irrigation: Results of Comprehensive versus Partial Strategies. Paper presented at the FAO/World Bank Technical Consultation on Decentralization, 16-18 December, Rome.

6. Samad, M. and Douglas L. Vermillion. 1997. Impacts of Participatory Irrigation Management in Sri Lanka: Partial Reform, Partial Benefits. Draft IIMI Research Report. Colombo, Sri Lanka: IIMI.

7. Vermillion, Douglas L. and Carlos Garces-Restrepo. Forthcoming. Impacts of Colombia's Irrigation Management Transfer Program. Draft IIMI Research Report. Colombo, Sri Lanka: IIMI.

8. Garcés-Restrepo, Carlos and Luis Alberto Mora. 1997. The Application of External Performance Indicators to Assess Irrigation Management Transfer Impacts in Three Irrigation Districts in Colombia. Presented at the International Workshop on Irrigation Performance, 3-7 November, Mendoza, Argentina.

3.3 Other Reports

The following papers were produced under PSM Phase II in support of project objectives to promote information exchange internationally among donors, technical assistance agencies, development agencies and NARS organizations.

1. Geijer, Joost C.M.A.; Mark Svendsen and Douglas L. Vermillion. 1996. Transferring Irrigation Management Responsibility in Asia: Results of a Workshop. (Report of FAO/IIMI Expert Consultation on Irrigation Management Transfer in Asia, 25-29 September 1995, Bangkok and Chiang Mai). Short Report Series on Locally Managed Irrigation. Report No. 13. Colombo, Sri Lanka: IIMI and FAO.

2. Mishra, V.S. and D.J. Molden. 1996. Management Turnover in the West Gandak Irrigation Systems, Nepal. Short Report Series on Locally Managed Irrigation. Report No. 14. Colombo, Sri Lanka: IIMI.

3. Svendsen, Mark and Douglas L. Vermillion. 1996. Results of Irrigation Management Transfer in the Columbia Basin Project, USA. Short Report Series on Locally Managed Irrigation. Report No. 15. Colombo, Sri Lanka: IIMI.

4. Johnson, Sam H.; Douglas Vermillion; Mark Svendsen; Wang Xinyuan; Zhang Xiying and Mao Xuesen. 1996. Management Reform and Performance Changes in Two Irrigation Districts in the North China Plain. Short Report Series on Locally Managed Irrigation. Report No. 16. Colombo, Sri Lanka: IIMI.

5. Vermillion, Douglas L. 1996. Irrigation Management Transfer: Conditions for Success, Options for Change. Paper presented at the GRET/IIMI Seminar "Les conditions de l'auto-gestion des organisations de producteurs dans les aménagements hydro-agricoles." Niamey, Niger, 24-28 September 1996.

6. Gosselink, Paul and John Thompson. 1997. Application of Participatory Rural Appraisal Methods for Action Research on Water Management. Short Report Series on Local Management. Report No. 18. Colombo, Sri Lanka: IIMI.

Annex 1: Methodological Note on Statistical Test of Difference in Regression Lines Before and After Irrigation Management Transfer

Regression analysis was carried out to determine the trend in performance before and after irrigation management turnover measured in terms of selected indicators, and to examine whether there is a significant change in performance following the transition. This note briefly explains the method employed and provides an example--trends in government expenditures for operations and maintenance (O&M) before and after management transfer.

The assessment includes analysis of trends in the following performance indicators, measured annually:

- Government expenditure for O&M from 1985-1995,
- Relative Irrigation Supply(RIS) 1985-1995,
- Relative Water Supply (RWS) 1985-1995,
- Cropping Intensity(CI),
- Paddy yield per hectare for each of two annual seasons, 1985-1995.
- Gross Value of Output(GVO) per hectare for each of the two seasons, 1985-1995.

Trend In Government Expenditure From 1985-1995

It was hypothesized that there would be a declining trend in government expenditure during the 10 year period from 1985-1995. It was also hypothesized that following the transfer of O&M responsibilities to farmer organizations in 1990, there would be a significant acceleration of decline in government expenditure for irrigation O&M.

The regression model and estimation strategy

In order to determine the trend in government expenditure for O&M during the period 1985-1995, the following single line regression was fitted:

$$Y_i = b_o + b_1X_i + u \quad \text{.....} \quad (1)$$

Where:

Y_i = O&M expenses/ha
X_i = Time in years
u = random error

A piece-wise linear regression model was fitted with government expenditure on O&M/ha (Y) as the dependent variable and time in years (X) as the explanatory variable. The aim was to determine whether: the regression of Y follows a particular linear trend up to 1990, the year of transfer, but follows a different linear trend in the post-turnover period 1991-1995. This involved: a) testing whether there is a discontinuity in the regression line starting at the year of transfer and b) testing whether there is a significant change in the slope over time.

