Workshop Proceedings

Evaluation of Irrigation Management Transfer Process and Performance

Workshop held in Lalitpur, Nepal

11 - 12 October 1999

Research and Technology Development Branch
and
International Water Management Institute

With Financial Support from

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Reprint

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Acronyms

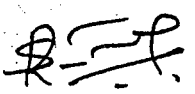
ADB/N - Agriculture Development Bank/Nepal
AIC - Agricultural Input Corporation
AKIS - Aandhi Khola Irrigation System
AKWUA - Aandhi Khola Water Users' Association
AMIS/s - Agency Managed Irrigation System/s
AO/s - Association Organizer/s
AP - Action Plan
APP - Agriculture Perspective Plan
AsDB/ADB - Asian Development Bank
B.S. - Bikram Sambat
BLGWP - Bhairahwa Lumbini Ground Water Project
BoD - Board of Directors
CADP - Command Area Development Project
CCA - Culturable Command Area
CIDP - Chiwan Irrigation Development Project
CMC - Canal Management Committee
Cumecs - Cubic Meter per Second
D/s - Down Stream
DDC - District Development Committee
DDG - Deputy Director General
DG - Director General
DIO - District Irrigation Office
DOA - Department of Agriculture
DOI - Department of Irrigation
EMC - Eastern Main Canal
FD/s - Farm Ditch/s
FMIS/s - Farmer-Managed Irrigation System/s
FO/s - Farmers Organization/s
FOD - Farmer Organization Division
FSD - Full Supply Depth
GIS - Geographic Information System
GWDB - Ground Water Development Board
H/W - Head Work
Ha - Hectare
HBMIS - Hirapur Barrage Manusmara I.S.
HDP - High Density Polythene
HIS - Hardinath Irrigation System
HMG/N - His Majesty's Government of Nepal
HRDTB - Human Resources Development and Training Branch
I. P. - Irrigation Project
I. S. - Irrigation System
IAAS - Institute of Agriculture and Animal Science
IDA - International Development Agency
IIMI - International Irrigation Management Institute
ILC - Irrigation Line of Credit
IMD - Irrigation Management Division
IMP - Irrigation Management Project
IMT - Irrigation Management Transfer
IMTP - Irrigation Management Transfer Project
IP - Irrigation Policy
ISF - Irrigation Service Fees
ISP - Irrigation Sector Project
ISSP - Irrigation Sector Support Project
IWMI - International Water Management Institute (formerly IIMI)
JADP - Janakpur Agricultural Development Project
JMA - Joint Management Agreement
KIS - Kankai Irrigation System
Km - Kilometer
Lps - Liter per Second
M&E - Monitoring and Evaluation
M/c - Minor Canal
MC - Main Canal
MFD - Main Farm Ditch
MIP - Mahakali Irrigation Project
MISU - Management Information System Unit
MLIP - Marchwar Lift Irrigation Project
MOWR - Ministry of Water Resources
MS - Micro Soft
NGOs - Non Governmental Organizations
N/WGIS - Nepal/West Gandak Irrigation System
NA - Not Available
NISP - Nepal Irrigation Sector Project
NLIS - Narayani Lift Irrigation System
NPC - National Planning Commission
NRs - Nepal Rupees
NTWIP - Narayani Tube well Irrigation Project
NZIDP - Narayani Zonal Irrigation Development Project
O&M - Operation and Maintenance
OT - Outlet Tertiaries
PIS - Panchkanya Irrigation System
PVC - Poly Vinyl Chloride
RIDs - Regional Irrigation Directorates
RTDB - Research and Technology Development Branch
SAR - Staff Appraisal Report
SFD - Special Farm Ditch
SISP - Second Irrigation Sector Project
SMB - System Management Branch
SMC - Sub-project Management Committee
SMD - System Management Division
SMHP - Sunsari Morang Hydro Project
SMIP - Sunsari Morang Irrigation Project
SMTP - System Management Training Program
STW/s - Shallow Tube Well/s
TA - Technical Assistance
TW - Tube Well
U/s - Up Stream
UMN - United Mission to Nepal
UNCDF - United Nations Capital Development Fund
UNDP - United Nations Development Program
UPVC - Ultra Violate Polyvinyl Chloride
USAID - United States' Agency for International Development
VDCs - Village Development Committees
WMC - Western Main Canal
WUA/s - Water Users' Association/s
WUACC - Water Users' Association Coordination Committee
WUCCC - Water Users' Central Coordination Committee
WUG/s - Water Users' Group/s
WUO/s - Water Users' Organization/s

Foreword

Irrigation Management Transfer (IMT) to the organized group of beneficiary farmers, popularly known as Water Users' Association - WUA in Nepal, is not a very old practice. In fact, it was initiated in the decade of ninety, even then it has already grained ground in Nepal. Many farming communities, farmers practicing irrigated agriculture and Water Users' Associations have heard the term, used the concept and implemented the program in different degrees. IMT has deep-rooted in some areas and little known in others. In order to narrow down this gap and widen the understanding of the concept and program, various research and evaluation related activities have been undertaken in this field. The RTDB-IWMI collaborative research is one in this series.

This workshop and proceeding is the part of the program, which was conducted for about three years. Different research programs were undertaken, results compiled and disseminated to the concerned through such workshops/proceedings. This being the concluding one in the series has special bearing on the whole exercises. Evaluation of Irrigation Management Transfer Process and Performance should not be one time activity rather it should be a continuous program until a well accepted process is developed and performance is achieved up to a standard range in terms of meeting the objective of IMT, particularly its sustainability.

I would like to express my sincere thanks to the organizers of the workshop, Dr. K. R. Sharma, Dr. D. J. Molden, and Mr. K. C. Prasad in particular. Sincere appreciation goes to the concerned for the preparation of the proceedings. I hope that IWMI will recognize the need and importance of such collaborative activities in the future also and DOI's appreciation is expressed here for the support provided to carry out this research program.



Ram Prasad Satyal
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1. Workshop Introduction

In the last decade, management transfer became an important topic in irrigation, especially in the developing countries. The concept of irrigation management transfer to their respective users was born mainly to bridge the widely recognized gap between investments to and returns from irrigation systems. This concept rests in the premise that an irrigation system cannot be managed best without full participation of its users, and considers farmers as the major actor in both turnover and joint management of agency built irrigation systems. In this background, several approaches and processes of irrigation management transfer are being adopted in different developing countries depending on their socio-political settings.

In Nepal, as in other developing countries, irrigation management transfer has been a policy tool since a last few years. Accordingly, the government is trying to transfer the management of agency built irrigation systems to their respective users, which were earlier managed independently by the government. At present, in Nepal, diverse forms of irrigation management transfer have been initiated at different levels by different projects under the Department of Irrigation (DOI). Nepal now started gaining some experience of irrigation management transfer through a process of learning by doing. With the growing understandings there are still much more to be learned in this regard.

Worldwide, International Water Management Institute (IWMI) is conducting research on process and performance of irrigation management transfer to understand its impact and to assist the concerned governments in formulating their policies and refining the process of irrigation management transfer.

It is widely recognized that success of the management transfer program rests in the regular evaluation of its process and performance. In this context, as in other parts of the world, the Research and Technology Development Branch (RTDB) of Department of Irrigation, conducted a research on processes and performances of irrigation management transfer in Nepal in collaboration with International Water Management Institute, Sri Lanka. It was a three-year research project. In this research, process and performance of IMT were studied in greater detail through several perspectives at various levels of development. The Ford Foundation, New Delhi, funded the research.

As a part of the research activity, RTDB and IWMI jointly organized a two-day workshop on 'Evaluation of Irrigation Management Transfer Process and Performance' in order to disseminate the research results and to identify the processes that lead to successful management transfer. This workshop was the fourth and final in the series of periodic workshops. Many key policy makers, planners, technicians and farmers representatives attended the workshop. The program schedule and the list of participants are given in the annexes.

The broad objective of the RTDB/IWMI activity in Nepal was to improve the process of management transfer leading to productive and sustainable impacts. Accordingly, findings of related studies were disseminated and discussed by arranging workshops.

The specific objectives of this workshop were as follows:

- Share the findings of RTDB/ IWMI studies during the last three years,
- Provide a forum for discussing processes, arrangements, and impacts of irrigation management transfer in Nepal,
- Provide feedback to the course of actions in management transfer initiatives including the second phase of Irrigation Management Transfer Project (IMTP), and
- Identify further research activities in the coming year.

2. Opening Ceremony

Mr. R. P. Satyal, Deputy Director General of Department of Irrigation (DOI), formally started the opening ceremony of the workshop, which was chaired by Mr. R. L. Kayastha, Director General of DOI. Mr. B. N. Sapkota, Secretary of Ministry of Water Resources joined the opening ceremony as the Chief Guest. Several participants presented their views in the opening ceremony as follows.

The first speaker Mr. R. P. Satyal, welcoming all the participants, gave a brief introduction on the workshop. He argued that the participatory irrigation management transfer program, being implemented in Nepal for a last few years, is one of the new approaches in irrigation development. This approach is designed mainly to bridge the widely recognized gap between investments to and returns from irrigation systems. He believed that in the past several irrigation development programs failed due to lack of understanding of irrigation systems in relation to their management. To avoid such a failure in IMTP, its process and performance were studied in detail through several perspectives at its various development levels. Accordingly, this workshop has been designed in order to disseminate results of this study and to identify the processes that lead to successful management transfer.

Mr. Satyal considered the workshop to be important for two reasons. First, it was the last workshop of this research project conducted by DOI in collaboration with IWMI, Sri Lanka. Second, several farmers' representatives also participated in this workshop to share their views regarding the process and performance of irrigation management transfer in Nepal.

The chief guest, Mr. B. N. Sapkota, thanking the organizers for having been invited as the Chief Guest to the workshop, highlighted the importance of farmer's participation for sustainable development of Nepal's irrigated agriculture. He indicated that the importance of farmer's participation was not realized in the past and there was no clear government's

vision in this regard. As a result, the level of farmers' participation in agency managed irrigation systems remained much low compared to farmer managed irrigation systems. However, at present, recognizing its importance, farmer's participation has remained one of the main government's policy tools for the sustainable development of country's irrigated agriculture.

In the context of promoting farmer's participation in irrigation system management, he suggested that the capability of farmers be improved so that they could manage the agency-constructed modern irrigation infrastructure and farmers be made aware of the efficient use of valuable water resources. He further hoped that as farmers participation had already been promoted in some irrigation systems through irrigation management transfer program, the workshop would analyze the experiences gained so far.

Similarly, as professionals of several disciplines related to agriculture development including farmers representatives were participating in the workshop, he also hoped that the workshop would come out with solutions related to the following questions:

- how can the farmers' participation be maximized;
- how can ownership feeling of farmers be developed;
- what are the genuine problems of farmers in managing irrigation systems; and
- how can irrigation management transfer improve agricultural and irrigation technology in farmers' field?

Lastly, he expected the outcomes of this workshop to be helpful for the policy makers in amending Nepal's irrigation policy in this context.

Mr. Kayastha in his address expressed that the country's present stage in relation to irrigation management was in a transforming stage. This is because, in Nepal, irrigation management transfer has been a policy tool just for last few years. Accordingly, the government is trying to transfer the management of a few irrigation systems to users, which were earlier managed independently by the government. In such a transitory stage, several technologies of irrigation management transfer, their constraints and opportunities are bound to emerge. He suggested that the present efforts should therefore focus on the sustainable development of irrigation system by incorporating the best technologies of irrigation management transfer. For this, the capability of both the users and irrigation officials should be improved.

Mr. Kayastha also raised the following concerns that need to be addressed while promoting farmer's participation in transferring irrigation management to users:

- present legal provisions in relation to irrigation management transfer;
- capability of farmers to understand and manage irrigation technologies introduced by engineers; and

- how could the irrigation infrastructures be designed and constructed so that farmer could manage them?

In this context, he requested all the participants, especially farmer representatives, to discuss in greater detail about the problems they have faced in transferring and managing the irrigation systems. He also requested to identify those management tasks, which farmers can perform independently in managing the irrigation systems.

In the present context when the government is spending a huge amount of resources on transferring the management of irrigation systems to users, he suggested that IMTP should give its highest priority to achieve sustainability of the irrigation systems. Emphasizing on sustainability and the targeted achievements in this regard, he noted that after IMTP the irrigation systems should be able to generate and mobilize resources needed to manage them out of the benefits accrued from irrigated agriculture itself.

Raising the concern of increasing women's participation in managing irrigation systems he suggested to look into the question - to what extent the irrigation infrastructure has effects on women's participation? As this issue is becoming increasingly important, he opined that the women's involvement in irrigation management might have to be redefined.

Speaking at the last, Dr. David J. Molden of IWMI, narrated the history of irrigation development in Nepal. He mentioned that during the early 70s, for the irrigation development, the emphasis was on the construction of irrigation infrastructures. Because of this, though water was made available in the system some disappointments were also noticed regarding the service provided to farmers. As a result, overall productivity of the irrigation system was low. With a large number of comparative studies on farmer- and agency-managed irrigation systems conducted in the past, the idea of management transfer of agency-constructed systems to farmers was born. With experiences of irrigation management transfer programs being implemented in Nepal for last 7-8 years, he suggested that it might be the right time to ask the following questions:

- Is IMT a right thing to do?
- If yes, how could it be better implemented; and
- What are the objectives of IMT?

He hoped that the presentations and discussions in the workshop would help in answering these questions.

3. Outcome of the Workshop

This section first presents the program of the workshop, which is followed by the summary of the papers presented. The section then continues summarizing discussions on issues and concerns raised by the participants in the floor. The section ends with some

recommendations made by the workshop.

3.1 Workshop Program

The workshop entitled "evaluation of irrigation management transfer process and performance" was held at Himalayan Hotel, Kathmandu[1]. The main objective of the workshop was to evaluate and disseminate the impact of irrigation management transfer and to identify the processes that lead to successful management transfer. It was a two-day workshop. Presentation of papers started after the opening ceremony, which continued till the first half of the second day. In the workshop, a total of eleven papers were presented. At the end of the presentation of papers and subsequent sessions, participants raised several issues and concerns.

In the second half of the following day, the participants were divided into four groups consisting of 9 to 13 members. In each group, participants discussed several pre-identified issues and concerns.

The workshop was an opportunity for most participants to obtain an understanding of the process of irrigation management transfer in Nepal. The workshop also offered an opportunity of bringing together irrigation professionals of several disciplines.

3.2 Summary of Papers Presented in the Workshop

As already noted, a total of eleven papers were presented in the workshop. Following is the summary of these papers.

Impact Assessment of Irrigation Management Transfer in Selected Irrigation Systems in Nepal
M. Samad, C. Fraiture and K. C. Prasad

In Nepal, irrigation management transfer (IMT) has been a policy tool since the early 1990s. Up to now, the management of four surface irrigation systems and about 60 tube well schemes, comprising of some 8 per cent of the irrigated area under agency managed irrigation systems, have been fully or partially transferred to respective users. As many more schemes will shortly be brought under irrigation management transfer program, there is a need to study impact assessment of the present IMT programs to address future policy issues. This paper, therefore, documents the effects of management transfer on the performance of irrigation management and irrigated agriculture. In this context, the paper tests the following hypotheses.

- IMT leads to a reduction in government's recurrent expenditures for irrigation.

[1] The detailed workshop program is given in the annex.

- IMT increases the shares of irrigation costs borne by users.
- IMT will improve the quality of irrigation service to users.
- IMT results in improved maintenance of irrigation infrastructure.
- IMT helps in increasing the level of agricultural productivity.

This paper is based on both the qualitative and quantitative data. The major source of data is the structured interviews conducted amongst a random sample of farmers in the study area. The paper also depends on secondary information, mainly from the agency records. The paper uses the procedures formulated by IWMI to assess the impact of IMT. Evidences of impacts are based on a comparison of performances of the systems with and without the effects of management transfer. The paper is based on case studies on three minor canals in the West Gandak Irrigation System (WGIS) and four tube well systems under the Bhairahawa Lumbini Ground Water Project (BLGWP). Some of them represent "with IMT" situation and some "without IMT" situation.

The paper first reviews IMT policy and programs followed by the discussions on results of management transfer. The paper draws following conclusions:

- IMT decreases the government's allocation for O&M
- IMT increases the irrigation costs to farmers
- IMT improves the quality of irrigation service.
- Although farmers perceive that irrigation infrastructure are better managed after management transfer, it may be because of their recent rehabilitation undertaken in the process of management transfer of irrigation systems.
- Although there is increase in agricultural productivity, it is difficult to argue that it is mainly due to management transfer of irrigation systems.

Monitoring and Evaluation Follow Up
T. P. Sharma and S. K. Shrestha

This paper discusses activities of monitoring and evaluation unit of System Management Branch (SMB) and Management Information System Unit (MISU) of DOI in developing database system for monitoring and evaluation of O&M of several irrigation systems, especially those which are under Irrigation Management Transfer Project (IMTP). The paper also presents the status of O&M data available at different irrigation systems over the last few years. Of the various O&M data, the database system developed concentrates mainly on three sets of data namely; agricultural, maintenance and operational performances. The paper also discusses the success achieved and constraints in developing above mentioned database systems. It also briefly describes the limitations and advantages of MapInfo software system, which is a computer-aided GIS based database system.

The paper suggests that a sustainable monitoring and evaluation system depends on several factors. Of them, proper demand for the data recorded in the M&E database,

regular flow of information into it, simplicity in getting access to the database and quality of data on it are important. The paper also suggests that for effective institutionalization of monitoring and evaluation system, which has often been the key concern, a phase-wise follow up program should be launched with necessary monitoring and evaluation units at field levels.

Institutional Development Processes for IMT: A Review
S. Upadhyaya

In Nepal, depending on the program, the processes of transferring management of irrigation systems to users vary greatly from system to system. In general, the process of irrigation management transfer involves two components: development of sustainable local irrigation institution that could take up the management of irrigation systems effectively after management transfer, and rehabilitation of irrigation infrastructure. As different irrigation systems adopt different processes of institutional development, this paper looks at these processes to answer what institutional process leads to successful management transfer of irrigation systems.

The paper is based on vigorous review of literature on institutional development processes adopted in about ten irrigation systems with various types of management transfer programs, and rapid assessments of four selected irrigation systems. In the process of rapid assessment, group interviews using a checklist and a question catalogue following the participatory rural appraisal were used. The paper presents an overview of management transfer and institutional development processes in various irrigation systems.

It concludes that a bottom-up approach of institutional development with effective participation and proportionate representation of users following hydrologic boundary of an irrigation system is useful. In this context, the use of farmer organizer (FO) from among users, introductory workshop, and adequate training and follow-up program implemented in the system area have shown positive results. Further, effective participation of farmers in the formulation of WUA's constitution is essential

Study on Rehabilitation and Management Transfer Phase II: Procedural Assessment of Rehabilitation
H. P. Hemchuri

In Nepal, one of the key thrusts of IMT programs is on the rehabilitation of irrigation infrastructures. The success or failure of IMT programs considerably depends on the rehabilitation process adopted. In Nepal, the processes of rehabilitation vary from project to project. Also, evidences to suggest an appropriate scheme rehabilitation process, leading to successful management transfer, are lacking and yet to be identified.

The paper documents how actually the rehabilitation was carried out in various irrigation

systems and the extent to what the management transfer has actually happened. The paper also tests qualitatively a set of propositions in relation to IMT.

It is based on review of agency documents and field visits to selected irrigation systems. A semi-structured checklist was used for soliciting the required data and information from the key informants.

It first presents an overview of the basic features of IMT process in selected irrigation systems. Then it compares the envisaged and adopted processes of irrigation infrastructure rehabilitation in different irrigation systems followed by impacts of rehabilitation process on IMT. The following conclusions are drawn:

- Mechanisms of tying the rehabilitation support with the development of WUA are essential. This is because an effective WUA aids the process of management transfer and can manage the irrigation system effectively after management transfer.

- Contracting the construction works to farmers makes the WUA more effective provided the beneficiary whosoever gets the contract is accountable to the general farmers and WUA.

- Farmer participation in the process of planning, design and implementation of rehabilitation works leads to the successful management transfer of the irrigation systems.

Leadership in WUA for Successful Irrigation Management Transfer: Comparison of Two Irrigation Systems Under Phase-1 of IMTP
A. Shukla, N. N. Joshi and B. Devkota

In Nepal, the main focus of IMT program is on organizing users into a legally recognized, viable and capable water users' association that could effectively take up operation and management functions of an irrigation system. Through IMT program, such an organization is expected to evolve as a democratic institution and effectiveness of such institution depends heavily on the emergence of its leadership. By analyzing evolution of irrigation institutions in Panchkanya and West Gandak Irrigation Systems under IMTP, this paper examines why two institutions facilitated to evolve and develop leadership under the same set of processes end with different institutional performances?

This paper is an outcome of a process documentation study being undertaken in the above mentioned irrigation systems and it consists of three parts. The first part briefly describes the physical and institutional characteristics of the two irrigation systems. The second part of the paper examines the pattern of leadership development in their WUAs and the processes thereof. The last part of the paper identifies some key concerns and issues pertaining to the process of leadership development in the WUA.

It suggests that the prior experiences of users' involvement in decision making, in managing irrigation system and community mixes in the system area have bearings on collective action and organizational capability of users. This paper further suggests that the heavy influence of party based politics in the evolution of WUA tends to restrict or at least retards the development of capable leadership in the WUA which in turn may make the WUA vulnerable.

Operational Practices in Khageri Irrigation System, Nepal
V. S. Mishra

Operation of an irrigation system is guided by a set of rules, which is designed for a certain flow conditions in terms of water levels and discharges in canals. Due to large fluctuations of available flow in the canals across cropping seasons, especially in run-off-the-river type of irrigation systems, such designed flow conditions rarely prevail. As a result, pre-designed rules may not ensure equitable distribution of water.

In this regard, this paper analyses the operational practices in Khageri Irrigation System covering 3,900 ha of irrigated area in order to define a set of rules with desired flexibility to match the available water and irrigation infrastructure for equitable distribution of water.

The paper is based on field measurements of discharge at various hydraulic levels of the irrigation system, field observations of operation, and informal discussions with key informants and farmers.

It first describes the physical and hydrological components of Khageri Irrigation System followed by a brief description of its operational rules. Then it analyses the operational practices in the irrigation system.

It concludes that in an irrigation system, flow control structures and their operational rules play predominant role in achieving equity, reliability and adequacy in water delivery. In systems where the fluctuations in available flows are considerably high, pre-designed rules of system operation would not be effective due to adjustable water control structures. This is partly because of system configuration and partly because operators and farmers are not skilled to match two conflicting goals of system operations. These conflicting goals are maintaining the supply levels and discharges simultaneously in canals across the system area. As a result, operators and farmers are bound to form their own *ad hoc* rules on a hit and trial basis. Sometimes these *ad hoc* rules become more erratic due to highly variable flows, deficiencies in irrigation infrastructures, lack of proper knowledge of system operation and insufficient communication facilities leading to inequitable distribution of water.

Participation of Women in West Gandak Water Users Association (WUA)
Jacobijn van Etten, Prabina Bajracharya, Amita Tuladhar and Barbara van Koppen

In Nepal's irrigation systems, the government supports IMT policy to decentralize more power to lower levels. To achieve this, a WUA consisting of several tiers as per different hydraulic levels of an irrigation system are formed. To guarantee internal democracy, a free flow of information from the lowest to highest levels and vice versa is needed, which may be difficult in a large irrigation system. This paper examines what is the direct influence a farmer has on the management of the irrigation system, irrespective of one is male or female, rich or poor.

This research was conducted in the West Gandak Irrigation System covering 8,700 ha of irrigated land with about 14,000 farmer families. This paper is based on part of the research results of the gender poverty and water research in Nepal conducted by IWMI. Open interviews with individual farmers and executive women members of different tiers of WUA, and small group discussions are the main inputs for this paper.

The paper first discusses different policies to include women in the WUA during the management transfer process, which is followed by presentation of WUA's organizational structure. In the second part of the paper, impacts of these policies on daily irrigation management practices are indicated.

It concludes that considering women's stake in irrigated agriculture their active participation in the management of irrigation systems is essential. As it is difficult for an ordinary farmer, especially for women, to influence in decision making in a male dominated meeting their participation in the WUA should be increased. For this, the paper points out that the affirmative actions of involving women in the WUA have shown positive results. The paper further suggests that the memberships in WUA should be open for more members per household in order to increase women participation. .

Step by Step Approach to Transfer of Irrigation Management: Experiences from IMT Activities of Hirapur Manusmara Irrigation System
S. Sijapati

Based on the experiences of the first phase of IMTP, significant refinements in the IMT process have been introduced in its second phase. Of them, one of the refinements is the introduction of step by step approach in the implementation of IMTP. This paper examines how this step by step process has been and is being implemented in Hirapur Barrage Manusmara Irrigation System.

The author is the sub-project manager of the Manusmara Irrigation System. The paper is based on his own experience in implementing IMTP in the above mentioned irrigation system. The paper first describes briefly the historical background of Hirapur Barrage

Manusmara Irrigation System followed by its status prior to IMTP. The paper then describes major activities undertaken so far in this irrigation system under IMTP.

The paper notes that, in this system, as the program of irrigation management transfer has recently started it is too early to arrive at any conclusion. However, based on the activities undertaken so far the paper argues that although the step by step approach tends to ensure the institutional development, this approach decelerated the pace of system rehabilitation which in turn delayed the progress of IMTP. The paper recommends that the schedule of institutional development activities undertaken by the IMTP central office should be decided in close consultation with the field offices. The paper further notes that some of the steps, especially system calibration works should be reorganized.

Role of the Federation of National Water Users Association in the Management Transfer
Tikaram Dahal

This paper was presented by the coordinator of federation of national water users association in Nepal. The paper consists of two parts. In the first part, the paper briefly describes the present situation of irrigated agriculture in the country and highlights the importance of sustainable irrigation management system for the development of irrigated agriculture to meet the country's present and future food demands. It also presents some constraints and opportunities (present needs) in managing irrigation systems.

In the second part, elaboration is made on the concept, objectives and program of the federation of national water users association established recently in the country.

The paper concludes that for the development of irrigated agriculture, the government should work in collaboration with the farmers. It notes that the value of farmers' participation should be recognized and implemented in actual practice for the betterment of the country.

Conjunctive Management of Surface and Ground Water for Irrigation in the Terai: Is it Needed? How Can it be Done?
Jeffery D. Brewer and K. R. Sharma

Irrigation and other water specialists have long advocated conjunctive management of surface and ground water. However, in much of the world, conjunctive management is not living up to its potential. In this context, this paper reviews the conjunctive management of surface and ground water in the Terai of Nepal with the following specific objectives.

- To evaluate the potential of conjunctive management in the Hardinath Irrigation System (HIS) to improve agricultural production, profitability to farmers, and environmental protection.

- To explore where the most effective locus of conjunctive management would lie.

The paper is based on rapid assessments in the field and group interviews with farmers. It also uses documented evidences from several government agencies.

The paper is divided into six sections. The foregoing summary is derived from section 1. Section 2 gives a general background on HIS and its water resources, and section 3 presents canal management practices. How farmers manage the sources of water conjunctively, including analysis of the economics of ground water irrigation is described in section 4. Section 5 evaluates the potential of conjunctive management to improve water distribution and agricultural production in HIS command. Finally, section 6 looks at the wider implications of this analysis.

The paper concludes that within the Hardinath Irrigation System area, use of ground water for irrigation is limited for economic reasons, although ground water is easily and abundantly available. The present low-level ground water use is primarily a problem of high operational costs rather than high installation costs. Because of high operating costs, farmers largely use ground water independently in conjunction with cheap surface water provided through HIS canal system. The paper suggests that availability of irrigation water to farmers can be improved through conjunctive use of water at system level if expensive ground water can be complemented by cheaper surface water in such a way that the average cost of irrigation water is lower than the present cost of ground water. This, however, may be possible if the water users association, with appropriate government support, take on the responsibility for conjunctive management of surface and ground water at the system level.

The paper also has following policy implications:

- Considering high operating cost of STW, the government should focus its efforts on reducing its operational cost and improving crop profitability to increase use of ground water as planned by Nepal's APP.
- There is a need to focus attention on development of conjunctive management of surface and ground water rather than their independent development.
- Where there is a potential for effective conjunctive management, there is a need to develop the institutional resources to provide irrigation water from both sources at a cost considerably lower than the present cost of ground water.

Summary of Findings and Recommendations of Process and Performance of Irrigation Management Transfer in Nepal
D. J. Molden and K. R. Sharma

This paper.presents the summary of findings and recommendations of various studies conducted under the research project on "process and performance of IMT in Nepal" by

RTDB and IWMI during the period 1997 to 1999. The findings and recommendations fall in the following areas:

- Performance of irrigated agriculture in terms of productivity, sustainability and costs at IMT sites.
- Processes of transferring irrigation management to farmers
  - Processes of rehabilitation of irrigation infrastructure
  - Processes of institutional development.
- Monitoring and evaluation of IMT and O&M systems
- Irrigation service fees
- Post transfer support to WUAs
- Building effective support systems for local management

At the end of the findings and recommendations, the paper raises a question whether IMT is the right thing to do in Nepal for sustainable development of irrigated agriculture. The paper argues that if the objectives of irrigation management are to achieve sustainable increase in productivity to farmers, to increase the amount of O&M spent on irrigation, and to decrease overall government costs by breaking the cycle of rehabilitation-degradation- rehabilitation, IMT could be the right thing to do. However, if the only objective is to reduce government's O&M expenditure, IMT may not be the right thing to do in Nepal.

The paper concludes that IMT does hold promise in Nepal. The paper calls for setting and pursuing the objectives of IMT seriously for the betterment of the people of Nepal.

3.3 Summary of Discussions

As noted earlier, during the workshop participants raised several issues and concerns at the floor. These issues and concerns are grouped into 4 sub-headings and presented here.

Performance and Impacts of IMT

One of the main issues raised by the participants in relation to performance and impact of IMT was the productivity of the system after management transfer. In this regard, it was noted that although there is an increase in productivity, due to lack of data it is difficult to argue that it is caused mainly due to management transfer of irrigation system.

One participant argued that increasing trend of system level productivity against the decreasing trend of district level productivity may indicate that the increase in productivity might have been caused mainly by management transfer of irrigation system.

Several others also raised concerns about lack of coordination between DOA and DOI.

Concerns were raised about the indicators of success of management transfer. The argument was that the overall income of the farmer should be the indicator rather than productivity of the system.

Regarding reduction in operation and maintenance costs after management transfer, participants argued that there could be two reasons for this. Firstly, it might be due to recent rehabilitation of the system. Secondly, it might also be due to sub-optimal level of maintenance, which may demand another rehabilitation after a few years.

In this context, it was also pointed out that the cost effectiveness of our programs of IMT should be assessed.

Monitoring and Evaluation System

Participants raised concern regarding the length of time series data required for analyzing performance of management transfer in order to achieve reliable results. In relation to data collection and management, concerns were raised that it might be difficult for DOI to collect and manage data centrally from irrigation systems. Thus, the need of collecting and managing data systematically from lower level, starting from WUA, was highlighted. Further, concerns were also raised regarding how to institutionalize these processes of data collection and management from lower levels?

Processes of Irrigation Management Transfer

Synchronization of institutional and physical development process

As the processes of irrigation management transfer involve both the institutional development and rehabilitation of irrigation infrastructure, concerns were raised how these two activities can be synchronized and implemented side by side.

It was noted that in most of the donor assisted projects, the progress of the program is usually judged by the progress achieved in physical development. Although the development of physical components is well within the control of implementing agency, institutional development depends heavily on the initiative of farmers. As a result, institutional development may be delayed with respect to development of physical components. In such a situation, either the physical development should also be delayed which in turn delays the project completion[2] or parallel developments of institutional

[2] This issue was raised especially in relation to the step by step approach followed in Manusmara Irrigation System for transferring irrigation management to farmers. The sub-project manager of Manusmara Irrigation System mentioned that although this step by step approach is a good procedure, which is developed based on the agreement with the farmers, this approach tends to delay the targeted schedule of the project.

aspects are ignored.

In this context, participants raised question–how can we design the processes of irrigation management transfer, which ensures parallel development of both the institutional and physical components within the stipulated timeframe?

Involvement of Women in the Process of Irrigation Management Transfer
Participants suggested that the findings concerning women's involvement in the process of irrigation management transfer in the Gandak Irrigation System should also be compared with other irrigation systems. In this context, considering women's stake in the irrigated agriculture, there was a consensus among participants that effective participation of women in the process of irrigation management transfer should be increased in order to facilitate ordinary farmer's, especially women's, influence in decision making.

Influence of Party Based Politics in the Processes in Irrigation Management Transfer
Participants also pondered on the processes of irrigation management transfer that might help in minimizing party based politics in the evolution of WUA considering that the heavy influence of party based politics in the evolution of WUA tends to make the WUA vulnerable.

Compatibility of Irrigation Infrastructure to Operational Requirement
Participants raised concerns whether the rehabilitated irrigation infrastructures have improved system operations. Since the system is to be operated by farmers, operational requirements should be given due consideration while rehabilitating irrigation infrastructures. This is because different types of irrigation infrastructures demand different operational requirements. Further, it was agreed that in systems, which are to be transferred to farmers, farmers should be trained on the operation of the system based on its infrastructure and design assumptions.

In this context, the WUA chairman of the BLGWP pointed out that it is beyond the capability of farmers to maintain the pumps, especially due to lack of spare parts. He also pointed out that farmers are not capable of paying a high demand charge for electricity to operate the pumps.

Discussions were also held regarding the calibration of the system in the process of management transfer. It was realized that the past experience should be used for better calibration of the system.

In relation to system rehabilitation, many participants expressed concerns on sustainability of farmer managed irrigation systems intervened by ILC, NISP and ISSP programs. Questions were raised whether the cause for non-sustainability is lack of farmers' participation or lack of understanding of technology in relation to local conditions of water control. Needs were felt to understand technology of farmer managed irrigation systems in

relation to local conditions of water control.

Regarding farmers' participation, a point made was to consider the importance of participation by local community in the process of rural development, the concept, values and methods of participation should be included in the curricula of our school level study programs.

Conjunctive Management of Surface and Ground Water

In the development of conjunctive use of surface and ground water at system level, participants felt that due consideration should be given in utilizing existing irrigation infrastructures such as branches and lower level canals.

Participants also pointed out that before going into conjunctive use of surface and ground water in an irrigation system, the area that can be irrigated by surface water alone and the area requiring conjunctive use should be clearly demarcated. For this, actual water requirements and the possibility of effective utilization of all available sources of surface water should be assessed.

3.4 Recommendations

Some of the key issues were also discussed in smaller groups. The issues discussed are presented in the following table.

Groups	Issues and concerns
Group I	1. How to institutionalize the monitoring and evaluation (M&E) mechanism? › Who is responsible for: Data collection and data flow Storage and analysis of data Dissemination of data • Who are the users of data 2. What are the objectives of irrigation management transfer program?
Group II	3. How should the agency change for effective implementation of irrigation management transfer program? 4. How can the WUA federation support WUAs with regard to IMT? 5. How could disadvantaged groups (women, poor and landless) be included in benefit stream of IMT?
Group III	6. Should rehabilitation be tied to institutional strengthening or development milestones? 7. How can it be insured that rehabilitation works (in design and quality) are up to farmers' satisfaction?
Group IV	8. What steps are needed for post transfer support and who should provide it? 9. What additional legal status do WUAs need to effectively accomplish their tasks?

Each group presented their recommendations in a plenary session. Based on the

discussions in the groups and also in the plenary session, following recommendations were made in the workshop:

- Sustainable monitoring and evaluation system is essential for successful transfer of irrigation management to users. This requires an institutionalized mechanism to insure regular flow of data into M&E system in a simpler way. Further, it was also recognized that the centralized collection and management of data by DOI was not practical. So it is recommended that the data which are also required by WUAs to operate the system should be collected by them, and data which are not needed by WUAs but needed by agency should be collected, managed and forwarded to DOI central office from district/regional levels. Also, MISU in the DOI central office should use, process, store and disseminate the information to all concerned.

- Recognizing the need for setting and pursuing the objectives of irrigation management transfer programs, it was recommended that the objectives of IMTP should be as follows:

  1. to achieve sustainable increases in productivity of irrigation systems by optimizing the use of available resources in order to upgrade livelihood of local community, and

  2. to decrease overall government costs by breaking the cycle of rehabilitation-degradation- rehabilitation,

- The department of irrigation should institute a separate unit for raising and collecting adequate irrigation service fees with adequate legal empowerment prior to implementation of IMTP. In the long run, this action by the agency can create an incentive to users for taking over management of irrigation system as the O&M cost can reduce drastically if managed by them.

- Selection of irrigation systems for irrigation management transfer should be based on demand-driven approach, and irrigation management transfer should be launched in a program mode instead of a project mode.

- The agency should build up awareness among the farmers by disseminating information regarding irrigation policies and programs of the government through national federation of water users association.

- Mechanisms should be developed to ensure representation of women, poor and land-less groups in the WUAs of irrigation systems in order to facilitate their influence in the process of decision-making. Affirmative actions of involving these groups in the processes of irrigation management transfer and allocating memberships to more members per household are some of the identified means for this.

- Agency should continue researches on processes and performances of irrigation management transfer on its own for policy feedback.

- Agency should continue training programs to train its staff and farmers on different aspects of irrigation management transfer to improve awareness.

- Rehabilitation of irrigation infrastructure in the process of irrigation management transfer should be tied with institutional development of local irrigation institutions (WUAs). However, as this may cause a delay in the plans of project completion, as institutional development depends heavily on the initiative of farmers, it was recommended that the targets of irrigation management transfer programs should be made more flexible.

- Considering that different types of irrigation infrastructures demand different operational requirements, rehabilitation of irrigation infrastructures should be designed considering the future operational needs and local conditions of water control. Further, it was recommended that in systems that are to be transferred to farmers, farmers should be trained on the operation of the system based on its infrastructure and design assumptions.

- The agency should continue monitoring and evaluation of irrigation systems and its technical support even after the transfer of irrigation management. Further, the best performing systems should be recognized and awarded.

4. Closing Ceremony

Mr. R. L. Kayastha, Director General of DOI chaired the closing ceremony. The first speaker of the closing ceremony, Mr. R. P. Sah, speaking on behalf of farmers representatives expressed that this kind of workshop is very essential and useful especially for farmers. He mentioned that water is life and it is farmer's responsibility to manage water. Thus, he stressed the need for organizing all farmers for a common goal of efficient and equitable delivery of water to all of its users.

The next speaker, Dr. K. R. Sharma, Chief RTDB, DOI, summarized the outcomes of the workshop on behalf of the organizer and expressed that the workshop provided an opportunity for most participants to obtain an understanding of the process of irrigation management transfer in Nepal. While expressing his opinion, he mentioned that the sustainability issue of Nepal's irrigation systems, which is the main theme of IMTP, is still questionable implying that there are still much more to be done in achieving their sustainability.

In his address, Mr. R. P. Satyal, IMD/DDG,DOI mentioned that despite of addressing

irrigation issues through a multi-dimensional perspective the sustainability of our irrigation systems has still remained questionable. In such a situation, this type of research and workshop activities need to be continued to learn more about irrigation. Accordingly, he requested IWMI and other donors to continue assisting DOI in such collaborative research activities. However, if no external support is available, he also assured that DOI will continue such programs to its best level. Finally, he highlighted the importance of this kind of workshops for disseminating the results of research activities.

Mr. M. M. Shrestha, Joint Secretary, Ministry of Water Resources, expressed that there was no need for looking for an alternative of irrigation management transfer programs for improving the performance of Nepal's irrigation systems. He stated that the irrigation management transfer programs are to be designed and implemented to suit our social and ecological conditions through learning by doing process. By doing so, he believed that the positive impacts of IMT could be clearly seen after a few years of its implementation. Finally, he assured that the Ministry of Water Resources, Nepal would give its due consideration to the recommendations made by the workshop.

Addressing the closing ceremony, Dr. David J. Molden mentioned that the workshop was an excellent opportunity to present research findings and to discuss key issues on IMT. He concluded that IMT was the right thing to do in Nepal and there were much more to be done in improving the IMT processes. Finally, he thanked all the participants, especially women and farmer representatives for being present in the workshop.

The Chairman, Mr. R. L. Kayastha, in his address in the closing ceremony, referring to irrigation management, mentioned that irrigation management transfer program is the only process whose ultimate objectives are to increase agricultural productivity and sustainability of irrigation systems. Referring to the issue of sustainability, he expressed that an irrigation system should be considered as sustainable only if the resources generated from the benefits derived from the irrigated agriculture can manage it. This requires farmer's participation, which is shaped by local social situations, our capacity to manage participation, and project environment. Thus, the need is to focus more on the agricultural productivity and creating awareness among farmers so that irrigation systems can be managed in close partnership with local community using a part of the benefits derived from irrigated agriculture.

Papers

Paper 1: Impact Assessment of Irrigation Management Transfer in Selected Irrigation Systems in Nepal

M. Samad, C. Fraiture and K.C. Prasad*

INTRODUCTION

The efforts of irrigation management transfer in Nepal started from 1992. This report presents the results of a study carried out in Nepal to assess the impacts of irrigation management transfer. Specifically, it assesses the impact of recent management changes on the performance of irrigation schemes. The analysis is based on data obtained from a surface irrigation scheme (West Gandak), and four groundwater irrigation schemes, which come under the Bhairahawa Lumbini Ground Water Development Project (BLGWP).

The report begins with an overview of the irrigation management transfer program in Nepal followed by the scope and objectives of the study. The next section outlines the methodology. The results of the analysis are presented next. The final section presents the principal findings of the study.

IRRIGATION MANAGEMENT TRANSFER POLICY AND PROCESS

In 1992, His majesty's Government of Nepal adopted a policy to transfer the responsibilities for the operation and maintenance of entire irrigation systems with command areas of less than 500 ha in the hills and 2,000 ha in the plains (terai) to water user associations (WUAs). Schemes with larger command areas were initially to be jointly managed by WUAs and the Department of Irrigation (DOI). At subsequent stages, WUAs were to be made increasingly responsible for the management of the schemes (Irrigation Policy 1992, and its first amendment 1997).

Up to now, the management of four surface irrigation systems, and about 60 tube well schemes have been transferred to WUAs. Under World Bank-supported "Irrigation Line of Credit", irrigation management of about 24 small irrigation systems have been devolved to WUAs. About 30 schemes are at various stages of joint management. At present the management of some 8 % of the area under government irrigation schemes have been fully or partially transferred to WUAs. Many more schemes will shortly be brought under irrigation management transfer program.

*Omission of Samad's name in previous print is regretted.

The process of irrigation management transfer (IMT), in general, begins with a government's support package of system rehabilitation/improvement and farmers' institutional development activities. Farmers are also required to share costs of such activities based on different criteria as outlined in policy, legal documents, and agreements between the support recipient WUAs and support provider DOI.

The IMT process takes off with joint irrigation management efforts in which both, farmers and DOI personnel, along with DOI-appointed consultants in some cases, jointly undertake related tasks and responsibilities inclusive of system operation, maintenance, rehabilitation, farmers' capacity build-up, resource mobilization, conflict management, monitoring and evaluation etc[1]. Gradually, increased O&M responsibilities are given to farmers heading toward full management transfer. The government through its related agencies provides technical and other supports after full management transfer leaving farmers themselves as the day-to-day managers of the transferred irrigation systems.

OBJECTIVES AND HYPOTHESES

The overall objective of this study is to determine the effects management transfer has on the performance of irrigation management and irrigated agriculture.

The specific objectives are to determine:

- the effects of management transfer on the recurrent expenditures for irrigation
- changes in the cost of irrigation to farmers
- the impact of management transfer on maintenance of irrigation infrastructure
- changes in the quality of irrigation services irrigation schemes, and
- the effects of management transfer on agricultural productivity levels in the irrigation systems.

The principal hypotheses tested are:

1. IMT leads to a reduction in government's recurrent expenditures for irrigation.
2. IMT increases the share of irrigation costs borne by farmers.
3. IMT will improve the quality of irrigation service to farmers.
4. IMT results in improved maintenance of irrigation facilities.
5. There will be an improvement in agricultural productivity levels in schemes benefiting from IMT.

[1] For more details, please see Prasad et al (1997), Irrigation Service Fees in Nepal, and IIMI (1997), Study on Rehabilitation and Management Transfer, Nepal: Identification of Current Processes.

THE RESEARCH DESIGN

The research design for this study draws on procedures formulated by IWMI to assess the impact of irrigation management transfer[2]. Evidences of impacts are based on a comparison of performances of systems with and without the effects of management transfer. For this study three minor canals in the West Gandak irrigation system and 4 pump systems under the Bhairahwa-Lumbini Ground Water Project (BLGWP) were selected for study.

In the West Gandak scheme, the Palhi minor was transferred to WUA management in May 1993. This canal was chosen to represent the "with IMT" situation. Manjhariya minor was among the last minor canals to be transferred to WUA in October 1996. For purposes of this study Manjhariya minor was considered to represent the "without IMT" case. In addition, Parsauni minor, which was transferred to WUA management in September 1994, was also selected for study.

In BLGWP, two non-transferred schemes (Tube Well no. 5 and 58) and two transferred schemes (Tube Well no. 13 and 48 both transferred in July 1995) were selected for study.

The Farmer Survey

The assessment of impacts was based primarily on a questionnaire survey conducted amongst a random sample of farmers from each of the locations selected for study. The objective of the survey was to obtain information from farmer about their perceptions of changes in selected performance attributes before and after transfer in the case of the IMT schemes. In the non-IMT systems farmers were asked to compare current performance with the levels realized five years ago.

A sample of 96, 76 and 80 farmers from Manjhariya, Palhi and Parsauni minors in the West Gandak scheme and 50 farmers from the four BLGWP schemes were selected by stratified random sampling. The sampling unit was a selected parcel of land in the irrigation scheme. The cultivators of the selected parcel were chosen as the survey respondent. The respondents were asked about changes in costs of irrigation, agricultural production, value of production, perceptions about the quality of irrigation service between pre- and post-transfer years (i.e., adequacy, timeliness and equity of water delivery, system maintenance and conflict resolution) and physical conditions of the canals before and after IMT.

In addition, information about government expenditure for irrigation was collected from secondary sources.

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[2] Vermillion et al (1996), A Standard Methodology to Assess the Impacts of Irrigation Management Turnover, IIMI, duplicated.

Performance Assessment

In this study performance is assessed both in quantitative and qualitative terms. Quantitative assessment is limited to the comparison of the current cost of irrigation to farmers and agricultural productivity levels in the schemes with IMT and without IMT. Qualitative assessment is based the comparison of farmer perceptions of changes in selected performance indicators before and after IMT in the transferred systems. In the non-transferred systems farmers were asked to compare current performance with the performance levels five years before. Table 1 gives the set of indicators used in this study.

Table 1: Performance Indicators and Data Sources

Performance Indicators	Data Source
Financial Performance Indicators	
Irrigation cash costs per hectare to farmers	Farmer survey
Family labor contributions for canal maintenance	Farmer survey
Operational Performance Indicators	
Farmer perceptions about adequacy, timelines and equity of water supply	Farmer survey
Perceptions on seeking the assistance of agency staff	Farmer survey
Maintenance Performance Indicators	
Farmer perceptions about canal/pump conditions before and after transfer (IMT schemes)	Farmer survey
Farmer perceptions about the present condition of canal/pump compared to 5 years before (Non-IMT schemes)	Farmer survey
Agricultural Performance Indicators	
Yield of major crops by season	Farmer survey
Farmer perceptions about changes in agricultural production	Farmer survey

RESULTS OF MANAGEMENT TRANSFER

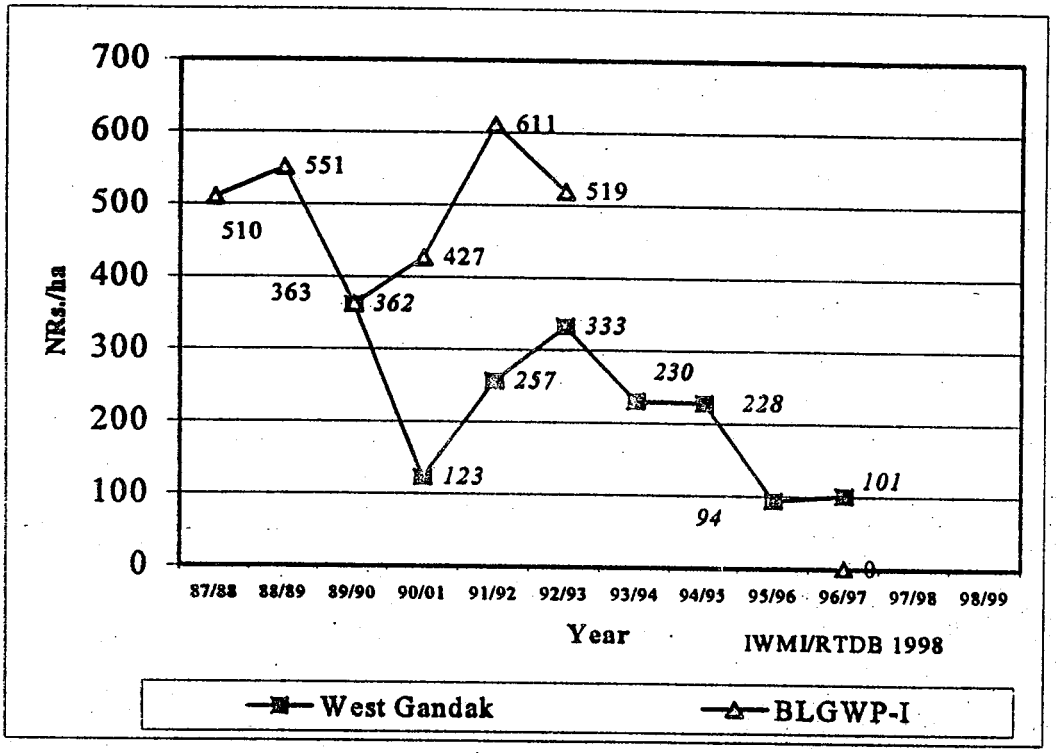
This part of the report presents the type of analysis carried out and related results and findings about the impact of irrigation management transfer. The results and findings are mostly confined to the BLGWP and West Gandak for the reasons discussed before. In presenting the results, we state the hypotheses and present the indicators used to test the hypotheses. Where possible we present the results of the hypotheses testing as well.

Hypothesis 1: IMT leads to a reduction in government expenditure for O&M.

Indicator	Data Sources
Annual O&M cost per hectare to government	Secondary data – Agency records

The average O&M cost to the government per ha in non-transferred schemes of the BLGWP over the last six years has been NRs. 497/ha. This has reduced to ZERO after the IMT (IWMI and RTDB, Performance Assessment Study, 1998). With regard to West Gandak, no conclusion can be drawn as minor-wise government's O&M expenses are not available. However, overall O&M budget allocation for the entire system has been decreased drastically after IMT. The trends of government budget allocation in West Gandak and BLGWP are presented below.

Chart 1: Government O&M Budget in West Gandak and BLGWP



Source: IWMI and RTDB, 1998

Hypothesis 2: IMT increases the share of irrigation costs borne by farmers.

Indicator	Data source
Pumping costs/ annual irrigation costs	Farm Survey
Labor contribution for maintenance	Farm Survey

The figures are given below.

Table 2: Annual Irrigation Costs to the Farmers in Transferred and Non-transferred Minors in West Gandak

Cost Components	Units	Manjhariya (without IMT)	Palhi (with IMT)	Parsauni (with IMT)	Difference in costs between IMT and non-IMT minors
Cash payments per hectare	NRs./ha	61	335	224	218 (t= -4.81)*
Value of unpaid family labor contributions for canal maintenance	Person Days/ha	8	12	5	0 (t= 0.143)

* t test comparing the means of with and without IMT samples indicate that there is a statistically significant difference in the means at the 95 % confidence level.
Source: Farm Survey (July 1998)

Table 3: Annual Irrigation Costs to the Farmers in the Transferred and Non-transferred Tube Wells in BLGWP

Cost Components	Units	TW 5 (without IMT)	TW 58 (without IMT)	TW 13 (with IMT)	TW 48 (with IMT)	Difference in costs between IMT and non-IMT tube wells
Demand Charge	NRs/ha	368	375	600	150	
Pumping charges per hectare	NRs./ha	916	556	1608	756	446 (t= - 3.3)*
Unpaid family labor contributions for canal maintenance	Person Days/ha	4	12	7	2	-3.5 (t= 3.0)*

Source: Farm Survey (July 1998)

Notes:
1. Labor-days have been calculated as days/ha considering 8 hrs a day.
2. Labor contribution data in TW 5 and 58 are inclusive of the labor contributed in rehab works in relation to IMT.
3. In calculations for irrigation costs, the total cost has been divided by irrigable area (by canal) of the individual respondent.
4. Since the electricity demand charge is not related to IMT, it has not been added for irrigation cost comparisons.

5. Since the demand charge rate is fixed, the same has been taken as the data except in TW 5 where different rates exist for lined portion (NRs. 450/ha) and earthen portion (NRs. 300/ha) of the canal system. For TW 5, the average of the payments has been taken.

Findings

West Gandak

1. Irrigation cash costs to farmers are higher in the transferred minors than that in the non-transferred minor.
2. Unpaid labor contribution in IMT sites, on average, is not different than that in the non-IMT sites.

BLGWP

1. Pumping charges for irrigation in the IMT schemes are higher than that in the non-IMT schemes.
2. Unpaid labor contribution in IMT schemes is lower than that in non-IMT schemes because the data in non IMT sites include the labor contributed in rehab works. Hence no conclusion can be drawn with regard to change in labor contribution before and after IMT.

Hypothesis 3: IMT will improve the quality of irrigation service to farmers.

Indicator	Data source
Farmer perception of adequacy of water	Farm survey
Farmer perception of timeliness of water	Farm survey
Farmer perception of equity of water distribution	Farm survey

The farmers' perception regarding the quality of irrigation service in IMT and non-IMT schemes are given below.

Table 4: Adequacy of Irrigation in Transferred and Non-transferred Minors in West Gandak

Perception by percent of response	Without IMT		With IMT			
	Manjhariya		Palhi		Parsauni	
	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Adequate most of the time	9	12	21	15	21	20
Sometimes adequate	42	50	61	68	49	44
Never adequate	49	38	18	17	30	36

Source: Farm Survey (July 1998)

Table 5: Adequacy of Irrigation in Transferred and Non-transferred Tube-wells in BLGWP

Perception by percent of response	Without IMT				With IMT			
	TW 5		TW 58		TW 13		TW 48	
	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Adequate most of the time	59	59	5	6	87	86	93	94
Sometimes adequate	35	32	95	94	13	14	7	6
Never adequate	6	9	-	-	-	-	-	-

Source: Farm Survey (July 1998)

Table 6: Timeliness of Water Supply in Transferred and Non-transferred Minors in West Gandak

Perception by percent of response	Without IMT		With IMT			
	Manjhariya		Palhi		Parsauni	
	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Mostly on time	8	10	24	20	17	20
Sometimes on time	45	52	54	62	58	50
Never on time	47	38	22	18	25	30

Source: Farm Survey (July 1998)

Table 7: Timeliness of Water Supply in Transferred and Non-transferred Tube Wells in BLGWP

Perception by percent of response	Without IMT				With IMT			
	TW 5		TW 58		TW 13		TW 48	
	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Mostly on time	57	59	10	11	85	84	80	90
Sometimes on time	37	35	90	89	15	16	10	10
Never on time	6	6	-	-			10	-

Source: Farm Survey (July 1998)

Table 8: Fairness of Water Distribution in Transferred and Non-transferred Minors in West Gandak

Perception by Percent of Response	Without IMT		With IMT			
	Manjhariya		Palhi		Parsauni	
	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Mostly fair	9	14	18	14	28	28
Sometimes fair	31	34	29	39	31	30
Unfair	60	52	53	47	41	42

Source: Farm Survey (July 1998)

Table 9: Fairness of Water Distribution in Transferred and Non-transferred Tube Wells in BLGWP

Perception by Percent of response	Without IMT				With IMT			
	TW 5		TW 58		TW 13		TW 48	
	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Mostly fair	94	88	18	18	98	98	98	98
Sometimes fair	3	10	82	82	-	-	-	-
Unfair	3	2	-	-	2	2	2	2

Source: Farm Survey (July 1998)

Table 10: Difficulty of Arranging Water in Transferred and Non-transferred Minors in West Gandak

Perception by Percent of Response	Without IMT		With IMT			
	Manjhariya		Palhi		Parsauni	
	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Difficult	62	54	44	35	58	47
Sometimes difficult	30	34	38	47	22	28
Easy	8	12	18	18	26	25

Source: Farm Survey (July 1998)

Table 11: Difficulty of Arranging Water in Transferred and Non-transferred Tube Wells in BLGWP

Perception by Percent of response	Without IMT				With IMT			
	TW 5		TW 58		TW 13		TW 48	
	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Difficult	44	48	39	40	11	14	5	4
Sometimes difficult	19	19	55	53	22	25	7	4
Easy	37	33	6	7	67	61	88	92

Source: Farm Survey (July 1998)

Table 12: Difficulty of Getting Assistance from WUA/Irrigation staff in Transferred and Non-transferred Minors in West Gandak

Perception by Percent of Response	Without IMT	With IMT	
	Manjhariya	Palhi	Parsauni
Difficult	54	35	47
Sometimes difficult	34	47	28
Easy	12	18	25

Source: Farm Survey (July 1998)

Table 13: Difficulty of Getting Assistance from WUA/Irrigation Staff in Transferred and Non-transferred Tube Wells in BLGWP

Perception by Percent of Response	Without IMT		With IMT	
	TW 5	TW 58	TW 13	TW 48
Difficult	24	10	15	-
Sometimes difficult	10	73	17	-
Easy	66	17	68	100

Source: Farm Survey (July 1998)

Findings

West Gandak

1. The adequacy of irrigation water is better in transferred minors.
2. The timeliness of irrigation water is better in transferred minors.
3. The water distribution is fairer in transferred minors than in non- transferred minors.
4. Farmers of transferred minors face less difficulty in arranging for irrigation water.
5. West Gandak farmers feel it easier to get assistance of the WUAs in transferred minors as compared to getting the assistance from the agency in non-transferred minors.

BLGWP

1. The adequacy of irrigation water is better in transferred tube wells as compared to the non-transferred tube wells.
2. The irrigation water supply is more timely in transferred tube wells.
3. The water distribution in transferred tube wells is fairer.
4. It has become easier to arrange for water in transferred tube wells.
5. Farmers feel it more difficult to get assistance of agency staff in not-transferred tube wells as compared to getting assistance of the WUAs in transferred tube wells.

Hypothesis 4: IMT results in improved maintenance of irrigation facilities.

Indicator	Data source
Farmer perceptions of conditions of irrigation facilities before and after IMT	Farm survey

Farmers' perceptions about the condition of the irrigation facilities in IMT and non-IMT schemes are as follows:

Table 14: Present Condition of Canals and Structures Compared to 1993 in Transferred and Non-transferred Minors in West Gandak

Perception by Percent of Response	Without IMT				With IMT							
	Manjhariya				Palhi				Parsauni			
	Within Study Unit		Main System		Within Study Unit		Main System		Within Study Unit		Main System	
	Canal	Stru.	Canal	Stru.	Canal	Stru.	Canal	Stru.	Canal	Stru.	Canal	Stru.
Better now	1	-	-	-	9	-	9	-	-	-	-	-
About the same	42	40	50	46	67	49	67	50	46	49	-	-
Better before	57	60	50	54	24	51	24	50	54	51	-	-

Source: Farm Survey (July 1998)

Table 15: Present Condition of Canals and Pumps Compared to 1993 in Transferred and Non Transferred Tube-wells in BLGWP

Perception by Percent of Response	Without IMT				With IMT			
	TW 5		TW 58		TW 13		TW 48	
	Canal	Pump	Canal	Pump	Canal	Pump	Canal	Pump
Better now	15	15	-	-	57	57	36	36
About the same	43	60	8	8	37	35	58	53
Better before	42	25	92	92	6	8	6	11

Source: Farm Survey (July 1998)

Table 16: Present Condition of Canals and Structures in Transferred and Non Transferred Minors in West Gandak

Perception by Percent of Response	Without IMT				With IMT							
	Manjhariya				Palhi				Parsauni			
	Within Study Unit		Main System		Within Study Unit		Main System		Within Study Unit		Main System	
	Canal	Stru.	Canal	Stru.	Canal	Stru.	Canal	Stru.	Canal	Stru.	Canal	Stru.
In excellent condition	2	1	1	1	15	4	12	4	-	-	-	-
In reasonably good condition	47	50	57	54	53	34	55	33	41	45	-	-
In poor condition	51	49	42	45	32	62	33	63	59	55	-	-

Source: Farm Survey (July 1998)

Table 17: Present Condition of Canals and Pumps in Transferred and Non-transferred Tube Wells in BLGWP

Perception by Percent of Response	Without IMT				With IMT			
	TW 5		TW 58		TW 13		TW 48	
	Canal	Pump	Canal	Pump	Canal	Pump	Canal	Pump
In excellent condition	33	33	6	10	2	2	24	19
In reasonably good condition	54	67	82	88	85	73	70	73
In poor condition	13	-	12	2	13	25	6	8

Source: Farm Survey (July 1998)

Findings

West Gandak

1. Within the study units, the canal condition of transferred Palhi minor is the best among the three whereas the other transferred minor Parsauni has slightly better condition than that in non-transferred Manjhariya minor.
2. The canal condition of the main system is better in transferred Palhi minor as compared to the same in non-transferred Manjhariya minor. Parsauni minor takes water from the Indian Main Canal and hence is not accounted in the analysis of the main system condition.
3. The farmers have mixed and inconclusive perceptions about the condition of structures in transferred and non-transferred study units as well as in their main systems.

BLGWP

1. The present condition of canals in transferred tube wells is better than in non-transferred tube wells.
2. The condition of structures and pumps also is better in the transferred tube wells.

Hypothesis 5: IMT will improve the agricultural production performance.

Indicator	Data source
Main and second season crop yields	Farm survey
Spatial variations in crop yields	Farm survey
Farmer perceptions on the changes in crop yields	Farm survey

The data on farmer perceptions of the agricultural yields in IMT and non-IMT schemes are as follows.

Table 18: Yields of Major Crops in the Transferred and Non-transferred Minors in West Gandak

Crop	Units	Manjhariya (without IMT)			Palhi (with IMT)			Parsauni (with IMT)		
		1997/98	1996/97	1995/96	1997/98	1996/97	1995/96	1997/98	1996/97	1995/96
Wheat	Tons/ha	1.37	1.59	1.57	1.15	1.02	0.95	1.65	2.10	1.79
Paddy	Tons/ha	3.20	3.22	3.23	2.83	2.73	2.62	3.99	3.63	3.21
Sugarcane	Tons/ha	39.45	41.97	45.21	-	-	-	37.44	40.54	39.98

Source: Farm Survey (July 1998)

Table 19: Yields of Major Crops by Location in the Transferred and Non-transferred Minors in West Gandak – 3 Years' Average

Crops	Units	Manjhariya (without IMT)				Palhi (with IMT)				Parsauni (with IMT)				Difference in crops yields between IMT and non-IMT schemes			
		Head	Middle	Tail	Agg.	Head	Middle	Tail	Agg.	Head	Middle	Tail	Agg.	Head	Middle	Tail	Agg.
Wheat	Tons/ha	1.53	1.20	1.56	1.49	1.23	1.14	0.88	1.04	1.41	1.87	2.94	1.76	-0.16 (t= -0.84)	0.39 (t= -1.97)	-0.08 (t=0.34)	-0.04 (t=0.34)
Paddy	Tons/ha	3.51	3.30	2.97	3.20	2.74	3.08	2.47	2.73	3.17	3.87	4.9[3]	3.58	-0.47 (t= -2.15)*	0.12 (t= -0.38)	-0.08 (t=0.39)	-0.08 (t=0.59)
Sugarcane	Tons/ha	35.32	38.13	47.40	42.23	-	-	-	-	35.46	46.44	60.09	38.77	0.14 (t=-0.02)	8.31 (t= -1.31)	12.65 (t= -3.44)	-3.46 (t=0.95)

Source: Farm Survey (July 1998)

Table 20: Farmer Perceptions on Major Crop Yields in Transferred and Non-transferred Minors in West Gandak

Perception by Percent of Response	Without IMT		With IMT			
	Manjhariya		Palhi		Parsauni	
	Wheat	Paddy	Wheat	Paddy	Wheat	Paddy
Higher Now	58	45	27	80	82	97
About the Same	39	50	46	20	8	3
Lower Now	3	5	27	-	10	-

Source: Farm Survey (July 1998)

[3] The reported yields are exceptionally high.

Table 21: Comparison of Yields of Major Crops in the Transferred and Non-transferred Tube Wells in BLGWP

Crop	Units	TW 58 (without IMT)			TW 5 (without IMT)			TW 48 (with IMT)			TW 13 (with IMT)		
		97/98	96/97	95/96	97/98	96/97	95/96	97/98	96/97	95/96	97/98	96/97	95/96
Wheat	Tons/ha	1.69	1.76	1.76	0.97	1.43	1.48	1.31	1.61	1.48	1.00	1.66	1.66
Paddy	Tons/ha	4.05	3.85	3.93	3.58	3.38	3.35	4.02	3.91	3.65	3.21	3.22	3.15

Source: Farm Survey (July 1998)

Table 22: Yields of Major Crops by Location in the Transferred and Non-transferred Tube Wells in BLGWP – 3 Years' Average

Crop	Units	TW 58 (without IMT)				TW 5 (without IMT)				TW 48 (without IMT)				TW 13 (without IMT)				Difference in crops yields between IMT and non-IMT schemes			
		Head	Middle	Tail	Agg.	Head	Middle	Tail	Agg.	Head	Middle	Tail	Agg.	Head	Middle	Tail	Agg.	Head	Middle	Tail	Agg.
Wheat	Tons/ha	1.85	1.62	1.79	1.74	1.13	1.65	-	1.28	1.13	1.72	1.10	1.43	1.62	1.34	1.49	1.44	0.1 (t= -0.4)	-0.17 (t=1.26)	-0.23 (t= 0.64)	-0.07 (t= 0.55)
Paddy	Tons/ha	4.26	3.84	3.85	3.96	3.36	3.50	-	3.41	4.03	3.76	3.80	3.87	2.92	3.04	3.50	3.19	0.06 (t= -0.24)	-0.31 (t= 1.62)	-0.36 (t= 1.22)	-0.17 (t= 1.28)

Source: Farm Survey (July 1998)

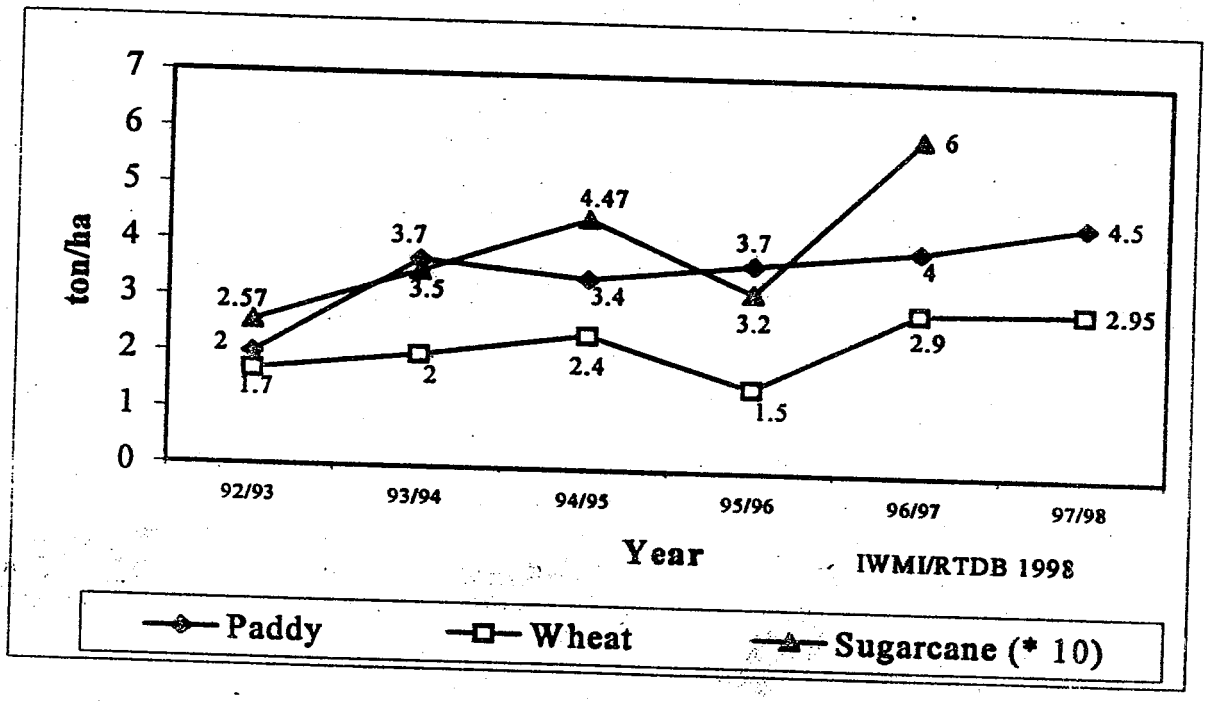
Table 23: Farmer Perceptions on Major Crop Yields in Transferred and Non-transferred Tube Wells in BLGWP

Perception by Percent of Response	Without IMT				With IMT			
	TW 5		TW 58		TW 13		TW 48	
	Paddy	Wheat	Paddy	Wheat	Paddy	Wheat	Paddy	Wheat
Higher Now	74	31	58	12	50	14	96	94
About the Same	26	56	40	40	47	64	2	6
Lower Now		13	2	48	3	22	2	-

Source: Farm Survey (July 1998)

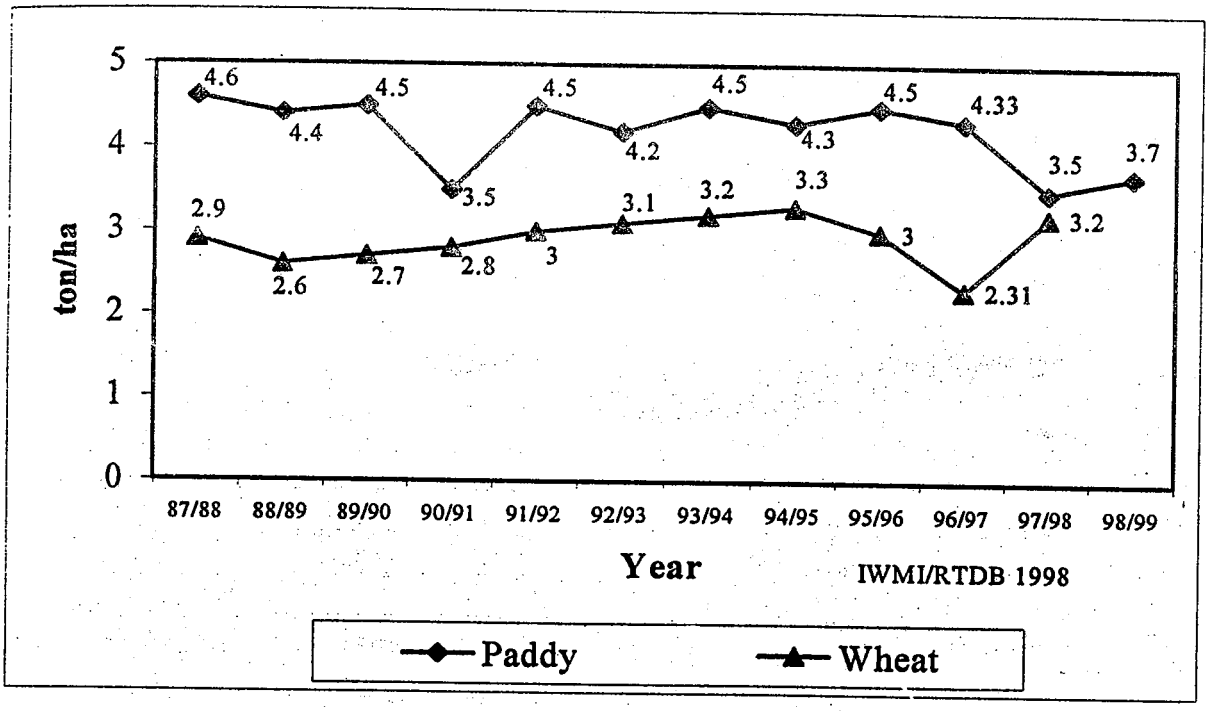
The average yields of major crops reported by the concerned projects are given below. These figures represent the averaged data in the whole system that are recorded in the individual systems based on crop cutting surveys.

Chart 2: Yields of Major Crops in West Gandak



Source: Performance Assessment Study, IWMI and RTDB, 1998.

Chart 3: Yields of Major Crops in BLGWP



Source: Performance Assessment Study, IWMI and RTDB, 1998.

Findings

West Gandak

1. Yields of wheat and paddy in Palhi minor have been increasing over the last three years and sugarcane is not grown at all.
2. Paddy yields in Parsauni minor also has been increasing over the time.
3. Yields of sugarcane in Manjhariya minor have a decreasing trend.
4. Wheat yield is the lowest in Palhi minor and the highest in Parsauni.
5. There are no significant differences in aggregate yields of major crops in transferred and non-transferred minors.
6. No significant variations by location are found in the yields of major crops.
7. Perception on the change in paddy yields in transferred minors is positive than that in non-transferred minors.
8. Parsauni farmers perceive that wheat yields have gone up.
9. Yields of all the crops reported by farmers are lower than those reported in project documents.

BLGWP

1. Paddy yields in BLGWP schemes have increased over the time and are lower than the project records.
2. Wheat yields have a decreasing trend over the last three years and are lower than project records.
3. There are no significant differences in aggregate yields of wheat and paddy in IMT and non-IMT schemes.
4. Variations in the crop yields by location are insignificant.
5. Farmers' perceptions about changes in major crop yields in transferred and non-transferred tube wells are inconclusive whereas perception about the change in transferred tube well no. 48 is positive.

SUMMARY

In sum, results and findings related to hypothesis 1, i.e. IMT will decrease O&M costs to the government; no conclusion can be drawn with regard to West Gandak as minor-wise government's O&M expenses are not available. However, overall O&M budget allocation for the entire system has decreased drastically with gradual IMT of the irrigation system.

In BLGWP, the average O&M cost to the government per ha in non-transferred schemes of the BLGWP over the last six years has been NRs. 497/ha. This has reduced to ZERO after the IMT supporting the above hypothesis.

With regard to hypothesis 2, i.e. IMT will increase cost of irrigation to the farmers; the annual irrigation costs to the farmers in IMT sites in West Gandak are significantly higher than that in non-IMT sites. However, there is no significant difference in unpaid family labor contributions for maintenance between IMT and non-IMT sites.

Also in BLGWP, the annual pumping costs for irrigation in IMT sites are significantly higher than that in non-IMT sites. Unpaid labor contributions in IMT schemes appear to be lower than that in non-IMT schemes. This is mainly because the data in non IMT sites include the labor contributed in rehab works and hence no conclusion can be drawn in absence of information about the exact amounts of labor contributed during rehab and afterwards. However, the rises in the irrigation cost to the farmers in cash in both the systems supports the hypothesis.

Regarding the hypothesis 3, i.e. IMT will improve the quality of irrigation service to farmers, the adequacy of irrigation water has improved in transferred minors of West Gandak. Similarly, the timeliness of irrigation water has become better and the water distribution has become fairer in transferred minors than in non- transferred minors. Farmers of transferred minors face less difficulty in arranging for irrigation water and West Gandak farmers feel it easier to get assistance of the WUAs in transferred minors as compared to getting the assistance from the agency in non-transferred minors.

In BLGWP, the adequacy of irrigation water is better in transferred tube wells as compared to the not-transferred tube wells. Similarly, the irrigation water supply is more timely in transferred tube wells and the water distribution is fairer. It has become easier to arrange for water in transferred tube wells and farmers feel it more difficult to get assistance of agency staff in not-transferred tube wells as compared to getting assistance of the WUAs in transferred tube wells. All of these indicate improvements in the irrigation quality as stated by the hypothesis.

On hypothesis 4, i. e. IMT results in improved maintenance of irrigation facilities, within the study units of West Gandak, the canal condition of transferred Palhi minor is the best among the three whereas the other transferred minor Parsauni has slightly better condition than that in non-transferred Manjhariya minor. The canal condition of the main system is better in transferred Palhi minor as compared to the same in non-transferred Manjhariya minor. Parsauni minor takes water from the Indian Main Canal and hence is not accounted in the analysis of the main system condition. The farmers have mixed and inconclusive perceptions about the condition of structures in transferred and non-transferred study units as well as in their main systems.

In BLGWP, the present condition of canals in transferred tube wells is better than in non-transferred tube wells. The condition of structures and pumps also is better in the transferred tube wells. The better canal conditions of in West Gandak and better conditions of both canal and structures support the above hypothesis.

On hypothesis 5, i.e. IMT will improve the agricultural production performance, the overall yields in West Gandak scheme increased substantially from 2.0 to 4.5 ton/ha. The differences between the transferred and non-transferred minors are less pronounced. Wheat and paddy yields in Palhi minor of West Gandak have been increasing over the last three years. Paddy yields in Parsauni minor are increasing too. Yields of sugarcane in Manjhariya minor, a non-IMT case, have a decreasing trend. However, there are no significant differences in the aggregate yields of major crops in transferred and non-transferred minors. Similarly, there are no significant variations in the crop yields by location in both transferred and non-transferred minors.

Nevertheless, farmers in Parsauni minor perceive that paddy and wheat yields have increased after IMT. Palhi farmers also express positive perception about the increase in paddy yields.

In BLGWP paddy yields have increasing trends whereas wheat yields have decreased over the time. There are no significant differences in aggregate yields of wheat and paddy in IMT and non-IMT schemes and no significant variations are found by location. Farmers' perceptions about changes in major crop yields in transferred and non-transferred tube wells are also inconclusive whereas perception about the change in transferred tube well no. 48 is positive.

It was noted that the yields of all the crops reported by farmers in both systems are lower than those reported in project documents. It is mainly because the project data are based on the crop cutting surveys whereas farmers reported the net productions after deducting the for losses incurred during harvesting, transportation, harvesting wage payments that are customarily often paid in some share of the harvested bundles of crops, etc.

In conclusion, it can be said that the IMT has had following effects:

- Decrease in the government's allocation for O&M
- Increase in the irrigation costs to farmers
- Improvement in the quality of irrigation service
- Framers perceived the physical conditions of the irrigation facilities are better after transfer. Partly this may be caused by the rehabilitation that preceded the IMT process. However, in the transferred tube wells and minor canals the positive perception was more pronounced than in the non-transferred ones.
- In West Gandak irrigation system agricultural production increased substantially. Differences between transferred and non-transferred minors are less pronounced. Yields in BLGWP tube wells increased only slightly. since the yield levels were already quite high before management transfer. It is difficult to desegregate contributions to improvements in yields to IMT and rehabilitation.

Paper 2: Monitoring & Evaluation Follow Up

T.P. Sharma and S. K. Shrestha

BACKGROUND

Monitoring and Evaluation of Irrigation System has been a "talked more" and "acted less" issue of the Department of Irrigation for quite a long time. Numbers of agencies, bank funded projects and individuals have tried to establish a sustainable and usable M&E system to date and few have succeeded and that too for a short period only.

Research and Technology Development Branch (RTDB) and International Water Management Institute (IWMI), has identified two basic questions[1] in relation to irrigation management transfer programs in Nepal. For the answer of those, RTDB & IWMI with the financial support from Ford Foundation is assisting Monitoring & Evaluation Unit of Irrigation Management Division and Management Information System Unit (MISU) under Planing Division in developing an M&E system along with developing a simple computer based database system.

In the initial phase of the present activity, M&E System Database was designed using commercial software, MS Access 97 and installed in the network environment of MISU. The system was first designed in its simplest form to capture the data related to main three categories, namely; Agricultural Performance, Maintenance Performance and Operational Performance. The Agricultural Performance Table relates to data pertaining to crop production, market price, average yields and cropped area, while Maintenance Performance Table relates to the budget for operation and maintenance, irrigation service fee etc. Similarly, Operational Performance gives the diverted irrigation water supply.

System Management Branch and Management Information System Unit are engaged in a collaborative way in monitoring selective aspects of irrigation development in Nepal. The Monitoring and Evaluation (M&E) Unit of SMB is mostly involved in collecting the data related to Irrigation Management Transfer Project (IMTP) sites (11 irrigation systems) and different DOI-

[1] The first question is related to appropriateness and outcomes of management transfer interventions in Nepal whereas the second is related to identification of successful intervention approaches that can be adopted to other irrigation systems. Convincing answers to these questions can only be obtained through analyses of a well-recorded longitudinal set of relevant data.

different DOI-managed irrigation systems (about 22) under Operation and Maintenance (O&M) whereas MISU is responsible for updating the Database System with new sets of data once available.

OBJECTIVE

The objective of this activity was to assist MISU and M&E units in the follow up activities on the established M&E System and its database for the continued use, updating and enhancement.

SCOPE OF WORK

The related tasks were as listed below:

1. To identify the second set of irrigation systems for which needed data are available to augment the established database,
2. To collect and compile the data on those systems using the modified questionnaires from respective irrigation systems,
3. To augment the database with additionally collected data,
4. To update the database with additionally collected data
5. To explore the possibility of using the MapInfo System already tried in the M&E unit
6. To initiate the process of circulating biannual reports through MISU on the established database to all divisional heads

IDENTIFICATION OF IRRIGATION SYSTEM

In irrigation systems identified for the purpose of the task were;

IMTP Sites

1. Panchkanya Irrigation System
2. Khageri Irrigation System
3. West Gandak Irrigation System
4. Chandra Canal Irrigation System
5. Manusmara Irrigation System
6. Banganga Irrigation System
7. Hardinath Irrigation System
8. Mohana Irrigation System
9. Patharaiya Irrigation System
10. Kamala Irrigation System
11. Chaurjaharai Irrigation System

Other Systems - Under O&M

12. Kankai Irrigation System
13. Sunsari Morang Irrigation Project
14. Koshi Pump Irrigation System
15. Jhanj Irrigation System
16. Narayani Zone Irrigation Project
17. Narayani Lift Irrigation System
18. Bulingtar Irrigation System
19. Bhairahawa Lumbini Groundwater Project
20. Marchawar Lift Irrigation System
21. Hemja Irrigation System
22. Pokhara Water Conservation Irrigation System
23. Phewa Irrigation System
24. Bijaypur Irrigation System
25. Rampurphant Irrigation System
26. Begnas Irrigation System
27. Aanpchaur Irrigation System
28. Phalebas Irrigation System
29. Gyandi Irrigation System

Tube Well Systems

30. Sagarmatha Tubewell
31. Mahottari Deep Tubewell
32. Narayani Tubewell Project
33. Kapilvastu Tubewell Project
34. Kailali Kanchanpur Tubewell

COLLECTION AND COMPILATION OF DATA

Once the Irrigation Systems were identified, M&E unit started collecting data based on a modified questionnaire developed. At present two sets of questionnaires have been developed for the purpose of data collection. Surface irrigation systems and Groundwater irrigation systems considering their technical differences. Some appropriate formats for data recording at field level have also been developed for maintaining simplicity and uniformity in the formats and data collected therein. There is a lot of scope to enrich the database with many other kinds of information such as institutional development data, training information, staffing, equipment, flow data below the headwork, etc.

The data were then compiled and made available to MISU to key-in the established M&E System Database. In the mean time, data entered earlier, were also updated, edited and appended. The additional data collected were also utilized to augment and update the

Database as a whole. The data inflow rate into the database system need to be monitored on a time series basis and periodic reports should be circulated to the concerned.

Most of the systems, having poor data, are to be instructed how to keep and update the quality data. The systems under IMTP phase I have better record keeping. The Phase II systems under IMTP have updated new records and only few systems have discharge data updated. In Manusmara and Banganga systems just started the gauge reading. Some systems like Mohana, Patharaiya, Hardinath and Chaurjahari do not keep the discharge records and they also don't have full time series data on agricultural performance and resources generated. Kamala has partial data on discharge measurement and agriculture crop yield and no data on resource generation. In the coming year of project period the record updating in these systems will be enhanced, but the problem is with other systems in operations. In case of systems under Operation and Maintenance only few systems have updated records of discharge measurements and ISF collections including other resource generation activities. Some of the systems with well-established record keeping are Kankai Irrigation System (KIS), Sunsari Morang Irrigation Project (SMIP), Narayani Zonal Irrigation Development Project (NZIDP), Narayani Tube Well Irrigation Project (NTWIP), Narayani Lift Irrigation System (NLIS) and Bhairahawa Lumbini Ground Water Irrigation Project (BLGWP). The reason of having updated records in these systems mentioned is the existence of established responsible M&E Units in most of these systems. Table 1 shows the data availability in different irrigation systems over the last five years.

Some other systems have updated partial data on agriculture and discharge measurements. The M&E unit of SMB/DOI has helped in developing calibration curves in the systems that have updated records of only gauge readings for the conversion into discharge data.

The records of Tube Well systems have just been collected and with a scope to enter in a separate format. The format has just been prepared. Three Tube Well systems have updated partial data on irrigated area, agricultural performances and resource generation. Other two systems are poor in record keeping. The blank spaces of the status table filled with color show that the data are not fully available in the records of concerned systems. It is also requested to concerned personnel to provide the records to MIS and M&E Units of DOI, if those are available with them. M&E Unit has tried to enrich the database source by making the irrigation systems conscious on collecting and updating records at their earlier attempts.

Table 1: Data/Record Availability at Different Irrigation Systems over Last Five Years

Name of the system	Data on agriculture performance	Data on O&M budget & expenses	Data on ISF target	Data on ISF collection	Data on alternative income	Data on discharge rate	Data on discharge by Volume
IMTP Sites							
Panchkanya I.S.	✔	✔	✔	✔	✔	✔	✔
Khageri I.S.	✔	✔	✔	✔	✔	✔	✔
Nepal Gandak I.S.	✔	✔	✔	✔	✔	✔	✔
Chandra Canal I.S.	*	✔		✔	*	✔	✔
Manusmara I.S.	✔	✔	*	*			
Banganga I.S.	✔	✔				...	
Hardinath I.S.		✔	*	*	*		
Mohana I.S.	*	✔	*	*	*		
Pathraiya I.S.	*	✔	*	*	*		
Kamala I.S.	*	✔				*	
Chaurjahari I.S.		✔					
Other systems (Under O&M)							
Kankai I.S.	✔	✔	✔	✔		✔	✔
Sunsari Morang I.P.	✔	✔	✔	✔	✔	✔	✔
Koshi Pump I.S.		✔				✔	
Jhanj I.S.		✔					
Narayani Irrigation P.	✔	✔	✔	✔		✔	✔
Narayani Lift I. S.	✔	✔	✔	✔		✔	✔
Bulingtar I.S.		✔					
BLGWP (two TWs)	✔	✔	✔	✔	*	✔	
Marchwar L. I.S.	✔	✔	✔	✔	*	✔	
Hemja I.S.							
Pokhara Water							
Phewa I. S.		✔					
Vijayapur I.S.		✔				✔	✔
Begnas I.S.							
Rampurphant I.S.		✔				*	
Aanpchaur I.S.		✔				✔	
Phalebas I.S.		✔					
Gyandi I.S.		*					
Tube Well Systems							
Sagarmatha TW		✔					
Mahottari Deep TW		✔				*	
Narayani TW Project	✔	✔	✔	✔			
Kapilvastu Investing.	✔	✔	*	*		*	
Kailalikanchanpur TW	*	✔	*	*		*	

✔ - Information available; * - Information partially available;
... - Just started keeping information

USE OF MAPINFO SOFTWARE

MapInfo is a Geographic Information System (GIS) based database system. Earlier M&E unit was assisted by ADB funded IMTP in establishing a database based on MapInfo Software. The system was built and data of the three systems, West Gandak, Khageri and Panchkanya were entered and the system was brought to operation. But, due to the lack of continuous flow of data into the system, the system was unable to deliver information, for what it was designed.

The present scope of work was to explore the possibility of using the spatial data of MapInfo and integrate with the presently developed database. The MapInfo software used was V. 3.0 which does not support relational database. The present database developed in MS Access 97 is relational database. Hence, the use of Access database in the MapInfo environment was not possible due to its incompatibility. The recent version of MapInfo which supports relational database, can be used to integrate the database developed in MS Access. But due to unavailability of the latest software of MapInfo with MISU or M& E Unit further works could not be carried out.

SUCCESS ACHIEVED

The follow-up activity has helped in updating the established M&E system database. Standard Reports based on the database have been designed and printed. The reports are basically on Agricultural Performance, Maintenance Performance, Operational Performance and comparison of Average yields of crops in different irrigation systems. With the computer based Database System, one can easily retrieve the data available with few strokes of keyboard. Further, with the database various kinds of reports can be generated for the purpose of evaluating performance of an irrigation system with the aid of identified indicators. The different indicators identified and used in the reports are cropping intensity, irrigation intensity, production per hectare, budget allocation per hectare, financial self-sufficiency, etc.

CONSTRAINTS

The modifications have been made on the basis of the designed database system and the data types presently installed on the database. Proper demand for the data installed on the M&E databases, regular flow of information into them, simplicity in getting access to the databases and quality of data on them, etc are very important. First of all, people at different management levels who seek information should have easy access to the database system and they should get something useful on it. If the source of data is reliable, all the demand will be directed to the data source. Further, to ensure a regular data inflow into M&E and MISU, computer network in the DOI should come into operation in an effective way. With this different divisions/units can be made responsible to key-in the relevant data from their respective divisions/units on the database. Periodic reports, which will be

circulated to all the concerned, and feedback from them will help in authenticating the database established in DOI by MIS and M&E units.

The MISU is still not functioning in its speed due to lack of rules, working vision and manpower. As the developed database is in MS Access 97, though being simpler, M&E Unit of SMB is still in need of an appropriate computer with necessary software.

Not only in IMTP, other proposed Irrigation systems under O&M have recently been turned over to Water Users. Nowadays, the trend of systems' turn over is overwhelmingly rapid. A question is raised here, whether the established record updating in some irrigation systems will continue after the management transfer. Who will be responsible in those systems recently transferred systems to keep and update the records and disseminate it to upper tier of hierarchy? In some turned over systems, all the government staff were deployed at once and record keeping on some indicators like discharge record at head-works has suddenly been discontinued (as in the case of West Gandak Irrigation System). This trend will adversely affect the record keeping as well as system sustainability. For establishing record updating system, projects' maintenance and disseminating useful information should be given priority while extending post-transfer or joint management supports from the higher levels. If there is a demand for data, people will collect data if data are useful for management, and decision making at field as well as central level. For fostering such an understanding among the field level people, hard and fast rules of support packages, for example in form of a post–transfer support program, should be designed on the basis of the record keeping practices at the field level.

In addition, the revised questionnaires (formats) have already widely been circulated to all the concerned at different levels of project management with explanation about potential use of the minimally sought data and their significance. The standard questionnaire is also translated into Nepali.