Discontinuity in the regression line and slope were taken into account by introducing dummy variables in the regression function, one to capture the shift in the intercept and the other to capture the change in slope. The equation for the regression model was as follows:

$$Y_i = b_0 + b_1 Xi + b_2 Z_1 + b_3 Z_2 + u \quad \text{.....} \quad (2)$$

Where:

Y_i = the relevant performance indicator
Xi = Time in years
Z_1 = a dummy variable which takes the form:
Z_1 = 1 for years >1990
0 for years ≤ 1990
Z_2 = Slope shifting dummy which is equal to the product of (Xi -1990) * Z_1
u = random error

If b_2 (shift in intercept at year of IMT) is significantly different from 0, it indicates there is significant change in government expenses for O&M from the year of transfer. If b_3 is different from 0, it indicates that the trend in O&M expenses for the post and pre-IMT periods are different.

When year ≤ 1990, $Z_1 = 0$ then $Z_2 = 0$, the regression equation for the pre-IMT period is :

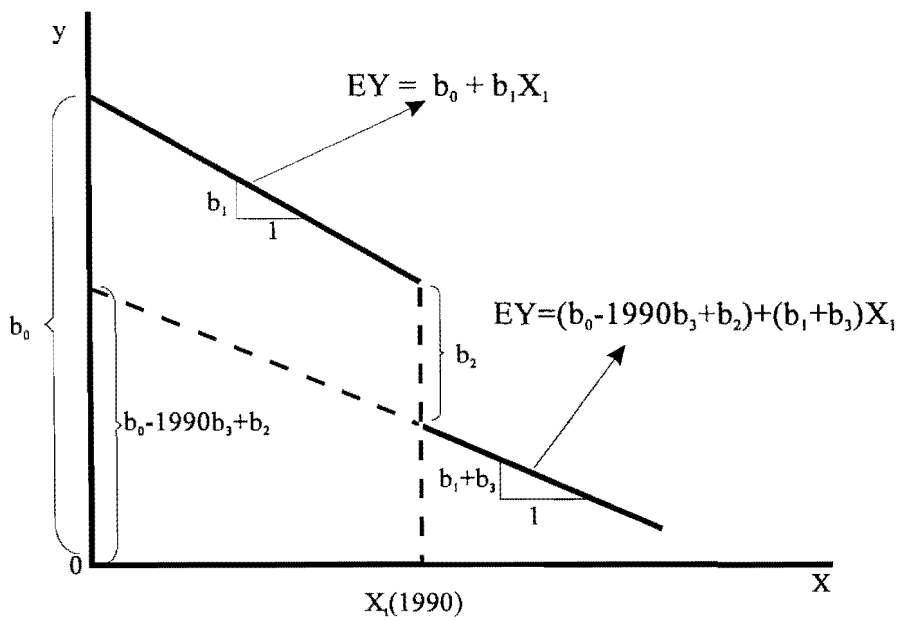
$$E(Y_i) = b_0 + b_1 Xi \quad \text{.....} \quad (3)$$

When Year > 1990, $Z_1 = 1$, then Z_2 = (Xi-1990), the regression equation for the post-IMT period is:

$$E(Y_i) = (b_0 - 1990\, b_3 + b_2) + (b_1 + b_3) Xi \quad \text{.....} \quad (4)$$

The two regression functions and the parameters are given in Figure 1. Parameter b_2 represents the estimated drop in the O&M/ha (Y) following the intervention (in this case IMT) at X_t and b_3 represents the difference in the two slopes.

Figure 1. Illustration of model for discontinuous piece-wise linear regression



Results

Tables 1 and 2 give the results of fitting the linear regression model (equation 1) to describe the trend in government expenditure for O&M during the period 1985-1995 for Nachchaduwa and Hakwatuna Oya schemes in Sri Lanka. The results show that for both schemes there is a statistically significant decline in government expenditure over the period 1985-1995 at the 99 percent confidence level.

Table 1. Regression results of O&M costs on time, Nachchaduwa Scheme

Variable	Estimates	Std.error	t-statistic	t-sig
Constant	1876.57	377.05	4.979	0.0008
X (Year)	-0.9384	0.1895	-4.953	0.0008

$R^2 = 0.73$; adj. $R^2 = 0.70$

Table 2. Regression results of O&M costs on time, Hakwatuna Oya Scheme

Variable	Estimates	Std.error	t-statistic	t-sig
Constant	1157.43	249.47	4.64	0.0017
X (Year)	-0.5789	0.1253	-4.619	0.007

$R^2 = 0.72$; adj. $R^2 = 0.69$

Tables 3 and 4 and Figures 2 and 3 give the results of fitting the piece-wise regression model specified in equation 2 for Nachchaduwa and Hakwatuna Oya, respectively.