The recent leap of technology in the information system has left no single sector, untouched. In Department of Irrigation, the concept of computer based information system was introduced way back in 1990. But due to the proper initiative from the management it's still in its infancy and is not able to deliver its output to achieve the objectives set forth. The constraints identified for the sustainability of the system identified are:

- Validation of data installed
- Feedback on the system
- Data security
- Data unavailability or missing data
- Frequent monitoring and updating of the irrigation systems for timely data dissemination
- Procedural set-up for data collection/compilation
- Role of MISU and M&E unit in the decision support system

- Human Resources deployment in MISU and M&E unit
- Regular Training/Updating on the recent development on information Technology
- Allocation of regular budget from HMG/N sources
- Use of database by the end users/ managers/decision makers

It was formerly recommended that for effective institutionalization of the developed database system, it would be necessary to devise appropriate follow up activities in accordance to recommendations made herein on M&E system. For simplifying proper institutionalization of the database, three categories of the irrigation systems could be made depending upon the extent of data available and being recorded in different irrigation systems. The systems having the complete set of presently proposed data can be differentiated as belonging to the first category followed by the systems under second category having partial data. The systems with no updated records can be considered of the primary category. The main purpose of this categorization is to attain efficient database management enabling MISU and M&E Unit to adopt necessary and appropriate follow up measures.

SUGGESTIONS

A phase-wise program for enhancing the databases can be launched of which the present job could be taken as the first phase. While proceeding with the follow up program, the systems with better record keeping practices should be given priority under the second phase. The systems under the last category can come at the last.

Selective and very important indicators to seek the answer to the management transfer should be pre-designed in questionnaire and special effort should be made to keep and update records in the irrigation systems in question.

Large irrigation systems should form a Monitoring and Evaluation Units for a well established monitoring and timely record updating. The same thing is also recommended to the small irrigation systems if felt necessary.

The following have been suggested for the continuity of the M&E system to work in the coming days as well:

1. Ford Foundation continues to support the activity for at least one more year to see the results.
2. A procedural guidelines be set-up for coordination between MISU and M&E unit in updating the database in the installed system,
3. Modification/enhancement of the database in coming days.
4. Training of manpower, involved in MISU and M&E unit in the computer software of database management and programming language, which will help to build the in-house capability
5. Create linkages for data flow into the system at MISU
6. Support in report production and circulation

7. Further. explore the possibility of using GIS based database (MapInfo, ArcInfo, ArcView etc.)
8. Immediate actions to be taken to run the Computer Network established after analyzing its faults and defects and properly setting it up.

CONCLUSION

A well-institutionalized and sustained M&E system has often been the key concern. However, it does not depend upon any single factor. Proper demand for the data recorded in the M&E databases, regular flow of information into them, simplicity in getting access to the databases and quality of data on them, etc are very important. First of all, people at different management levels who seek some information should have easy access to the database system and they should get something useful on it. Unavailability of such information on the database, or hardships in getting access to them, tends to divert the potential users to some alternative sources. This undermines the importance of maintaining a database. Once the information seekers start getting the desired information, the demand for such information loaded on the database fosters. Similarly, if such information are used back at different management levels, especially at the field level, the information providers at the lower levels start realizing the benefit of sending the asked data on a regular basis as well.

If there is a demand for data, people will collect data if data are useful for management, decision making at field as well as central level. In actual situation, now, demand is there but data are difficult to get. So, people get discouraged. So, the assumption is that if data are easily and widely available, demand will be created.

Further, simplicity in filling the formats through which various information are sought from different levels are also important as the complicated formats tend to annoy the data recorder and eventually adversely affects the extent of data collection and their quality.

Every individual irrigation system should have its own identification in the form of a well set of data records, which can be termed as its "unique identity".

Paper 3: Institutional Development Processes for IMT: A Review

Sanju Upadhyay

INTRODUCTION

The management transfer efforts have commonly involved, in addition to the rehabilitation of the targeted irrigation systems, the establishment of the Water Users Associations (WUAs) and strengthening WUAs' institutional capability through training and follow up. Ultimately, the aim is eventual turn over of these systems to the organized group of beneficiaries.

The agency's support in the scheme strengthening works or some form of the rehabilitation/ modernization components including command area development activities have often been used as an incentive for the beneficiaries to motivate them towards assuming the greater responsibility of managing their own irrigation systems. Nevertheless such works also have the objectives of improving the effectiveness and serviceability of the irrigation and drainage schemes as well. Also the farmers' involvement in the management tasks is thought to be important in improving the performance of the irrigation schemes.

The processes of turning over the management have been noted to be different in different projects and are at different stages. IMT efforts in Nepal, both in the donor assisted as well as in the HMG/N own projects involve two components - Local Institutional Development and the Irrigation System Improvement. Both of these can be considered as the forms of interventions through which the partial or complete transfer of the system is envisaged. In order to explore the plausible answers to the question what institutional process leads to successful IMT, it is necessary to look into the different processes of local institutional development efforts followed in Nepal in the context of the IMT. This study has made efforts on the same line with the following objectives.

THE STUDY AND ITS OBJECTIVES

The main objectives of this study were as follows:

- To identify effective institutional development processes, both of the agency and the farmers
- To recommend possible corrective measures and modifications to be made in the ongoing efforts of the institutional development efforts at the local level.

Keeping these objectives in view, the study involved the following works:

1. Documenting different institutional development efforts made for the purpose of IMT in Nepal's irrigation systems.
2. Comparative assessment of the adopted processes in terms of similarities and differences.
3. Impact assessment of the adopted processes in relation to the extents of IMT and related irrigation management tasks.
4. Performance assessment of WUAs.
5. Identifying effective approaches to institutional development efforts.
6. Indicating the changes that would be required in order to make the ongoing efforts for institutional development more effective from IMT perspective.

Bases on the above works and related analyses some conclusions and recommendations have been drawn. These recommendations are expected to facilitate the agencies in making better choices out of the alternative approaches for institutional development activities and in making necessary modifications in ongoing efforts as well. It is expected to help in effective implementation of IMT efforts in Nepal as envisaged by the Irrigation Policy.

STUDY AREA

The study has covered the following cases in which the IMT has been tried or being tried in Nepal.

1. Irrigation Management Transfer project (IMTP)
2. Bhairahawa Lumbini Ground Water Project (BLGWP)
3. Sunsari Morang Irrigation Project (SMIP)
4. Marchwar Lift Irrigation project (MLIP)
5. Kankai Irrigation System (KIS)
6. Aandhi Khola Irrigation System (AKIS)
7. Irrigation Management Project (IMP)
8. Mahakali Irrigation Project (MIP)
9. Nepal Irrigation Sector Project (NISP) and others
10. Second Irrigation Sector Project (SISP) and others

Irrigation Management Transfer is a process of complete or partial turnover of the projects developed and being operated and managed by the HMG/N to the organized group of the beneficiary farmers (Neupane and Neupane; 1997). In the projects such as the ILC, ISP, SISP, NISP etc., the process of facility transfer back to the farmers is being misinterpreted as IMT. In fact, these projects briefly intervene into FMISs for rehabilitation.

As also mentioned before, the processes and approaches for IMT followed have been different in different irrigation systems developed and managed by the DOI. Moreover the progress achieved in IMT are found at different stages. Generally the achievements are only partial in many respects, as IMT efforts have been mostly implemented in part of the command area of the projects concerned. The irrigation systems currently under Irrigation Management Transfer Project (IMTP) are at an advanced stage of IMT. Therefore, IMTP-supported systems were considered logical representatives for this study. Accordingly, three irrigation subprojects under phase-I of the IMTP have been chosen. UNCDF-funded Marchwar Lift Irrigation system also has been selected for its uniqueness in its development modality. Kankai Irrigation system is another representative of the DOI's O&M systems where IMT efforts are being made with DOI funds alone through System Management Training Program (SMTP). Other cases of SMIP, NISP, SISP, IMP and Mahakali are assisted by different donor agencies. The cases thus selected under the study are expected to represent the irrigation systems in Nepal in general.

METHODOLOGY

A vigorous literature review has been made on the institutional development processes adopted in various irrigation projects in Nepal. Field visits were made to four of the selected irrigation systems.

Besides some secondary information collection during literature review, the data were primarily collected from group interviews using a checklist and a question catalogue following the participatory rural appraisal techniques. WUA office bearers were the key informants during the study. Group interviews were conducted in larger gatherings, as much was possible. In-depth interviews were conducted with key informants in one of the irrigation system namely Panchkanya Irrigation system. The interviewees from the head, middle and tail parts of the system were selected to crosscheck the information already acquired from group interviews. This helped in acquiring information regarding the leadership as well as about the particular problems and conflicts in the system.

The interviews were however not based upon rigidly administered questionnaires that are generally used on the standard sample surveys. They were flexible guiding the discussions with the informants. The questionnaire included a number of questions focussing on the institutional aspects related to IMT.

Keeping in view the key tasks that a WUA is expected to perform a tool for assessing the functional status of the WUAs was also developed and used. The tool envisaged the WUA

not to be merely a structural arrangement to carry out the tasks but as an entity to respond to the external and the internal opportunities as well as the constraints. These constraints may be political, socio-economic and or ecological. The ecological constraints may be the problem of the catchment protection in the Panchakanya irrigation system and settlement of the displaced population of the Chitwan national park to the Padampur, the upstream of the Khageri Irrigation system or likewise.

Similarly, the organizational structure was interpreted as representative bodies and operational group with defined roles and responsibilities with linkages between different tiers of the organization.

The tool for the rapid assessment of the functional status and the capacity of WUAs looked at the farmer organizations in selected irrigation systems from two perspectives:

- The organizational structure and the key tasks.
- The current issues and problems with which WUAs are confronted and how the members and the leaders of WUAs are dealing with them.

The study has concentrated on two aspects in each of the selected projects:

- Institutional Development Processes Adopted
- Present Functional Status Assessment

During the interviews, the problems and the issues surfaced at any point of time were given the top priority without disrupting the arguments. Once the problem aspect and the issues were fully discussed, the aspects that were not fully covered were queried. One of the shortcomings of the rapid assessment is that there is always a danger of receiving a biased information. Care was taken to avoid biases of individual informants by verifying the answers with the others.

Field observations were also made to understand the physical condition of irrigation systems. The information and the data obtained from the field visits are complemented by the secondary sources from the publications and the gray literature of the DOI, IWMI Nepal and the others. Based on these information and the data, a comparative analyses have been made to arrive at the judgement on the successes and the failures of different institutional development approaches.

The inferences and the conclusions are "INDUCTIVE", as they were based on the post-facto empirical data and the evidences. In the end of the study, pertinent recommendations have also been made.

STATUS OF MANAGEMENT TRANSFER

The status of the management transfer could largely indicate the success of the process adopted whereas the functional status of the WUAs could indicate their capacity to deal with the opportunities and challenges in the course of undertaking the assumed irrigation management responsibilities. The status of the management transfer in systems under the study is summarized in the table below.

Table 1: Overview of the Management Transfer in Various Irrigation Systems

Sub-Project	Formally turned over	Percent of gross area transferred
IMTP		
Panchkanya	• 600ha. gross command area • Head-works • 5 km. main canal • 9 branch canals	100
West Gandak	• 10,100 ha. • 32km. main canal • 4 branch canals • 18 large minor canals • 24 smaller minor canals • 7 special farm ditches • 176 main farm ditches	100
Khageri	• 3,900 ha. (gross command area) • 9 out of 9 distributaries • 4 of 4 minor canals	100% of the Minors /Distributaries - main system under the joint management.
BLGWP: Out of a total of 181 tube wells, 117 are the electric pumps and rest others are the artesian. Distribution system has open channels in the Stage-I and UPVC pipe loops in Stage-II and Stage-III tube well systems. Participatory approach was adopted since the beginning of Phase-II of the Stage-II program and Stage-III program. Management Transfer activities of Stage-I tube wells are under the Stage-III of the project.		
Stage-I	• Tube well system transferred 31 • Not-transferred but paying electricity charges 28 • Artesian tube well 1	
Stage-II	• Tube wells paying electric charges and • wages of pump operators 11 • Tube well systems with no WUG's participation 4 • Non functional tube wells 1 • Recently installed tube wells 22	
Stage-III	• Stage-III of the project still ongoing with the participatory approach since the beginning • Under Stage-III, lining if canal stretches of Stage-I development and remaining construction works of Stage-II also included • In 16 tube well systems WUGs on their own completed 121kms of trench excavation out of the total 171 kms.	

Sub-Project	Formally turned over	Percent of gross area transferred
SMIP	• Only under Stage-III of the project, the participatory approach has been adopted from the beginning. • Because of the command area size, the project is under the Joint Management • Based on the Joint Management agreement (JMA) the responsibility of managing the water courses lies with the WUOs. Gradually, the tertiary systems too are transferred to the WUGs in the second year and the sub secondary system to the WUAs in the third year after signing of the JMA. • Total management responsibility of the Jhumka canal system (SSJ-891ha) has been transferred to the WUA	
MLIP	• Phase-I of the project was not developed under the participatory approach • Phase –II incorporated the participatory approach from the very beginning • Except the pump house and intake chamber, all the seven canal systems in the lower MC together with Hardi minor with a total command area of 2,805ha have been transferred to the WUA.	100%
KIS	• Secondary canals S9 (126ha), S10 (259ha), S11 (144ha), S0 (300ha), and S12 (385ha) transferred to the beneficiaries' organization. Thus, system covering a total of 1,214 ha area under the secondary canals has been management transferred till date. • General assembly has passed the resolution that the whole systems except the main canal system will be taken over by the beneficiaries by the end of the year 2001.	17.34%
AKWUA	• Except the intake and conveyance structure (tunnel), the canal system and accessory structures with a total command area of 282 ha is transferred to AKWUA.	100%
MIS	• Operated as a Jointly Managed Irrigation system with the vision of transferring all the tertiary systems to WUA. The farmers are maintaining most of the tertiary systems. Stage-II of the project is still ongoing and the tertiary systems still need to be completed.	
IMP	• The pilot projects namely Handetar (about 400ha) could not be handed over as envisaged and is presently being looked after by the DIO, Lamjung. • Sirsia-Dudhaura system (about 2,000 ha) envisioned to operate under the joint management is under the management of DIO Bara. The O&M of the system reportedly has worsened after IMP.	

Sub-Project	Formally turned over	Percent of gross area transferred
NISP	• Aims at rehabilitating the farmers' system in an assistance mode. After rehabilitation the system automatically goes under the farmers' management. • For the new systems too, the participation starts from the demand request phase. The project starts only after it is agreed upon that the system will be transferred to the respective WUAs upon the project completion. • Total of 59,600ha including both the new and the rehabilitation schemes are targeted for development and transfer to the organized beneficiaries.	
SISP	• Focuses at rehabilitating the farmers' system in an assistance mode. After rehab the system automatically goes under the farmers' management. • For the new systems too, the participation starts from the demand request phase. The project starts only after it is agreed upon that the system will be transferred to the respective WUAs upon the project completion. • Total of 41,000ha including 9,000 ha under new schemes and 32,000 ha under the rehabilitation schemes is to be developed and transferred to the organized beneficiaries over a period of 6 years.	

STUDY FINDINGS

The studied cases have some basic similarities as well as differences in the approach taken with regard to institutional development endeavors. The study was divided into two components namely the process and performance evaluation.

Process Evaluation

The table below gives the main features of adopted processes for institutional development.

Table 2: Overview of the Institutional Development Processes

Project/ Program	Rationale for Institutional Development	Stepwise Process for Institutional Development	Agency's Institutional Arrangements
IMTP	• To improve water cess collection • To increase service area from 32,000 ha to 67,800 ha and improve system performance by bettering O&M. • To delegate the management responsibility to the WUAs.	*WUA Formation* • Introductory Workshop • Designing organizational structure of the WUA • Information dissemination through public meetings in 500 – 1000ha blocks. • Selection of local farmer organizers • Inventory collections • Formation of constitution drafting committee • Constitution drafting and ratification by the General Assembly • Formation and the registration of the WUA *Training* • Share system development and administration • Administration and financial management • Hydraulic operation and structure calibration • HMG accounting procedure etc. • International study tours for farmers one each from the three IMTP-I sites. • Overseas training to IMTP personnel on irrigation management. • Observation tours for the middle level and the higher level DOI managers. • Advanced level training to four IMTP engineers. (The numbers of training/workshop/seminar conducted in PIS, Khageri and NGWIS (main) were 10, 16 and 10 respectively. Involvement in terms of person days in training was 4417,1793 and 1580 in PIS, Khageri and NGWIS respectively)	• SMB/DOI assistance in formation process • Capability building of the WUAs and associated agency personnel by HRDTB/DOI through peer and action training, study tours and workshops, seminar, national and international exchange visits, etc. • Technical assistance by a consulting team • Some post transfer supports

BLGWP	• To facilitate the Management Transfer program. • To resolve the problems associated with cost sharing, land acquisition, etc. • Effective irrigation.	*WUA Formation* • AOs hold meetings with 2-3 prominent farmers. • Introductory meeting of all beneficiaries. • Finalizing the standard format of WUA's constitution. • Ratification of the draft constitution by the General Assembly. • Registration of WUA with AO's assistance. *Training* • Leader farmers training and tube well level farmers training at sub service center on agricultural aspects. • Field crop demonstration and mini kit distribution	• FOD under BLGWP headed by a sociologist • A Technical Assistance team assists FOD. • AOs conduct training to the WUGs. • Agriculture Division of the project engaged in agriculture extension services, minikit distribution and training on modern agriculture practices. • Agriculture Service Centers also have been established. • Engineering Division involved in survey, design and cost estimation
SMIP	• Irrigation Policy foresees SMIP in the category of the Joint management considering the command area size.	*WUA formation* • Introductory meeting • Inventory collection • Formation of farmers' organization • Formation of the constitution committee • Registration of the WUACC *Training* • Training on water management and O&M • Financial and administrative management • Roles and responsibilities of WUGs in the participatory irrigation management • Demonstration in the pilot area for the modern agricultural development techniques • Observation tour of farmers to the Tarhara Agriculture Research farm	• Four divisions each headed by a senior divisional engineer and one mechanical division headed by a mechanical engineer. • WMD responsible for water management activities of the project headed by one agriculture engineer • Various training programs to build up the capability of SMIP professionals.

MLIP	▪ To include beneficiaries in design and conceptual framework of the project. Phase-I of the program did not involve beneficiaries. ▪ To improve the sense of ownership in farmers ▪ Irrigation Policy foresees the project under the category of Joint Management and possibly full turn over to the WUA.	*WUA formation* ▪ Introductory meeting ▪ Ratification of the constitution ▪ Formation of WUA and registration *Training* ▪ Training on modern agriculture practices	▪ Water Operation Center established for proper water management practice ▪ Agriculture and institutional development programs have been launched ▪ Arrangements of training programs for the MLIP personnel ▪ Inter-organizational linkages with agencies like DOA, ADB/N, AIC etc.
KIS	• To increase the service area by 46% of the targeted command area when JMP was launched. • Irrigation Policy foresees the system to be under joint management.	*WUA Formation* ▪ Same as in case of IMTP *Training* ▪ Share system development and canal management ▪ Management procedures for WUA. ▪ Administrative and financial management of WUA. ▪ Share system administration and canal maintenance ▪ Record keeping	▪ Same as in IMTP, however the technical assistance component is absent.
AKIS	• Organized beneficiary groups were required to meet the objectives of alleviating food deficit and converting the tenants into landowners.	*WUA formation* ▪ Formal request from farmers to UMN. ▪ Introductory meeting ▪ Drafting the constitution. ▪ WUA formation and registration *Training* ▪ NORAD was supposed to provide grant assistance for institutional strengthening but no program has so far been conducted either before or after turn over of the system. ▪ Agriculture support services which were being provided by UMN too were discontinued after the turn over of the system	▪ Management committee headed by one overseer to look after the technical aspects of the system. ▪ AKWUA building has been constructed. ▪ Inspection committee to review the decisions made by the AKWUA Board ▪ Land Distribution Committee to acquire the land and distribute it to the tenants.

MIS	• Irrigation policy requires the system to be under joint management.	*WUA formation* • Inventory collection • Introductory meetings • Constitution drafting • Formation of the users' committee • Registration of the WUACC *Training* • SAR reported that IMP was mandated to conduct training to the farmers • Various training programs for the farmers and the Association Organizers • Training on Resource mobilization and canal O&M • Peer training	• A seven-member Board (MIDB) headed by the secretary/MOWR as the governing body to frame the policy. • FOD responsible for formation and strengthening of WUAs • Pool of AOs trained by IMP. • Water revenue section responsible for collecting irrigation service fee.
IMP	• To carry out ESI works with the participation of organized beneficiaries for improving the system's performance and attaining sustainability of the system.	*WUA formation* • Sensitization workshop • Constitution drafting and ratification by the general assembly • Formation of farmers' organizations • Registration of the organizations *Training* ▪ Training on water management ▪ Action training on gate operation etc. (IMP was mandated for necessary institutional development in DOI and farmers' institution as well. Several training programs were conducted at the pilot sites. Unlike IMTP much of the training was targeted to the DOI personnel).	• Establishment of IMC at the center for carrying out researches and capacity building activities of the farmers and DOI personnel. • SMB executed ESI works at the pilot sites • SMB through IDU was responsible for formation and strengthening of the WUAs. • IMP was later restructured with three branches: SMB, RTDB and HRDTB. • For the first time AOs were trained and deployed for the formation of WUAs in IMP sites. • Interdisciplinary pool of professionals assisted by a TA team.

NISP	• To achieve direct participation of the beneficiaries at all the stages of irrigation development with appropriate institutional support.	• Demand request (from the organized beneficiary groups) • Project appraisal and approval • Constitution drafting • Bylaws • Registration of WUAs *Training* • Introduction to engineering units • Environmental protection measures • River training measures • Orientation on construction drawings • Orientation on construction techniques	• Sociologists deputed in each of the RIDs. • One AO deputed in each of the 75 DIOs. • MIT of interdisciplinary pool of professionals to review the designs and capacity building of the WUAs. • TA assistance in drafting the implementation process, preparing designs and monitoring construction works.
SISP	Same as NISP	Same as NISP	Same as NISP

Evaluation of the Performance

Resource Mobilization

A summary on the status of resource mobilization and ISF collection in various cases is shown below.

Table 3: Resource Mobilization

Projects	Means of resource mobilizations
IMTP	ISF, road tolls for using the service road in NGWIS, membership fee, share fee, donations and entry fee in PIS and NGWIS.
BLGWP	ISF, electricity tariffs, etc.
SMIP	ISF and the penalty from the absentee farmers @ NRs. 75/ha
MLIP	Farmers' contribution from the allowances received from consultants, membership fee, ISF, adult education program, contract of fish pond; community forestry, nursery and dealership, rentals from tractors, fines, etc. The figures up to mid April 1997-98 indicate that a total collection was of NRs. 301,274.
KIS	ISF, membership fee, rents from godowns, selling of branches of the Sisam trees, charges at the headwork site for picnic and film shooting, road tolls from the vehicles using service roads, application fee, etc. The annual budget of the WUA main committee of the fiscal year 1996-97 indicates that the annual income was NRs. 21,137 and expenditure was NRs. 19,201.
AKIS	ISF has been the main resource, which is collected on the basis of the share system. For O&M, AKWUA requires NRs. 300 per ha. AKWUA collects NRs.3/share/season (twice a year). In addition, NRs. 2/share/year is collected to meet the 20% of the total maintenance requirement of the tunnel. Also, for the loan payment to UMN, AKWUA is collecting NRs. 12/share/year.
MIS	ISF has been the main resource. Besides, toll collection from the vehicles using service roads also exists in each of the blocks.
IMP	There was no fixed basis for contribution from farmers in ESI works. 10% of the payments for the works awarded to the WUA was required to be deposited in the WUA account. In some cases farmers were given some cash advance to undertake the awarded ESI works. Farmers also devoted some of their time in finalizing the designs and construction supervision.
NISP	NRs. 50/ha was to be deposited with the demand request form. After the project is approved WUA must deposit 5% of the total project cost as the security deposit for the future O&M of the system. Farmers' part of the contribution is met through 15% of the total project cost in the case of a rehabilitation project while 10% in the case of a new construction either in the form of cash or labor or both as per the irrigation policy (amended version 1997).
SISP	After the project's approval WUA must deposit 5% of the total project cost as the security deposit for the future O&M of the system. Farmers' part of the contribution is met through 15% of the total project cost in the case of a rehabilitation project while 10% in the case of a new construction either in the form of the cash or labor or both as per the irrigation policy (amended version 1997).

The status of irrigation service fee collection in various projects under study is summarized below:

Table 4: Status of Irrigation Service Fee Collection

Project	ISF Rate NRs./ha	ISF target (NRs)	ISF collection (NRs)	Collection Efficiency	Remarks
IMTP					
PIS	150, 75 and 75 for paddy, wheat and early paddy respectively	66,300	42,874	64%	In 1998.
KIS	120	662,744	368,486	65.2%	In 1998.
NGWIS	60	989,690	NIL	0%	1999 data, collection efficiency 42% in 1997-98.
BLGWP	400	NA	NA	NA	
SMIP	200	3,310,000	880,346	28%	1995-96 Stage-II data. As per the Joint Management Agreement, 50% of the total sum needs to be given to the project. Out of NRs. 440,173 only 80% i.e. NRs. 353,474 was deposited. Some cases of misappropriating the sum by WUC were also reported.
MLIP	180	504,900	115,378 till March	23%	1997-98 data. The collection efficiency is decreasing gradually. It was 43% in 1995-96 and decreased to 24% in 1996-97.
KIS	100	562,400	315,514	56%	1996-97 data with the total assessed area of 5,624ha. ISF is collected only for the early paddy. The collection efficiency has increased from 7% in 1992 to 56% in 1997. Except in 1994-95 (63%), there is an increasing trend.
AKIS	900	253,800	164,510	64.82%	The rate includes share fee, tunnel maintenance and the payback loan. The collection efficiency has increased from 12.78% in 1991-92 to 64.82% in 1996-97.
MIS	200/crop	684,218	509,529	74%	In 1997-98 in stage-I of the project. Gradually increasing trend in collection efficiency except in 1992-93 and in 1987-88 when it was 88% and 78% respectively.
IMP	None	None	None	None	In 1988 farmers mobilized 1,843 person days of labor to improve the on-farm structures.
NISP	As decided by the general assembly	NA	NA	NA	
SISP	As decided by the general assembly	NA	NA	NA	

Other Parameters

Performances of WUAs in IMT sites based on the various indicators chosen for comparative analysis in terms of the major tasks are qualitatively presented below.

Table 5: WUA Performances in IMT Sites

Project/ Programs		Effectiveness of Organizational Structure	Checks, Balance and Transparency	Sound Record Keeping	Effective Conflict Management	Resource Mobilization	System Operation	System Maintenance	Agricultural Performance	System Sustainability
IMTP	Panchkanya	Excellent	Excellent	Good	Good	Excellent	Good	Excellent	Good	Fair
	Khageri	Good	Good	Good	Good	Good	Good	Good	Good	Good
	West Gandak	Fair	Fair	Fair (records not updated)	Fair	Poor	Good	Fair	Good	Fair
BLGWP		Good	Moderate	Moderate	Fair	Good	Fair	Fair	Good	Fair
SMIP		Good	Moderate	Moderate	Good	Good	Good	Good	Good	Good
MLIP		Good	Good	Good	Good	Good	Good	Good	Good	Good
Kankai		Moderate	Good	Good	Good	Excellent	Good	Good	Good	Good
AKIS		Good	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Good
Mahakali		Good	Good	Good	Excellent	Excellent	Good	Good	Good	Fair
IMP		Good	Fair	Poor	Fair	Poor	Fair	Fair	Good	Fair
NISP		-	-	-	-	Good	Good	Good	NA	NA
SISP		-	-	-	-	Good	Good	Good	NA	NA

INFERENCES

As discussed above, cases of BLGWP, SMIP, NISP, SISP, KIS and MIS have adopted the approach of a package program under certain agreement between users and the agency. After the completion of the plan that is agreed upon, the system is transferred to the beneficiaries. MLIP and IMP were led on experimental basis. IMTP has adopted a" phased and conditional" approach for IMT tied with some conditions of the institutional development activities. AKIS adopted an assistance package with the aim of converting tenants into landowners.

Looking at these different cases along with adopted processes of institutional development and corresponding strengths and weaknesses, WUAs in PIS and AKIS are found be best functioning in terms of their management tasks. Their main features are presented in the table below.

Table 6: WUAs' Strengths, Weaknesses, Opportunities, and Threats in AKIS and PIS

Description	Strength	Weakness	Opportunity	Threat
AKIS	• Equitable representation from the entire command area. • Adequate checks and balances. • Board and GA meetings are regular. • Elaborate structure with responsibilities to all the divisions properly assigned • Share system properly administered • Reliable source of water • Minimal water related conflicts • High resource mobilization. ISF collection efficiency (64.82%). • Organized record keeping on administrative, financial and water delivery • Net revenue increased, per capita income increased by 45%, encouraging agricultural performance	• Obligation of loan repayment to UMN outstanding • Inadequate funds with WUA for O&M. • No training before or after the IMT. • Agriculture extension service discontinued after IMT. • Farmers' ideas were not considered during construction.	• Received loan assistance from the UMN to develop the project. • 80% of O&M cost of tunnel and intake maintenance borne by BPC	• Vulnerable zones along the canal alignment • Hydropower component getting top priority • Lacking adequate skill to maintain sophisticated structures
PIS	• Equitable representation from the entire command area and examples of self-modifications in the governance structure exhibited. • Regular executive committee and general assembly meetings. • Annual budget approved in GA meetings. • Sound checks, balances and transparency • High ISF collection efficiency (64%) together with other means of resource mobilization. • Effective conflict management • Comprehensive administrative and financial record keeping • Significant increase in the paddy yield from 2.84 t/ha to 3.21 t/ha • Rotational water delivery followed based on the obligations fulfilled resulting in equitable water distribution. • WUA successfully carrying out the required maintenance works	• High seasonal variation of discharge at the source from 0.6 to 1.25 cumec. • Lack of water delivery records	• Adequate training was imparted by IMTP	• Drying out small springs feeding the main source due to land development activities in the catchment

Reviewing the processes adopted for the institutional development in these WUAs, it is noted that UMN deputed a sociologist for the formation of WUA. The WUA was formed considering the hydrological boundaries and the canal network. The formation started from the lowest level. Although the formal training was not imparted before or after the transfer of the system, it is inferred that UMN definitely had given required orientation to the WUAs through informal ways. This has led to successful administration of the share system and a strong intra-organizational structure. This system was taken up due to the genuine need of the beneficiaries and farmers contributed labor worth of 3.9 million NRs. In addition, they are gradually paying back the loan of NRs. 5.39 million to UMN. Before the UMN intervention, farmers had to rely on the rainfall only. The situation has largely improved after the system was built.

Agricultural performance of the system has also improved with the increase of the per capita income by 45% and the net revenue generated by individual farmers reached a figure of NRs. 51,000. Farmers' involvement in the construction activities resulted into a sense of ownership among them. However as the farmers' ideas were not considered in the planning and design of the system, farmers are facing difficulty in maintaining the sophisticated structures on their own or getting access to such specialized services.

Main reasons for rating WUA in PIS as a highly functional are because of an elaborate process adopted for the WUA formation by IMTP. A detailed household survey to collect the inventories of the beneficiaries' household and the irrigated area has led to genuine, accountable and equitable representation in the WUA. The organizational structure was designed on the basis of hydrological boundaries and the nature of canal network reaching up to the lowest part of the command area. Here also the formation started from the lowest level.

Strength on resource mobilization and the record keeping as well as the canal O&M could be attributed to the adequate training imparted together with the institutional arrangements made in the IMTP to facilitate the management transfer. The exchange visits and out-of-country training of the farmers, and participation of key office bearers in central level workshops have enhanced farmers' skill to manage their systems on their own.

The WUAs in cases of IMP, NGWIS and MLIP were highly functional during the implementation phase. After the agency's pull out from these systems, the WUAs did not perform as expected. The organizational effectiveness in these systems has degraded gradually.

With regard to resource mobilization in IMP farmers never had an institutionalized process of internal resource mobilization. There was no fixed basis of cost sharing by the beneficiaries in maintenance works. Instead, local farmers were given contract to raise the funds for the WUAs. Such arrangements did not promote local initiatives for continued resource mobilization for O&M activities in the systems despite the elaborate organizational arrangements.

CONCLUSIONS AND RECOMMENDATIONS

Major conclusions and recommendations of the study are as follows:

1. Organizational design based on the genuine and proportionate representation, canal network, and hydrological boundaries is found to be more effective approach of institutional development than forming the WUAs on the basis of the village boundaries. In fixing the organizational hierarchy, discharging capacity of the canal system should also be taken as a basis as in NGWIS. In forming the lower tier WUA, Kankai WUA was not found to have established a linkage with the hierarchy of the canal network resulting in a poor inter-organizational linkage. Further the WUA formation started from the lowest level of canal network and a fair representation from the lower tier result in an equitable representation of the entire command area in the WUA main committee. Hence a bottom-up approach in the formation of the WUA is recommended.

2. Introductory workshops need be convened as the first step towards formation of the WUA to sensitize the beneficiaries and disseminate various information related with the irrigation policy, plans and programs of the government, etc. As in IMTP these meetings should involve as large number of beneficiaries as possible. In the bigger systems, these meetings need to be conducted in blocks of 500 to 1000 ha, as in NGWIS where series of such meetings were conducted accordingly.

Larger participation in the introductory workshop has helped in creating awareness even to the root level beneficiaries making it easier to mobilize resources from the beneficiaries for the system's O&M and attain direct participation from the users in the overall system management.

It is also noteworthy that the unrealistic promises by the agency people during these meetings may leave detrimental effects on WUAs. Such acts would increase the aspirations and expectations of the farmers as observed in cases like IMP.

3. Involvement of beneficiaries in the WUA formation process tends to ensure authenticity of statistics related to number of beneficiary households and actual irrigated area under different canal systems. In IMTP and KIS, the recruitment of the Farmer Organizers (FOs) from among the beneficiaries has resulted in generating an authentic database that helped in developing an appropriate organizational design based on canal networks. Also it has provided a sound basis for preparing the water schedules and for mobilizing the resources for the canal O&M. In NISP, a mandatory provision of cash deposit of NRs. 50/ha along with the demand request has been able to keep a check to false signatories and the inventory data are more authentic. In rest of the systems inventory collection mechanism was missing which is essential for the WUA formation.

4. In bigger irrigation systems, general assembly should be a representative body as it has been the case in the IMTP systems. If all the beneficiaries are included within general assembly, it would be practically difficult to conduct such meetings as observed in the systems like SMIP and MIP where no general assembly meetings at the central level have been conducted so far. However the general assembly meetings at the lower tier organizations are being held at regular intervals. Lack of general assembly meeting results in weakened mechanisms of checks and balances and transparency.

5. Unlike IMTP, in the systems like BLGWP, NISP and SISP, AOs provided a standard format for the WUA's constitution. After some amendments, the constitution committee prepared a draft constitution, which was ratified by the general assembly. In such cases major issues relevant to the specific systems are largely abandoned. Preparation of the draft constitution by the constitution committee on their own could yield all the required provisions related to the organizational design, roles and responsibilities of the key WUA office bearers, fines and penalties, modes and mechanisms of resource mobilization including the ISF etc, matching with the nature of the physical system. Good governance structure and the operation performance in the case of PIS and Khageri could be attributed to it. NGWIS is not performing as good as it used to till the IMTP assistance. This could be attributed to the poor resource mobilization especially ISF, lack of accountability of the WUA office bearers towards the farmers, and inadequate O&M of the system.

6. An elaborate institutional arrangement has been adopted by the agency in the case of IMTP, IMP and KIS to facilitate IMT activities. A separate training branch and units responsible for the formation and strengthening of the WUA have been formed in DOI. There is a mechanism to assess the functional status of the WUAs. A pool of interdisciplinary professionals assisted by the Technical Assistance team was working at the center. This institutional arrangement has helped in capacity building of the WUAs. Organs responsible to conduct training have been established in BLGWP, MIP, NISP and SISP. However, they are not as much elaborated as in cases of IMTP, IMP and KIS. Such an institutional arrangement lacks in MLIP as well.

7. Training and follow-up are major inputs in the institutional development. In IMTP, KIS and IMP training need identifications were carried out prior to conducting the training. An updated information on the functional status assessment of WUA also served a basis to identify the areas in which the WUA is lagging. This proved to be an effective tool for increasing the effectiveness of training. The excellent organizational governance through the resource mobilization, checks and balances, system O&M in the case of PIS could be attributed to the training imparted to the WUA that synchronized with the hardware of the system. In IMTP too, training of the skill development type such as training on construction management and the advanced level training such as the training on Optimum Water Use has not been organized. In systems like AKIS, formal training was not provided though UMN was working

closely with farmers throughout the construction period. Hence informal orientations in the form of the action training, demonstration etc have helped in an effective execution of share system resulting into excellent O&M activities and minimum water use conflicts eventually leading to an improved agriculture performance in the system. These orientations further led to a strong intra-organizational structure within AKWUA and encouraging resource mobilization performance. In other systems like BLGWP, training on agricultural aspect has been emphasized much overlooking O&M aspects. This has resulted in rather inferior O&M status of the system. In ground water systems like BLGWP where the cost of ground water extraction is very high, training on optimum use of water and the improved water management practices need be imparted to the farmers. Notably, SMIP has used demonstration techniques for farmers' skill development.

MLIP system was envisaged to operate with the aid of the OMIS software for attaining the equitable water distribution. This is still an arguable issue whether the farmers could be made capable of handling the software for water distribution.

Other Recommendations

1. In systems that are already turned over to the WUAs, it is suggested that funds ranging from 200,000 to 300,000 need to be allocated for emergency maintenance in form of post turn over support each year. It would still be better if the allocation of the maintenance budget is tied up with ISF collection efficiency. ISF should be collected in the system with the proper enforcement.

2. If the ISF collection efficiency is low, there is a danger that this may cause further decline in the collection efficiency as the farmers not paying the ISF could discourage the ones who are paying ISF. This way the amount of ISF collection will gradually go down.

3. The programs like NISP have laid emphasis on the poverty alleviation. Due consideration needs to be given to the project selection and related criteria. The projects where most of the beneficiaries live in food deficit condition should be given priority in implementation. The projects like Aandhi Khola need to be implemented in the rural areas of the country aiming at converting tenants into landowners.

Paper 4: Study on Rehabilitation and Management Transfer Phase II: Procedural Assessment of Rehabilitation

H. P. Hemchuri

JUSTIFICATION OF THE STUDY

Irrigation Management Transfer (IMT) is occurring worldwide and Nepal is also no exception. The present Irrigation Policy - first amended version 1997 (2053 B. S.) also stresses on the principles and criteria for IMT.

The Department of Irrigation (DOI) has been engaged in transferring the management of public irrigation systems over to farmer organizations through joint management and turnover programs from late 1980s. Up to mid 1980s, DOI was somehow managing these systems by bearing their full annual recurrent operation and maintenance cost from its own resources. Despite the considerable investments made in the public irrigation schemes, their performance has been much lower than expected leading to inequity and inefficient water use. These systems could not fully meet the anticipated goals and benefits expected to foster the national economy.

Hence, from late 1980s, the Government started looking for cost-effective solution to this problem. Beginning the Seventh Five Year Plan (1986-1990), there was a growing realization of users participation in the planning, implementation, operation and maintenance of irrigation related activities. A number of policy reforms have been made since then, including Basic Needs Program (1988), Water Resources Act (1992) and Irrigation Policy (1992). The Irrigation Policy - 1992 was then subsequently revised and its first amended version: Irrigation Policy - 1997 (2053 B.S.) has been promulgated. The new policy greatly emphasizes the organized participation of beneficiary farmers at all stages of project development and management and the reduction in O&M obligations to DOI by gradually transferring such tasks to organized beneficiary farmers through joint management and turnover programs. The policy embraces both surface and groundwater types of irrigation systems.

Basically the joint management and turnover programs are associated to a gradual management transfer process. Through all such programs, O&M responsibilities of irrigation systems are gradually transferred from DOI to the respective Water Users' Associations (WUAs). A joint management program involves sharing of the operation and management

responsibilities between the users and DOI whereas a turnover program involves complete transfer of irrigation management responsibilities over to the beneficiary farmers.

In line of the new Irrigation Policy, the Government of Nepal has initiated several management transfer programs in different state-run public irrigation schemes scattered through out the country. These Turnover and joint management programs in Nepal typically incorporate two specific components: (i) establishment of sustainable and effective WUAs, and (ii) rehabilitation and improvement of irrigation and drainage facilities. Both these components are equally significant prior to management transfer.

Rehabilitation refers to the upgrading of physical status of the system to a level that can be managed by the WUA and a minimal O&M cost is required after the transfer whereas strengthening the WUA refers to the efforts of building up of the capability of organized beneficiary farmers for assuming the irrigation management responsibilities of the physically improved systems.

The arrangements for rehabilitation and the way in which it is carried out are considered to have a substantial bearing on the implementation of entire management transfer program and the impacts thereof. In other words, the success or failure of the management transfer process considerably depends on the rehabilitation process adopted. In the DOI, the processes of rehabilitation vary from project to project. Also, evidences to suggest an appropriate scheme rehabilitation process, leading to successful management transfer, are lacking and yet to be identified.

This is why, Research and Technology Development Branch (RTDB) of IMD/DOI and the International Water Management Institute (IWMI) have been jointly concentrating on processes of rehabilitation in the study on Management Transfer Process and Performance. A study focussing on the process identification was already undertaken during Phase I. This Phase II study was carried out to investigate how the rehabilitation was actually done and eventually, to evaluate the effect of rehabilitation procedures on system performances.

OVERALL STUDY PLAN

The ultimate goal of this study series is to identify the rehabilitation and modernization process that leads to successful management transfer from among the many rehabilitation/ modernization processes that have been practiced by the DOI. Findings of Phase I study indicate that the studied cases have some basic similarities as well as difference in the approach. Further, in the course of actual implementation of such programs at the field level, one could expect further deviations from the planned ones. Hence, this study was undertaken to assess the actual process of scheme rehabilitation/ modernization in relation to management transfer in a better way and also to evaluate the impacts thereof on performance of the partially of or fully turned over schemes.

OBJECTIVES OF THE STUDY

This phase of the study mainly had two objectives. They are as below:

1. To document how actually the rehabilitation was carried out in various cases and the extent to what the management transfer has actually happened.

2. To test, qualitatively, the following stipulated propositions in relation to the management transfer programs.

    i) The method of phasing and conditioning the rehabilitation/ modernization support to some development milestones of local irrigation organization facilitates in building up the management capability of the organization.
    ii) Contracting the construction works to beneficiaries makes the local irrigation organization more effective.
    iii) An effective local irrigation organization aids the process of management transfer.
    iv) Beneficiaries' participation in design consideration leads to a successful management transfer.
    v) Quality of construction works to beneficiaries' satisfaction leads to a successful management transfer.
    vi) Management transfer to an effective beneficiaries' organization results in better performance of the partially or fully turned over irrigation schemes.

SCOPE

This study has covered both surface and groundwater schemes. The covered nine projects/ programs of DOI are as follows:

1. Irrigation Management Transfer Project (IMTP)
2. Kankai Irrigation System under the DOI funded O&M projects
3. Marchwar Lift Irrigation Project (MLIP)
4. Bhairahawa Lumbini Ground Water Project (BLGWP)
5. Sunsari Morang Irrigation Project (SMIP)
6. Irrigation Line of Credit (ILC)
7. Irrigation Sector Project (ISP)
8. Nepal Irrigation Sector Project (NISP)
9. Second Irrigation Sector Project (SISP)

Specifically, the study has focussed on the following parameters in all the individual cases:

* Project/ program activities
* Rehabilitation/ modernization component

* Rehabilitation process adopted
* Cost sharing arrangements
* Impact of rehabilitation on performance

APPROACH AND METHODOLOGY

This study on procedural assessment of rehabilitation is in continuation of the Phase I study of "Identification of Current Process" under the study series of "Evaluation of Management Transfer Process and Performance". Findings of the Phase I study were studied in depth and it helped to a great extent in designing the framework of this study. The study has mainly assessed the actual processes of rehabilitation in the field compared to the stated or envisioned processes of rehabilitation in relation to IMT.

To meet the anticipated objectives of the study, 9 DOI projects/ programs were selected for the in-depth studies, which mostly are donor-funded and have gone through IMT efforts. Some of the projects are in the middle of implementing IMT whereas some are about to complete. Irrigation schemes that are just at the construction phase have not been considered. The sample projects/programs are selected to represent different types of projects implemented by DOI i.e., lift irrigation schemes, surface irrigation schemes and groundwater schemes.

Major sources of data for this study are various project documents, evaluation reports, progress reports, project formulation documents, project completion reports, Action Plans, Memorandums of Agreement etc. In addition, necessary information and data were collected during the field visits to selected sites. Also, a semi-structured checklist was used for soliciting the required data and information from the key persons involved in relevant project/ program implementation.

After identifying the key variables in each of the selected schemes, the collected data and information were compiled and tabulated for making meaningful analysis and inferences.

Considering the findings of the study under Phase I, the cases (AMIS) were identified in which rehabilitation processes in relation to management transfer have significant variations. Subsequently, field surveys were conducted on the identified sites with the view to document the entire process of rehabilitation actually carried out in the field with close consultation with involved entities. The collected data, information, etc. on rehabilitation process were compiled using appropriate tools so that they could reflect the variations or modifications during actual implementation in the field compared to the stated and envisioned approach and processes. The reasons behind such variations were also identified and investigated. Also assessed were the extents to what the management transfer has been done in different cases.

FINDINGS OF THE CASE STUDIES

A total of nine cases under DOI namely: IMTP, KIS, MLIP, BLGWP, SMIP, ILC, ISP, NISP and SISP were selected for the study. NISP and SISP have been launched recently and hence their impacts on IMT process and performance are yet to be realized and hence these could not be used in analyses. All these cases have the rehabilitation/modernization component in some way or the other in relation to management transfer. This section presents key findings comparative analysis of these different cases in terms of their project/ program features, rehabilitation process envisioned versus adopted and impact of adopted rehabilitation process on performance in related schemes.

PROJECT/ PROGRAM FEATURES

An overview of the basic features of IMT in selected cases is given below:

Table 1: Overview of the Project/ Program Features

Project/ Program	Year of IMT implementation/ Status	Type/ Location	Targeted CCA (ha)	Funded by	Major Components	Envisaged extent of IMT	Cost
IMTP	1994, (Two-phase implementation: Phase I (Panchkanya, Khageri and West Gandak). Under Phase II IMT activities are ongoing in 8 other subprojects.	All surface irrigation schemes	11 subprojects covering a total of 67,800 ha	As DB Loan, USAID Grant, and farmer contribution	-Establishment of formal WUAs -Rehabilitation and improvement of irrigation and drainage facilities -Training to farmers and farmer leaders -Training to agency staff involved in the IMT efforts -Action training and applied researches -Farmers participation in rehabilitation works	Full turnover in 4 subprojects and partial in 7 subprojects	US$ 18.34 Million
KIS	1993 (scheme construction started in 1973 and completed in 1991, IMT activities are ongoing)	Surface irrigation scheme located in Jhapa district	7,000 ha	Under the category of O&M projects funded by DOI and farmer contribution	-Establishment of a formal WUA -Repair of endangered H/W -Rehabilitation of specific branch and tertiary canals -Training to representative farmers -Participation of farmers in rehabilitation works	Gradually partial turnover	Since 1993 to 1998 NRs. 28.3 Million (1$=47 and 56 NRs in 1993 and 1998 respectively)
MLIP	1991 (project started in 1980 and completed in two phases: I & II, presently Consolidation phase is ongoing)	Lift irrigation scheme, Marchwar	2,806 ha out of initially anticipated 5,600 ha CCA	UNCDF Grant and farmer contribution	-Construction of intake structure, pump house and sedimentation tank -Involvement of private sectors for irrigation development and management -Rehabilitation of irrigation infrastructure in the form of 'fine tuning works" -Development of access roads -Establishment of formal WUA -Establishment of proportional water distribution mechanism -Establishment of block system (20-25 ha) in the command area	Initially partial turnover then full turnover including the pump station and sedimentation tank	US$ 4.65 Million
BLGWP	1990, after the launch of Irrigation Policy. Initiated in 1976 and implemented in 3 stages: Stage I, II & III and expected to be completed by this year 1999.	Ground water schemes, Rupandehi district	20,880 ha	World Bank/IDA Loan and farmer contribution	Under Stages I & II: -Development of 181 deep tubewell units -Development of brick-lined or UPVC pipe channel distribution networks -Establishment of rural road networks in the project area -Electrification for pump operation -Organizing WUGs in tubewell units for farmers' involvement in implementation process under Stage III -Establishments of formal WUGs -Rehabilitation of Stage I and II tubewell units and channel distribution networks -Participation of users in the rehabilitation activities	Full turnover of all the developed tubewell units including the pump houses	US$ 40.44 Million
SMIP	1991, Constructed as Chatra Canal Project in 1975, rehabilitation started in 1978 and implemented in	Large surface irrigation scheme in the eastern region	58,000 ha	World Bank/IDA Loan and farmer contribution	Under Stage I: -Rehabilitation and command area development works on 9,750 ha -Koshi river control works and installation of two Vortex tube Silt Ejectors in the main canal Under Stage II: -Rehabilitation and command area development works on additional 16,600 ha -Beneficiary participation in rehabilitation and command area development works	Gradually partial turnover after the turnouts on pilot area basis	US$ 30, 30, and 28 Millions for Stage I, II & SMIP respectively

	different stages as: Stages I, II, SMHP & III.				-Initiation of WUA formation on Pilot area basis Sunsari Morang Headwork Project (SMHP): -Shifting and construction of new H/W -Construction of a large capacity desilting basin to mitigate the siltation problem -Utilization of dredgers for silt removal -Construction of micro-hydropower unit to provide power for operating dredgers Under Stage III: -Rehabilitation of irrigation infrastructure up to distributory and remaining command area development of 46,000 ha -Establishment of formal WUAs -Participation of users in the command area development activities -Preparing the respective WUA for taking over the management responsibility after the turnouts		
ILC	1988, completed in 1996.	Surface and groundwater schemes covering 40 districts in 3 western regions	39,000 ha total from 229 surface irrigation schemes and 4,120 ha from 18 clusters of tubewells	World Bank/IDA Loan and farmer contribution	-Establishment of sector program approach -Making the program demand driven from farmers -Rehabilitation of existing farmer managed and construction of new surface irrigation systems -Development of tubewell systems in the Terai in clusters -Establishment of formal WUAs -Training to WUA members and farmer leaders on different aspects	Full turnover of surface and tubewell systems immediately after completion	US$ 23 Million
ISP	1988, completed in 1996.	Surface irrigation schemes covering 35 districts of central and eastern regions	63,400 ha total from 515 surface irrigation schemes	AsDB Loan and farmer contribution	-Establishment of sector program approach -Promotion of the demand driven approach -Rehabilitation of farmer managed or farmer initiated irrigation systems and construction of new irrigation systems -Participation of the beneficiaries at all stages of project implementation -Establishments of formal WUAs -Training to WUA members and farmer leaders on irrigation management aspects	Full turnover immediately after completion	US$ 33 Million
NISP	Sep. 1997, and will continue for 6 years in continuation of ILC program	Same as of ILC	59,600 ha, includes rehab of 39,500ha of FMISs and 8,000 ha of tubewell schemes and rehab of 20,100 ha of AMISs	World Bank/IDA Loan and farmers contribution	-In continuation of ILC program -Rehabilitation of farmer managed surface schemes and development of new tubewell schemes -Participation of beneficiaries at all stages of implementation -Establishment of formal WUAs -Action training to WUA members and farmer leaders	Full turnover immediately after completion	US$ 103.2 Million
SISP	June 1996, and will continue for 6 years in continuation of ISP	Same as of ISP	37,500 ha, 18 new schemes with 8,000 ha and 150 rehab schemes with 30,000 ha	AsDB Loan and farmer contribution	-In continuation of ISP program -Rehabilitation of farmer managed surface irrigation schemes -Establishment of formal WUAs -Participation of beneficiaries at all stages of implementation -Action training to WUA members and farmer leaders	Full turnover immediately after completion	US$ 33.3 Million

From the above table of projects/programs overview, following inferences can be drawn.

- In all the cases, the irrigation management transfer activities has been implemented after the promulgation of Water Resources Act 1992 and Irrigation Policy (1992) although the cases like KIS, MLIP, BLGWP and SMIP were initiated long time back i.e., before 1980s.
- Except KIS, all the projects/programs have been implemented in two or more phases.
- IMT activities have been implemented in all types of irrigation systems of DOI, which cover from surface, ground water to lift irrigation systems scattered throughout the country. ILC and NISP have included both the surface and groundwater schemes.
- Except KIS and MLIP, which aim to cover 7,000 ha and 2,806 ha respectively, all other cases are targeting to cover bigger command areas ranging from 20,880 to 67,800 ha for IMT implementation. IMTP, BLGWP, ILC, ISP, NISP and SISP programs have included groups or clusters of subprojects for implementation whereas KIS, MLIP and SMIP are individually single irrigation systems.
- Except the KIS and MLIP, in which the IMT activities have been implemented from DOI's own O&M fund and UNCDF grant respectively, all remaining 7 cases have been implemented from the LOAN MONEY either from the World Bank or from the Asian Development Bank.
- All of the 9 cases involve rehabilitation component in one way or the other, and establishment of a formal WUA in relation to management transfer efforts. All the cases, except SMIP, envisage maximum participation of the beneficiaries at all stages of irrigation development and management. SMIP seeks beneficiaries' participation only after the turnouts in the command area development activities.
- Except MLIP, BLGWP and SMIP, all remaining cases involve training activities as a major component of the project to build up the capability of the beneficiary farmers to operate and maintain their systems.
- ILC, ISP NISP and SISP envisage establishing a sectoral approach in contrast to the project-by-project approach in the past and intervening in those subprojects that are genuinely requested by farmers.
- All the projects/programs aim at full or partial management transfer of the system over to the formal WUA in line with the Irrigation Policy. The policy expects that the schemes smaller than 500 ha in hills and 2,000 ha in terai would be fully transferred over to the beneficiaries and larger schemes would remain under participatory joint management.

REHABILITATION PROCESS ENVISAGED VS. ADOPTED

The following table summarizes the key findings related to envisaged and adopt processes of rehabilitation in different cases.

Table 2: Summary of Envisaged and Adopted Rehabilitation Processes

Scope of Rehabilitation works		Conditions / Requisites for Rehabilitation		Activities in Rehabilitation	
Envisaged	**Covered**	**Envisaged**	**Fulfilled**	**Envisaged**	**Undertaken**
IMTP					
•Emergency maintenance and flood damage repair •Essential structure maintenance •Catch-up maintenance •System Improvements •System calibration and establishment of flow measuring facilities •Improvement of canal service roads and •Construction of farm to market roads	- Almost all the agreed works are complete in West Gandak and Khageri. -In Panchkanya, lining work of 500m in tail portion of main canal and repair of gates are reportedly incomplete.	•WUA must fulfill specified conditions before initiating any kind of rehabilitation works. -for emergency maintenance, WUA must be formed, registered and preliminary AP should be approved; -for essential structure maintenance and catch-up maintenance, joint system walk-thru, formal adoption of AP, and record keeping by WUA were necessary; -for general system improvements, WUA's O&M plan, initiation of ISF collection and administration of share membership were required; •Beneficiaries were required to share 26% of total rehab cost in terms of cash or kind.	•In IMTP-I subprojects -WUAs have been formed, registered in the District Administration Office and preliminary AP was prepared before commencing any emergency maintenance works; -joint system walk-thru was done, AP and MOA were formally adopted and WUA record keeping was started before carrying out essential structure maintenance and catch-up maintenance works; -WUA O&M plan was prepared, ISF collection process was started and share membership was initiated before carrying out the system improvement works; •Users shared close to 26% of the total cost of rehab by providing labor in all the three subprojects.	•<u>Initial organization stage</u> -Training and recruitment of FOs, WUA formation and registration, SMC formation; •<u>Preparation stage</u> -Joint system walk through, identification and prioritization rehab needs, survey, design and cost estimate, development of AP, cost sharing arrangements, signing of MOA, share system development and share membership certificate distribution; •<u>Implementation stage</u> -Implementation of AP, preparation of tender documents, awarding contracts, construction of civil works (ESM, catch-up maintenance and system improvement), resource mobilization, ISF collection, preparation of O&M plan, commissioning of completed works and management transfer; •<u>Post turnover stage</u> -Annual system walk through, gradual system upgrading by WUA, revised O&M plans and agricultural services and linkage development with NGO/INGO.	-In all IMTP-I subprojects, the same stipulated procedures have been followed for rehabilitation/ modernization of the systems. -After completing rehabilitation works, Panchkanya has been fully transferred to the WUA. In West Gandak, except the intake, the irrigation infrastructure has been transferred. In Khageri, all branch and minor canals have been transferred to the WUA. -Post transfer support activities are reportedly inadequate.
KIS					
•Physical Improvement of specific part of the canal system (mainly lining of branch canal sections, repair of control structures, improvement of canal service road and tertiary development) as demanded by the beneficiaries.	- 5 branch canals out of 17 and 4 out of 145 tertiary canals rehabilitated. -A few canal service roads and control structures within the canal systems repaired.	•Availability of annual O&M budget from DOI. •The farmers should first demand rehabilitation needs. •Farmers should approach to the system in charge in an organized way. •Farmers should first form formal WUAs at different levels of the system. •Farmers should be willing to share 12% of the total rehabilitation cost.	-DOI has been providing very small annual O&M budget ranging from NRs. 71 to 929 per ha from 1993 to 1998. -Farmers requiring improvements in their canal section approached to the office and requested for assistance. - A three tiered WUA at tertiary, branch and main canal levels formed. -Farmers contributed 12% of the total rehab cost by mobilizing labor.	•Demand from farmers requesting assistance; •Joint walk-thru along the subsystem to identify and prioritize the rehab needs; •Detail designs and cost estimates of the identified and prioritized works; •Preparation of Action Plan (AP); •Cost sharing arrangements and break down of works; •Formation of Canal Management Committee (CMC); •Award of contract and construction of stipulated works; •Transfer of the subsystem to the respective tiers of WUA after rehab works.	All the stipulated activities of rehab process have been followed.

MLIP					
•Upgrading of inspection and service roads •Drainage improvement works •Relocation and redesigning of inefficient outlets •Repair of water controlling gates and regulating structures •Strengthening and lining of canal banks •Block system development	-All types of improvement works were carried out for correcting the defects observed during Phase I & II construction works as fine tuning works. -Some linings at the tail end are reportedly incomplete. A -Proper placement of outlets is not complete.	•Formation of WUA •Development of block system of command area •On-farm system development in blocks i.e., after the outlet, was to be done by the users themselves by their own means. •WUA should be willing to take over the management of the system except the pump house and intake structure. •WUA should be ready to bear 10% of the cost of electricity for pump operation.	-A formal WUA has been formed. - 9 canal systems, 130 blocks, each comprising 20-25ha have been developed. -WUA has already taken over the management responsibility of the canal system beyond the intake. It also is committed to assume the responsibility of pump house and intake with time. - WUA has been paying 10% of electricity bill for pump operation.	•Joint walk-thru along the entire canal system •Identification of rehab needs •Finalization of list of works to be carried out under the category of fine tuning works •Preparation of design and estimates of identified works •Approval of design and estimates •Break down of works into different packages •Construction of identified correctional works •Supervision of construction works by engineer representative of local consultants	-WUA members, MLIP technicians and consultants jointly walked along the entire canal system to identify needed correctional works. -Consultants and MLIP technicians finalized the list of correctional works along with design and estimates, to be done under the category of fine tuning works and it was approved by DOI. -Two sets of work were identified: one to be done by professional contractors and another to be done by WUA. -Works done by contractor were supervised by the consultants.
BLGWP					
•Distribution network improvement inclusive of lining and UPVC pipe repair •Repair of water controlling and regulating structures •Relocation of turnouts at appropriate places •Upgrading of drainage system •Construction of foot bridges	-Most of the tubewell units developed under Stage I & II were in a bad shape and they were rehabilitated. -Lining was done on breached portions of distribution canal of Stage I units. - Many outlets were relocated based on farmers' advice. Some outlets still are reportedly improperly located. -Damaged UPVC pipes were changed in the Stage II units except in the tubewells that were dry or where transformers were stolen. -In Stage III, drainage system has been improved and foot bridges constructed along the rural roads.	•Formation of WUGs in each tubewell units. •Willingness to bear 5% of total rehab cost. •Providing land required for constructing the pump house and canal distribution networks for free of cost.	- By the start of Stage III, farmers formed WUGs and registered in the District Water Resources Board. -Farmers have shared 5% of the total cost of rehabilitation in tubewell units of Stage I & II by providing labor for E/W and pipe laying. -Farmers also have provided land for constructing the pump house and canal distribution networks for free.	•Formation of WUGs •Information dissemination •Signing of agreement •Joint walk-thru and inventory •Design, estimate and tendering •Construction •Joint inspection, rectification and commissioning •Management transfer	-With AO's help WUGs were formed and registered. -Provision of the available assistance was disseminated to the farmers through Farmer Organization Division of the project. -Agreement was signed between WUG and the project regarding management transfer after the rehab. -A joint walk-thru was carried out to identify the rehab needs. But there was no mechanism for fixing individual priority to the identified works. -Design and estimates were prepared by technical section of the project. -Both contractors and WUGs carried out construction works. For quality control a joint supervision committee was also formed. -Upon completion of the construction work a joint inspection was made and after rectifying the observed defects, the units were declared commissioned. -After one year of maintenance period tubewell units were transferred to the respective WUGs.

SMIP					
•Mitigation measures for persistent silting problem •Rehabilitation and improvement of existing irrigation and drainage facilities. •Command area development works	-The intake structure is moved 1,300m u/s. -A large capacity desilting basin has been constructed and dredgers are being utilized for silt removal. -Rehabilitation of existing irrigation and drainage facility and command area development works were done on stage-wise basis: i) Under Stage I, it was accomplished in Shankarpur distributory covering 9,750 ha. ii) Under Stage II, it was accomplished in Sitagunj and Ramgunj secondary canal covering 16,600 ha. Iii) Under Stage III, the activities are ongoing in the remaining command area.	•No significant conditions for rehabilitation of the main irrigation facilities. It is solely decided by the agency. •Beneficiaries are involved only in fixing, aligning and developing watercourses, which comes under the command area development activities. •WUA formed to carry out command area development activities. •No cost sharing basis.	- Farmers are involved only during the last phase of Stage II in the command area development activities. - Water users groups were formed at different levels of the canal system starting from the watercourses. -WUG was first formed in the pilot area of Jhumka sub-secondary (SSJ), and then in Sitagunj (S8 & S9) and Ramgunj (S10 & S12) distributory again on pilot area basis. -There are 1,034 WUGs, 67 WUCs, 15 WUCCs and 1 WUCCC in the project area. -Though there was no fixed cost-sharing basis, beneficiaries are constructing watercourses and field channels.	•DOI's rehab process covered irrigation and drainage facilities up to the turnouts. •In watercourses after the turnouts, as the command area development activities, following activities were expected: -joint walk-thru in the watercourses; -fixing alignments; -signing of agreement by the WUG and project, regarding watercourse alignment, construction of field channels and beneficiaries' contribution in constructing field channels; - transfer of management responsibility of watercourses.	-All the construction and rehabilitation works of related structures and canal systems and drainage facilities up to the turnouts were awarded to both the international and local professional contractors according to HMG/N rules and norms and beneficiaries were not involved at all, in such activities. -Beyond the turnouts, beneficiaries were fully involved in constructing and developing the watercourses under the command area development activities. They even provided labor for digging the watercourses. -In fixing alignments of the watercourses, beneficiaries' ideas were duly considered.

ILC					
•Construction and rehabilitation of farmer managed surface irrigation schemes both in the hills and terai of 40 districts of three western regions. •Development of medium and deep tubewell systems in terai of three western regions. •DOI's capacity building for implementing sector program approach.	- 229 new and existing surface irrigation schemes were developed and rehabilitated. -217 medium and deep tubewells in 18 clusters have been developed. -All the schemes selected were developed and rehabilitated in sectoral approach.	•Schemes should fall under the specified sector. •Schemes should be demand-driven. •Formation of formal WUA. • Beneficiary participation from inception to commissioning of the project. •Beneficiaries should share from 7 to 25% of the total rehab cost both in cash and kind, (cash contribution varying from 1 to 5%) depending upon cost per ha.	-Subproject groups were selected from each of the districts depending upon the economic and technical feasibility. -Most of the subprojects were genuinely demanded by the beneficiaries. Some subprojects had to be selected without the genuine demand of farmers due to political and other reasons. -ILC followed the Irrigation Policy 1988. -Prior to the construction and rehabilitation of the subprojects, WUA in each of the subproject was formed and registered in the District Administration Office. -Farmers were involved at all stages of improvement and rehabilitation and their ideas were also incorporated in design and construction. -Beneficiaries shared from 7 to 25% of total cost of rehabilitation both in cash and kind with respect to the cost per ha from NRs. 10,000 to 40,000 per ha. In some cases the leader farmers and local elite mainly made the cash contribution.	•Identification of subprojects •Subproject preparation •Design and cost estimation •Approval from RAC and ACC •Organizing WUA and cost sharing arrangements •Execution of construction works •Completion and commissioning	-Subprojects were identified from various requests filed by beneficiaries at Ministry, Directorate, Department and District Irrigation Offices. -Subproject profiles were prepared by agency incorporating various socioeconomic, technical and agricultural aspects provided by the beneficiaries. -DIO technicians prepared design and cost estimates. In design, farmers' ideas were considered only in some schemes. In estimating the cost per ha, it was found that command areas in most of the schemes were exaggerated to remain within the cost per ha ceiling. -Feasibility reports of the schemes thus prepared by DIO were reviewed by RAC and then approved by ACC. -WUA was formed with the assistance of DIO and cost-sharing agreement was signed. However, in some of the cases, the WUA was found defunct after the management transfer. -Rehab works were broken down in two sets: to be done by DIO and WUA. -DIO's part of works was awarded to professional contractors, WUA, and contractors from among beneficiary farmers[1]. - In most of the schemes the construction works were satisfactory. Some works were reported to be incomplete. -Works done by beneficiary contractors were found to be poor in majority of the cases. -WUA's part of the works was done by mobilizing farmers. -After joint commissioning, a completion certificate was prepared and subprojects were immediately transferred to WUAs.

[1] Based on WUA's recommendations.

ISP					
•Construction and rehabilitation of farmer managed and farmer initiated surface irrigation schemes in both the hills and terai of 35 districts in Central and Eastern regions. •Strengthening DOI capacity in implementing the sector program approach.	-A total of 515 FMISs were assisted through rehabilitation or new construction -Sector program approach adopted in taking up subprojects	•Subprojects should fall within the specified 35 districts. •Subprojects should be demand-driven. •Formation or strengthening of WUAs. •Participation of farmers in each stage of rehabilitation activities. •WUA should make an up-front cash deposit of 0.5% of the total estimated construction cost as earnest money in the joint bank account before commencing construction. •Farmers should share 15% of the total rehabilitation cost either in cash or kind or labor as part of their contribution.	-All the subprojects selected were from the specified districts. -With some exception majorities of the subprojects were genuinely demanded by farmers. - Formal WUAs had been formed in all the subprojects. -Farmers were involved at all the stages of rehab and their ideas were duly considered. -In majority of the subprojects, WUA members or some elite farmer leaders mobilized 0.5% cash of the total estimated cost by themselves. -Farmers shared 15% of the total rehab cost as their part of contribution by mobilizing labor.	•Information dissemination •Identification of subprojects •Preliminary investigation •Subproject preparation •Preparation of detail design and estimates •Subproject appraisal and approval •Formation of WUA and agreement with WUA for cost sharing •Execution of construction works •Subproject completion and commissioning	-Sufficient information about the availability of ISP assistance was disseminated to the farmers. -Subprojects were identified as per the demand filed by the farmers. -Preliminary investigation of the subproject was done by making joint walk-thru in the schemes. -Preliminary feasibility report of the subproject was prepared and submitted for appraisal and approval to RAAC. -After approval, AO was sent to the subproject site to organize farmers to form a legitimate WUA. -Then detail design and cost estimate was prepared and cost-sharing agreement signed. -Rehab works were done both by DIO (by hiring contractors) and WUA. DIO and WUA jointly controlled the quality of construction works. In some cases, the contractors' part of the work was not satisfactory. -After completion of rehab works, a completion certificate was prepared and the ownership of the improved system was formally transferred to the WUA for O&M. However, in some cases, the WUA was found inactive after the transfer.

From the above table of rehabilitation process, envisaged vs. adopted, following inferences can be drawn:

- In IMTP, the cost sharing by farmers is close to 26%, which is higher than expected by the Irrigation Policy. Out of the three subprojects, some 500m lining work in the tail portion of Panchkanya subproject is still incomplete. Very less effort has been made on the post transfer support.
- KIS has been undertaking IMT activities out of the very small regular O&M budget allocated for the system itself in contrast to the donor assisted rest of the projects and programs.
- In MLIP, farmers were not involved in design as envisaged and many complaints were noted with regard to the placement of outlets. In contrast to other projects/programs the engineer representative of the local consultant hired by UNCDF for MLIP supervised the construction works by professional contractors.
- BLGWP also has faced complaints of farmers regarding inappropriate outlet placements because of insufficient farmer participation in the design in the course of rehabilitation.
- SMIP does not have well-stipulated conditions for cost sharing by farmers in rehab works in the main system.
- In ILC the cost ceiling for taking up the schemes for rehabilitation led to artificial inflation of the command area size. Regarding the share of cash contribution, only the WUA members and elite made the contribution in most of the schemes.
- In ISP also the 0.5% up-front cash contribution required before commencing the construction/rehabilitation of the schemes was also mobilized by WUA representatives and some elite farmers fearing that the assistance might be withdrawn in case the contribution is not done in time.

Impacts of Adopted Rehabilitation Processes

The impacts of the rehabilitation processes are summarized below:

Project/ Program	Main Features of Adopted Rehabilitation Process	Results and Consequences	Progress on the Extent of IMT
IMTP	-Setting up conditional ties for rehabilitation supports with some institutional development milestones -Scope of rehab works covered from emergency maintenance works of the headwork to service and farm-to-market roads. -Introducing and intensifying ISF collection process and share membership administration for better O&M of the system -Capacity building of farmers and agency staff by imparting O&M related training -Intensive farmer participation right from the need identification to commissioning stage of rehab works -Condition of 26% cost sharing of the total rehabilitation works by farmers	- Provided reasonable time for maturity to the WUAs. Increased sense of ownership towards the system because of their organized participation in rehab works. Greater preparedness to gradually assume the management responsibility of the system. -Systems are able to deliver adequate, reliable and equitable water supplies. Improved access to markets for agricultural produces ensuring good returns to the farmers. O&M of the canal system have become easier. -Less water logging areas, enlarged service areas, less frequent breaching of canal sections, and less damages to control structures. -Larger contribution of farmers in rehab works, increased ownership feeling towards the system, and partly checked unnecessary demands from farmers. -Local irrigation organization has become more effective to run the system, which helped in the process of management transfer. -Farmers have modified their organizational set up in West Gandak for effective management of the system. -Farmers became more capable for O&M of the system by generating and mobilizing their own resources. ISF collection efficiency has increased and share-membership distributed. -Agency staff became more capable in implementing the management transfer process	-Phase I, IMT implementation in 3 subprojects already completed. Panchkanya is fully transferred. In West Gandak except the intake all the irrigation infrastructures have been transferred. In Khageri except the main canal and H/W all the branch and minor canals (except 1 branch and 3 minors) have been transferred and the remaining are in the process of transfer. Presently, some post transfer support is being extended. -Phase II, IMT implementation in remaining 7 subprojects is ongoing.

KIS	-Improving physical status of the irrigation system -Formation of an effective and formal WUA -Effective use of available O&M budget -System improvement projected as incentive or leverage for management transfer -Training to key farmers on O&M and agricultural aspects.	-Adequate delivery of water from the source to farmers' field by which they can irrigate almost whole command area in monsoon season. In the winter, they adopt rotational schedule for equitable water distribution by dividing the command area into two parts. -With the formation of an effective WUA, the partial management transfer of branch and tertiary canal has become easier. -Instead of spreading the available O&M budget thinly and unproductively over the entire command area, it has become better beneficial to concentrate on some effective rehabilitation works on specific portions of the irrigation system and thereby IMT.	-Five branch canals: S-0, S-9, S-10, S-11, S-12 and four tertiaries: TO-10, TO-12, TE-1, TB-8 have already been transferred to the respective WUAs and other branch and tertiaries are gradually being transferred depending on available annual O&M budget.
MLIP	-Correctional measures -Improving physical status of the irrigation and drainage facilities -Ensuring proportional water distribution system -Developing block system of command area for better on-farm water management -Institutional development of farmer organization -Reducing O&M cost to farmers after IMT	- The defects observed during the implementation of Phase I & II were mostly corrected to farmers' satisfaction in the form of fine tuning works. -Adequate and equitable water distribution to irrigate 2,806 ha of command area. -Improperly designed and incorrectly located outlets were redesigned and relocated to achieve proportional water distribution mechanism. -130 blocks under the 9 canal systems have been developed and better on-farm water management practices being adopted. -A formal WUA has been formed with a good office set up and is generating O&M funds from ISF collection, selling Sisam tree branches, renting out the tractor received with the transfer. -Key farmers have been trained on operation and maintenance of the pumps and intake structures.	-Management responsibility of the canal system except the pumps and intake structure has been already formally transferred to the WUA. Once the WUA becomes fully capable of O&M of the system, the pumps and the intake structures will also be transferred in due course of time. -Presently, the O&M responsibility of the pump house has been contracted to NHE, Butwal by UNCDF and responsibility of cleaning the intake has been taken by WUA. -WUA, at present is sharing 10% of the electricity cost of pump operation and it also pays salaries of the pump operators deputed by WUA.

BLGWP	-Improving efficiency and serviceability -Incentive or leverage for management transfer -Restoring the defunct tubewll systems through rehab related to IMT -Training to representative farmers on repair and maintenance of pumps and agricultural aspects	-Adequate water delivery and equitable water distribution adopted. -Beneficiaries became ready to assume the management responsibility of the rehabilitated systems. -All the defunct tubewells were rehabilitated. -Farmers became capable of repairing and maintaining the pump by and they started growing cash crops.	-All the tubewells developed under the two stages are turned over to the respective WUGs
SMIP	-Improving conveyance efficiency of the main and secondary canals by discharging water containing minimum silt -Improving physical status of the irrigation and drainage facilities. -Increasing the efficiency of on-farm water management by command area development. -Participation of the beneficiaries in the command area development activities. -Formation of water users groups at different levels starting from the watercourses	-Improved delivery of adequate and reliable water supply -Achievement of equitable water distribution in the command area -Farmers were highly involved in fixing the alignment and constructing the watercourses -Four-tier WUA was formed. There are 1,034 WUGs, 67 WUCs, 15 WUCCs, and 1 WUCCC.	- Turned over subsystems are as below: Jhumka sub-secondary – 1 (891 ha) Vishrampur minor – 1 (403 ha) Sitagunj secondary – 14 (7,985 ha) Ramgunj secondary – 12 (6,845 ha) Duhabi minor – 1 (426 ha) Shankarpur distributory - (6,858 ha) Singhiya minor – (740 ha)
ILC	-Enhancing DOI's capacity of implementing the sector program approach -Upgrading the physical status of FMISs to the extent farmer can manage after the transfer -Developing medium and deep tubewells -Strengthening farmers' organization	-All the farmer-managed systems were intervened and rehabilitated on a sector basis. -Schemes were upgraded by carrying rehabilitation only in the needed portions. -Farmers' organizations were formally formed and then schemes were handed over back to them after the rehabilitation. -Water deliveries were improved - Institutional development activities mostly concentrated on formation of WUAs without giving much attention to their long	-All 229 new and existing farmer managed surface irrigation schemes were transferred immediately after rehab. -All 217 medium and deep tubewells in 18 clusters were immediately transferred after rehab.

	-Ensuring adequate and reliable water delivery in the canal systems -Training to representative farmers on O&M of the system	term sustenance	
ISP	-Enhancing DOI's capacity of implementing the sector irrigation development program -Upgrading the physical status of farmer managed surface irrigation systems. -Formation of WUAs and capacity building through training.	Same as in ILC.	Same as in ILC

FINDINGS WITH RESPECT TO THE STIPULATED PROPOSITIONS

Proposition I: The method of phasing and conditioning the rehabilitation support to some development milestones of local organization facilitates in building up the management capability of the organization

Project/ Program	Inclusion of conditional ties in the rehabilitation process	Arrangement for conditional ties	Helped in building up the management capability of WUA
IMTP	Yes, it was the primary condition for initiating rehabilitation process	-To start the emergency maintenance work, WUA must be formed and registered and preliminary AP should be approved. -To carry out the essential structure maintenance, joint system walk-thru must be accomplished, AP formally adopted, and MOA executed. -To carry out general system improvements, WUA O&M plan must be prepared, WUA should establish ISF collection process and share-membership be administered.	Yes
KIS	No such conditional ties, however the rehab works depend upon the available O&M budget and farmers' demand.	-Farmers should form WUA, rehab needs be identified, and AP should be approved beforehand.	No
MLIP	No	NA	NA
BLGWP	No	NA	NA
SMIP	No	NA	NA
ILC	No. Rehabilitation was done in one package after farmers deposited the required cash and organized themselves in a group.	1-2.5% up-front cash of the total cost of rehabilitation should be collected from the farmers and deposited in a joint bank account before initiating any rehab works. -Agreement is signed prior to rehabilitation to take over the management responsibility of the system immediately after completion.	No
ISP	Same as above ILC	0.5% up-front cash of the total costs of rehabilitation should be collected from the farmers and deposited in a joint bank account before initiating any rehab works. -Agreement is signed prior to rehabilitation to take over the management responsibility of the system immediately after completion.	No

Proposition 2: Contracting the construction works to beneficiaries makes the local irrigation organization more effective.

Project/ Program	Awarding construction works to beneficiaries	Process of contracting out the construction works	WUA became more effective
IMTP	Yes	Easier works upon the WUAs' recommendation	Moderately
KIS	Yes	Easier works upon the WUAs' recommendation	Moderately
MLIP	Yes	Earthworks	Yes, but farmers became more inclined towards making money
BLGWP	No	NA	NA
SMIP	No	NA	NA
ILC	Yes	Easier works upon the WUAs' recommendation	In majority of the cases the quality of works was poor and created competition to receive contracts, farmers became more profit oriented losing trust among genuine farmers
ISP	Yes	Easier works upon the WUAs' recommendation	Same as above

Proposition 3: An effective local irrigation organization aids the process of management transfer.

Project/Program	Overall Effectiveness of WUA[2]	Extent of management transfer
IMTP	Excellent to fair	More than envisaged
KIS	Good	As envisaged
MLIP	Good	As envisaged
BLGWP	Good	As envisaged
SMIP	Moderate	Progressing
ILC	Fair to poor	As envisaged but many WUAs are defunct
ISP	Fair to poor	As envisaged but many WUAs are defunct

[2] Based on institutional development process study findings.

Proposition 4: Beneficiaries' participation in design considerations leads to successful management transfer.

Project/Program	Beneficiaries' participation in design works	Extent of Management Transfer
IMTP	Intensive	More than envisaged
KIS	Intensive	As envisaged
MLIP	Poor	As envisaged but farmers have many complaints about the design aspects
BLGWP	Fair	As envisaged but farmers have some complaints about faulty location of outlets
SMIP	Intensive but beyond the turnouts only	Progressing
ILC	Fair	As envisaged but many WUAs are defunct
ISP	Fair	As envisaged but many WUAs are defunct

Proposition 5: Quality of construction works to beneficiaries' satisfaction leads to successful management transfer.

Project/ Program	Joint quality control committee	Farmers satisfaction toward the quality of construction works	Extent of Management Transfer
IMTP	Yes	Good	More than envisaged
KIS	Yes	Good	As envisaged
MLIP	No	Poor	As envisaged but farmers have many complaints about the work quality
BLGWP	Yes	Fair	As envisaged
SMIP	No	Good, beyond the turnouts only	Progressing
ILC	Yes	Fair to poor	As envisaged but many WUAs are defunct
ISP	Yes	Fair to poor	As envisaged but many WUAs are defunct

Proposition 6: Management transfer to an effective beneficiaries' organization results in better performance of the partially or fully turned over irrigation schemes.

Project/ Program	Overall Effectiveness of the WUA	Performance of the transferred system
Panchkanya	Excellent	Carrying out the all irrigation management tasks very effectively
Khageri	Good	Resource mobilization and system operation are deficient
West Gandak	Fair	Poor ISF collection, O&M deficient, irregular meetings
KIS	Good	Carrying out the main irrigation management tasks satisfactorily
MLIP	Good	Poor system maintenance and insufficient resource mobilization
BLGWP	Good	Carrying out the main irrigation management tasks satisfactorily
SMIP	Moderate	Carrying out the main irrigation management tasks satisfactorily but beyond the turnouts only
ILC	Fair to poor	Many WUAs are defunct
ISP	Fair to poor	Many WUAs are defunct

CONCLUSIONS

The following are the conclusions of this study.

1. The mechanisms of tying the rehabilitation support with some development milestones of local organization help in building the management capability of the WUA and eventually aids in the successful management transfer process.
2. By contracting the construction works to beneficiaries makes the WUA more effective provided the beneficiary whosoever gets the contract is accountable to the WUA as well as to other general beneficiaries and does not get inclined towards making money out of the contract for himself or herself.
3. An effective WUA aids the process of management transfer provided it is formed by following the tested institutional development processes and it is accountable to the general beneficiaries.
4. Participation of the beneficiaries in design considerations during the initial stage of rehabilitation activities help complete the rehabilitation works to the satisfaction of the beneficiaries and also help achieve the better performance of the system leading to successful management transfer of the system.
5. Quality of construction works to beneficiaries' satisfaction definitely leads to successful management transfer provided the quality is jointly supervised and monitored.
6. An effective WUA effectively mobilizes the resources, conducts regular meetings, carries out regular O&M of the system, and efficiently collects ISF. In other words, management transfer to an effective WUA results in better performance of the partially or fully transferred irrigation schemes.

Paper 5: Leadership in WUA for Successful Irrigation Management Transfer: Comparison of Two Irrigation Systems under Phase I of IMTP

A. Shukla, N. N. Joshi and B. Devkota

INTRODUCTION

The strategic objective of irrigation management transfer (IMT) program in Nepal is to reduce the ever increasing financial burden on the government in funding the operation and management of irrigation schemes controlled and managed by Department of Irrigation (DOI) through direct participation of users in the management tasks, decision making and resource mobilization. The implicit in the IMT objective is expansion of incentives and opportunities for increased production, income and equity through better water control and management in the systems, possible with the users in-charge of operation and management of the systems. Thus, IMT program in Nepal aims at transformation of DOI managed irrigation systems to farmers' controlled system, either in whole or in part.

The processes of IMT program are designed to help developing and fostering an environment that could lead to progressively increasing roles of users and subsequently decreasing roles of DOI in operation and management of the systems until complete management transfer takes place and to ensure sustainability thereafter. The key focus of IMT program is on the organization of users' into legally recognized, viable and capable water users' associations (WUAs) that could take up the operation and management functions effectively and serve the interest of the users. In the beginning DOI is expected to work as a partner with WUA until it becomes capable enough to assume full responsibilities.

Most institutional analysts believe that leadership is most critical, if not the only critical factor, for successful development of irrigation institutions (Ostrom, 1992; Burns, 1979). Presence of good leadership in an institution help developing and fostering greater possibility of collective action among the users. One may begin with the arguments- what are the attributes of good leadership? What are the conditions for the emergence of good leadership? Are there ways to facilitate the emergence and development of good leadership? Are there substitutes to leadership to reduce the dependence of institutional

development on the existence of acceptable leadership? What does one do if there is no good leadership to work with?

The WUAs are expected to evolve as democratic institutions with equal opportunity for every potential members of the users' community to demonstrate and supply leadership in the WUA. The basic assumption being that there is no dearth for potential leadership in a user community and that the leadership can emerge out of the processes of collective actions in the course of institutional development for management transfer (Shah, 1993; Kolavalli, 1995). One acquires leadership by demonstration. By making commitment and fulfilling the commitments one can acquire the status of a leader. Then one may further argue here - Why two institutions facilitated to evolve and develop leadership under the same set of processes end with differential institutional performance? It is this key question attempted to be addressed in this paper. The paper attempts to compare two irrigation systems- Nepal West Gandak Irrigation System in Nawalparasi District and Panchkanya Irrigation System in Chitwan District, in terms of pattern of leadership in the WUA, the processes of leadership development and performance of leadership vis-a-vis WUA in the two irrigation systems. Both these irrigation systems have been candidate systems where processes of irrigation management transfer were implemented, under similar framework, under phase-I of Irrigation Management Transfer Project (IMTP) during 1995-1998 and that both these systems have been formally turned over to WUA for total operation and management.

The first part of the paper briefly describes the physical and institutional characteristics of the two irrigation systems and the structure of WUAs that have evolved in the two systems. The second part of the paper examines the pattern of leadership development in the WUA of the two irrigation systems and the processes thereof. The last part of the paper identifies some key concerns and issues pertaining to the processes of leadership development in the WUA.

The paper is an outcome of a process documentation study being undertaken in three irrigation schemes- Nepal West Gandak Irrigation System (Nawalparasi), Khageri Irrigation System (Chitwan) and Panchkanya Irrigation System (Chitwan) by Water Management Study Program (WMSP) at the Institute of Agriculture and Animal Science (IAAS), Rampur in collaboration with International Water Management Institute (IWMI) and Research and Technology Development Branch (RTDB) of DOI.

FRAMEWORK OF PROCESSES IN IMTP

The framework of management transfer process adopted by DOI in IMTP is illustrated in Fig.1. The processes have been designed to begin with the formation of users' organization wherein the users are to be organized in a multi-tiered water users' association (WUA) consistent with the structural complexity of the system. This process is to be started with an introductory workshop to explain the users and discuss with them the objectives and process of management transfer. Personnel from DOI are expected to identify and train

local farmers to become farmer organizers (FOs). The DOI personnel together with FOs are then expected to generate relevant information to decide upon the structure of WUA organization of the best fit to the socio-technical complexity of the system. The formation of WUA is to be initiated based on hydraulic boundary of the system beginning from the block and tertiary level to the main system level.

Side by side of WUA formation, the constitution of WUA is to be drafted and election of functionaries at different levels is to be completed. The WUA is then to be registered to obtain the status of a statutory body. This then becomes the starting point for further processes of institution development.

The second phase of activities include joint agreement between WUA and DOI stating the roles and responsibilities of each party. At this stage, the DOI personnel together with WUA are expected to identify operation and maintenance options that eventually lead to development of operation and maintenance plans. A classification of operation and maintenance plans into short term, medium term and long term, would help defining the gradual process of management transfer to WUA. A memorandum of agreement is to be developed between WUA and DOI to this effect.

The third stage in the management transfer is the actual implementation of plan of action conceived, developed and agreed upon between DOI and WUA. This includes program of canal operation, deferred and regular maintenance, payment for operation and maintenance etc. Extensive training for water users, WUA functionaries and agency personnel are to be organized to develop and strengthen their capabilities in such areas as communication and leadership, accounts and record keeping, canal operation and maintenance and improved on-farm practices. The full implementation of management transfer is expected to take a course of 3 to 5 years depending on the nature of a system and the capabilities that the WUA develops over time.

PHYSICAL FEATURES OF NEPAL WEST GANDAK AND PANCHKANYA IRRIGATION SYSTEMS

Nepal West Gandak Irrigation System (NWGIS) is a large reservoir backed irrigation scheme designed to command 8,700 ha of land in Nawalparasi District. The construction of the system was initiated under Indo-Nepal Gandak Agreement. Upon construction, the scheme was handed over to HMG/N in 1979. The original construction of NWGIS included a 32-km long main canal with a designed flow of 8.5 m^3/sec and branch and minor canals. Below the secondary canals, tertiary and quaternary canals and on-farm facilities were not developed when the system was constructed and handed over to Nepal. During 1982-1989, Command Area Development Project (CADP) was implemented in NWGIS with the objective of developing command area with the construction of tertiary and quaternary level canals and farm ditches serving 7-12 ha.

The network of canals in NWGIS is schematically shown in Fig. 2. In the hierarchy of canals, eight different types of canals exist in NWGIS based on the service area and discharge criteria. Branch canals and watercourses off-take from main canal while minor canals off-take from branch canals. Before CADP, few tertiary canals off-taking from branch canals were also constructed which have been named as outlet tertiaries (OT). During CADP, some piped outlets off-taking directly from main canal were constructed which have been named main canal course (MC) and special farm ditch (SFD). Main farm ditches (MFD) are quaternary level canals off-taking from branch, minor canals and watercourses. Farm ditches (FDs) off-take from MC, MFD and SFD to convey irrigation water to farmers' field.

Panchkanya Irrigation System (PIS) is a small gravity flow irrigation scheme located in Chitwan District. The source of PIS is *Panchnadi*, a tributary of *Khageri* river, which is in-fact a perennial drain formed by confluence of five perennial springs in the catchment. PIS existed as a farmer managed irrigation system until 1974. In 1974 the system was adopted under Chitwan Irrigation Development Project (CIDP) for rehabilitation, improvement and expansion of command area with the aim to bring 600 ha of area under irrigation. The construction works were completed in 1979 but only about 200 ha of area could be brought under irrigation due to physical deficiencies, losses and lack of branch and tertiary level facilities for water distribution. CIDP took-up 2nd phase of rehabilitation and improvement works in 1982-83 that included boulder lining in the main canal, constructions of branch canals and outlets. With these improvements the area under irrigation in PIS increased to 400 ha. But only in few years the canal lining began to collapse because the main canal was constructed in full filling. Beginning 1989-90 it become impossible to provide irrigation to even 100 ha during monsoon.

Much of the structures and the canal systems that are seen today in PIS were developed during 1st and the 2nd phase of construction works under CIDP. The intake in *Panchnadi* is an overflow weir with front intake. The main canal is 4.92 km long. There are all together 8 branch canals and 10 outlets in the canal network. The branch canals are much shorter in length and are mostly unlined. Water delivered to the farmers' fields through network of tertiary and watercourses. The outlets have also connection with small canals with the area under each outlet ranging from 2 to 10 ha. A schematic diagram of canal network in PIS is illustrated in Fig. 3.

EXPERIENCE WITH COLLECTIVE ACTION AND USERS' ORGANIZATION PRIOR TO IMTP

One of the aims of CADP in NWGIS was to initiate participation of users in the operation and maintenance of the system at quaternary levels by organizing them into water users' groups. Though some water users' groups were organized but they remained mostly non-functional. There had not been evidences of collective action and organized participation of users in NWGIS prior to IMTP.

PIS was developed with expansion of a farmer managed irrigation system with long tradition of users participation in system operation, management, decision making and resource mobilization for repair and maintenance and upkeep of the system. Immediately after the 2nd phase of rehabilitation and improvement under CIDP in 1985-86 attempt had been made to organize the users into an informal (because not registered) association of water users. An 11 member of executive committee of the users' association had been functional in PIS until the initiation of joint management process in 1993 and subsequently IMTP in 1995. Though the functionaries in the executive committee used to be elected/nominated in an ad-hoc basis and the tenure were not fixed, the committee had been involved in making decisions pertaining to water allocation and repair and maintenance of the system. Though, the then committee was not registered as a statutory body of water users, it appears from the records of the committee (minutes of meeting available for the period Ashar 2048 - Poush 2050 B.S.) that CIDP had recognized the committee as the representative organization of water users because CIDP officials had been participating in the meeting of the executive committee and the executive committee had been coordinating with CIDP for repair and maintenance.