Table 3. Results of piece-wise regression, Nachchaduwa Scheme

Variable	Estimates	Std.error	t-statistic	t-sig
Constant	1876.57	989.21	1.832	0.1096
X (Year)	-0.9060	0.4977	-1.8201	0.1115
Z_1 (Intercept dummy)	-0.6431	6.3039	-1.0201	0.4631
Z_2 (Slope dummy)	0.6406	0.8253	-0.7761	0.3416

$R^2 = 0.77$; adj. $R^2 = 0.67$

Table 4. Results of piece-wise regression, Hakwatuna Oya Scheme

Variable	Estimates	Std.error	t-statistic	t-sig
Constant	1348.93	748.54	1.802	0.1216
X (Year)	-0.6752	0.3765	-1.793	0.1231
Z_1 (Intercept dummy)	-1.2591	1.5524	-0.811	0.4483
Z_2 (Slope dummy)	0.4985	0.5324	0.936	0.3853

$R^2 = 0.77$; adj. $R^2 = 0.66$

The equation for the fitted model for the Nachchaduwa scheme is:

$$Y\ (O\&M\ expenses) = 1812.57 - 0.9059year - 6431\ Z_1 + 0.6406\ Z_2$$

The equation for Hakwatuna Oya scheme is:

$$Y\ (O\&M\ expenses) = 1348.93 - 0.6752year - 1.2591Z_1 + 0.4985\ Z_2$$

Figure 2. Trends in Government O&M Expenditure for Nachchaduwa Scheme

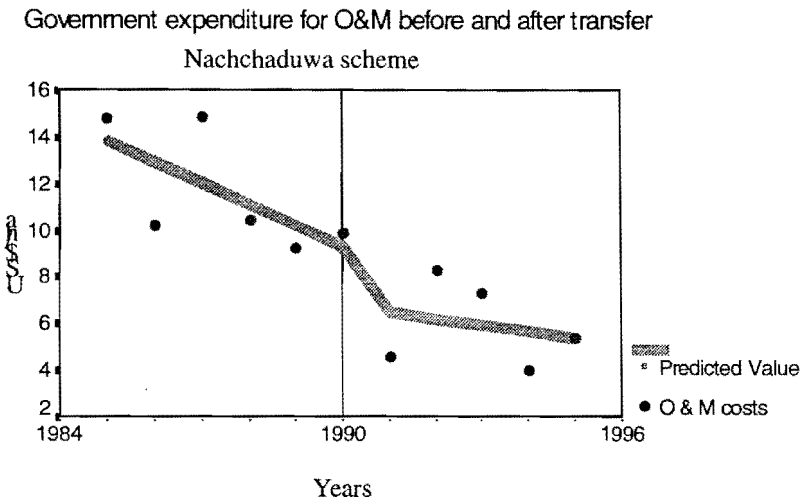
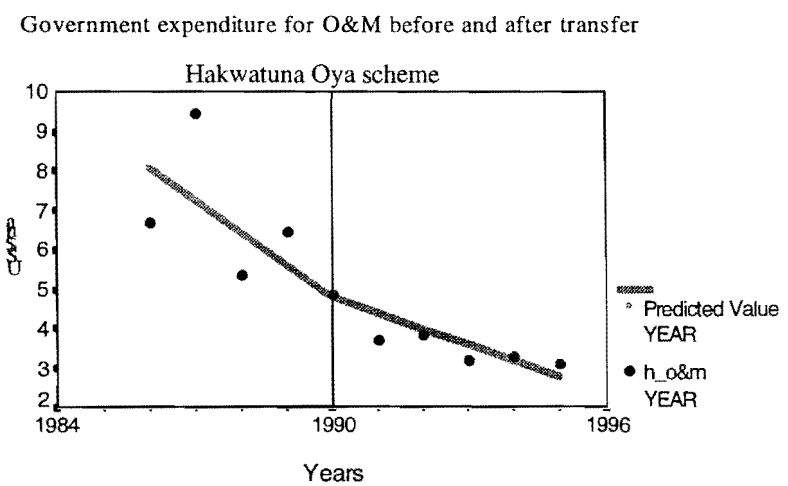


Figure 3. Trends in Government O&M Expenditure in Hakwatuna Oya Scheme



Analysis of variance showed that there is a statistically significant relationship between the variables at 95% confidence level in the regression functions for both schemes. The regression coefficients of the dummy variables introduced to capture the shift in the intercept (b_3) and slope (b_2) were not statistically significant at the 95% confidence level. This indicates that in both schemes the declining trend in O&M expenses after turnover (i.e., 1991-1995) period is the same as in the period before turnover (i.e., 1985-1990). We conclude that there is no significant difference in either the slope or shift in the intercept at the year of transfer.