Another distinguishing feature of the two systems, which does have bearing on collective action and organizational capabilities of the users relates to the community mixes in the two systems. PIS was developed by *Tharu* landlords of the area somewhat 200 years ago. Beginning 1951 the government started resettlement program in Chitwan District under Rapti Valley Development Project. Major influx of migrants who came to settle in the District was from adjoining hill Districts of *Lamjung, Tanahun, Gorkha, Baglung, Parbat, Dhading and Nuwakot*, though people from all parts of the country came to settle in the District. Both original inhabitants and migrants who came to settle in the area had been proven to have had prior experience of organized participation and collective action in irrigation development and management.

The original inhabitants in NWGIS are again the *Tharus* whose settlements were scattered and in the beginning of this century there were also few scattered settlements of people in the southern part of *Parasi* area along the border of *Uttar Pradesh* (Ghimire, 1998). Rest of the command area of today's NWGIS was under forest. Several harvest failure and wide spread famine during 1930s and 1940s in adjoining Indian States encouraged migrants, mostly from *Uttar Pradesh* and *Bihar* States of India, to come to settle in the area. Construction of the Gandak Project during 1964-1971 and Gaindakot-Butwal section of the East-West Highway during 1968-1975 further encouraged migrants from adjoining Indian States to come to settle in Nawalparasi District. With the government initiated malaria eradication and settlement program people from adjoining hill Districts also came to settle in Nawalparasi between 1961-1981.

In today's settlement pattern within the command area of NWGIS, *Tharus* and people migrated from hills constitute the majority of population in the head reach while in the tail reach majority of population is constituted by migrants from adjoining Indian States who came to settle in the area at different phases of times. In the middle reach the population is

constituted by approximately equal to proportion of *Tharus*, migrants from the hills and the migrants from bordering states of India.

The migrants who came to settle in the area from the bordering states of India did not have prior experience on irrigated agricultural system because irrigated agriculture in the bordering states of India is believed to have begun only after the completion of Gandak Project. While the *Tharus* and the hill migrants have had long traditions of irrigated agriculture because their livelihood was dependent on growing rice, that even continues today. Since growing rice needed dependable irrigation supply, they have traditionally been experienced with development and management of irrigation systems.

EVOLUTION OF ORGANIZED USERS' PARTICIPATION UNDER IMTP

The institutional development process in NWGIS with the aim to initiate shared responsibility for operation and maintenance between water users and DOI began in 1992 under joint participatory management program of DOI. The organized participation of users in the operation and management in PIS began with the initiation of joint participatory management program in April 1994. NWGIS and PIS taken under IMTP for further extension of participatory program with the aim of gradual management transfer beginning November 1994 and December 1994, respectively. Both the systems have been formally turned-over to WUA beginning November 1997 and December 1997, respectively, within three years of implementation of IMTP. The time line of events and process that led to evolution of WUA, gradual management transfer and eventual turnover in NWGIS and PIS are illustrated in Table-1 and Table-2, respectively.

The organization of WUA in NWGIS is federated that matches with the size and structural complexity of the system, evolved in different phases of time through the processes of adjustments and modification in the structure of WUA. As of now, there are 175 quaternary level canals in NWGIS (MCs, MFDs and SFDs). At each quaternary canal, an Upatoli Committee is to be constituted with seven functionaries: chairman, secretary, a member to represent in WUA general assembly, a member to represent in the immediately upper tier of organization to which the Upatoli is connected, a woman member and a general member. A total of 175 General Assembly Members are to be elected from the respective 175 Upatoli Committees constituted at the quaternary canals. The Toli Committees at the tertiary level canals (Minors, OTs and watercourses in the hierarchy of canals in NWGIS) are to be constituted by member representatives from the respective Upatolis within the tertiary, who among them elect: chairman, vice-chairman, secretary and a member to represent in the immediately upper tier of organization where the Toli is connected. The Branch Committees are to be constituted by all the member representatives from the respective Toli Committees, who among them elect: chairman, vice-chairman, secretary and a member to represent in the Board of Directors. Board of Directors is the upper most tier of the WUA organization.

In NWGIS, there are 35 off-takes from the main canal with MC, SFD, watercourses and Branch Canals connected to the main canal. From each off-take a member representative is to be elected from constituent Branch Committees, Toli Committees and Upatoli Committees. The Board of Directors is to be constituted by a maximum of 41 members and functionaries including 35 member representatives from each off-take from the main canal and 4 women members representing each of the four regions of the system who are to be nominated by the member representatives in the Board of Directors from respective regions. The chairman and vice-chairman of the Board of Directors are to be elected from among 175 General Assembly Members and 35 member representatives in the Board of Directors from each off-take of the main canal.

The organogram of WUA in NWGIS is shown in Fig. 4 and the representation of users at different tiers of WUA is illustrated in Table-3.

After turnover of the system in November 1997, the WUA made provision of an Executive Committee responsible for day-to-day technical, administrative, financial and judicial management functions of the WUA. The Executive Committee is to be constituted by 5 members nominated from among the members of the Board of Directors. One of the members in the Executive Committee is to be designated as manager who is also to work as a secretary of the Board of Directors. Other four members of the Executive Committee, representing each of the four regions of NWGIS, are to be designated as sectional heads of administrative, accounts & store, technical and judicial sections of the Executive Committee. A cadre of Canal Operation Work Force (*Karyadal*), consisting of people trained for canal operation and water management (from among the users) has been instituted to work directly under the technical section for day-to-day operation, water allocation and distribution at different levels of the system.

Another change brought in the organization of WUA after the turnover of the system has been the provision of Regional Committee. The Regional Committee is to function as representative of the Board of Directors in each of the four regions of NWGIS, constituted with the representation of the Board of Directors from the respective regions as ex-officio members in the Regional Committee. The rationale for the formation of Regional Committee has been that because of larger system size it was found a daunting task for the Board of Directors to coordinate, supervise and monitor the activities of each Upatoli, Toli and Branch Committee and that Regional Committees were expected to be in a better position to coordinate at the regional level.

The organization of WUA in PIS also evolved through a process of adjustments and modifications in the structure of WUA. Present structure of WUA is a two tiered organization. The lower level of WUA organization includes branch or outlet committees constituted with a total of 5 functionaries and members including chairman, secretary and three members, elected from among the branch or outlet assembly of the users. One woman membership in the branch or outlet committee is made compulsory. General assembly representatives are to be elected by the users' assembly at each branch and outlet

canals on the basis of one member representatives from each of 15 bighas (10 ha) under irrigation. In addition to elected general assembly members, provision has also been made for ex-officio representation of chairman and secretary from each branch level committee and chairman from each outlet committee in the general assembly.

The main committee in PIS is the apex executive body at the main system level constituted with a total of 16 functionaries and members as following:

- Three functionaries- chairperson, vice-chairperson and secretary to be elected by the members of the general assembly.
- Eight chairpersons from each of the eight branch committees as ex-officio member.
- Two ex-officio member representatives from the constituent outlet committees nominated from among the chairpersons of the outlet committees- as to one member from outlet No. 1 to 5 and another member from outlet No. 6 to 10.
- Two members nominated/elected from among the general assembly members from branch canal No. 1 and 5, due to area larger than 50 hectares in command of both these branches.
- One woman member nominated/elected from among the general assembly members.

The organization of WUA in PIS illustrating the mechanism of representation at each level is shown in Fig. 5.

USERS' REPRESENTATION AND LEADERSHIP DEVELOPMENT IN WUA

In both NWGIS and PIS the WUA have devised certain boundary rules to define eligibility for appropriation from the system. In PIS a farmer owning land within the command area of the system needs to obtain membership in WUA by paying a membership fee of NRs. 10, to be renewed every year. Since the membership alone is inadequate to ensure equity in appropriation- as to control on quantity and time is essential to ensure equitable access to irrigation by the users depending upon the land area under irrigation and their location in the system, the WUA has implemented a procedure of share registration as second level of boundary rule for appropriation. The "system share" in PIS has been defined based on area that could potentially be irrigated- one share equal to one *kattha* (0.033 ha) under irrigation. All the farmers within the command area are required to obtain and register as many as shares with WUA depending upon their land area under irrigation by paying one time share registration fee of NRs. 3.00 per *kattha.* In NWGIS share registration is the sole basis for membership in WUA and access to irrigation. In NWGIS also one unit of share is equivalent to 1 kattha of land under irrigation.

All the users who have membership in WUA are eligible and qualify to be elected as functionary at any level of WUA in both the systems. Three terms of elections of WUA

functionaries have completed in both the systems and there is already almost seven years of experience available in both the systems in terms of users' representation in WUA and leadership development. Following section presents an assessment of pattern of leadership development in both the systems.

Nepal West Gandak Irrigation System

The first election of WUA functionaries at all levels was conducted during March-June 1993. The awareness of the users on participatory processes and management transfer was minimal at that stage and nature of election process was almost a kind of picking of few individuals, relatively better informed, to work as functionaries at the lower tiers of WUA. The election of functionaries at the main committee level was also through a general consensus. Beginning the second election of WUA people started realizing the importance of WUA election and the role of leadership in the WUA particularly at the upper level of organization. By the time of second election (April-August 1995) the procedure of share registration and collection of irrigation service fee (ISF) were already implemented by WUA. These two innovations had helped building awareness among a broader mass of the users about their roles and obligations in the WUA. One of the negative externalities that became starting apparent beginning the second term election, particularly at the main committee level, has been increasing politicization of election process. The political parties started taking interest in the election of key functionaries (chairman, vice-chairman and secretary) at the main committee level. The rationale for the interest of political parties for the key positions in the main committee has not merely been authority and control in the WUA associated with key positions but a much wider political interest. NWGIS is a larger irrigation system with approximately 8,700 ha of command area covering 22 Village Development Committees (VDCs). The system covers one of the densely populated areas of Nawalparasi District that includes almost two constituencies of parliamentary election (Constituency No. 2 and 3). If a person is elected for the key positions in the WUA, it would make him known to a bigger mass. The political parties therefore started using the WUA election as a platform in recruiting candidates to contest election at the District level political units or at the parliament level. The WUA election also became an arena to test the pre-parliamentary poll strength of a political party. If a candidate supported by a political party wins the election of key positions in the WUA, it would be a test of mood of people in favor of that party.

Beginning the second term election, the level of expenses made by candidates contesting election for key positions at the upper level also started appearing. The candidates started making use of printed pamphlets, laud speakers and laud hailers for campaigning. The candidates also started offering foods and drinks and transportation for the voters on the day of election.

The scenario remained essentially the same even in the third term election that was completed during April-July 1998. The only remarkable achievement credited to WUA in the third term election was that the election processes at all levels of WUA were conducted

solely by the WUA and the role of DOI/IMTP was limited to monitoring and providing advisory support only. The first and second term elections were conducted through active involvement of DOI/IMTP personnel in the administration and management of the election processes.

Starting the second term election more people started aspiring to be elected to upper tiers of WUA. There have been very few people who would show willingness to work at Upatoli, Toli and Branch Committee level. The decision making in the process of selection/election of candidates even at the lower tiers of WUA was found to be dominated by few individuals, either aspiring to contest election at the upper tier of WUA or supporting a particular candidate. Such a situation restricts the role of common users in the decision making.

The pattern of diffusion of leadership in the WUA in terms of number of functionaries elected for one, two and three terms in the three elections of WUA is shown in Table-4. This comparison in Table-4 is for one of the branch canals (Bhujahawa Branch) in NWGIS. There have been more number of people elected as functionary at the Upatoli, Toli and Branch level committees for one term only and only very few have been elected for two or three terms. Similar trends are also observed in other secondary, tertiary and quaternary level canals in the system. Even at the main committee level organization of WUA, no single person has been elected as chairman and vice-chairman for more than one term. This illustrates that the trend of patterned leadership at any level of WUA does not exist.

Panchkanya Irrigation System

The users of PIS have had prior experience of users' involvement in decision making in the operation and management of the system, prior to the initiation of the management transfer process. The three terms of elections of WUA have demonstrated sense of political tolerance despite political influences in the election process. The sense of political interest was apparent only in the third election of WUA conducted during October 6-10, 1998. During the third term, election was contested through secret ballot for key positions of functionaries and representatives in branch canal number 1 and 5 and for the position of vice-chairman and secretary in the main committee. In general, the users seem to have developed some criteria in electing/nominating leaders for different levels in the WUA. Some of the criteria used by them in selecting/electing leaders at the main committee level are- vision, responsibility and accountability and impartiality in decision making.

In the main committee of WUA majority of the functionaries in the past three terms of elections have been elected for one term only- a total of 20 persons have been elected for one term only, 4 persons have been elected for two terms and only two persons have been elected for three terms. The chairman and secretary of the main committee are continuing to occupy the positions for three consecutive terms. These two persons seem to have played pivotal role in the functioning of WUA and therefore on its performance.

DISCUSSION AND ISSUES

This paper began with an argument that development of appropriate leadership in the WUA is critical for successful transfer of operation and management of irrigation systems from DOI to WUA. This was further contemplated that there is no dearth of potential leadership in a user community and that the leadership can emerge in the course of the processes of collective action. What is observed in NWGIS is continued influence of party based politics in the WUA election process over the past two terms of elections. This is also accompanied by increasing level of expenses by the candidates contesting the election for key positions in the apex tier of WUA. One may come with the viewpoint that this is all resulting due to transitional phase in national political scenario and that in the course of time it would diffuse by itself. But what is observed in NWGIS is that increasing politicization has influenced the process of leadership development in a very critical way. Immediately after third term election, the WUA came to a stage of non-functioning, all because of political intolerance among the functionaries and representatives in the WUA. The experiences from NWGIS have shown that the politicization restricts or at least retards the process of capable leadership development in the WUA.

The WUA in PIS appears to have reached the regime of performance. Still an issue that may be raised is- whether the existing state of performance of WUA can be attributed to chairman and secretary who are in pivotal positions of WUA and that these two individuals have been there for three consecutive terms of WUA elections. Will the state of performance of WUA continue to increase, or at least remain at the same level, even after the change in leadership at these two pivotal positions.

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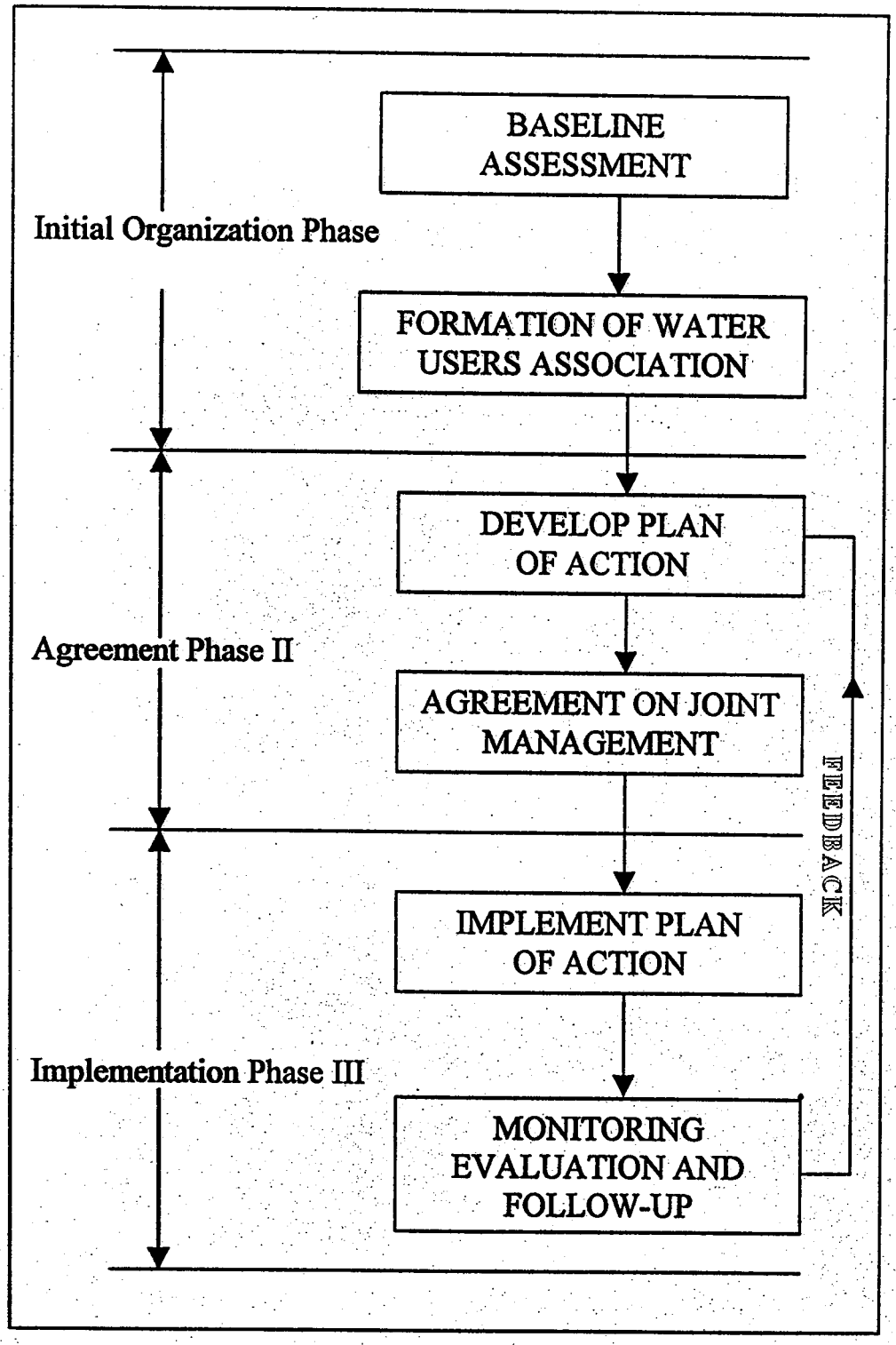
Figure 1: Framework for Management Transfer Adopted by DOI



Source: Laitos and Rana, 1992

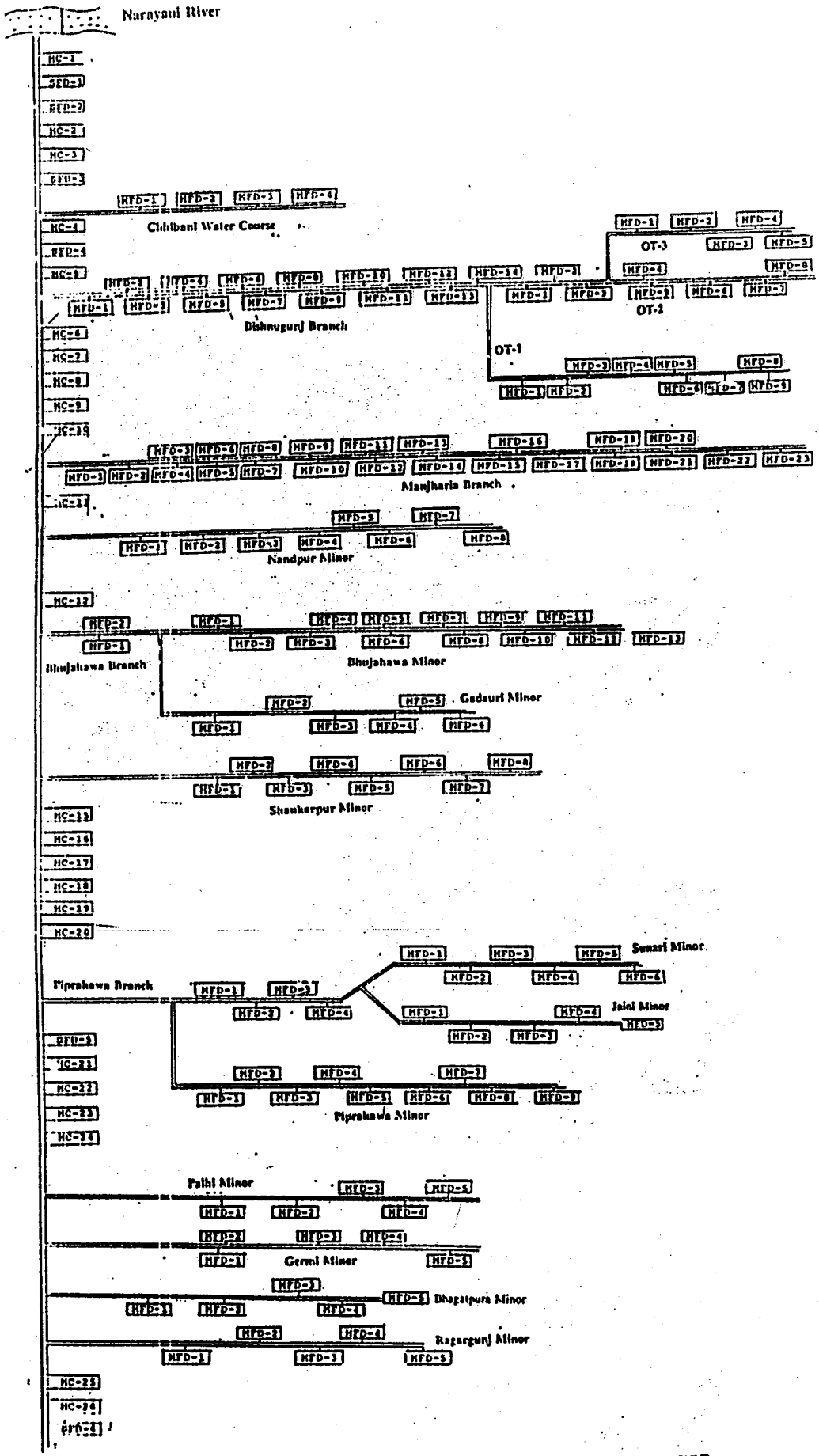
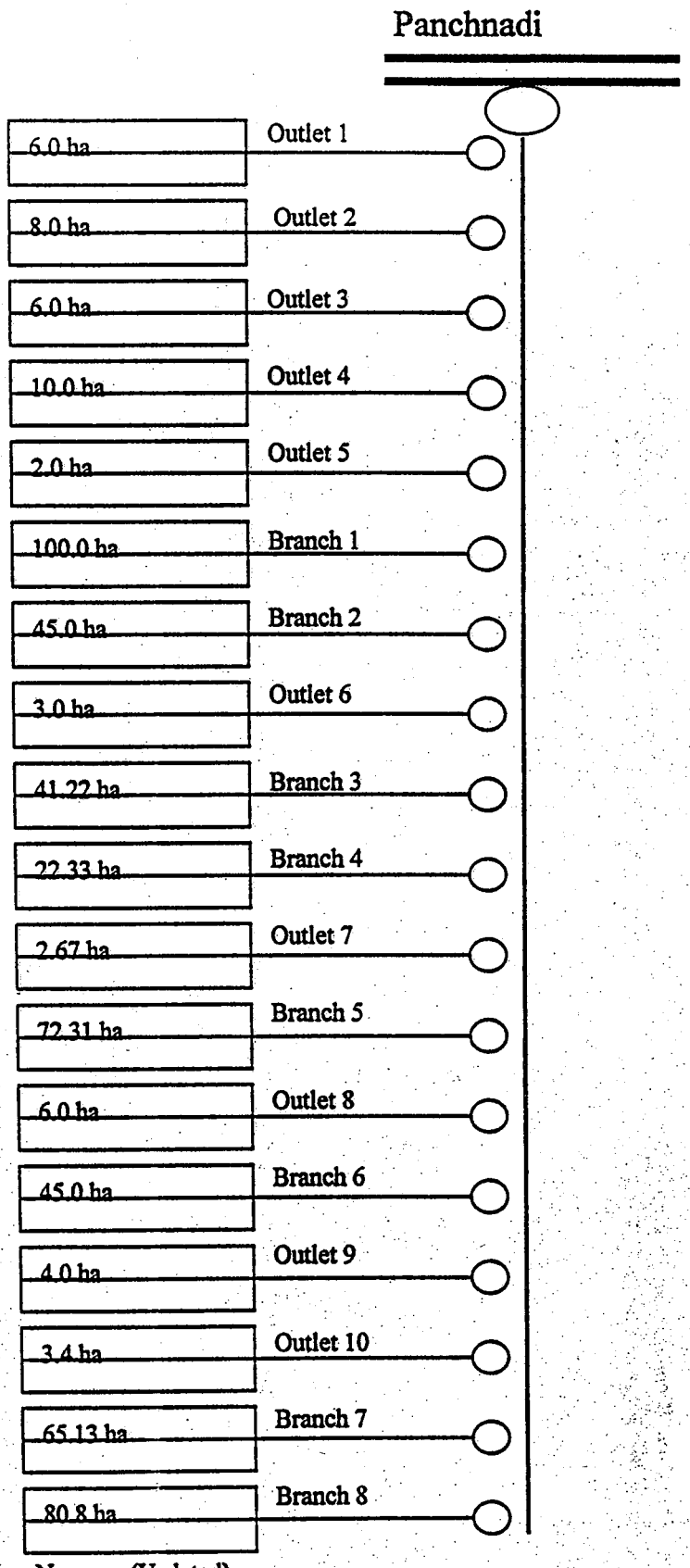


Fig. 4 Schematic Diagram of Canal Network in NWGIS

Figure 3: Schematic Diagram of Canal Network in PIS



Source: Neupane (Undated)

Figure 4: Organization of WUA in NWGIS

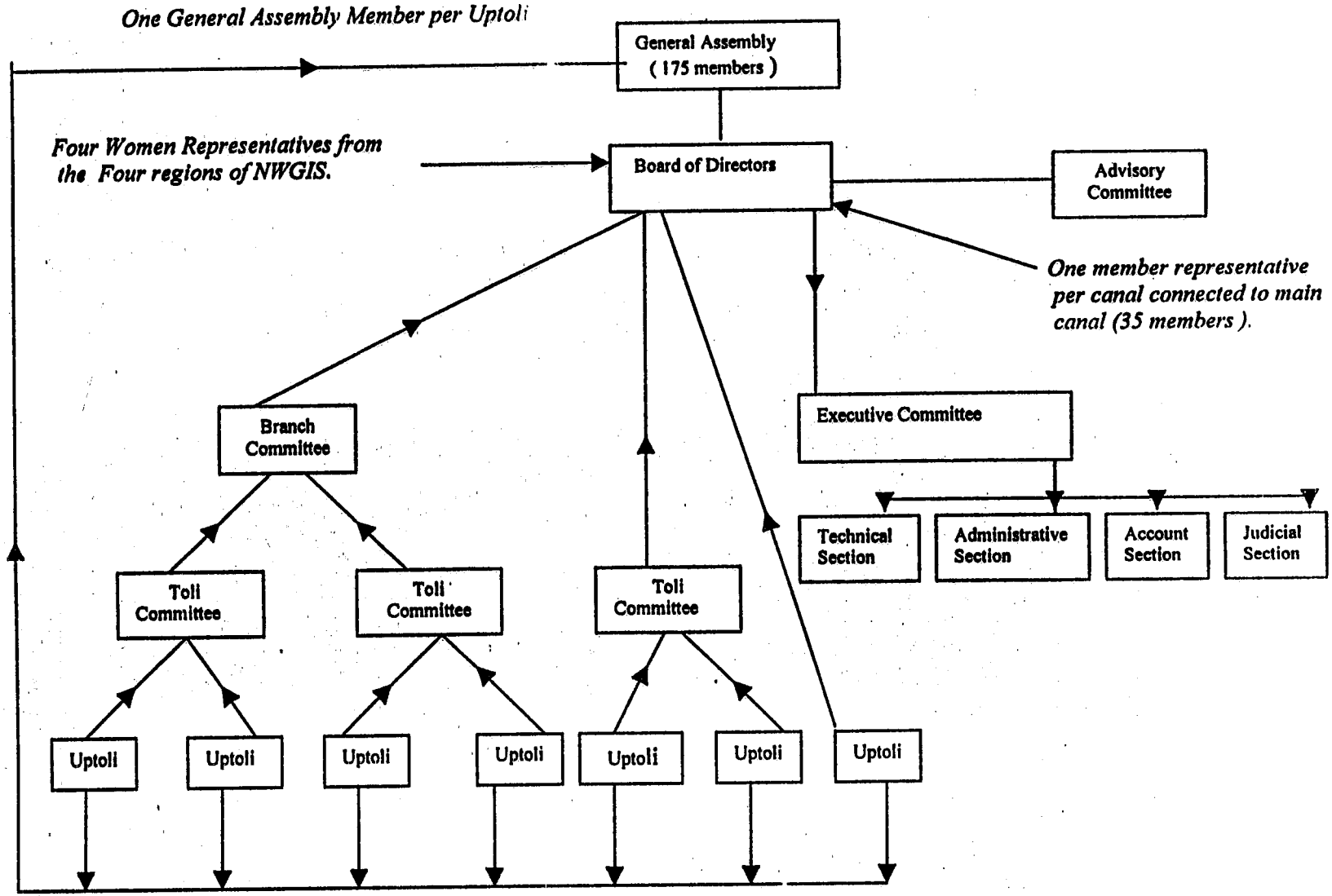


Figure 5: Organogram of WUA in PIS as per Constitutional Amendment of December, 1997

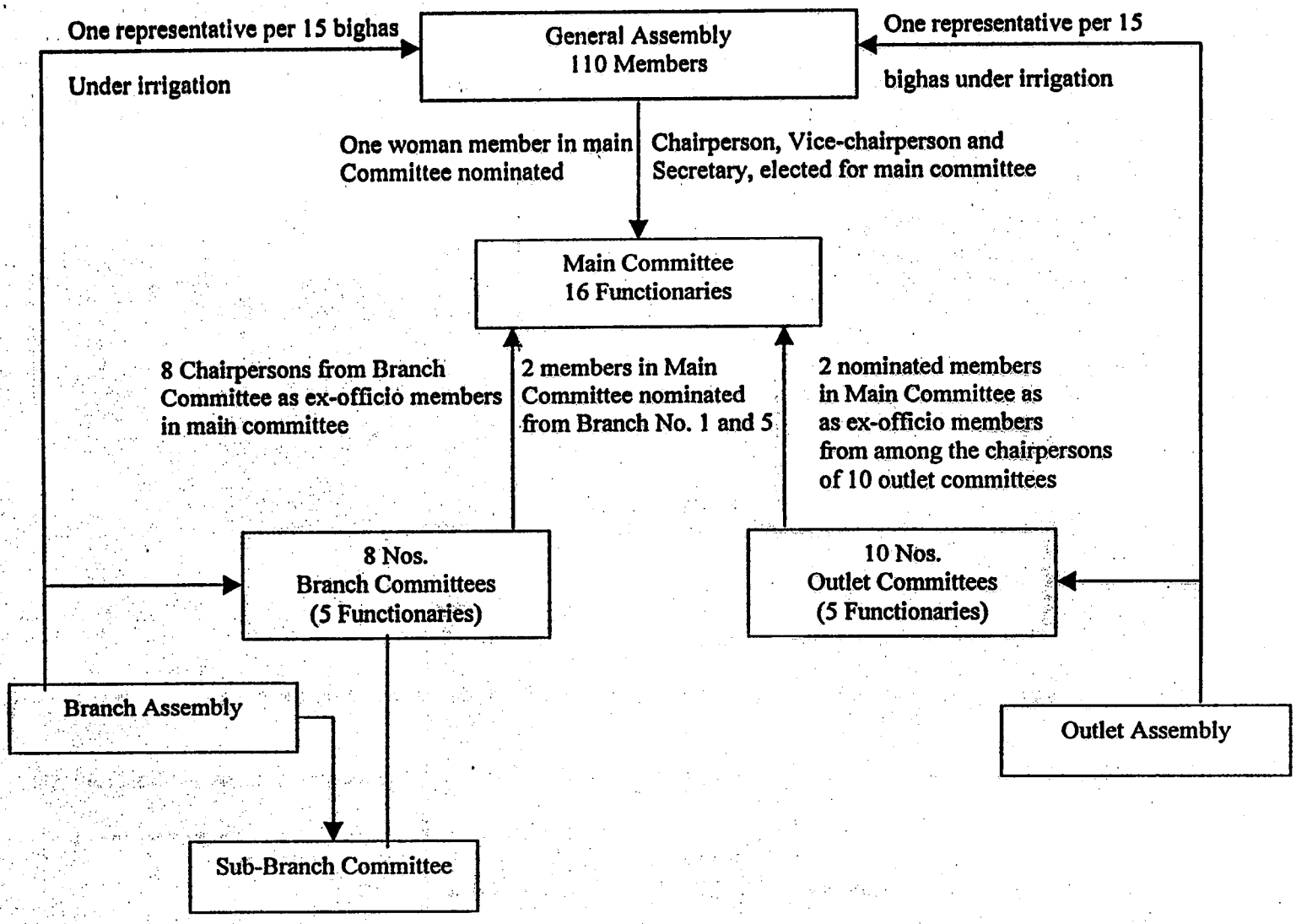


Table 1: Time Line of Evolution of WUA in NWGIS

Date	Event	Outcome
Nov. 2, 1992 (2049/7/17)	Meeting of farmer representatives, local leaders and representatives of line agencies under the initiation of IMWUD/ DOI at NWGIS office, Semari. A total of 220 people were present.	The need of joint management program in NWGIS was agreed
Dec. 30, 1992 to Jan. 6, 1993 (2049/9/15-2049/9/22)	Selection of farmer organizers (FOs) to organize the process user in blocks of approx. 500 ha.	Data need to initiate institutional development were collected. Users were informed of objectives and the process of joint management program.
Feb 27, 1993	A 15-member committee was formed to draft constitution of WUA	The committee members drafted constitution of WUA with the support from IMWUD/DOI officials. A four-tiered organization of WUA was proposed.
March 19, 1993 to June 18, 1993 (2049/42/6-2050/3/4)	1st election of functionaries at different tiers of WUA.	Functionaries at Upatoli, Toli, Branch and Main committee level were elected. The main committee was formed on June 18, 1993 with the general consensus of elected functionaries at lower tiers.
March 30, 1993 (2049/12/17)	An ad-hoc committee was formed with the members of constitution drafting committee to work as main committee of WUA until the election of functionaries at all tiers and formation of main committee.	Beginning of participation of users in the operation and maintenance of NWGIS
June 27, 1993 (2050/3/13)	Registration of the constitution of WUA at the District Administration office, Nawalparasi.	The WUA in NWGIS became an institution recognized by the state.
June 27, 1993 2050/3/13)	Decision made by the users of Palhi Minor, Bhagatpurwa Minor, Germi Minor, Ragargunj Minor, MC-2, SFD-2, MC-25 and SFD-6 to take over operation and maintenance.	Beginning of turnover of secondary and tertiary level canals to WUA for operation and maintenance.
Nov. 29, 1994 (2051/8/13)	Beginning of IMTP involvement in NWGIS	Irrigation Management Transfer Project (IMTP) selected NWGIS as one of the sub-projects to support the management transfer process. A sub-project management committee with the WUA representatives and NGGIS/DOI official was formed on Nov. 29, 1994 (2051/8/13).
April 18, 1995 (2052/1/5)	Initiation of process for 2nd election of WUA at all tiers.	Decision was made by WUA to request NWGIS/DOI for help in conducting free and fair election of functionaries at all levels.
April 24, 1995 to Aug. 21, 1995 (2052/1/11-2052/5/5)	Election of functionaries at all levels of WUA	NWGIS/DOI officials conducted and supervised the election of WUA functionaries at all levels. The election of WUA main committee was conducted on Aug. 21, 1995 (2052/5/5).
May 4, 1995 (2052/1/21)	Establishment of separate office of WUA within the premises of NWGIA office at Semari.	Initiation of day-to-day involvement of WUA in operation and management of the system.

May 4, 1995 (2052/1/21)	A committee constituted by WUA to suggest constitutional amendments.	Constitutional amendment for restructuring to introduce "Board of Directors" and "Executive Committee" in WUA organization and to make women participation in WUA compulsory. The constitutional amendment was approved by the general assembly of WUA on November 29, 1997 (2054/8/14).
Oct. 7, 1996 (2053/6/21)	A Water Management Task Force (*Karyadal*) appointed by WUA main committee at the Main Canal Level to take up water measurement and water distribution tasks at the main system level.	Beginning of WUA involvement in canal operation, water distribution and supervision of water distribution on of day-to-day basis.
Feb. 3, 197 (2053/10/21)	Decision made by WUA main committee to take over trees along canal bank.	A delegation led by a team of WUA functionaries negotiated with the Ministry of Forest and decision was made to develop a forest utilization plan on August 23, 1997 (2054/5/7).
Oct. 7, 1997 2054/6/21)	A committee constituted by WUA main committee to draft election rules for the election of WUA functionaries at all tiers.	A election rule was drafted that was approved by general assembly on November 29, 1997 (2054/5/14)
Nov. 6, 1997 (2054/7/21)	Main committee decision to take over the entire operation and maintenance of NWGIS beginning November 26, 1997 (2054/8/13).	Turnover of the system to WUA. A formal turnover ceremony was organized on November 29, 1997 (2054/8/14).
Nov. 29, 1997 (2054/8/14)	Election Commission formed by the general assembly to initiate the process for the third election of WUA functionaries at all levels.	WUA began conducting the election. Previous ones were conducted entirely by NWGIS/DOI officials.
April 2, 1998 (2054/12/20)	Beginning of 3rd election of WUA functionaries at all levels.	Election of Upatoli level functionaries was conducted on April 2, April 7 and April 13, 1998 and the election of Toli level functionaries was conducted on April 23, 1998. The schedule for the election of functionaries for the "Board of Directors" was yet to be decided.

Table 2: Time Line of Evolution of WUA in Panchkanya Irrigation System (PIS)

Date	Event	Outcome
Chaitra 31, 2050 (April 12, 1994)	Notification issued by NLIP/DOI to organize a meeting of the Water Users to discuss the proposal of joint management process in PIS.	
Baisakh 5, 2051 (April 18, 1994)	A meeting of Water Users called at the Head works of Khageri including water users, local leaders and NLIP/DOI officials to discuss the proposal of joint management process in PIS. A 13-member committee was constituted to draft the constitution of WUA.	Beginning of Joint management program in PIS
Baisakh 5-15, 2051 (April 18-28, 1994)	Personnel deputed from NLIP/DOI helped preparing records of area under irrigation under each branch, tertiary and outlet of the system, number of users, landholding size etc.	Data needed to initiate the institutional development process were collected.
Baisakh 22-24, 2051 (May 9, 1994)	Election of functionaries for the branch level committees was completed. General Assembly Members were elected with one member from each of 10 ha under irrigation.	1st election of Functionaries for the lower tiers of WUA that led to the beginning of organized participation of users in governance of the system.
Baisakh 26, 2051 (May 9, 1994)	1st election of functionaries for the WUA Main Committee that included 4 – functionaries-chairman, vice chairman, secretary and treasurer, and 9 members	Completion of election of functionaries at all tiers of the federated organization of WUA.
Baisakh 26, 2051 (May 9, 1994)	Decision made by General Assembly to enact the constitution drafted by the constitution drafting committee and initiate the process of registration of WUA. Decision was made for the users to obtain membership of WUA by paying a membership fee of NRs.10.	Beginning of formalization of users' claim on water by setting boundary rules- the rules for inclusion and exclusion of users.
Jestha 25, 2051 (June 8, 1994)	Decision made in the main committee to draft Operational Rules and Regulations of WUA. The draft Rules and Regulations were enacted with the Main Committee decision of August 7, 1997 that laid out frameworks of rules for membership, share administration, water allocation, resource mobilization, fines and sanctions, monitoring and preservation/conservation of physical infrastructure.	Beginning of operation and management on written rules.

Mangsir 15, 2051 (December 1, 1994)	Beginning of IMTP involvement in PIS. Decision made to open the bank account of WUA.	PIS was taken as one of the sub-projects under IMTP to support management transfer process. A seven members sub-project management committee was constituted with the WUA representatives under the chairmanship of NLIP Chief.
Mangsir 22, 2051 (December 8, 1994)	Main committee made decision to collect irrigation service fee @ NRs. 40 per bigha per year beginning the fiscal year of 2051/52 (1994/1995).	Initiation of ISF Collection
Shrawan 27, 2052 (August 12, 1995)	General Assembly made decision to initiate the process of developing action plan for rehabilitation and improvement of the system under IMTP and that the WUA would take-over the operation and management of the system after the completion of rehabilitation and improvement.	Initiation of identification of rehabilitation and improvement needs under IMTP.
Paush 29, 2052 (January 13, 1996)	Decision made by the main committee to set up an office of the WUA in a rented room at Bhanu Chowk/Ratnanagar VDC.	Establishment of regular office of the WUA
Falgun 5, 2052 (February 17, 1996)	Beginning of physical rehabilitation and improvement works under IMTP.	Construction works for the 1st phase of rehabilitation and improvement began. WUA deputed personnel for supervision and monitoring to ensure construction quality.
Jestha 18, 2053 (May 31, 1996)	Second term election of functionaries at all tiers of WUA.	
Ashwin 5, 2053 (September 21, 1996)	Decision made by general assembly to raise ISF @ NRs. 90/ha/crop.	
Paush 12, 2053 (December 27, 1996)	Introduction of share system to define users' right on water. One share of water in the system was defined to be equivalent to 1 kattha (0.2 ha) of land. All the users were required to register share with the WUA depending upon land holding size.	Initiation of operation and management of the system as a corporate body with users having defined claim on water and resource mobilization obligation depending upon the land holding size.
Baisakh 24, 2054 (May 6, 1997)	Decision made by the general assembly to take over the part of the system rehabilitated under phase-I under IMTP.	Beginning of system turnover.
Ashadh 2, 2054 (June 16, 1997)	Decision made by the main committee to charge a fixed sum of fee to the individuals and institutions coming to PIS for observation visits/study/research etc.	Beginning of exploring other sources for financial resource mobilization besides regular ISF, membership fee and share registration fees.

Ashadh 20, 2054 (July 4, 1997)	Decision made by the general assembly to take over the operation and management of the system from DOI. This included the transfer of use right of all the physical structures pertaining to the system and the land in possession of the system.	
Shrawan 27, 2054 (August 11, 1997)	Decision made by the main committee to install staff gauge at several locations in the main canal to measure and record the canal flows.	Beginning of efforts towards scientific flow monitoring and water allocation on the basis of volumetric flow in the system
Marga 28, 2054 (December 13, 1997)	Turnover of PIS to the WUA in a formal ceremony organized in the presence of Director General of DOI. A total of 141 persons including WUA functionaries, user farmers, representatives of line agencies, GOs, NGOs and DOI officials were present on the occasion.	Formal transfer of use right and operation and management of the system to the WUA.
Paush 4, 2054 (December 19, 1997)	Decision made in the general assembly to enact the amendment in the constitution of WUA and new operational rules and regulations to match with the changes in the structural attributes of the system brought through rehabilitation and improvement under IMTP.	Restructuring of WUA organization consistent with the physical layout of the system.
Ashwin 20-24, 2055 (October 6-10, 1998)	Third election of functionaries at all tiers of WUA within the framework of organizational structure as per the amended constitution. The main committee on 2055 Bhadra 27 enacted a regulation for election process of functionaries at all tiers of WUA.	Beginning of independent system operation and management by the WUA.

Source: WUA Records

Table 3: Representation of Members in the Board of Directors from Lower Tiers of WUA in NWGIS

Name of the Canal	Area Under Command (ha)	Upatoli Committee		Toli Committee		Branch Committee		No. of General Assembly Members	No. of Representation in Board of Directors
		No. of Committees	No. of Functionaries	No. of Committees	No. of Functionaries	No. of Committees	No. of Functionaries		
MC-1	40.7	1	7	1	4	-		2	1
SFD-1	10.5	1	7						
SFD-2	12.62	1	7	1	4	-		2	1
MC-2	63.21	1	7						
MC-3	91.72	1	7	1	4	-		2	1
SFD-3	12.62	1	7						
Chhiwani Water Course (MFD-1 to 4	123.93	4	28	1	7	-		4	1
MC-4	120.71	1	7					1	1
MC-5	134.44	1	7	1	4	-		1	1
SFD-4	20.08	1	7					1	
Bishnuguni Branch	1320.6								
MFD-1 to 14		14	98						
OT-1 (MFD-1 to 10)		10	70	1	10				
OT-2 (MFD-1 to 8)		8	56	1	8	1	21	37	1
OT-3 (MFD-1 to 5)		5	35	1	5				
MC-6	45.91	1	7	-	-	-		1	1
MC-7	177.4	1	7	-	-	-		1	1
MC-8	34.2	1	7	-	-	-		1	1
MC-9	87.26	1	7	-	-	-		1	1
Manjharia Minor (MFD-1 to 23)	1225	23	161	1	23	-		23	1
MC-11	73.4	1	7	-	-	-		1	1
Nandapur Minor (MFD-1 to 8)	368.8	8	56	1	8	-		8	1
MC-12	27.98	1	7	-	-	-		1	1
Bhujahawa Branch	1150.54								
MFD-1 and 2		2	14	-	-				
Bhujahawa Minor (MFD-3 to 15)		13	91	1	13				
Gadauri Minor (MFD-1 to 6)		6	42	1	6	1	9	21	1
Shankarpur Minor (MFD-1 to 8)	392.7	8	56	1	8			8	1
MC-15	21.92	1	7	-	-	-		1	1
MC-16	42.44	1	7	-	-	-		1	1
MC-17	35.93	1	7	-	-	-		1	1
MC-18	37.85	1	7	-	-	-		1	1
MC-19	23.95	1	7	-	-	-		1	1
MC-20	31.5	1	7	-	-	-		1	1
Piprahawa Branch	1096.75								
MFD-1 to 4		4	28	-	-				
Sunari Minor (MFD-1 to 5)		6	42	1	6				
Jaini Minor (MFD-1 to 5)		5	35	1	5	1	11	24	1
Piprahawa Minor (MFD-1 to 9)		9	54	1	9				
SFD-5**	8.92	1	7	-	-	-		1	1
MC-21	46.3	1	7	-	-	-		1	1
MC-22	84.15	1	7	-	-	-		1	1
MC-23	38.07	1	7	-	-	-		1	1
MC-24	22.00	1	7	-	-	-		1	1
Pathi Minor (MFD-1 to 5)	189.1	5	35	1	5	-		5	1
Germi Minor (MFD-1 to 5)	248.92	5	35	1	5	-		5	1
Bhagatpurwa Minor (MFD-1 to 5)	240.31	5	35	1	5	-		5	1
Ragungunj Minor (MFD-1 to 5)	246.33	5	35	1	5	-		5	1
MC-25	47.28	1	7	-	-	-		1	1
MC-26	25.08	1	7	1	4	-		2	1
SFD-6	20.00	1	7			-			
SFD-n 1 and 2	77.00	-	-	-	-	-	-	-	-
Total	8041.12	174	1218	21	148	3	41	174	35

** Upatoli level functionaries were not elected in these SFDs during this election of WUA.

Table 4: Number of Functionaries Elected for One, Two and Three Terms in the Three Elections of WUA in Bhujahawa Branch of NWGIS

Level	No. of Functionaries Elected for One Term	No. of Functionaries Elected for One Term	No. of Functionaries Elected for One Term
Upatoli Level Committee			
MFD-1	18	4	-
MFD-2	16	2	1
Bhujahawa Minor			
MFD-1	12	6	1
MFD-2	21	1	1
MFD-3	15	2	-
MFD-4	*	*	*
MFD-5	9	5	-
MFD-6	8	8	1
MFD-7	6	2	3
MFD-8	13	3	-
MFD-9	8	1	3
MFD-10	8	4	1
MFD-11	10	3	1
MFD-12	15	2	-
MFD-13	17	1	-
Gadauri Minor			
MFD-1	**	**	**
MFD-2	17	1	-
MFD-3	15	2	-
MFD-4	4	3	3
MFD-5	10	3	1
MFD-6	12	2	3
Toli Level Committee			
Bhujahawa Minor	23	2	3
Gadauri Minor	14	1	2
Branch Level Committee			
Bhujahawa Branch	18	5	1
WUA Main Committee* **	56	16	6

* First and second elections were not conducted at this Upatoli

** First election was not conducted at this Upatoli

*** In the new organizational structure of WUA, the Board of Directors has replaced Main Committee.

Paper 6: Operational Practices in Khageri Irrigation System, Nepal

V. S. Mishra

ABSTRACT

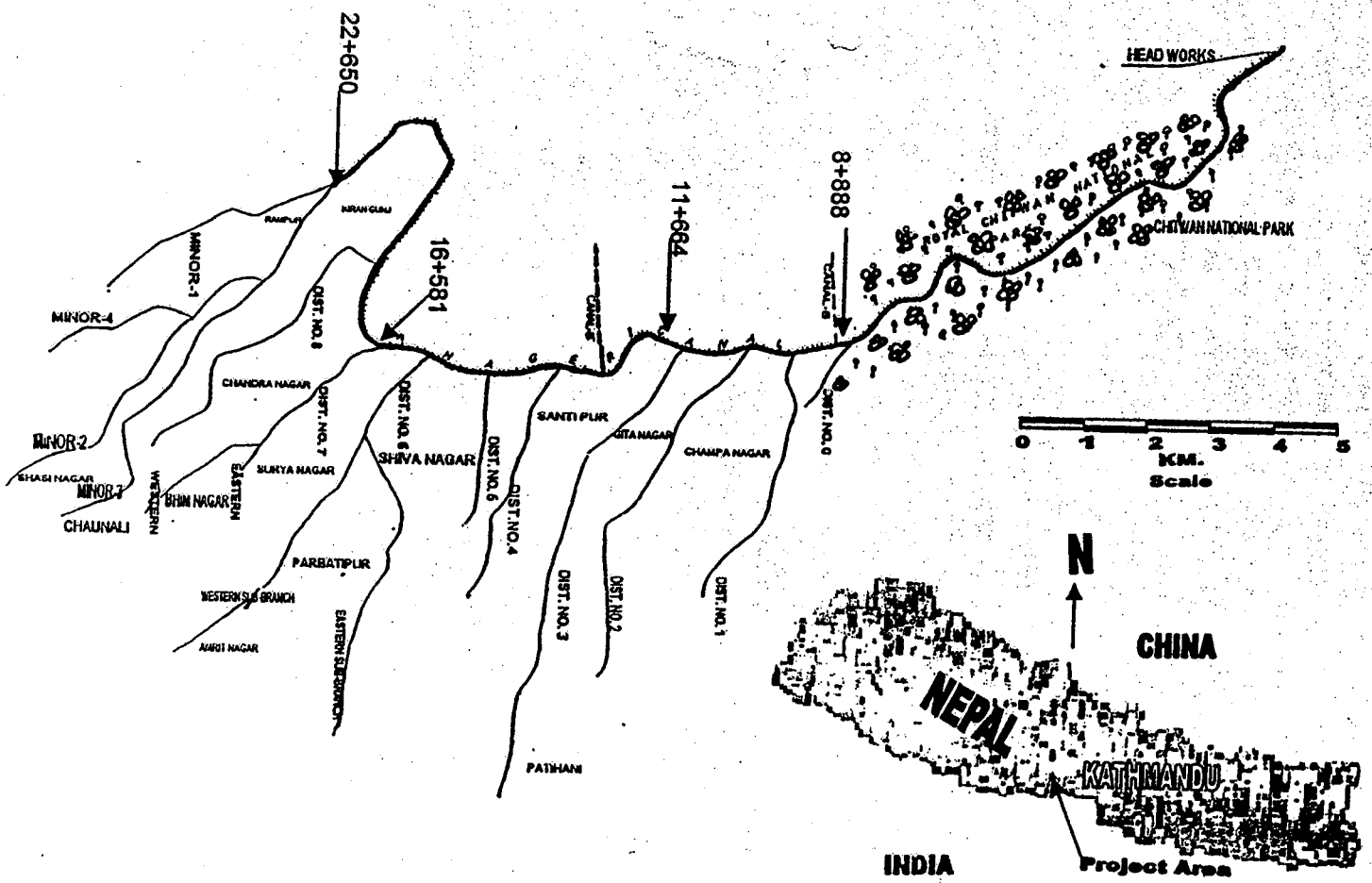
Operation of a system is guided by a set of rules. These rules are applicable in a designed flow condition, which rarely prevails in any system. Conflicting and competing objectives are the major reasons hindering the formulation and implementation of an effective set of rules. This study was conducted in a medium scale project of Nepal with an aim to define a set of rules with desired operational flexibility to match with available resources and facilities for equitable water distribution. As in other river diversion scheme this system is also suffering from unreliable and varying flows during the periods of high water requirements. This has led to increased demand for frequent and efficient adjustments of water controlling structures. Because of conflicting goals to be met at a time such as water level management and discharge based management, operators get confused and are bound to form their own rules to satisfy the users which often is difficult. As a result inequity in water distribution persists.

From the analysis based on a simple methodology of field measurement and survey associated with simple statistics, it has been noted that the gate operation for equal water distribution in an irrigation system depends over several factors such as; planning and design of physical systems, planning of operation schedule, communication and information transferring procedure, skill of monitors and operators, and above all, social understandings.

INTRODUCTION

Due to growing demand on scarce water resources a need for efficient irrigation systems with higher degree of water delivery performance is realized. Consequently a new management practice has yielded and is defined in terms of equity and reliability in water distribution. Although adequacy is an important parameter for better performance of a system it has not much importance in comparison to equity and reliability evolving a sustainable irrigation system in long run.

Figure 1: Layout Map of Khageri Irrigation System



There are several factors influencing the performance of a system among which operation of flow control structure plays dominant role in maintaining equity and reliability. A widely accepted irrigation system is the conventional upstream control system. All old canal systems and most of large projects in developing countries are designed for upstream control irrigation system. Operational flexibility is constricted in an upstream control system because at low flows the gate will be almost closed and at the maximum design flow rates the gate may be raised out of the water to maintain a constant level, regardless of the flow through the structures. Operation of flow controlling structures is guided by a set of rules but in fact the rules are applicable in design flow condition only, which seldom prevails in any system.

Design, placement and operation of flow controlling structures are inter-related from managerial point of view. Since water control devices are provided in all irrigation schemes in order to facilitate management of water distribution the relationship between choice of technology and management ability of the system and the decision to choose a certain technology should be made in the light of the local situation (Horst, 1990). It is because the modernization option will be more costly than the simplification option. Still in developing countries manually or mechanically operated technology is in use because of financial, technical and social problems. A large room for farmers involvement in decision making process exists in contrast to a modern computer guided system (Horst, 1990). So a precise set of rules is required for the operation of the system to yield a higher performance.

In most of the river diversion schemes fluctuations in river flow exist. Due to such fluctuations the preset rules cannot work in absence of efficient and effective information transfer and communication facilities. Also due to some natural problems such as sedimentation and weeds, the hydraulic regime of canal changes changing the flow conditions. Gate operators get confused and operate gates as per the schedule (idle rule) provided by the management or follow the self-made rule resulting in inequity and unreliability in water distribution throughout the system.

The hydraulic flexibility of the canal bifurcation is one of the major factors influencing the operational procedure. A set of rules regarding the extent of flexibility to be allowed in gate operation depends on the changing hydraulic condition and is a subject of great importance for improved water delivery performance. The rules may vary with site conditions but systems having a similar set of conditions can be generalized. For this, a co-relation between control structures and flow conditions must be established.

The importance of control structures in maintaining the equity in Khageri Irrigation System was analyzed through observations and field measurements.

DESCRIPTION OF THE STUDY AREA

Khageri Irrigation System (Fig-1) is a jointly managed medium scale project of Nepal. The system was basically proposed to supplement the irrigation requirement of monsoon paddy covering 3,900 ha through 9 branch canals, 4 minor canals and 42 direct pipe outlets along 22.6-Km long main canal.

The source of the system is the Khageri River. Water supply to the project is highly variable both from season to season and within a particular season because of limited watershed area producing the runoff. The discharge observed in the system during April was 2.50 m^3/sec. The lowest discharge of 0.42 m^3/sec was in May and the maximum design discharge of 7.084 m^3/sec was available during October and November. Thus, this system faces water shortage during dry period.

The study area lies in a hot and humid subtropical climatic region of Nepal. The heaviest downpour in the area occurs during the month of July. The average annual rainfall is 1,870 mm. 90% of the rainfall occurs during the wet season from May to October whereas July is the wettest month and December is the driest month.

The mean air temperature varies from 5°C in December-January to 40°C in April-May with an average of 24°C resulting in an evaporation of 50 mm (1.7 mm/day) in December to about 200 mm (6.7 mm/day) in May with an annual average of 1,450 mm.

The system topography comprises of a large number of ridges and valleys in the head reach where as middle and tail portions of the command area are fairly plain. The soil in major portion of the command area is sandy loam, sand mixed with grits and highly porous. This type of soil needs more water as compared to that of the Indo-gangetic plain. The total evapo-transpiration and percolation loss is 15.6 mm/day.

The main canal system is contour aligned with head reach in cutting where as in tail and middle reaches it is running over fairly plain land crossing over several natural drains and induce high seepage in middle and tail reaches. Both the main canal and branch canals are used to irrigate the field. In early planning only two types of gated outlets were proposed. One is weir (submerged) type (D0, D1) and another is side weir free fall type outlet (D2-D8 and M1-M2). Later on, direct pipe outlets were also placed to irrigate uplands on demand of users without any technical justification. Openings of pipe range from 0.15m to 0.30 m. Discharges through outlets are controlled by cross regulator d/s rather than by the gates of outlets. Outlets are operated on on-off basis. In the case of direct pipe outlets, no particular schedule is followed. Operation of this depends on individual demands. Since direct pipe outlets are placed at higher level, some of them are placed even higher than full supply level.

At the field level there are no well-defined field channels. Only pipe outlets have been provided for irrigation that cause high application loss reducing the system efficiency.

Khageri is being jointly managed since January 1993. Users are responsible for operation and maintenance of branch canals and below, whereas the agency operates and maintains the main system. But gradually users have assumed operational responsibility of the main system too except the H/W. The operational schedule followed is as previously used by the agency and no significant change has been observed in the distribution pattern. However, farmers' involvement has reduced conflicts in water distribution at field level as well as the information transfer and communication process have become more efficient (faster) than before resulting in timely decisions to operators and quicker conflict resolution. This also has benefited resource generation and mobilization efforts with low cost and timely maintenance of branches and below the system.

EXISTENCE OF OPERATIONAL RULES

Two types of water distribution rules are adopted: Two-phase (weekly) rotation and three-phase (sectional) rotation system. These rules are being followed for long since the project was brought in operation. Initially weekly system was adopted according to which a number of outlets are scheduled for seven days and the remaining for next seven days.

From the table-1 we see that discharge scheduled in both weeks are almost the same but the area to be irrigated in 1st week is more than 2nd week by 25% which clearly reflects inequity in water distribution.

Table 1: Schedule for Weekly Rotation

Week	Branch to be Opened	Duration (days)	Area (ha.)	Discharge Scheduled in M/C (m^3/sec)	Total Volume $(Mm)^3$	Av. Depth (mm/day)
1st	D0, D1, D2, D5, D6 E, D7, D8,M-1	7	2166.9	4.72	2.852	18.8
2nd	D0,D1,D3,D4,D6W, M-2,3,4,	7	1671.3	4.64	2.807	24.0

Some observations are as follows:

a) The total of discharge scheduled to all outlets are more than the design discharge of 7.084 m^3/sec. So two-phase rotation system is adopted.
b) It does not cover the direct pipe outlets, which means direct pipe outlets are randomly scheduled.
c) The discharges scheduled for each week is quite less than design capacity, which reflects the existence of high fluctuation in flows.

Whenever discharge reduces below 5 m^3/sec a three-phase rotation is adopted. The total flow is diverted to particular section under schedule. This schedule is adopted during drought and occasionally during land preparation and seedling for few days. The column 7 of table-2 reflects the inequity in water distribution. Although the direct pipe outlets are not

considered in schedule, they can get water easily in a large quantity for longer time than that of two-phase rotation because the flow is fully controlled by checking the cross-regulators at downstream end of the section. So users of direct pipe outlets prefer the three-phase rotation system.

Table 2: Schedule for Sectional Rotation

Sector	Branch to be opened	Duration (days)	Area (ha)	Discharge Scheduled (m^3/sec)	Total Volume (Mm^3)	Av. depth (mm/day)
Gita Nagar	D0, D1, D2, D3	4	1163.7	2.83	0.980	21.11
Shiva Nagar	D4, D5,D6E,W, D7	6	1497.5	3.29	1.706	18.90
Mangal Pur	D8, M -1, 2, 3, 4,	5	745.6	1.44	0.620	16.72

GATE OPERATORS VIEW

An informal discussion with gate operators was held to understand the prevailing operational procedure, its effectiveness and facilities available. It was noticed that operators are not satisfied with the operational flexibility provide to them. They are restricted by fixed design rules, which never prevail due to frequent fluctuations in the flow. The flexibility provided on ad hoc basis has no justification. It creates confusions. Operators are supposed to adjust the gates so as to satisfy the users' demand irrespective of actual flow available. So operators have formulated their own rules on their experience as follows.

1) They have observed the following water depths above the crest to run the canal at full supply level to meet the requirements.

Table 3: Design, Expected and Observed Depths over the Outlet Crests

Outlets	Design depth over crest. (m)	Expected depth (m)	Observed average depth (m)
Branch D0	----- (0.46)	0.65	0.649
Branch D1	----- (1.04)	0.85	0.768
Branch D2	0.39 (0.51)	0.60	0.530
Branch D3	0.39 (0.45)	0.45	0.405
Branch D4	-	0.35	-
Branch D5	-	0.40	-

Note: Numbers in parenthesis stand for available depth at design FSD.

2) While adjusting supply levels for direct pipe outlets, they fix level so that the u/s of pipe outlets gets submerged for 24 hours.
3) Usually they adjust gates in the evening so that the next morning morning flow becomes stable.

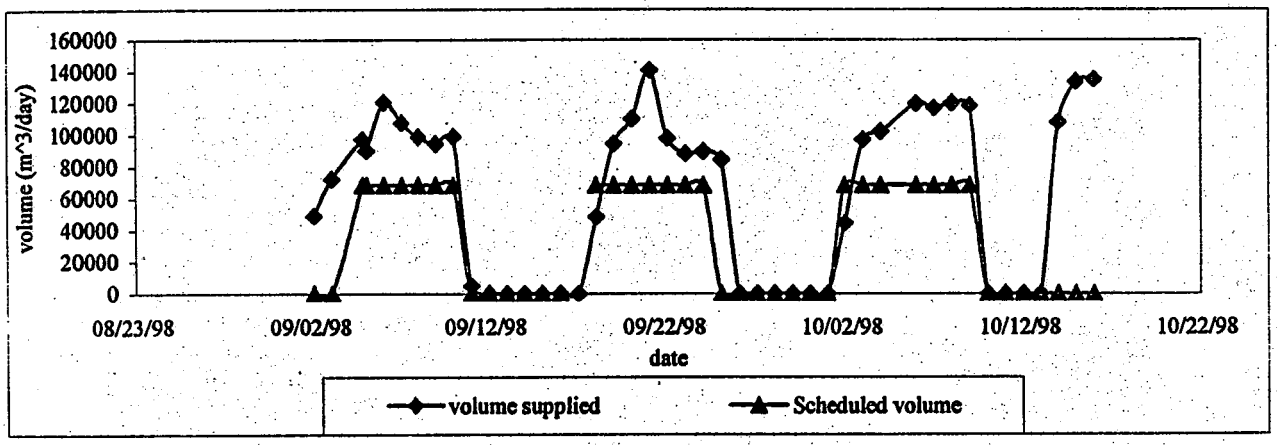
During discussions they expressed that social pressure has reduced because there are user organizations at field level to coordinate between users and agency and among users as well. Further they argued that rules are still not so effective. Farmers from direct pipe outlets in the head reach are completely dissatisfied where as tail-end users comment on low flow and uncertainty of delivery. So they expect some changes in existing rules for better and efficient operation as follows.

HYDRAULIC BEHAVIOR

The gate adjustments and flow patterns were studied from 2nd Sept. to 23rd Oct. 1998 (vegetative to flowering stage). The most common problems concluded are as below.

1) Designed outlet capacity does not match with the actual requirements. Most of the outlets are of less capacity, which require frequent gate adjustments. As we see in fig. 2, the discharge supplied through outlet D2 is always more than the designed but the depth applied is less than the required (fig 3). Whereas, the volume supplied through outlet D3 (fig 4) is always less than the designed but depth applied is more than that in D2.

Figure 2: Variation in Volume Supplied in Distributory D2



2) Direct pipe outlets have been provided to irrigate uplands so even a small fluctuation in the main canal affects a lot. These outlets always need a level-based management. Also the existing schedule does not define water use right for direct pipe outlets so it becomes difficult task for operators to cope up.

Figure 3: Variation in Depth Applied in Different Outlets

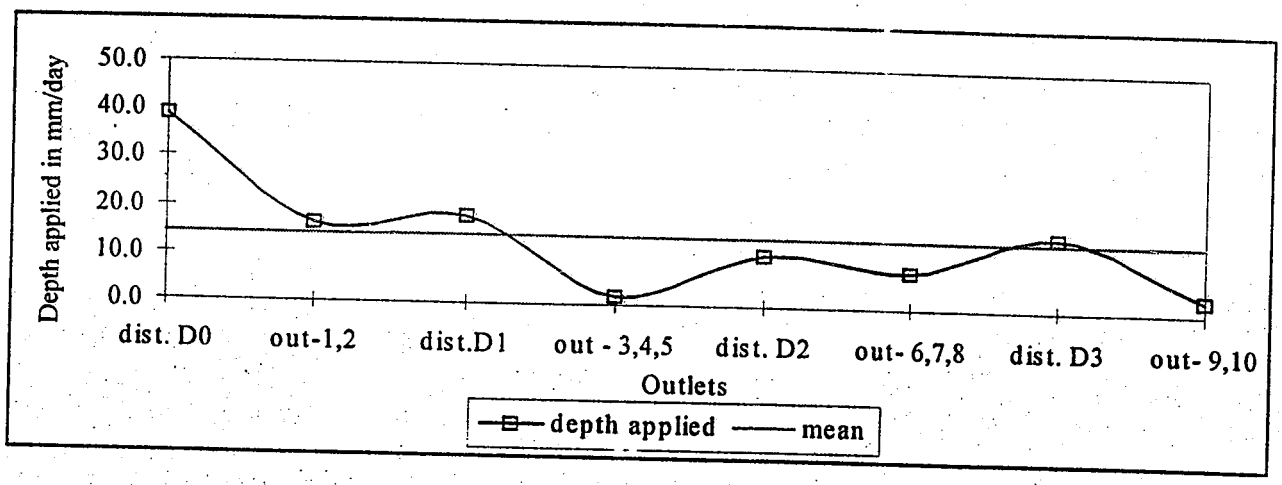


Figure 4: Variation in Volume Supplied in Distributory D3

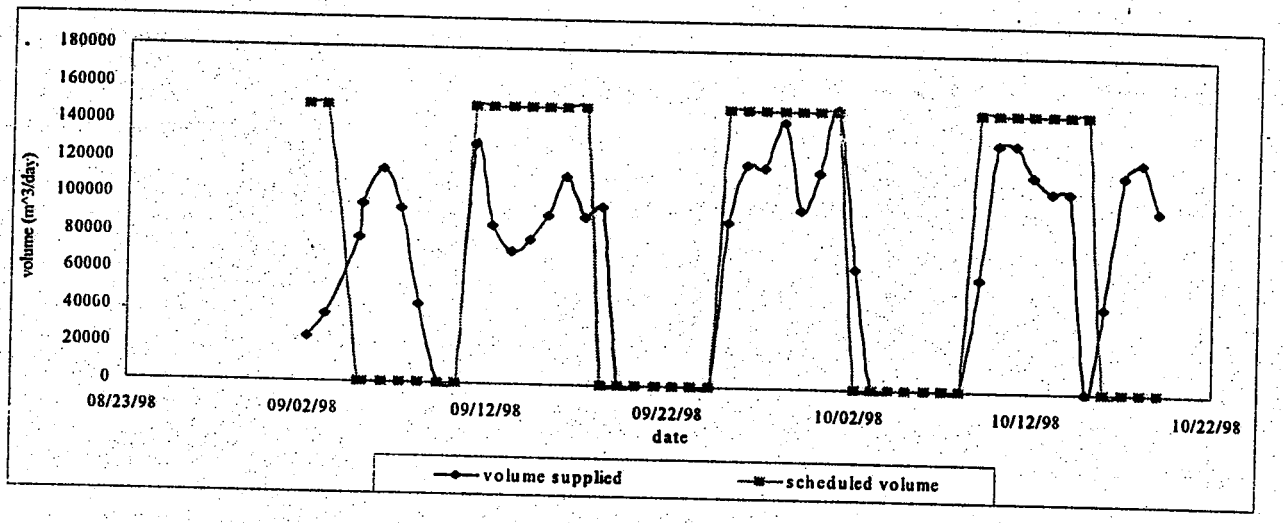
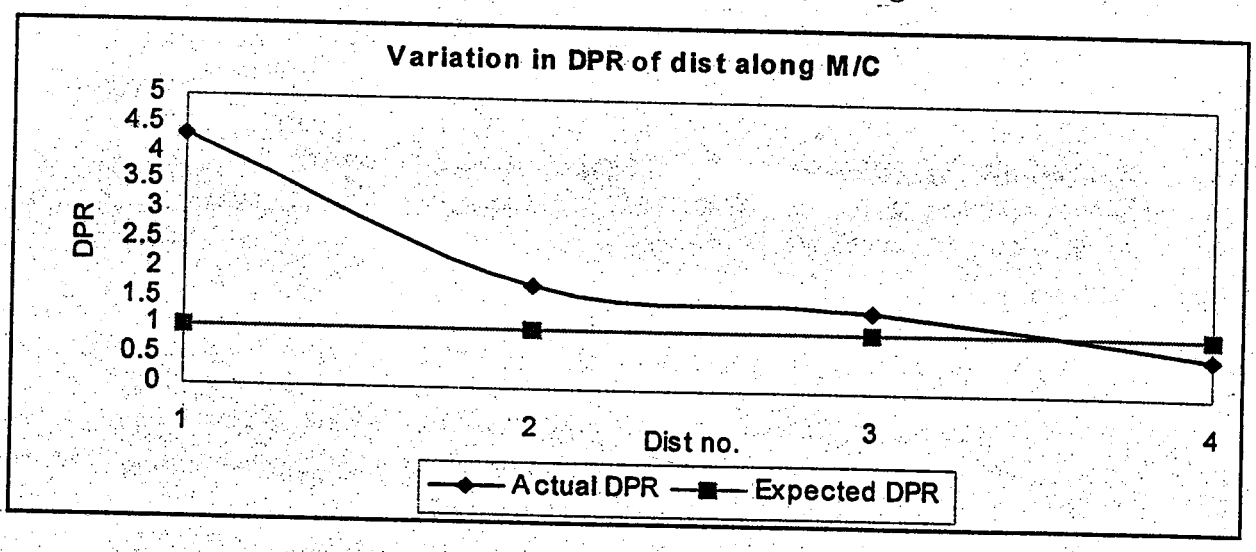


Figure 5: Variation in DPR of Distributory along Main Canal



3, The prevailing operational schedule is not sufficient to meet the crop water requirements. Inequity is the major issue of existing rules (fig 5). Although outlets are drawing more than designed, users do not seem to be satisfied.

4) Flow in the canal highly fluctuates requiring frequent adjustments.

5) Gate operators follow the level-based management on their experience irrespective of the discharge passing through control structures. Table 4 and 5 provide a picture of this. Table 4 reflects that u/s levels of 1st three cross regulators are always maintained more than the designed. Since all the cross-regulators are in a series, the excess level maintained in u/s of previous three cross-regulators has resulted a lower water level in u/s as well as d/s of cross-regulator D3. Similarly full supply depth d/s of these cross regulators also reflect similar results. Gradual reduction in d/s FSD is observed. This shows that a level-based management operation induces high degree of inequity in water distribution.

Table 4: Deviation of Water Level from the FSD in the Upstream of X-Regulators

X-regulator Km	FSD m	Deviation from FSD to			Stad deviation m	% of reading below FSD
		Mean m	Maxm m	Minm m		
8.890	1.4	0.11	0.36	-0.22	0.09	9.6
9.989	1.4	0.20	0.52	0.04	0.11	0.0
10.445	1.4	0.18	0.39	-0.30	0.09	2.0
11.582	1.37	-0.06	0.10	-0.45	0.09	62.9

Table 5: Deviation of Water Level from the FSD in the Downstream of X-Regulators

X-regulator Km	FSD m	Deviation from FSD to			Stad. Deviation M	% of reading below FSD
		Mean m	Max m	Min m		
8.890	1.40	0.04	0.29	-0.46	0.103	25.0
9.989	1.40	0.10	0.35	-0.17	0.084	11.0
10.445	1.37	0.02	0.25	-0.32	0.130	39.0
11.582	1.28	-0.06	0.14	-0.64	0.140	63.1

6) Water master on behalf of WUA instructs gate operator to open and close the gates but does not provide any guidelines to minimize frequent skilled gate adjustments.
7) Actual need assessment made by water masters do not seem to be correct as a result of which gate operators get confused in adjusting the gates.
8) Gate operators have full authority to adjust gates during heavy rain and floods and other problems hindering operation of the system.
9) Control structures have relatively higher degree of flexibility causing further confusions (table 7).

Table 6: Gate Width and Height of Cross-regulators

Description	X-D0	X-D1	X-D2	X-D3
Net gate width (m)	5.46	5.67	3.97	4.52
Gate height (m)	2.05	2.24	2.30	1.65
Design water depth(m)	1.40	1.40	1.40	1.37

10) Although gate operators strictly follow the rules provided by the management, inequity in distribution exists, indicating defects in the rules.
11) Flexibility of Operation was used to measure the level of inequity in distribution. The flexibility of two structures at a canal bifurcation describes the relative change in flows over the other two structures. A change in the flow ΔQ is defined as the ratio of rate of change in discharge of outlet to rate of change of discharge in parent channel $((\Delta Q_o/Q_o)/(\Delta Q_p/Q_p))$ or m/n x D/H, where D is the depth in main channel and H is the depth over crest of outlet, m is the outlet index ($Q_o = CH^m$) and n is the channel index ($Q_o = CD^n$).

From the table 7 we see that most of the time, Flexibility at X-D_o and X-D_2 is less than 1 which means that the level maintained is more than the design depth or the setting of outlet is below than the proportional setting. As a result, a higher degree of adjustment is required to increase or decrease the supply. In the case of outlet D1 we find that flexibility is mostly higher than 1, which means that outlet is hyper-proportional or the setting of outlet is higher than the proportional setting or level.

Table 7: Flexibility of Operation Adjacent to Gate Setting

Bifurcation X-Regulator	F	% Go. Adj.	F	% Go Adj.	F	% Go Adj.	F	% Go Adj.	F	% Go Adj.	F	% Go Adj.
D/s of Do		10.7	-0.27	-39.6	0.04	+43.0	-0.41	-12.7	2.85	+21	-0.13	+0.7
D/s of D1	18.31	-5.6	30.57	-20.4	-7.05	- 0.8	0.03	+28.8				
D/s of D2	-0.79	+18.6		-14.3		-140.0	0.32	+42.0	-0.24	-14	-1.44	-16.3
D/s of D3	-0.31	+57.7	-2.15	- 8.9	-0.52	+ 9.8	-0.33	-18.6				

+/- signs for G0 adjustment stand for gate opening and closing respectively.

The level maintained is lower than proportional level and hence even a small adjustment highly affects the outlet discharge. Similarly in the case of X-D3 we see that there is simultaneous change in the sensitivity. It means that the level is fluctuating and wherever the level goes below than the proportional setting, the flexibility increases and whenever the level increases than that it behaves as sub-proportional with low sensitivity. It reflects that the outlet setting is a prime factor governing the adjustment of gates.

USERS OPINION

A set of structured questionnaires was prepared to know irrigators' opinion. Sample farmers were selected on the basis of stratified random sampling techniques. The project area was classified into three segments, head, middle and tail. Since there were different types of outlets such as branch, minor and direct pipe outlets, all types were selected because management problems differ from one type to another.

The farmers were asked 17 statements related to almost each and every aspect of operational management problems and the responses were analyzed.

Table 8: Irrigators Responses over Different Operational Management Problems

Irrigators opinion				
Statement	**Head**	**Middle**	**Tail**	**Overall response**
Adequacy of Irrigation delivery	+1.84	0.00	-0.7	+0.64
Effectiveness of three phase rotation system	+0.11	-0.67	-0.2	-0.23
Effectiveness of two-phase rotation system	+2.05	+0.67	-1.6	+0.75
Needs for rules modification	+1.42	+1.60	+1.2	+1.43
Impact of lining	+0.84	+1.47	+2.3	+1.39
Impact of desilting on performance	-0.90	-1.33	-0.4	-0.93
Gate operators sincerity and punctuality	+2.47	+0.73	+1.7	+1.70
Information transfer and communication	+0.26	-1.33	+1.4	-0.02
Frequency of contact with gate operators	-0.42	+0.13	-0.4	-0.23
Sincerity of gate operators to entertain the users request	-1.95	-1.87	+1.0	-1.25
Right to operate distributory Intake gate	-1.53	-3.00	-2.4	-2.23
Participation of users in modifying or forming rules	+0.58	-1.67	-0.4	-0.41
Frequency of change in operational problems	+1.11	+0.13	-0.6	+0.39
Punishment for rule breakers	-1.00	-1.73	-0.9	-1.23
Punishment to gate operators who deliver water incorrectly	+0.05	-0.20	0.0	-0.05
Understanding of rules	-0.21	+1.33	-0.8	+0.18
Difficulty of the rules for gate operators to adopt	+1.16	-0.47	-0.3	+0.27

+3 =strongly agree, +2= moderately agree, +1 =slightly agree, 0 =neutral, -1 =slightly disagree, -2 =moderately disagree, -3 =strongly disagree.

RESULTS DISCUSSION

Operational Rules

By going through the summary table of responses, we see that users are not satisfied with the existing water distribution rules (operational rules). This can be defined as a planning

mistake. The operational schedules discussed before also reflect that inequity in distribution clearly exists. In the two-phase rotation system, area scheduled in the first week gets 18.8 mm/day and in 2nd week it gets 24mm/day. Similar is the case for three-phase rotation. Notably, at head reach water application rate (mm/day) is higher and gradually diminishes towards the tail reach as expected but when we think about total volume of crop requirement, we see that the head reach is getting water after 11days and tail reach after 10 days where as middle reach gets water after 9 days. It gives a clear picture that the head reach is getting 5.61 mm/day. During weekly rotations, outlets scheduled in 1st and 2nd week get 9.4 mm/day and 12 mm/day (Table 9).

Table 9: Scheduled Water Depths in different Rotation Systems

Rotation	Outlets	Area ha.	Total volume Scheduled Mm^3	Duration Scheduled for	Average depth mm/day
Weekly					
1st Week	D0, D1, D2, D5, D6 E, D7, D8, M1	2166.9	2.852	14 days	9.40
2nd Week	D0, D1, D3, D4, D6 W, M 2, 3,4	1671.3	2.807	14 days	12.00
Sectional					
1st Section	D0, D1, D2, D3	1163.7	0.979	15 days	5.61
2nd Section	D4, D5, D6-E, W, D7	1497.5	1.706	15 days	7.60
3rd Section	D8, M-1, 2, 3, 4	745.6	0.623	15 days	5.57

Overall, users have reflected their preference to a two-phase rotation system over a three-phase rotation.

It is noticed that tail-end users and direct pipe outlet users are always in favor of the three-phase rotation. This means that during the two-phase rotation tail-end users get very less water because of interruptions from u/s users. This is also evident from the curve of delivery performance ratio. Some outlets of u/s are using more than scheduled resulting in water scarcity for d/s users. Direct pipe outlets users prefer the three-phase rotation because the desired level can be maintained by closing the cross-gates d/s of the section.

As usually found in farmer-managed systems, users as well as gate operators satisfactorily follow the rules provided by the organization. Some deficiencies exist because few groups of farmers of some outlets have overruled the norms in absence of clear rules or tools for assessing water use. To increase accountability both in the agency and farmers, a clearly defined agreement of water use is needed for equitable water distribution. Equity always does not mean equal distribution of commodities. Sometimes it is equality in sharing of feelings and understandings. For a sustainable organization leading to successful system operation equity in water distribution is essential.

Maintenance

Maintenance such as desilting and lining of canal are executed to improve the system performance. But always it does not happen. It has been realized that excess desilting has created problems in water allocation lowering the flow levels in canal and heads at outlets. Of course it has benefited the tail-end users but head reach outlets have suffered. Especially the direct pipe outlets placed at higher levels bear a negative influence because they always need a water-level based management. So desilting works need much care otherwise it may build pressure over gate operators for adjusting gates resulting in inequity through out the system.

On average, users are satisfied with the canal lining works but they do not feel indirect impacts. These lining works have changed the hydraulic regime increasing the velocity and reducing the depth of flow. As a result of which outlets in u/s of branch canals are suffering from low heads. The need for excess volume of water is intensified to maintain the supply level leading to water scarcity to d/s outlets in the main canal. So existing rules should be considered while rehabilitating the system. Alternatively, new rules to match the hydraulic conditions after rehabilitation should be introduced.

Effectiveness of the Rules

One of the major drawbacks observed from the users' responses is that violators of rules are not punished properly. This may encourage the users not to respect the rules. This has resulted in incidents of gate adjustments breaking the rules. This drawback reflects a weaker organizational status of the WUA. The WUA is not much capable of forming clear norms and communicating effectively.

Skill of Operator and Users' Organization

Even though it seems that user organization is running the system better than the agency, no new rules are followed as introduced by agency, which were argued to be ineffective in the past. For improved performance of the system, a need for changing the rules is realized but due to lack of needed the WUA is not capable to modify or change. Organization fully relies over the experience of operators based on hit and trial.

Operators are provided full authority to adjust the gate during floods and heavy rainfall or some minor problems like removing weeds and others. They have also flexibility to adjust the outlet gates under schedule so as to supply water to the users' satisfaction. As a result of which operators are bound to adjust the gates based on the demand of users, which sometimes creates water scarcity d/s. So, on the basis of users' expectation of full supply level, operators have formulated level-based operational rules irrespective of discharges passing through outlets or cross regulators d/s. Such a level-management sometimes cerates confusion because even though the level is high due to filling effect or siltation and weeds, the discharge d/s may not be sufficient. So even though the operators are following

the rules they lack enough understanding about the depth-discharge relationship. Flexibility in the gate operation without appropriate operating rules may instead induce inequity and irregularity in water distribution (Abernethy 1988).

Adaptability of Rules

High fluctuation in river flow makes the operation procedure very complex. Sometimes the operation pattern fully changes from a two-phase to a three-phase rotation system or vice-versa. It becomes difficult to follow a single pattern of water allocation. Operators have to take very frequent decisions on gate adjustments. A large number of undulated parcels of land is also one of the major problem hindering the operational performance. Water requirements from plot to plot vary tremendously so it is very difficult to fix a single target of outlet discharge. It needs frequent and timely assessment of requirements for which an efficient communication system is required inducing a higher cost of operation making it a more difficult task for the WUA.

Direct pipe outlet users are also obstacles for a smoother canal operation. Because of these outlets, operators have to play dual roles to meet two conflicting objectives at a time while maintaining the required level for direct pipe outlets as well as ensuring required discharge d/s of the system.

Structural Flexibility

Flexibility associated with the structures is one of the major parameter influencing the decision making by operators. Higher degree of built-in flexibility requires a higher cost of construction as well as more skilled manpower. In this system, considerable confusions has been created by providing high degree of flexibility to the structures in absence of any specified rule and skilled manpower. From the table 7, it is seen that the gate heights are significantly more than the designed depth, inducing u/s water depth always more than design FSD. Operators to deal with such flexibility must have sufficient knowledge of depth-discharge relationship and be capable of providing quick decisions to cope with the fluctuations in flows as well as demands for water. So such type of structures are hardly found in users-managed systems because they reduce the space for farmers' participation (Horst 1990).

Early Design and Planning Problem

As seen before, although the outlets are drawing more than designed users do not seem to be satisfied. The actual water requirement now is more than designed. Also, there is no consistency in outlet design. Some are designed for more than requirements and some for less. So actual need assessment becomes necessary for fairer water allocation. The placement of outlets is also defective such as in branch D_0 and direct pipe outlets. They run effectively only when the water depth is more than designed full supply depth in the main canal.

Another drawback of earlier planning is lack of well-defined farm channels at field level and water level control structures in branch outlets. Since the soil is highly permeable the existing field to field irrigation practice induce high application and percolation losses. So a clear agreement with the beneficiaries of such outlets is needed so they may not have any complaints or confusions. In other words, the principle of clarity is needed.

Flexibility of Operation

From the analysis, it is observed that the flexibility changes with a sudden increase or decrease in flow depths. Where the flow level is highly fluctuating it becomes difficult task for operators to keep the canal always at full supply level for proportional distribution of flow in outlets and d/s of main canal because this requires frequent and effective monitoring increasing the cost of supervision. Also it is analyzed that when the outlets are hyper-proportional, i.e. flexibility is more than 1, more caution is required while reading the gauges because a little difference may lead to a high degree of fluctuation in outlets. So adjustments need to be done very carefully. Where as in the case of sub proportional setting of outlet (flexibility is less than one) large extent of flexibility is needed in gate adjustment (table 7). There is one major benefit of such outlet because there is good opportunity for tail-enders to get fair share of water. In all system where discharge is always fluctuating, mostly outlets designed are sub-proportional. The lowest level of flow is generally considered for setting of the outlets. Because of this it becomes difficult for operator to think the actual level required for proportional division of flow. Whenever there is an increase or a decrease in the flow, operators get confused to decide on the proportionate level and adjustment is made erroneously, either more or less, leading to inequity.

Also the type of outlets governs the flexibility of operation. The best type of outlet for the proportional distribution is side weir free flow type structure but it is not always easy to provide because of high head loss. Orifice type outlets are more sensitive to variations in the depth of flow where as the flow in submerged weir type outlet depends on flow depths in main canal as well as branch canal. So even if the setting of outlet is done for proportional distribution, it is very difficult to achieve. Even at the same depth over the crest of outlet, different discharges can be observed.

In this system a variety of outlets exists. So if channel indices (n) and outlet indices (m) of a bifurcation is known, then for different depths of channel and depths over crest of outlet, the value of flexibility can be calculated from $F = (m/n) \times (D/H)$. This can be further used to evaluate the desired flexibility and the value by which the gate needs to be adjusted. The example can be illustrated using the theoretical values for weir type (free fall side weir) and orifice type outlets.

For weir type outlet or orifice type outlet, $m = 3/2$ and $1/2$ respectively and the value of n for trapezoidal channel is 5/3, so $m/n = 0.9$ for weir type and 0.3 for orifice type. Now for different main channel depths (D) and working heads over outlets (h), flexibility can be

calculated as shown in Table 11 and Table 12 for free fall side weir and pipe or orifice outlet respectively.

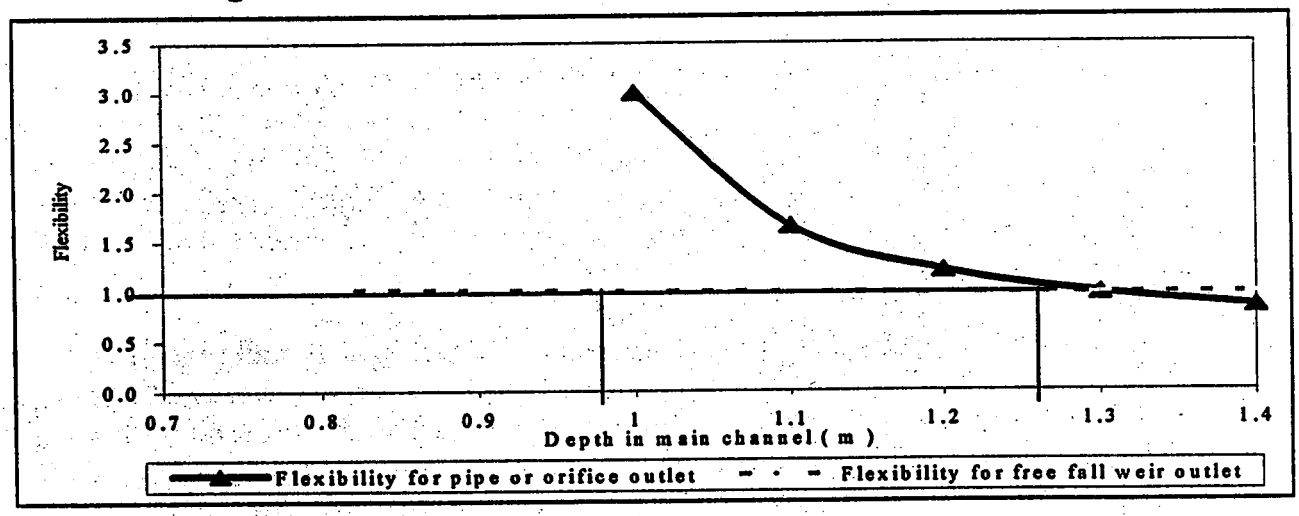
Table 10: Flexibility for Different Depths over Crest of Outlets and in Main Canal for Free Fall Side Weir

Depth in channel D	Depth over outlet crest h	m/n	D/h	F=(m*D)/(n*h)
0.8	0.7	0.9	1.140	1.026
0.9	0.8	0.9	1.125	1.013
1.0	0.9	0.9	1.110	1.000
1.1	1.0	0.9	1.100	0.990
1.2	1.1	0.9	1.090	0.983
1.3	1.2	0.9	1.080	0.975
1.4	1.3	0.9	1.077	0.970

Table 11: Flexibility for Different Channel Depths and Working Heads for Pipe or Orifice Outlet

Depth in Channel D (m)	Working head h (m)	m/n	D/h	F=(m*D)/(n*h)
1	0.1	0.3	10.00	3.000
1.1	0.2	0.3	5.50	1.650
1.2	0.3	0.3	4.00	1.200
1.3	0.4	0.3	3.25	0.975
1.4	0.5	0.3	2.80	0.840

Figure 6: Curve of Flexibility versus Depth in Main Channel



Communication Facilities

Communication system has been improved than that before but still it is not effective enough. Users are not satisfied with the communication system. Rules are still not clear to majority of users. Also while observing the gate adjustment events, it was noticed that

there was no efficient information transfer and communication facilities among the operators as well as between operators and organizations. Due to this several incidents of rule violations have occurred. Timely and correct decisions are necessary to improve the system performance and they depends on how effectively information is transferred. So by adopting cost effective and suitable communication facilities, one should improve the existing quality of the decision making, coordination and cooperation among the related groups.

CONCLUSION

Flow controlling structures and their operations play predominant role in achieving the targets of water management practices in terms of adequacy, equity and reliability. The importance of gate operators cannot be undermined. Although they are provided with a set of rules, most of the time those rules do not provide adequate operational flexibility as a result operators are bound to form their own rules on hit and trial basis. Sometimes these rules become more erratic due to highly variable flows and deficiencies in physical systems, lack of proper knowledge and skill and insufficient communication facilities leading to inequity in water distribution. Operators' rules are consequences of several factors that were not considered while formulating the rules. The factors are summarized below:

- Present rules would not be effective in systems with high variations in discharges.
- Design of outlet capacity must match with the actual water requirements. If not, operators are bound to deviate from the preset rules.
- Placements of direct pipe outlets to irrigate uplands compel operators to deal with dual conflicting functions: water-level management and discharge- based management.
- The type and settings of outlets govern the flexibility of bifurcation. A particular type of outlets can be chosen for optimal equitable distribution depending upon the flow conditions, skilled manpower and communication facilities. Outlet settings with flexibility less than 1 and free flow weir type outlets are more suitable for fluctuating flows and low skilled manpower with poor information transfer and communication facilities.
- Maintenance or rehabilitation of a system should be done in accordance to the existing rules. Or, new rules should be formulated to match the changed flow conditions.
- Inequitable water distribution and lack of clarity in planning of operation schedules compel operators to work under pressure to adjust gates as per users' satisfaction. A clearer and well-defined set of rules for water use is necessary for equitable water distribution.
- Competent monitoring process and appropriate information transfer and communication facilities are desired for effective and efficient system operation.

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Paper 7: Participation of Women in West Gandak Water Users' Association*

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This paper is based on part of the research results of the Gender Poverty and Water Research in Nepal by the International Water Management Institute (IWMI), which is funded by Ford Foundation.

The aim of the overall research is to:

- improve the understanding of inclusion and exclusion processes in agency supported irrigation, with special reference to poor women and men.
- formulate recommendations for inclusive intervention approaches, that primarily strengthen the rights to irrigated land and water by poor women and men.
- improve the capacity to address gender and poverty issues of researchers, policy makers and farmer leaders.

In Nepal the two research sites are selected West Gandak and Andhi Khola. In this paper only one aspect of the research in West Gandak is discussed, namely the impact of the affirmative action[1] policy by the Water User Association (WUA) and the selection mechanism to mobilize women in decision-making bodies of the West Gandak WUA.

Open interviews with individual farmers and small groups are the main inputs for this paper. Individual interviews with women members of different tiers of the West Gandak WUA were held to hear from them the bottlenecks they have experienced and the ambition they have. Apart from these, interviews with farmers and farmer representatives, both male and female, were held to hear from them how they judge the participation of women in the West Gandak WUA .

In the first part of this paper, we will discuss Irrigation Management Transfer in West Gandak, the organizational structure of the West Gandak WUA and the policies and

* The heading in the previous print be corrected accordingly.

[1] Affirmative action in this case is the rule that at least one elected and one selected female should be member of the Upatoli Committees, and that 4 women members have a position in the Board of Directors. This rule is stated in the constitution of the WUA.

measures to enhance female participation in water management. In the second part of this paper, we will discuss the impact of these policies and measures, and conclusive notes are given.

IRRIGATION MANAGEMENT TRANSFER IN WEST GANDAK

In 1993, the government of Nepal began the implementation of its Irrigation Policy which envisaged the transfer of irrigation management responsibility to democratically elected legal Water User Associations (Kalu and Satyal, 1998). Irrigation Management Transfer (IMT) is meant to bring more decision making power and responsibilities to decentralized levels and to increase the productivity of the irrigation systems. An expected outcome of IMT is to improve operation and maintenance of irrigation systems, while cutting down in public expenses on irrigation. To materialize this policy in the West Gandak irrigation system, several programs and projects have been implemented. The latest in this range was the Irrigation Management Transfer Project (IMTP), which was carried out from 1995 to 1998, as its first phase.

The IMTP is designed to guide the process of transfer of management from a situation of joint management of the Department of Irrigation (DOI) and Water User Association to a situation where the WUA has the final responsibility of the entire management of the system. In this process of transfer, a considerable participation of women in Committees was attempted. In the IMTP the different actors were prepared for their new tasks and responsibilities. The government obliged itself to deliver a fully rehabilitated irrigation system and to provide training for the farmer representatives to be able to prepare themselves to take over the management of the irrigation system. The farmers were organized in a Water Users Association according to the Water Resources Act of 1992. Finally in November 1997 the entire West Gandak irrigation system was handed over to the WUA, only the management of the Headwork remained the responsibility of DOI. The IMTP is financed by several donors (AsDB and USAID), the DOI and the WUA itself contributed 26% in the rehabilitation cost.

ORGANIZATIONAL STRUCTURE OF THE WEST GANDAK WUA

In order for an organization to function, accountability from the leaders to the lower levels is a prerequisite; an important characteristic of a successful organization is the members' trust in its leaders.

West Gandak is an extensive irrigation system, covering 8,700 hectares where 14,000 farmer families have their land (Yadav, 1998). In such a vast irrigation system it is difficult to guarantee a free information flow from the lowest to the highest levels and vice versa. So, the question arises: what is the direct influence a farmer has on the management of the irrigation system, irrespective of whether one is male or female, rich or poor? To answer this question first a brief outline of the organizational structure of the West Gandak WUA is given.

West Gandak WUA: a Four Tiered Organization

The Water User Association in West Gandak was formed in 1993. The WUA is a four tiered organization based on the hydrologic boundaries of the irrigation system. The organizational chart is given in figure 1.

The Upatoli Group

The water users of the sub tertiary level form the *Upatoli* Group. This Upatoli Group consists of 20 to 100 water users, depending on the size of the sub tertiary canal. Once every four years[2] elections are held to elect the 5 to 9 members of the Upatoli Committee, which includes the representatives for the Toli Committee and the representatives for the General Assembly. A well functioning Upatoli Committee has a meeting every month. The Upatolis which receive water straight from the main canal, are directly represented in the Board of Directors, the other Upatolis are represented through the Toli and the Branch Committees.

The West Gandak WUA consists of 173 Upatoli Groups (IAAS, RTDB/DOI, 1998a).

The Toli Group

On average 8 to 10 Upatoli Groups are clustered in one *Toli* Group. All Upatoli Committees in the Minor canals send one representative to the Toli Committee meetings, which according the constitution should be held every month. During these meetings issues of the tertiary level are discussed. The West Gandak WUA counts 19 Toli Committees (Yadav, 1998). Some Toli groups, which do not receive water via a Branch, are directly represented in the Board of Directors.

The Branch Committee

Two to four Toli Groups are clustered in one Branch. Tertiary canals, which are supplied by one and the same branch canal send a Toli representative to the Branch Committee meetings; this representative is elected every four years. The West Gandak WUA has 3 Branch Groups.

Board of Directors

For the main system a Board of Directors (BoD) is formed out of 35 representatives of the different tiers: Upatolis, Tolis and Branches and the four female representatives selected by the Regional Committees.

[2] In the amendment of 1997 the period for functionaries is extended from 2 to 4 years.

These representatives and the General Assembly members can nominate themselves as candidate for the position of the chairman and vice chairman of the BoD. Together these two bodies elect the two office bearers. At this moment the Board counts 40 members[3].

The irrigation system is divided in four regions. In each region a Regional Committee is formed to facilitate decentralized decision making, monitoring and coordination. The members in the Board of Directors are the ex-officio members of the respective Regional Committees. Each Regional Committee selects one woman to take up a position in the Regional Committee and in the Board of Directors. The Regional Committee members select a chairperson amongst themselves.

General Assembly

One representative of each Upatoli Committee forms a system-wide General Assembly. The General Assembly meets once a year. The main task of this highest body is to control the Board of Directors and to approve the policy of the organization. During the General Assembly the Board gives an overview of its performance during the last year and presents its plans for the coming years.

The General Assembly is the most important meeting for farmers to influence the overall management of the irrigation system. Issues, which are of importance at Upatoli level, are brought forward by the respective representatives. However, it depends much on the own initiative of the representative, to which extend the points discussed at the General Assembly are fed back to the other farmers of the Upatoli.

Executive Committee

The Executive Committee is a five-member committee formed by members of the Board of Directors, responsible for day to day technical, administrative and financial management of the system. Under the technical section a system wide organizational structure is implemented, which is responsible for water delivery and takes care of maintenance and repair of the infrastructure. This Water Management Work Force (karyadal) can be considered as an operational body, which is organized according the canal lay-out:

- for the main canal and overall coordination (*mool* karyadal)
- for branch and minor levels (*tewa* karyadal)
- for lower canal levels (*sewa* karyadal)

Members of the *mool* karyadal are selected by the Board of Directors, while the *tewa* members are selected by the respective branch and Toli Committees and the *sewa* members are selected by the concerning Upatoli Committee. The work force is accountable to the

[3] The total number varies between 39-41 and depends on if the chairman and vice chairman come from within the BoD representatives or from the General Assembly.

body by which they are selected. Work Force members receive training to be prepared for their tasks. While the elected members of the Committees bear office only for a limited period, the trained members of the Work Force will hold a permanent position. For this reasons these organizations are supposed to have enough continuity to guarantee that the necessary knowledge and experience to carry out technical maintenance works is available within the organization.

At each level, the members of the Work Force have been granted the status of non-voting membership in the WUA. A provision in the constitution has been made that no member of the Work Force could contest the election for any position in WUA at any level while being member of the Work Force (IAAS, RTDB/DOI, 1998b).

In contrast to Committee members, Work Force members are paid. Work force members of the lowest levels receive 20% of the Irrigation Service Fee (ISF) collection as remuneration. Members of the *mool* karyadal get a nominal monthly salary.

In total 10 women are selected in the *sewa* and *tewa*. All these women participated in the training organized by IMTP in canal operation and management. An overview of the number of farmers participating in the Work Force is given in Table 1, also indicating the number of female Work Force members.

Table 1: List of Total Members in Water Management Work Force

Group	Canal	No. Work Force members	
		Total	Women
Mool	Main	5	0
Tewa	Branch/minors	52	5
Sewa	MCs/ MFDs/ SFDs.	152	5
Total		209	10

Source: IAAS, RTDB/DOI, 1998b

DIRECT FARMER INFLUENCE ON MANAGEMENT

As can be read from the preceding section, farmers can influence on management in different ways:

- participate in Upatoli meetings
- elect Upatoli Committee member
- elect Toli Committee member
- elect General Assembly representative
- direct contact with farmer leaders

The elections take place once in four years. Only those water users who have shares can take part in elections and are eligible for a post in a Committee. To become a shareholder, one has to present a land certificate. To participate in a meeting, one has to be member of the concerning Committee. Decisions on water distribution and organizing maintenance sessions for the respective levels are taken in these meetings.

For those farmers who are not shareholders, the options to influence the management are:

- direct contact with farmer leaders
- mobilize the land owner

It goes without saying that the personal contacts with farmer leaders is an important strategy for farmers, shareholders or not, who face a specific problem. After all, the other options do not lead to solutions on short term. At field level, farmers discuss the water distribution among themselves, they do not arrange special meetings for this. Share ownership is not decisive at this level.

It looks like the representation from farmers to higher levels in the organization works quite well: elections guarantee a certain justification for representation. Question remains however, if decisions at higher levels are communicated back to the lower levels. This seems to be a cross cutting problem for the WUA as a whole.

FEMALE PARTICIPATION IN THE WEST GANDAK WUA

Evolution

In the national Irrigation Policy it is stated that: 'Necessary emphasis shall be given to the provision that there should be at least 20% female users in all the executive units of the WUA' (Irrigation Policy, article 2.3, 1992). However, until recently neither the West Gandak WUA nor the DOI actively promoted the participation of women in the WUA. Hardly any women became members of Committees in the WUA.

The latest amendment to the constitution, accepted by the General Assembly in 1997, made it compulsory to have at least one elected and one selected female member in the Upatoli Committee. The 1998 elections show a dramatic increase of the number of women involved in the WUA. In more than 80% of the Upatoli Committees there is now at least one female member.

Table 2 presents historical figures on female participation in the different tiers of the WUA.

Table 2: Organizational level & number of functionaries of the West Gandak WUA

	First election, 1993		Second Election, 1995		Third election, 1998	
	# of functionaries	# female functionaries	# of functionaries	# female functionaries	# of functionaries	# female functionaries
General Assembly	155	3	171	3	173	2
Board of Directors[4]	-	-	-	-	40	4
Branch Committee	39	0	40	0	44	0
Toli Committee	83	1	95	2	98	0
Upatoli Committee	1143	7	1268	23	1179	145

Source: IAAS, RTDB/DOI, 1998a

As can be concluded from the table, hardly any women appear in the Toli and Branch Committees. In the Upatoli Committees, the bodies where the Toli representatives are elected, there is apparently a lack of confidence that women are able to represent the Upatoli as a whole. As a consequence there appear also no women in the Branch Committees, as these are elected out of the Toli representatives.

In the following paragraph we would like to analyze how the selection of the female Upatoli members took place.

Selection Mechanisms

The figures in Table 2 show that before 1997 a very limited number of women came forward to nominate themselves for election. The 1997 amendment made the Upatoli responsible for having at least one elected and one selected female member in the Upatoli Committee. There were no directions how to select women for the Committees. As a consequence, the members of the outgoing Committee normally selected a woman out of their direct kin or political network. Other women were selected because of their experience in community work (health work, or adult education), and some were selected because they were active irrigators.

Most of the women selected do not have water shares in their name, because they do not have irrigated land in ownership. Formally, being a shareholder is a precondition to become member of the WUA and get a position in a Committee.

In one Upatoli, the Committee members felt really limited because they had to select a female member who owns shares. This resulted in the selection of a candidate who is aged and illiterate instead of a motivated and knowledgeable person.

[4] The Board of Directors came into existence in 1997.

However in some Upatolis it is accepted for the husband (landowner) to write a consent letter to indicate that his wife can participate using the shares registered in his name.

In general however, is 'having shares' not seen as very strict condition for membership of female members. We even came across the case where nobody in the household owns shares, but the wife has become female member of the Upatoli. She had been elected because of her qualification and affiliation with the local elite. It was decided unanimously that she would be the best candidate.

Another interesting case is a woman who has been a representative in the WUA since the very first election. She has got shares registered in her own name though she does not have formal land ownership. She said it was possible to register the shares in her name because she has been holding a post in the WUA.

Women's status in the Upatoli is thus different from that of men: men are elected by a majority and are landowners. Women are selected (in stead of elected) and in general do not have water shares.

PERCEPTIONS ON AND IMPACT OF AFFIRMATIVE ACTION

Perception of Female Office Bearers

We interviewed 13 women with a position in WUA. Of these, six are the main irrigators of the household. Five are involved in agriculture. They are important decision-makers but not the main irrigators. Only two are not involved at all in agriculture (one is appointed because of her political affiliations, the other woman is a well off lady). Six women have organizational experience and are relatively well educated (more than grade 7). Of these, 4 women were health trainer or involved in adult education. Five women out of 13 are either kin or have political affiliation with the person who came to recruit her for a certain position.

Most female office bearers expressed their concern that they are not well informed about their tasks in the organization. Four women (out of 13) told us that they had no idea what their function implied, other women could indicate some of their tasks but expressed the wish to be further informed. Some women feel that the male members of the organization purposely keep relevant information behind; the female members of the BoD told that their fellow farmers refused them to consult the constitution. Some women do not know if they really are invited for every meeting. Female office bearers face difficulties to be accepted by males who occupy a lower rank in the organization.

Perception of Male and Female Farmers on Women's Participation in Upatoli[5]

The perception of men on women's participation is in general positive:

- If women are present, meetings pass off quietly and in a more disciplined way.
- Women give a good example. If women participate in cleaning and maintenance, men cannot refuse. If even women are collecting Irrigation Service Fees or request to participate in maintenance work, it is difficult for men to withdraw.
- It is easier for female office bearers to influence the behavior of other women. Women make dung cakes for which they use the canal bed to dry. According to the men interviewed this makes the canal silt up quickly. Women also use the clay of the canal bed to make pots, which makes the canal shape irregular. In the perception of the interviewed men, it is easier for women office bearers to talk about this with the concerned women than it would be for men.

Some men have critical remarks as well:

- 'How can a woman be a functionary as they cannot go out at night?'
- 'Women do not have the strength to do gate operating works'
- 'Women do not have time'
- 'I do not like women in WUA. If women become active they would dominate men'
- 'Women do not know about canal management and irrigation. Women have nothing to do in WUA.'

In women's views 'there is no work nowadays which can not be done by women.' The main thing is 'ability and interest to work'. Several women mention that education is needed to perform well in WUAs, and specific training in irrigation matters would make them feel surer in meetings. They also indicate that the contact between female farmers and female office bearers is easier than that between female farmers and male functionaries. But where men stress the need to change the misbehavior of female farmers, women stress the need for female farmers to contact office bearers to discuss their problems.

Impact of Affirmative Action

For different groups of women the obligation to have one elected and one selected woman in Upatoli Committees worked out differently. Some women do not even know that there are now female members in the Upatoli Committee, neither do some men.

From interviews with female members in the Upatoli Committees it becomes clear that affirmative action creates possibilities for motivated, capable women to become active members of an Upatoli Committee, which otherwise wouldn't have been possible.

[5] Based on 33 interviews, of which 3 were open interviews and 2 small group discussions.

Some women even 'grow' further in the organization after being selected as the female member. For example the lady who got a position as female member in the Regional Committee got later elected as chairperson of that same organization. She was competing with several men who also wanted that position.

Affirmative action also has its drawbacks. Affirmative action does not help if women are chosen in the Committee who are not motivated and do have little farming experience. And it is of course difficult for one women to represent all the different women (caste, age, class) of her canal. From the interviews we know that the selected women normally have only very little contact with other women farmers of the same canal. Therefore the selected women do not represent other women of the canal. They feel more accountable to the person who provided them with this position than to other women using the same canal.

As mentioned by both men and women, female functionaries are easier to be contacted by female farmers. Female members of the Committees at the different levels in the WUA can facilitate that concerns of women farmers are taken up in the Committees. This will happen more easily if the rest of the Committee members are receptive to women's concerns. However this requires a change in attitude of men to be more gender sensitive. Men tend to underestimate the contribution in labor and decision making at family level of their wives, daughters and daughters in law in irrigated agriculture. This makes that they do not fully realize the stake women have in decision making at community level.

If women farmers are considered equal to male farmers, the performance of the irrigation system could improve as well. There is the example of a woman, whose husband migrated, who wanted to fulfill the maintenance obligation herself. Alternatives for her would be hiring labor to do her part of the canal maintenance (which is too expensive to her) or not to contribute at all and to risk a fine. This woman decided to do it herself. When she turned up to do her part of the maintenance she was laughed at by male farmers. Next year she might not come and her part of the canal won't be cleaned.

Female members in Committees and the Work Force have a exemplary role to show how women make a difference. The female members who are active in the Committees are very motivated and have a positive contribution to the WUA. These women show the stake women have in irrigated agriculture and perhaps slowly change the prevailing perception in which women's contribution are not taken fully into account

Affirmative Action after IMTP

After conclusion of the IMTP, the policy of affirmative action is continued by the WUA. There are several reasons for this:

- Still Technical Assistance (TA) is given: these officers have considerable influence on farmers as they have built up a long-term relationship. The TA officers emphasize

women's participation in WUA. They sometimes provide conditional services to the WUA.

- Male farmers can gain influence in Upatoli and other bodies in WUA if the female member is affiliated with their ideas. This support can help to keep influence in the Committees.
- The DOI still has a considerable stake in WUA policies for several reasons. DOI is still managing the headwork and it gives post transfer support to WUA, basically for O&M cost. The WUA has good reasons to keep warm relationships with DOI and follow the national policies, which include the provision that there should be at least 20% female users in all the executive units of the WUA.

CONCLUSIVE NOTES

- Without positive action, in the form of making women membership in Upatoli Committee and Board of Directors compulsory, the entering of women in these groups is highly unlikely. If women are invited to participate, some will take the opportunity and become active members. By affirmative action women are given a chance to participate in decision making.

- So far only half of the rule in the constitution is implemented: of the compulsory one selected and one elected female member in the Upatoli Committee, only selected members took up a position. The elections of female members took never place. In the field people seem to be poorly informed about this part of the rule.

- Women who are active in irrigated agriculture and motivated to become member of WUA are more likely to be active office bearers. They are prepared to invest time and effort in the organization and they are well informed about the situation in the field.

- Support for selected women is necessary. They are normally less informed and feel more insecure than men. Female office bearers complain that they, more than men are excluded from information. Support from other Committee members can help them to get more acquainted with the tasks involved and to feel comfortable enough to speak out in public. External agencies can support elected (and other) women by giving them training in irrigation management and communications skills. Awareness raising among men about the stake women have in irrigated agriculture might create a more receptive environment for women as farmers and in Committees.

- Appointing women in Committees by the male local elite might only strengthen the power base of these male leaders. In that case female members do not represent other women, but are accountable to the male Committee members who appointed them. Appointing women by other Committee members blurs the transparency of the Upatoli and weakens its functioning.

- If all the stakeholders would elect a fixed number of women and men, both men women have the same accountability to the farmers.

- If female members have to represent other women of the canal, then women should select female Committee members themselves.

- To increase further women's active participation in decision making, it should be made possible for women to become member of the WUA. Given the fact that many women do have a stake in water management as water users, membership of the WUA should be open for them. This implies that land ownership can not be a prerequisite for membership.

- If membership is open for women, all those who are interested and motivated can participate on their own behalf, without depending on male kin for information. As a consequence membership should be open for more members per household. This principle is already quite common and proven useful in forestry projects (Madhu Sarin, 1996).

- It should be realized that women do not feel invited by normal public announcements, either by the village *chaukidar*[6] or by notices in public places. If one aims to inform women about meetings and elections extra efforts are necessary to effectively reach women.

[6] In this case a *chaukidar* is person responsible for dissemination of information.

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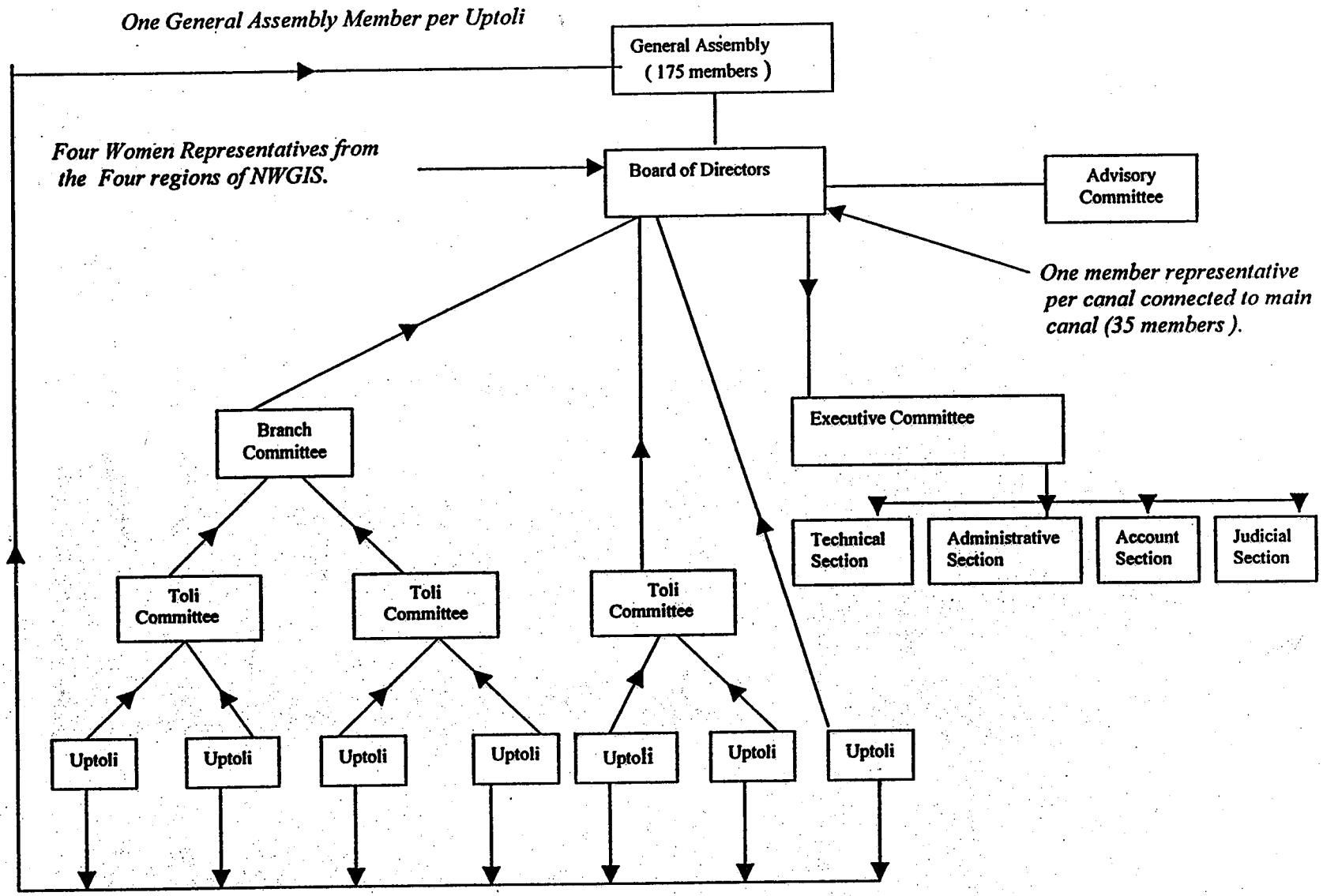
Figure 1: Organizational Structure of West Gandak WUA



Paper 8: Step by Step Approach to Transfer of Irrigation Management: Experiences from IMT Activities of Hirapur Manusmara Irrigation System

S. Sijapati

INTRODUCTION

Significant refinements have been introduced by Irrigation Management Transfer Project (IMTP) in its Second Phase[1] on the basis of experiences of the First Phase of IMTP. One of the major refinements has been the replacement of *piecemeal approach*[2] in the physical improvement works by a process of preparing a *Master Estimate* and *Action Plan* of all the activities prior to intervention. The second has been the introduction of a step-by-step approach in the implementation process. Third is the introduction of 'Food for Work Concept' to achieve participation from the WUA. It has been expected that through all this a *healthy* growth of the WUA will be achieved ultimately making them capable of management of the system. The step-by-step process is expected to ensure that the WUA has reached a certain stage of maturity and that they have fulfilled certain amount of commitments on their part before they achieve certain benefit from the project.

This paper explains how this step-by-step process has been and is being implemented in Hirapur Barrage Manusmara Irrigation System. It briefly narrates the historical background of the system, explains it status prior to IMTP and describes the activities implemented so far in the process of transfer of irrigation management. Finally, it states the results of the endeavor so far and enumerates the lessons learnt.

HISTORICAL PREVIEW

After the failure of the headwork constructed by the Indian government at Manusmara River, a new barrage was constructed at Hirapur during 1961-1965. The system fed by this headwork is called the Hirapur Barrage Manusmara Irrigation System (HBMIS)[3]. The

[1] MOU between AsDB and DOI for the second phase of IMTP was signed on June 5, 1998.
[2] In the First Phase of IMTP the rehabilitation works were implemented in accordance to the fund made available to system in the annual program.
[3] Even though the term "MIS" is commonly used to indicate both Hirapur and Manpur Systems here the two systems have been separated as they indicate different command areas and have separate

system essentially consists of a barrage of 48m span, a main canal of 3.14 km and six branch canals with the total length of 21.5 km.

Command Area Development Project was implemented in the system between 1982 and 1988 during which along with the construction of tertiary canals, farm ditches and gated outlets rehabilitation of main[4] and branch canals and construction of additional check structures were also conducted. From 1990, the management of the system was shifted to DIO. Joint Management was launched in the system in the year 1992 and WUA was formally formed for the first time. A major setback was faced by the system in the year 1993 when a devastating flood heavily damaged many parts of the system.

STATUS PRIOR TO IMTP

After the O&M responsibility of Manusmara Irrigation System was bestowed to DIO in 1990 there was a sudden slack in the intensity of activities in the system. The annual budget made available to DIO for the O&M of MIS was insufficient. Not only the budget but also the staffs assigned to manage the system were reduced. The general understanding was that the DIO would operate the head regulator gates, the main canal head gates and a few branch canal gates and the water user would be take care of the portion below that. However, the water users of the system were not organized. Individually they were neither capable nor motivated to carry out the works. Consequently the contribution of the user farmer for O&M was meager. Thus, deferred maintenance of the system lagged every year. This initiated a vicious circle of unreliable water supply, which discouraged the farmer to mobilize their resources for the maintenance activities. Thus the condition of the system was deteriorating day by day.

MAJOR ACTIVITIES UNDER IMTP

The effort to organize the farmers was initiated in the system since 1992 with the introduction of *Joint Management* Program. The first election of Main and Block Committee was held during March to April 1993. The WUA Legislation was approved and the WUA was formally registered in the Chief District Administrative office on the 17th of May 1993. Thus, the organizational activities were completed and the WUA started functioning. However, the WUA could not be very efficient. Sufficient attention was not given to monitor the WUA activities. The money collected by the WUA from road-cess and fishing contract was not properly recorded hence the WUA lost the faith of the general farmers.

A new thrust was given after the selection of the system under the second phase of IMTP and the re-elections of the WUA executive members. The second election of executive

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WUAs. HBMIS has been selected as this WUA is slightly more advanced.

[4] The main canal was originally designed for 2.125 cusecs but was renovated to carry a discharge of 2.8 cumecs.

members at the branch and block level was held from April 13 to 28, 1998. Finally, on the 26th of May 1998 Main Committee Members were elected. Diagnostic Maintenance walk-thru by the farmers and sub-project technical staff was held Dec 1997 to Jan 1998. Then Diagnostic Study was conducted through a consultant. The final report of which was submitted on July 1998. The WUA office was established at Basworiya from Oct 1998. In order to manage the physical improvement activities, a Sub-project Management Committee (SMC) was formed on the 12th Jan 1999. During March and April 1999 System Improvement Survey was conducted in the system. Water Management Workshop was held on the 23rd March 1999 and consequently, Main Canal Water Management Taskforce was formed few days after that.

Design works were completed by the end of April 1999. Following which maintenance works were jointly prioritized and the Bill of Quantities finalized by both the office and the WUA. The works were then categorized into six categories as defined in the IMTP guidelines and an Action Plan was prepared to suit the grouping as laid out in the different steps to management transfer. See figure 2 for a schematic presentation of the Step-by-step Approach.

SMC formally gave the approval to the Estimate of System Improvement Works on May 27, 1999. Approval of by the Main committee to the Estimate of System Improvement Works and draft Memorandum of Agreement and Action Plan prepared by DIO was obtained on May 29, 1999. On the 30th of May a General Assembly was called and the President of the WUA was selected as the representative on behalf of WUA to sign in the MOA between WUA and DOI, HMG. The estimates were approved and the Chief of DIO, Sarlahi was authorized to sign on the MOA on August 13, 1999. Signing of MOA and AP was conducted on September 20, 1999. Thus at present the DIO is implementing the emergency maintenance works and the WUA is working out the laws and bylaws. See figure 1 for a chronicle of the major activities under IMTP.

RESULTS AND CONCLUSIONS

Even though some time has elapsed since the introduction of IMT program in MIS most of the time was spent in the initial organizational activities and it has not been long since the actual implementation. Hence, it may be too early to reach to any concrete conclusions. However, as the morning shows the day, an effort has been made to analyze the preliminary results of the endeavor and make comments that have been enumerated as follows:

- Step by step process has *delayed the progress* of implementation of the program. It has decelerated the pace of system rehabilitation and improvement works. Hence, if the program is to be implemented in this mode *this fact has to be accepted both by the donor and DOI.*

- The *growth* of the WUA *is tested at each step* in the step by step process. As we move to the next step only after ensuring that all the preconditions of the present step has already been completed, institutional growth of the WUA is ensured.
- The software activities viz. Studies, Training, Institutional Development and Water Management Activities launched by IMTP center has not been based on the views of the field staff of MIS. Since the ultimate output of these works is to be used by the field staff and the WUA these works must be implemented in *close coordination with field office.*
- In the present categorization System Calibration Work has been placed in the third step. From the experience of IMT implementation at HBMIS it has been realized that System Calibration Work must be placed in the first step. *It should be a software activity* under water management and no labor contribution should be expected from the farmers for this work.
- The cost involved in the software activities is less than 10% thus it has been suggested that a larger number of systems should have been selected and only the most matured systems should be taken up for the implementation of the hardware part.
- Even though the actual implementation is yet to be seen, the Food for Work concept has been welcome by the farmers. They opine that it will make their participation works easier.

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Figure 1: CHRONICLE OF HIRAPUR BARRAGE MANUSMARA IRRIGATION SYSTEM

Historical Preview

1961-1965	:	Construction of headwork and canal system.
1982-1988	:	*Command Area Development Project* implemented.

- Rehabilitation of Main and Branch Canals.
- Construction of additional Check Structures and Measuring Devices.
- Construction of Tertiary Canals and Farm Ditches.
- Construction of Gated Outlets and other pertinent structures.
- Gravelling of Service Road.
- Bagmati and Lakhandehi flood protection works.

1990	:	Management of MIS shifted to DIO.
July 20, 1993	:	MIS heavily damaged by devastating floods.

Activities Related to 'Irrigation Management Transfer'

1992	:	Joint Management Program launched by DIO.

Initial Organizational Phase:

March & April 1993	:	First Election of Main and Block Committee.
May 17, 1993	:	Approval of the WUA Legislation and Registration of WUA in the Chief District Administrative office.
April 13 to 28, 1998	:	Second Election of the WUA executive members at the branch and block level.
May 26, 1998	:	Election of the WUA Main Committee Members.

Management Transfer Preparation Phase:

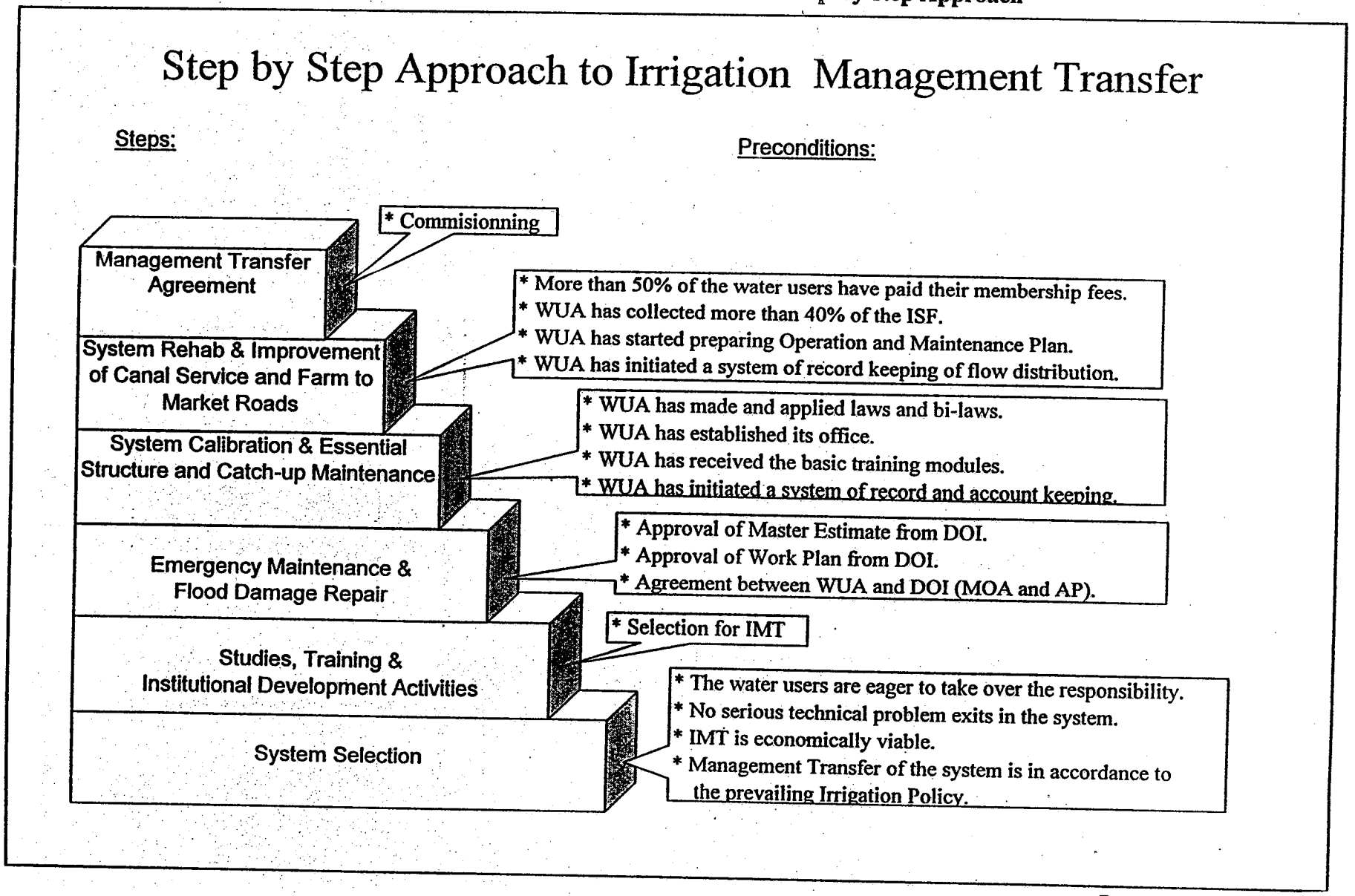
Dec 1997 & Jan 1998	:	Diagnostic Maintenance walk-thru by the farmers and sub-project technical staff.
July 1998	:	Final Report of *Diagnostic Study* submitted by the consultant.
Oct 18, 1998	:	Establishment of the WUA Office at Basworiya.
Jan 12, 1999	:	Formation of Construction Management Committee.
March & April 1999	:	System Improvement Survey conducted.

March 23, 1999	:	Water Management Workshop held.
April 1999	:	Formation of Main Canal Water Management Taskforce.
May 27, 1999	:	Design works completed, prioritization of maintenance works jointly by office and WUA and finalization of Bill of Quantities.
May 27, 1999	:	Approval of Estimate of System Improvement Works by the Construction Management Committee (SMC).
May 29, 1999	:	Approval of by the Main committee the Estimate of System Improvement Works and draft Memorandum of Agreement (MOA) and Action Plan (AP) prepared by DIO.
May 30, 1999	:	Training for all General Assembly members on AP and MOA.
May 30, 1999	:	General Assembly held: • Discussion and finalization of AP. • Selection of the President of WUA as the representative on behalf of the WUA to sign in the MOA between WUA and DOI.
August 13, 1999	:	Estimate and draft MOA and AP approved by DOI. The chief of DIO appointed as the representative on behalf of DOI to sign in the MOA between WUA and DOI, HMG.
September 20, 1999	:	Signing of MOA on the implementation of AP.

Management Transfer Implementation Phase:

September 20, 1999	:	First SMC meeting. SMC formally gave the approval for the immediate implementation of Emergency Maintenance Works.
September 30, 1999	:	Bid documentation prepared and got approved.
October 8, 1999	:	Notice of Invitation for Bids flashed.
October 1999	:	Initiation of Emergency Maintenance Works and Catch-up maintenance works through farmers' participation. WUA prepared a draft of the laws and bylaws.

Figure 2: Schematic Presentation of the Step-by-step Approach



Paper 9: Role of the Federation of National Water Users' Association in the Management Transfer[1]

Tikaram Dahal
National Federation of Irrigation Water Users Association

BACKGROUND

There is a pressing need to develop and manage the abundant water resources for multiple uses available in Nepal and to manage the irrigation systems in order to increase the agricultural production. Over time, different irrigation management programs have been conducted in the country. A lot of investment has been made in the irrigation sector through planned programs by the government and farmers themselves but it has not been able to increase the agricultural production as expected. As a result, food grains are imported in the country. This is an irony for an agrarian country like Nepal.

As the heavy investment and efforts made in the irrigation sector have not been able to meet the expected benefits, it is necessary to find out the causes in time to take appropriate measures. Many countries in the world have become self reliant in food grains production through agricultural revolution. Appropriate policy and related steps in this sector are still lacking in Nepal. "Irrigation Management" is the primary means for agricultural production. The increasing population day-by-day has started affecting watershed areas and natural resources. Environmental degradation has created different problems like heavy rain, flood, and landslides. As a result, people are facing different epidemic problems. Therefore in order to cope with these problems it is necessary to first become self reliant and self-dependency is necessary for this.

PROBLEMS IN IRRIGATION

By carefully scrutinizing the irrigation systems in the country, their situations and processes are found as follows:

1. Farmers have developed and managed irrigation systems on their own but these systems have not yielded the desired benefits due to lack of scientific management on institutional basis.

[1] Translated into English from Nepali by Tribhuvan Poudel and K. C. Prasad.

2. Farmers do not realize their duties and responsibilities in various small and big systems that were developed and managed by the agency using state's resources.
3. Farmers and agency people do not realize their duties and responsibilities and transparency is not maintained. Thus, necessary operation and maintenance works are not accomplished in time.
4. Framers lack eagerness because of lack of quality and scientific management in agricultural inputs and accessories.
5. Lack of coordination and interaction among the GOs & NGOs involved in the agriculture and irrigation sectors.
6. Improper identification of arable lands has constrained full utilization of available water resources going waste.
7. There is no sense of responsibilities even in the jointly developed and managed irrigation systems.

There are a lot of problems as mentioned above. It is realized that "peoples' participation in all aspects" plays vital role in solving the problem. Accordingly, Irrigation Policy 1992 was amended in 1997. Even then, works are not being accomplished as per the notion of Irrigation Policy.

REASONS BEHIND WORKS NOT BEING ACCOMPLISHED AS PER THE NOTION OF IRRIGATION POLICY

1. Policy itself is not sufficient. Act and Regulations are not developed as per the policy thrust.
2. By policy, participation and cost sharing by the beneficiary farmers in new construction and rehabilitation is 10% and 15% respectively. However, it is 26% in the case of Irrigation Management Transfer Project (IMTP). This sort of anomaly in the policy and implementation has kept from accomplishing meaningful works.
3. Transparency related to people's participation and management as intended by the irrigation policy lacks in the processes of construction, operation and maintenance. Management transfer in pressed without fulfilling the adequate process. The capability of the WUA has not been critically assessed.
4. Though irrigation and agriculture are the integrated components, there is no connection between irrigation and agricultural policies. No programs for increasing the agricultural production have been launched yet in the management transferred irrigation systems.
5. No tradition has been set to evaluate and promote agricultural productions considering labor inputs.
6. The WUA by policy is to be developed as the main institution involved in the operation and management of the irrigation system. However related agencies are not prepared to accept this in practice.

PRESENT NEED

1. Well-managed and quality service to irrigation.
2. Evaluation of the pre and post transferred situations.
3. Assessing the institutional sustainability of the transferred irrigation systems.
4. Assistance to the WUAs in their institutional development and participation.
5. Awareness programs in irrigation management and advertisement through communication media.
6. Creation of environment for effective collection of irrigation service fee (ISF) as decided by the WUA or provisions to realize ISF as a liability like land revenue.
7. Creating cooperative environment among the local development institutions i.e. VDC NPC, DDC by clarifying the roles and rights of the WUAs projecting the WUAs as an integral part of such institutions themselves.
8. Local elite has promoted negative feelings about the people's participation, demeaning and questing to hamper the WUAs. Such people are engaged in getting the water forcefully. Such tendencies need to be discouraged by developing appropriate thoughts.
9. Needed attention is to be given to the full management and conservation of the available water resources.
10. Priority needs to be given to the systems exploring feasible sources that can run by local resource mobilization.
11. Scientific agricultural programs are to be implemented through WUAs in management transferred systems.
12. Open market policy has created competition on sales of fertilizer and seeds. But, no mechanism exits to check the quality of such fertilizers and seeds. This responsibility should be assumed by the concerned agricultural development office or related institutions. Without this, traders are bringing such items from India by counting only on the profit and it has further reduced the agricultural productions.
13. Framers are incurring heavy losses because of pests and insects at the harvest time. This could be mainly because of the fertilizers and seeds brought from India that are suitable to climate there. An intensive study is needed in this regard.
14. To promote the agriculture as an enterprise a trend needs to be developed for assessing benefit by considering agricultural labor and other investments made by the farmers.

CONCEPT OF WUA FEDERATION

Peoples' participation for development has been taken as the primary concept in the context of coming 21st century. No doubt exits in agricultural development through promotion of cooperative approach while developing water resources based on the concept of collectivity. Leadership development, development of natural water resources, raising awareness among common water users, protecting, managing, improving and sustaining irrigation systems by multipurpose water resources development, enhancing women's participation, creating employment opportunities in agriculture reducing the poverty, etc., are important subjects for pursuance.

First National PIM seminar also had realized the aforesaid as the national objective. Farmers' representation on that seminar has left a feeling that policy efforts are being made in this direction. The federation also has aimed at expanding the organization nationally:

- to improve the prevailing irrigation management process;
- to help understand the importance of local people;
- to help realize the importance of proportionate water distribution and management;
- to provide knowledge on system improvement and protection;
- to extend the benefits to the targeted groups by promoting crop diversification in agricultural production; and
- to launch necessary programs while carrying out studies, researches, and evaluations.

OBJECTIVES OF WUA FEDERATION

The objectives are as follows:

- To make the WUAs aware of prevalent water resource acts, rules and regulations, their statuses and processes maintaining contacts with different GOs & NGOs.
- To emphasize on the quality and transparency through direct participation of WUAs in system construction and maintenance.
- To foster the slogan of participatory irrigation management by institutional development, pursuing awareness raising programs, promoting direct participation of the women and poor farmers, and bringing all the WUAs together.

PRESENT PROGRAM

Now the WUA federation, having been legally registered and recognized, is engaged in expanding the organizational network. It expects cooperation from all sectors in the efforts of convening a national level assembly after forming different district level organizations in some identified districts.

MISSION OF THE WUA FEDERATION

In our country where only 30% of the potentially irrigable land is irrigated now, there is an urgent need for changing the traditional approach of irrigated agricultural development by promoting farmers' participation in adoption of appropriate scientific technology, means and resources, construction and utilization, transportation, exploring marketing arrangements, multipurpose water resources development, identification and mobilization efforts.

SOLUTIONS

We have to work harder to uplift our nation to the level of other nations. Undertaking development works by forming the policies and rules by the government only is like a

blind traveling on foot. Therefore, to realize farmer participation in the irrigation sector based on the self-help approach, the notions of forming WUAs, irrigation management transfer, farmers' involvement in O&M, and institutional development have come into existence. Undoubtedly this is an appropriate thinking by time. In order to succeed both the government and WUA have to play the following roles:

ROLE OF THE GOVERNMENT

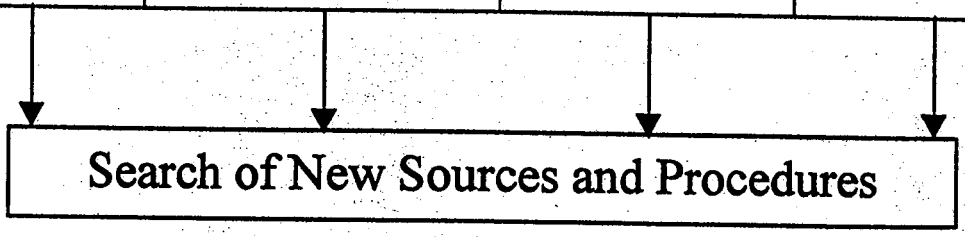
1. Formulation of appropriate policy and rules and implementation
2. Technical and financial assistance as necessary to a given limit
3. Involving WUAs in all activities transparently
4. Identification and development of feasible water resources
5. Formulation of appropriate agricultural policy
6. Awareness raising and institutional development programs
7. Advertisements through communication media, occasional study, research and evaluation
8. Incentive, encouragement and protection.

ROLE OF WUA

1. Timely resource mobilization
2. Operation and maintenance
3. Proportionate water distribution
4. Study and record keeping of irrigated area
5. ISF collection

WUAs need to give special attention to the following:

Institutional Development	Canal Operation	Maintenance	Protection
Constitution	Canal operation arrangement	Technical knowledge	Structures inventory
Rules and Regulations	Water records	Inspection	Awareness raising
Training	Priority	Estimate	Necessary maintenance
Data	Records of irrigable land	Resource mobilization (cash and kind)	Complete maintenance
Observation	Proportionate mechanism	Explicit accounts	-
Monitoring and research	Utilization	Transparency	-
Identification of source and collection	Actual shares	-	-



CONCLUSION

Based on the concepts of the first national seminar in Rampur, it is necessary to introduce changes in the traditional approach of the related agencies in the government. Change is needed also in the farmers' earlier concept. The government and WUAs are complementary to each other. Peoples' participation is essential for the country's development. Adopting positive people's participation by assessing norms and values of the users is necessary. This will lay foundation stones of new Nepal.

Paper 10: Conjunctive Management of Surface and Ground Water for Irrigation in the Terai: Is it Needed? How Can it be done?

Jeffrey D. Brewer and K.R. Sharma[1]

INTRODUCTION

The Value of Conjunctive Management for Irrigation

Conjunctive management of surface and ground water has long been advocated by irrigation and other water specialists as a way to make more effective use of available water resources and reduce environmental problems caused by irrigation (Vincent and Dempsey, 1991). However, in much of the world, conjunctive management is not living up to its potential.

Conjunctive management most commonly exists at the individual farmer level, since the farmer generally has the ability to give or not give water to his crops whenever the water, from whatever source, is available. Where farmers own their own wells, they control the use of ground water, within the limits set by the natural variability of the source and pumping limits, if any, established by a governmental or quasi-governmental authority. Surface water, however, is generally delivered through a system of canals and pipes serving numerous farmers. This means that the individual farmer generally has relatively little control over the availability of water in the system and thus relatively little *simultaneous* control over both sources of his irrigation water supply.

Establishing effective conjunctive management of surface and ground water for irrigation thus requires the establishment of a management entity such as an association, authority, or similar body, together with a set of rules and other principles enabling it to effectively manage the water resources, and development or adaptation of technologies to allow that entity to control the water. Establishment of the management entity, rules, and technologies may require a considerable effort. It is worthwhile therefore to consider carefully what the benefits would be before incurring the costs involved.

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This paper reviews the conjunctive use of surface and ground water in the Hardinath Irrigation System (HIS) in the Nepal Terai to:

- Evaluate the potential of conjunctive management in the Hardinath Irrigation System to improve agricultural production, profitability to farmers, and environmental protection.

- Explore where the most effective locus of conjunctive management would lie.

Basically, we found that in the present situation, conjunctive management in HIS offers a potential to improve agricultural productivity and profitability for farmers. However, the potential is small and may not be worth exploiting without government subsidies. Also, we found that the best locus for such responsibilities would be the newly established water user associations in the HIS.

HIS shares many characteristics with other irrigation systems in the Terai of Nepal, and to a lesser extent, with other irrigation systems in Nepal - because of common institutions - and in Northern India - because of the common physical environment. Our findings, therefore, may give some guidance to planners in both countries.

Methodology of the Study

The Hardinath Irrigation System (HIS) is located near the town of Janakpur in Dhanusha District in the eastern portion of the Nepal Terai. The HIS was selected because it was known that conjunctive use of surface water and ground water is very important there, it is large enough to be interesting and small enough to be studied through rapid assessment, and because there had been a previous study there that could help provide needed data (RTDB/IWMI, 1998).

The present study[2] (see Brewer and Sharma, 1999) was carried out through the use of existing documentary evidence and by rapid assessment. The authors visited the scheme to collect documents from various government agencies and to interview farmers and government personnel. Groups of farmers were interviewed in all the major portions of the scheme.

Unfortunately, several types of desired information are totally lacking. For example, there are no records of water flows either in the river that feeds the Hardinath System or in the

[2] This paper is based on research conducted in March and April of 1999 as one of four short studies under the Conjunctive Management Project being carried out by the International Water Management Institute in collaboration with CSIRO in Australia and PCRWR in Pakistan and funded by the Australian Council for International Agricultural Research. The authors gratefully thank the farmers and other persons who patiently answered our questions in the field.

canals. Similarly, there are no records of well usage. Also, estimates of crop yields are necessarily imprecise since government data is not reported for the area studied. For much of this data, we have relied on farmer reports.

Organisation of this Paper

The present paper is organised as follows:

- Section 2 gives a general background on the Hardinath Irrigation System and its water resources.
- Section 3 describes the present canal management within the HIS.
- Section 4 describes how farmers manage the sources of water conjunctively, including analysis of the economics of ground water irrigation.
- Section 5 evaluates the potential of conjunctive management to improve water distribution and agricultural production in the HIS command.
- Finally, Section 6 looks at the wider implications of this analysis.

WATER FOR IRRIGATION IN THE HARDINATH IRRIGATION SYSTEM (HIS)

Irrigated Agriculture in Nepal

Irrigation is important to agriculture in Nepal, not because rainfall is low, but because it is poorly distributed in time. Rain is heavily concentrated in the monsoon season between June and September. Three farming seasons are generally recognized in Nepal:

- Monsoon season from June through October,
- Winter season from November/December through March,
- Early rice season from April into July.

In the study area, the main (almost exclusive) crop in the monsoon season is rice. The main crop in the winter season is wheat. Most of the land is fallow in the early rice season.

Rainfall

The annual rainfall of the Hardinath Irrigation System area varies from slightly over 1,000 mm to about 2,400 mm with an annual average of over 1,450mm. More than 80% of this rainfall occurs during the monsoon period from June through September. The monthly rainfall data recorded at Hardinath Agricultural Station from 1986 to 1996 is shown in Table 1.

Surface Water

Location, Topography, and History of the HIS

Surface water is supplied to farmers through the Hardinath Irrigation System (HIS). The HIS is located in Dhanusha District in the Terai, an extension of the Gangetic Plains into Nepal. The area is thus quite flat. The town of Janakpur, located just outside the HIS command, is about 100 meters above sea level and the slope to the Ganges more than 100 kilometers south is quite shallow.

Construction of the HIS was carried out by an Indian Aid Mission to the Government of Nepal from 1960 to 1967. There has been no major rehabilitation or change to the system since. Beginning in 1999, the HIS will be rehabilitated under the Irrigation Management Transfer Project (IMTP) funded by the Asian Development Bank and USAID.

The HIS Canal System

The Hardinath Irrigation System (HIS) is a gravity-fed canal system drawing water from the Jalad River, a tributary of the Ganges. A 80.6 meter long brick masonry weir with two gated scour sluices controlled by manually operated gates on both sides of the weir diverts water from the river to two intakes, one on each bank of the river.

The intakes feed two canals: the Eastern Main Canal (EMC) and the Western Main Canal (WMC). Both are ridge canals. The EMC is 5.5 kilometers long with a design discharge of 990 lps at the head and 220 lps at the tail and a bed slope of 1:3500. The design command area was 1000 hectares. The WMC is 9.9 kilometers long with a design discharge of 990 lps at the head and 538 lps at the tail and a bed slope of 1:3600. The design command area was 1000 hectares.

The only control structures on the main canals are drop structures ("falls"). There are 12 falls in the WMC and six falls in the EMC. Branch canals take off from both sides of each main canal just above these falls. The layout plan is shown in Figure 1. Ungated pipe outlets, all of the same size, were originally installed for the branch canals. Only some of these are still used.

All development below the heads of the branch canals was left to the farmers. The farmers constructed branch canals of varying lengths and capacities, mostly small. The branch canals total 14.4 km in the EMC and 22.6 km in the WMC. Branch canals have not been equipped with fixed water control structures; farmers use stones and mud to control flows when necessary. Much water distribution is from field to field.

No flow measuring structures exist anywhere within the system except for the river stage gauge on the headwork. There are also no sediment flushing structures or drainage canals.

The physical condition of the system is not good. The District Irrigation Office figures that about 50% of the area under the WMC is not getting water because of the reduced canal capacities caused by failure to maintain the main canals. Before February 1999, the head reach of the WMC had 0.9 meters of silt in it. Farmers at the tail of the WMC received hardly any water. In the EMC, farmers have been cleaning the upper portions of the main canal themselves, thus water flows have been better. In both main canals, the canal banks have been eroded in several locations, increasing the seepage losses. There are also severe embankment slumping, weed infestation, illegal outlets, damaged and vandalized outlets, and damaged flow control structures. Many outlets are clogged with sediment. Farmers draw water directly from the main canal either from the outlet or, more often, from cuts in the banks replacing the pipe outlets. The degree of water control is better in the head reach and gets much worse toward the tail end of the main canals. The branch canals also lack adequate maintenance. Uniformity and steadiness in flow of water in the main canals are not maintained due to the absence of water control and monitoring mechanisms. Flow uniformity is also greatly affected by diversion of water through the bank cuts.

Water Availability in the HIS

The HIS draws water from the Jalad River. The Jalad River originates in the Churia Hills and has a catchment area of about 65 square kilometers. Until very recently, no regular measurements of the river flow were made. Available documents report that the Jalad River has a maximum discharge of 230 cumecs during monsoon floods and a minimum base flow of 0.1 cumec in the spring. Recently the Dhanusha District Irrigation Office (DIO) started to measure the river discharge at the HIS headwork. River flows calculated on the basis of those measurements are given in Table 2. Table 2 shows that flows fluctuate greatly.

Water is abstracted by five farmer managed irrigation systems upstream of HIS. Informal understanding among the various water users on the Jalad River has been reached to release at least 60% of the river flow to the HIS (GITEC/GEOCE, undated). However, the limits have not been followed. The general feeling among farmers is that water availability for HIS has decreased. This decrease is attributed by farmers and irrigation officials to deforestation upstream leading to more variability in river flows and to siltation at the river diversion and elsewhere. At the diversion, silt was observed up to the crest level.

Ground Water

Ground Water Extraction

There is tremendous scope for developing ground water resources in the HIS command area. Farmers within the HIS command make use of ground water through three types of wells:

- shallow tubewells (STWs),

- deep tubewells,
- artesian wells.

As shallow tubewells dominate, we do not discuss the other two categories here.

The HIS canal system is supposed to provide water to land within 11 villages (Village Development Council areas). As shown in Table 3, there are 115 STWs in nine of these villages. Individuals own all.

Most STWs are about 60 feet deep, in a few cases the depths are as little as 35 feet. A four-inch diameter casing pipe of mild steel, a slotted mild steel pipe for screen, and a well plug are the materials commonly used in a STW. Some newer wells use PVC screen or HDP Pipe Screen instead of mild steel strainers. STWs are energized with 5-8 HP diesel pumpsets; discharges average about 12 lps. The present cost for the complete installation and equipping of a 4" STW is NRs. 45,000-57,000.

Pumpsets are portable and are generally mounted on small wooden wheeled carts. There are two reasons for this. First, farmers are afraid of theft of or damage to their pumpsets if left alone. Second, portable pumpsets can be used on more than one boring so that if a single farmer has two or more borings he can use the same pumpset and so that pumpsets can be rented out to others for their own borings or for pumping from the river or a canal.

Operating costs for the typical STW include:

- Diesel: 1.25 liters/hour @ NRs. 16/liter
- Engine oil: 3.5 liters for 80 hours of operation @ NRs. 125/liter
- Average annual maintenance costs: NRs. 2,500-5,000

Assuming pumpage of 500 hours per year and taking maintenance costs to be NRs. 3,750 per year, the average hourly cost for these three items is:

$$1.25 \times 16 + 3.5 \times 125/80 + 3750/500 = 32.97 \text{ or NRs. } 33$$

We will take this figure as an approximation of STW operating costs. Note that it does not include any depreciation, nor any cost for the operator. The STW owners do not usually figure these two items into operating costs. The owners operate all STWs.

Though no statistics on the number of functional STWs were available, the Janakpur office of the Agricultural Development Bank of Nepal estimates that not more than 50% of the STWs in the area are in operating condition. Reported problems include screen damage, clogging of filters, inappropriate casing material, deficient well development, deficiency in design, earthquake damage, and others. The number of farmers reporting non-functioning tubewells is increasing. Fixing wells is expensive so many are unwilling to do so (see discussion in Section 3.3.5).

Earthen field channels rather than pipes are generally used to carry water from a well to the fields. In some cases, water is pumped into a canal for conveyance to a farmer's fields. Some farmers have installed STWs next to the HIS main canals for this purpose. During the monsoon season, when the primary crop is paddy, farmers often allow the water to flow from field to field rather than construct field channels. Farmers generally permit other farmers to construct temporary channels through their fields, particularly for winter season crops. These field channels are usually destroyed during the monsoon season.

Availability of Ground Water

Information from the Ground water Development Board of Nepal (UNDP, 1992) indicates that most of the Dhanusha District plains, where HIS is located, have excellent shallow zone lithology. Depth to the static water level in the Hardinath command area is shallow everywhere - 2 to 3 meters below ground level - with variation of 1-2 meters throughout the year. Transmissivity values in the District range from 200 to 8000 m^2/day and shallow tube well (STW) yields vary between 5 and 15 liters/second. UNDP/GWDB mapping reveals that the entire HIS command area is classified as a probable area for STW development for irrigation.

According to a report on the Hydrogeologic Technical Assistance to the Agricultural Development Bank of Nepal, Dhanusha District has a potential of 2547 STWs, based on percolation recharge and perennial recharge. Discharges of 12 lps, 1500 operating hours, and a well density of 4.7 wells per square kilometer were assumed for this estimate.

Compared to the total potential, ground water extraction in the area is small. A total of 990 STWs were installed in Dhanusha District as of 1997. Though no statistics on the number of functional STWs were available, the Janakpur ADBN office estimates that 50% of the STWs are not functional. Thus, it is not surprising that farmers do not report falling water tables.

Ground water potential is good in most of the HIS command; however, in a small area near the head of the system STWs cannot extract ground water. On the other hand, in portions of the tail of the HIS, a deep artesian aquifer is tapped by a number of small (1.5 inch) tubewells.

The Water Market

A market in ground water has developed in the HIS command area. Two forms of water marketing exist: sale of pumping services from STWs, and rental of pumpsets. Pumpsets are used by renters to pump from their own borings or from the river or canal. Note that water is not valued; a buyer pays for pumping service. Thus the prices for pumping service and for pumpset rental are the same. Also, well and pumpset owners justify their prices on the basis of operating costs rather than on the basis of the value of water.

Farmers install STWs to irrigate their own crops; none has installed a STW primarily to sell water. However, most well owners also sell water to farmers in the neighborhood; most STW owners have regular buyers. Often a STW is operated more for others than for the owner.

The reported prices for pumping ground water are NRs. 50 and 60 per hour. STW owners generally demand immediate payment in cash. Not all buyers pay these prices; some buyers are close relatives who only provide diesel for operating the pumpset. Relatives may also give the owner small presents, such as a little mustard oil.

Farmers reported no problem in making temporary field channels in their neighbors' fields to take water to their own fields. Water may be conveyed up to two kilometers from the STW. In some cases, farmers buying water regularly from the same STW owner cooperate in constructing and maintaining a field channel to serve all of them for the season. However, they do not buy water collectively; each farmer makes a separate deal with the STW owner.

DISTRIBUTION OF CANAL WATER IN THE HIS

Three sets of managers are involved in the distribution of water from the Jalad River via the HIS canal system, the District Irrigation Office (DIO) of the Department of Irrigation, the water user associations (WUAs), and the farmers collectively.

Canal Management by the District Irrigation Office (DIO)

From commissioning until 1998, operations and maintenance for the HIS headworks and main canal was officially the responsibility of the Nepal Government's Department of Irrigation. An irrigation service fee was levied on the irrigators to pay for irrigation services and the collected fees were sent to the national treasury. Since 1998, canal operations, including operation of the headwork, have officially been the joint responsibility of the District Irrigation Office (DIO) and the water user associations (see below).

The government's annual budget for O&M in HIS has generally been much less than required to meet O&M needs. Over the past 10 years, the total annual government O&M expenditure for the HIS has varied between NRs. 80 and NRs. 240 per hectare. The actual requirement is in the order of NRs. 600 per hectare. Due to lack of funds, desilting of the main canals was not done for the last three years. No major rehabilitation has ever been done. Over time, the real amounts provided for management of the HIS have decreased. In the past, the budget was sufficient to hire temporary workers to act as gate operators and to undertake routine maintenance. No such funds have been available for the past few years. Pay for DIO staff is low and staff members are not well motivated.

Three DIO staff members are assigned to operate the HIS head regulators. According to farmers and DIO staff, prior to 1998 the DIO operated the headwork as follows:

- From mid-July to mid-September, when river flows are high, the head-gates for both main canals were left open and the canals ran continuously.
- For the rest of the year, irrigation water was supplied to each main canal on a rotation. Rotations were made by alternately opening the main canal head-gates for four days each.

DIO staff carried out no operations on or below the main canals. However, they would inspect areas to see how well farmers were distributing water.

Canal Management by the Water User Associations (WUAs)

HIS was selected for management transfer under the ongoing Irrigation Management Transfer Project (IMTP). Beginning in 1998, a DIO Association Organizer worked with farmers to establish two water user associations (WUAs) within the HIS, one for the Eastern Main Canal and one for the Western Main Canal. These organizations were registered on 23 April 1998 in the office of the Dhanusha District Water Resources Development Committee. Within each WUA, there are branch canal committees representing the farmers under each outlet. A Coordination Committee comprising representatives of both WUAs has also been formed to manage the division of water at the HIS diversion structure.

The members of the WUAs are the farmers whose lands fall with the HIS command. This includes 2,617 farm households on 1,617 hectares of irrigated land in 11 villages (Village Development Committee areas). Each outlet has a representative in the General Assembly which elects the four officers (Chairman, Vice-Chairman, Secretary, and Treasurer) making up the WUA's Main Committee. Each outlet has a Branch Committee comprising seven or nine members including a Chairman, a Vice-Chairman, and a Secretary who also acts as Treasurer.

The HIS is to be rehabilitated under the IMTP. The WUAs play a key role in rehabilitation planning and implementation. Until rehabilitation has been completed, the WUAs are to manage the HIS jointly with the DIO. After completion of rehabilitation, management of the whole system will be turned over to the WUAs.

Joint WUA-DIO management began with winter season 1998-99. The present division of responsibilities between the DIO and the WUAs is that the head-gates for the main canals are operated by a DIO staff member, as advised by the WUAs' Canal Coordination Committee. Some committee members noted that the DIO operator does not always follow the Committee's instruction. WUA staff with occasional DIO advice carry out all other operations.

The WUA Coordination Committee meets when there is scarcity of water in the river. For winter 1998-99, the Committee decided to allow water into both canals during the critical first irrigation for wheat, but to give water for the second wheat irrigation only to the Eastern Main Canal (EMC) so that the Western Main Canal (WMC) could be desilted. Thus, water was directed alternately into the main canals for three weeks beginning in the last week of January. Thereafter the WMC was closed and the EMC left open.

In the main canals, the WUAs decided that water would be delivered continuously when the canals flow at full supply level (i.e., water supplies are plentiful as in monsoon season), but that when there were shortages, they would implement scheduled deliveries.

For winter 1998-99, the WMC WUA implemented a schedule by closing upper outlets on the main canal when irrigation under those outlets was finished. The WUA employed a man to monitor water distribution who checked the areas to be irrigated and closed outlets when done. During the first portion of the period, the six outlets at Falls 1, 2, and 3 took all the water, then the lower outlets were given water as the upper ones were closed. Following the three-week open period, the canal was closed for cleaning. The farmers told us that this season is the first winter season that water has reached the tail of the main canal; a fact that they attribute to the scheduled and controlled deliveries.

The EMC WUA also planned rotational deliveries for the winter 1998-99 season. In addition, they planned to stagger crop operations so that they can get water to all farmers. For rotation, they divided the EMC into two sections: the outlets at Falls 1-3, and the outlets at Falls 4-6. Like the WMC, they hired a man to implement the rotation throughout the season.

During the monsoon season, the WMC WUA officers expect that the entire present command area (1133 hectares) will be irrigated. They hope to bring more area under irrigation in the future. The EMC WUA officers also expect to irrigate the whole EMC command during monsoon season and hope to expand the area irrigated in the future.

Below the main canal, it is the responsibility of each Branch Committee to distribute water to all WUA members who want water. To become a member, a farmer must pay a one-time membership fee of NRs. 10. WUA officials stated that they would not offer membership to a farmer if they could not get water to him. It is the Branch Committee that decides on membership. In theory, each Branch Committee should develop a delivery schedule. In fact, in winter 1998-99, individual farmers according to long established precedence rules carried out water distribution on the branch canals.

The WUAs plan to charge irrigation fees of NRs. 120 per hectare for both wheat and paddy, from which they will pay government irrigation fees. The Branch Committees are to collect the fees to pass on to the Main Committees.

Collective Management of O&M by Farmers

Prior to the formation of the WUAs in 1998, farmers collectively took responsibility for certain activities. Most important, farmers have customary distribution practices below the outlets so that water is distributed without a great deal of conflict. However, little maintenance was done. One major exception was that, in the Eastern Main Canal, an annual meeting of the local leaders would be held to plan maintenance of the upper portions of the main canal. The work would be carried out through labor contributions.

Canal Water Distribution Performance in the HIS

Water distribution through the canal system is extremely poor. The HIS was designed to serve an area of 2,000 hectares, but currently it is providing monsoon season irrigation for only 1,200 hectares and winter irrigation for about 300 hectares. Failure to serve the designed command, even in monsoon season, is due to three reasons:

- Lack of water and variability of flows in the river. Both main canals were designed to have capacities of 990 lps. But the recorded discharge in the EMC on 15 January 1999 was 168 lps and the discharge in the WMC on 16 January 1999 was only 105 lps. Aggravating the situation, are the five farmer-managed irrigation systems upstream from the HIS that divert most of the flow during times of water shortage.

- Poor condition of the canal system caused by lack of maintenance, leading to high losses and lack of ability to control the flows. In addition, because the design and construction of the water distribution system were left to unorganized farmers, there are numerous places where the canals were not constructed to serve the planned area.

- Lack of Department of Irrigation personnel and operations planning left operation of the canal system to unorganized farmers. Thus, as expected, farmers near the head of the system take the water they feel they need without regard for farmers further downstream.

The two latter problems are being dealt with by the Irrigation Management Transfer Project.

Both the DIO and the farmers feel that, under both main canals, there is potential to expand the HIS canal command area. Physical and management improvements to the canal system can certainly stretch the available river water further. It may be, however, that significant expansion would be possible only by making additional use of ground water.

PRESENT CONJUNCTIVE IRRIGATION MANAGEMENT IN THE HIS

Present conjunctive management for irrigation in the HIS is carried out by individual farmers at the farm level. Specifically, individual farmers make decisions and

arrangements to get irrigation water as needed to serve crop needs from the canals or STWs. A farmer can purchase pumping service from someone else's STW or can install and operate his own STW.

Crops and Basic Features of Irrigated Farming

Almost the whole HIS command is cultivated with paddy during the monsoon season. The other major crops are wheat, potatoes, oilseeds and pulses; all planted during the winter season. In winter, about 60% of the area is planted with wheat; most of the remaining area is covered with a variety of crops. Early paddy is grown only in limited areas because of lack of water; most of the remaining area is fallow. Higher areas where irrigation water is not easily available have fruit orchards with vegetables and pulses. Because of their dominance, we limit the following discussion to monsoon paddy and winter wheat.

The primary method of water application is basin flooding. Within a single farmer's area, he will have several bunded basins. Most farmers have no field channels; generally water flows from one basin to another. In many cases, one farmer gets his water from another's fields.

As in most of South Asia, the farmers in the HIS command are poor and have small landholdings. Landholdings average less than a hectare and many landholdings, particularly larger ones, are divided into a number of separate parcels in different locations.

Preferred Water Application for Monsoon Paddy and Winter Wheat

In the monsoon season, farmers reported that with assured irrigation they grow improved paddy varieties and apply chemical fertilizers. In rain fed areas they plant local varieties and use little chemical fertilizer. They use insecticides when needed.

For paddy, farmers prepare a nursery for seedlings - generally about 500 square meters for each hectare of field to be planted. The seedbed is generally prepared in June at the beginning of the rains so that transplanting occurs in July following the preparation of the regular fields. Shallow irrigation is required for the seedbeds unless rainfall is adequate.

During land preparation, the land is soaked and puddled. Farmers believe that submergence (up to 10 cm) is favorable for the transplanted paddy until grain filling is complete. Following the grain filling, the field should be dried. Adequate water is most critical during the grain filling stage; farmers will make strong efforts to get sufficient water during grain filling.

In the winter season, wheat is directly seeded into the fields in December following land preparation. Improved varieties and fertilizers are used. Farmers prefer two watering for wheat; the first should be 22 days after seeding and the second 22 days later. Farmers believe that the first watering is critical for wheat; the second is much less important.

The Economics of Ground Water Irrigation in the HIS

Ground water management is carried out by individual farmers, either through the use of their own wells, or by buying ground water from others. The major problem is the cost of ground water. As we will show, the cost of irrigation from a STW is high enough that farmers consider carefully the returns against the costs whenever they use ground water.

The Cost of Ground Water Irrigation of Monsoon Paddy

Because of variability in the onset of the monsoon, it often happens that the rains do not begin before it is necessary to prepare seedbeds in order to ensure the correct timing for the winter crop. Thus, farmers often depend on STW water for paddy seedbeds. Up to three shallow irrigation may be provided if rains are deficient. Each irrigation requires 8-10 hours of STW pumping per hectare. At the average operational cost of about NRs. 33 per hour, this amounts to at least NRs. 264 per hectare per irrigation. At the selling price of NRs. 50 per hour, this amounts to at least NRs. 400 per hectare per irrigation. However, since the average holding is less than a hectare and because each hectare of seedbed serves about 20 hectares of field, most farmers need to pay only small fractions of these costs. The cost of ground water for seedbed irrigation is not a major constraint and is not further considered.

During July and August, the period of heaviest and most reliable rainfall, there is little need for irrigation of paddy in the field. During this period, too, the canals have abundant flow and many farmers can use canal water to supplement rainfall. Thus, except for extended dry spells, farmers do not make much use of the STWs for irrigating monsoon paddy. Most STW use occurs during the critical grain filling stage in September-October. Even farmers with access to canal water report that they generally have to irrigate with ground water at least once a season. If rainfall is inadequate, farmers say they would have to irrigate paddy at least three times to get a crop.

Farmers say that it takes 10 hours of pumping to irrigate a hectare of paddy. Therefore, if a farmer buys ground water, he must spend at least NRs. 500 per hectare per irrigation at present prices. If he owns his own STW, a farmer must pay NRs. 330 per hectare per irrigation in operating costs. Since a farmer may irrigate up to three times per season to protect his crop, the cost of irrigation for the paddy crop could be as high as NRs. 1500 per hectare if he must buy water or NRs. 990 per hectare if he owns a STW.

Technicians from the Hardinath Agricultural Farm reported that the consumptive requirement for monsoon paddy in the HIS command is 10-16 mm per day. For a 100-day rice variety, this would be 1,000-1,600 mm. Let us assume that the paddy is transplanted in early July to take maximum advantage of the rains. The average rainfall for July, August, and September is 1,023 mm (Table 1) or more than the lower value for the consumptive requirement. These figures suggest that in some seasons and places monsoon

rainfall alone is adequate for paddy production. However, in other places, there is an irrigation requirement of up to 600 mm. Clearly, any lack of rainfall at critical times will adversely affect the crop.

The Cost of Ground Water Irrigation of Winter Wheat

Wheat is usually planted near the end of December. Farmers believe that winter wheat should be watered twice, once at 22 days after seeding, generally in mid-late January, and then 22 days later, generally in mid February. The first watering is considered critical and most farmers will not plant wheat unless they have assurance of water for the first irrigation. Farmers generally expect to use ground water for this first irrigation although canal water may also be available.

The second watering is not considered critical and many farmers will not give a second watering when irrigation costs are high. In 1998-99 winter season, the WMC WUA decided to forgo providing canal water for the second irrigation to finish cleaning the main canal.

One farmer estimated that it takes eight hours to irrigate a hectare of wheat from a STW. A farmer who has to buy ground water will pay NRs. 400 per hectare per irrigation at NRs. 50 per hour. A farmer with his own tubewell will pay NRs. 264 per hectare per irrigation in operating costs. These figures then represent the minimum expected costs for ground water irrigation of wheat while the maximum expected costs are twice these figures.

According to technicians at the Hardinath Agricultural Farm, the seasonal consumptive requirement of wheat in the HIS command is about 250 mm. The total average rainfall from December through March is about 60 mm (Table 1). If all irrigation is provided from STWs, and we ignore transmission losses, we can calculate the total ground water provided as follows. Reported time to irrigate one hectare of wheat is eight hours and the average STW has a discharge of 12 lps. The amount of water supplied in eight hours from a STW is thus:

$$8 \text{ hr} \times 3600 \text{ sec/hr} \times 12 \text{ lps} \div 1000 \text{ lt/m}^3 = 345.6 \text{ m}^3$$

If this is applied to one hectare (10,000 m^2), the total applied is 34.6 mm. Therefore if one irrigation from a STW is given, rainfall is normal, and no canal water is used, the total supplied is only about 35 mm from ground water plus 60 mm from rainfall or less than 100 mm, less than half the consumptive requirement. Even if a second irrigation from a STW is given, the total amount is only about 130 mm or about half the requirement. These figures imply dependence on canal water on the one hand, and under-irrigation on the other.

The Cost of Ground Water Irrigation versus Returns from Irrigated Agriculture

Table 4 shows revenues and cost of production for one hectare of irrigated monsoon paddy and one hectare of winter wheat, excluding the costs of irrigation and the costs of household labor, own animal labor, farmyard manure, and the capital costs of the farm establishment. Farmers do not consider these last four items as costs of production because they do not require cash outlays.

Table 4 indicates that the expected cash return excluding the cost of irrigation from irrigated monsoon paddy is about NRs. 21,000 per hectare assuming a yield of 3 tons/ ha. As calculated earlier, the normal maximum cost of ground water irrigation is NRs. 1,500 per hectare or 7.5% of the expected profit. The table also shows that the expected cash return from irrigated winter wheat is about NRs. 10,000 per hectare assuming a yield of 2.4 tons/ha. As calculated earlier, the maximum cost of ground water irrigation would be NRs. 800 per hectare or 8% of the expected profit.

We calculated the total cost for irrigation by purchasing ground water of a hectare of monsoon paddy followed by a hectare of winter wheat as NRs. 2,300 while the expected returns are NRs. 31,000. These figures suggest that investment in ground water irrigation is worthwhile for both crops. However, this conclusion is premature. Consider the following:

- The expected return to these two crops is NRs. 31,000 per hectare. This is less than NRs. 2,600 per month, a sum that is barely adequate for a family to live on. Since most farmers hold less than a hectare, actual family income is less. Any reduction to this return because of the expenditures on irrigation is extremely painful unless the family has other sources of income. Also, this income compares unfavorably with returns to labor in Punjab where the reported wage rate is NRs. 150 per day or at least NRs. 3,000 per month.

- Farmers do not count family labor, own animal labor, farmyard manure, and their capital investment as part of the costs of production. However, farmers evaluate cash profits as returns to these factors, particularly to family labor. If we assume that one hectare of monsoon paddy followed by one hectare of winter wheat requires 200 person days of family labor (a low estimate), the total return is NRs. 155 per person day. While this is significantly higher than the local agricultural wage rate of NRs. 50 per day, it is still low.

- The figures in Table 4 are the costs and returns *expected* by the farmers. These are not average figures. Unfortunately we do not have average figures for the area, but we expect that average yields are lower than the yields shown here. Even a yield reduction of half a ton per hectare of paddy means a 16% reduction in annual income.

- Groundwater irrigation requires cash expenditure at the time of irrigation - either to pay the well owner or to purchase diesel to operate the pump. Farmers, because of

their poverty and the seasonal nature of farm income, often lack the necessary cash and cannot use ground water when their crops are most in need of watering.

The risk and low return to agriculture in the area make poor farmers reluctant to spend anything more than absolutely necessary. Farmers told us clearly that at best they are only breaking even; they do not feel that the returns to farming allow for any advancement. Thus, they avoid expenditure on ground water irrigation whenever possible. There are, of course, some farmers who are making profits; one such farmer explained how he made regular use of his tubewells to ensure good yields. Most farmers, however, feel that they must minimize expenditures on ground water irrigation.

The Economics of Tubewell Installation

The value of owning a STW depends a great deal upon a farmer's landholdings. As reported earlier, the present cost of installing a STW is about NRs. 50,000. If this can be amortized over 20 years, the annual cost is NRs. 2,500. However, as calculated earlier, a well owner generally spends *at least* NRs. 330 per hectare during monsoon season and NRs. 264 per hectare during winter season for operating costs for his own irrigation. This makes his total operating and capital costs about NRs. 3,100 annually for a one-hectare farm. In comparison, a farmer who buys water generally needs to spend at least NRs. 500 per hectare during monsoon season and NRs. 400 per hectare for a minimum of NRs. 900 annually for a one hectare farm. Even if the farmer irrigates three times in monsoon season and twice in winter, he would spend about NRs. 4,000 per year on his own well for a one hectare farm while if he bought water, he would spend only about NRs. 2,300 per year. Considering these figures, it would be unwise to invest in a STW solely to provide irrigation for a one-hectare farm.

Three factors affect this evaluation:

- Clearly, the value of a STW increases with larger landholdings and decreases with smaller landholdings because the capital cost is fixed. Presently, the average landholding is less than a hectare, and is spread in several parcels at various locations. Considering just own use, investment in a STW is clearly not wise for most farmers at the present installation and operating costs.

- Two government programs have offered subsidies to farmers in the HIS command for installation of STWs: the Janakpur Agricultural Development Project (JADP) and the program of the Agricultural Development Bank of Nepal (ADBN). A few years ago, the subsidy rate was 50% for wells purchased with a loan from both sources. A 50% subsidy makes the farmer's minimum and maximum annual costs of irrigating a one-hectare farm from his own well respectively NRs. 1,850 and NRs. 2,750. The comparable costs of buying water are NRs. 900 and NRs. 2,300. At the higher usage end of this scale, the costs of the two alternatives begin to approach each other. In addition, owning his own well gives the farmer control over his water supply, an asset

that may be worth NRs. 450 per year to him. It is not surprising then that the great majority of STWs in the HIS command have been installed under one or the other of these programs. However, the JADP no longer offers subsidies and the ADBN subsidy for individually owned tubewells has been reduced to 30%. Thus demand for loans for STW has plummeted.

- Selling water to others can make investment in a STW worthwhile. Sales of even 100 hours of pumping a year at NRs. 50 per hour (the lower consensus rate) would bring in an income of NRs. 1,700 (NRs. 50 per hour revenue minus NRs. 33 per hour operating costs giving NRs. 17 per hour profit). This income covers the difference in cost between owning a STW and buying water for a one-hectare farm in even the least favorable situation. Such sales make it worthwhile for a farmer with one hectare to own a well even without a subsidy. Higher sales, of course, make investment in a STW more valuable. However, as new STWs are installed, the increasing density of STWs will reduce the possibility of sales or force reduction in profits, thus reducing the return on the investment in a STW.

Not only is purchase of a STW economically unwise for most farmers, farmers also face difficulties in purchasing a STW. A major problem is the need to gather enough cash at one time to put up the deposit for the JADP program. For the ADBN program, farmers reported discouraging procedural difficulties and extra costs.

Operating costs are high compared with capital costs - for a one hectare farmer using a STW only for his own farm, annual operating costs are between 24% and 60% of the annual capital cost depending upon the amount of pumpage. Thus government subsidies for installation are not very effective in encouraging ground water use unless the subsidies are very high.

The present subsidy programs offer a 75% discount for purchase of a tubewell by a group of farmers. We asked why farmers did not get together to purchase a STW. Farmers told us that they were not capable of organizing themselves for this purpose. While we doubt that this is the complete truth, there are real difficulties involved. The local social capital does not include any common concept of a small group of field neighbors jointly owning a capital item such as a STW (Brewer and Sharma, 1999). Farmers could understand village ownership and operation of a network of tubewells to serve the villagers. However, at present, village level governments do not have the legal power to create and operate public utilities. However, one Village Development Committee is considering offering subsidies to farmers for STW installation, and another is installing its own tubewell.

Well Usage

Cost considerations limit both the installation and use of wells for irrigation even though there are rich groundwater resources underlying almost the whole of the HIS area. The annual average use of STWs in the area is reported to be in the range of 400 to 550 hours

against a potential use of 1500 hours. This clearly indicates under-utilization of the STWs. This is, however, considerably higher than the average use reported for the Terai. One study (Koirala 1998) reported an annual average of 162 hours per STW for the Terai. Another study (IIMI 1991) reported a Terai annual average of 168 hours per STW.

Using Canal Water and Ground Water Conjunctively

Farmers recognize the value of irrigation. Farmers reported great variation in crop yields depending on water availability and the use of other production inputs. Reportedly, yields under rain fed conditions are about half of those under irrigated conditions. This difference occurs not only because of the less reliable source of water, but also because, under rain fed conditions, farmers plant local rather than improved paddy varieties and use far lower amounts of fertilizer.

From the farmers' point of view - which ignores the costs of construction because the government covered it - canal water is cheap. In the past, government irrigation fees have been very low and often uncollected, hence farmers generally considered canal water almost free. Even if the WUAs succeed in enforcing payment of NRs. 120 per season for canal irrigation, it will still be considerably cheaper than ground water irrigation. On the other hand, ground water is expensive, both in comparison with canal water and in comparison with incomes from irrigated agriculture. Because of high pump operating costs, ground water is relatively expensive even if a farmer owns his own STW.

The high cost of ground water makes farmers unwilling to depend solely on STWs for irrigation. Thus, most STWs are used for irrigation conjunctively with cheaper canal water. Few farmers are willing to purchase a STW unless they also have access, at least sporadically, to canal water. In the HIS command STWs and deep tubewells are found only where canal water is available. Thus STWs are found in most of the command of the EMC because water, at least occasionally, has reached the tail, in part because of the regular desilting carried out by EMC farmers in the past. However, no tubewells are found in the lower half (below the 6th fall) of the WMC where, until the 1998-99 winter season, canal water did not flow. This area thus has been purely rain fed.

THE POTENTIAL VALUE OF CONJUNCTIVE MANAGEMENT IN THE HIS

Our question is whether conjunctive management by some entity other than the individual farmer can improve water distribution and enable farmers to improve yields and area irrigated.

To summarize the situation:

- The HIS canal system does not provide adequate service to a large fraction of the farmers located within the official command.

- In much of the HIS command, farmers have, with government support, installed wells to supplement rainfall and canal water with ground water.
- The high cost of ground water prevents farmers from using STWs effectively to solve the problems of poor water distribution through the canal system, even though a very large reservoir of ground water is available.
- Thus not all the area is irrigated and yield levels are low.

The physical and management improvements to the canal system being implemented under the Irrigation Management Transfer Project should improve the canal situation, but will not remedy the river water shortages. To deal with the under-use of ground water, government subsidies for STW operations could be implemented. Also, of course, efforts to improve fertilizer availability and marketing opportunities would help. Conjunctive management must be considered apart from these efforts and potential improvements.

Conjunctive management of surface and ground water must focus on how to use each resource to complement the other. If surface water is short in some places or times, ground water should be provided, and vice versa. However, if the costs are not similar for water from the two sources, conjunctive management is not likely to produce the expected results.

In the HIS, conjunctive management at system level could be useful if it complements cheap but limited surface water with expensive but unlimited ground water in such a way that farmers pay, on the average, prices significantly lower than the present cost of ground water. One way to achieve this result would be to distribute ground water through the canal system - after upgrading by the IMTP - to supplement the river water. That is, if tubewells were to pump water into the canals at appropriate places, it would be possible to use the ground water to complement the available surface water to ensure that all farmers within the command of the HIS receive water. The WUAs would cover the costs and all farmers would be charged the same fees irrespective of the source of water. The wells used for this purpose would serve more farmers than do present STWs and thus would be operated for longer periods annually, reducing per hour and per farmer capital costs. Also, those who have good access to canal water would pay part of the cost of providing ground water to other farmers, thus lowering the price to those who use the ground water.

However, given the high operating costs, this technique might raise the costs of irrigation for some farmers but not lower costs sufficiently to make the effort highly attractive. The key is to use the WUA to lower pumping costs. Given the favorable electricity tariff in Nepal, electrified pumps would reduce pumping costs considerably, although electrification would require additional investment in the pumps and in providing the power lines and connections. Other government efforts could be formulated to reduce pump-operating costs.

To carry out this plan, an organization needs to be established with authority to manage both the canal system and supplementary wells so as to deliver water to all farmers within

the HIS command. Such agencies exist in many countries. The Department of Irrigation presently divides responsibility for management of surface and ground water into different wings of the agency at all levels, so it is not the logical candidate for this management role. Clearly, the WUAs would have to serve this function. The newly elected leaders of the Western Main Canal WUA told us that they were hoping to convince the government to give them electricity connections through a government rural electrification program to existing wells located along the WMC so that they could use those wells to supplement river water to irrigate the tail regions of the WMC command.

Social capital consists largely of the organizational concepts widely accepted among the population. The social capital within villages in Nepal does not include widely accepted concepts on which to base supra-village organizations made up of members from the villages. It does, however, include the idea that the "government" can create supra-village organizations (Brewer and Sharma, 1999). Thus the WUAs in the HIS command are government created supra-village organizations that will not function without explicit government support. This means that the WUAs also need some government support to take on responsibility for conjunctive management of surface and ground water within the HIS. Simple recognition of the WUAs' authority to take on this function by the Department of Irrigation, the WUAs' sponsoring authority, may be sufficient. However, it would be better to provide more direct help, such as helping with electrification of pumps and technical advice in implementing a conjunctive management plan. With help from the Department of Irrigation, the WUAs might be able to take advantage of other government-sponsored opportunities, including the rural electrification program already mentioned and, perhaps, the 75% subsidy offered by the Agricultural Development Bank of Nepal to groups of farmers for the installation of new tubewells.

At present, there is no government support for conjunctive management by WUAs. The Irrigation Management Transfer Project, which is supporting the WUAs and rehabilitating the canal system, makes no provision for assistance to conjunctive management. The lack of support is largely caused by the fact that the portion of the Department of Irrigation supporting the WUAs (and implementing the IMTP) deals only with surface water; ground water is dealt with by a wing of the Department of Irrigation that is separated from surface water irrigation right up to the very top levels of the Department.

CONCLUSION

We have shown that within the command of the Hardinath Irrigation System, use of ground water for irrigation is limited for economic reasons, although ground water is easily and widely available. We have also shown that, because of the cost, ground water is used by farmers largely in conjunction with cheap surface water provided through the HIS canal system. In addition, we have suggested that, with appropriate government support, it may be possible to improve the availability of irrigation water to farmers within the HIS command at a reasonable cost if the newly formed water user associations, with

appropriate government support, take on responsibility for conjunctive management of ground water and surface water at the system level.

We believe that this analysis for the HIS is largely valid for the whole Terai, primarily because the economic conditions of farmers are similar in most of the Terai. Our conclusions thus have the following implications for irrigation and agricultural development in the Terai:

- Nepal's Agricultural Perspective Plan (APP, 1995) makes subsidized installation of STWs the centerpiece of its Terai agricultural development strategy. This analysis calls this plan into question by pointing out that the present low level of use of ground water for irrigation is primarily a problem of high operational costs rather than high installation costs. Instead it suggests that, to increase ground water use, the government should focus its efforts on reducing STW operational costs and improving crop profitability.

- There is a need to focus attention on conjunctive management rather than primarily on ground water development since ground water is most valuable to farmers when used in conjunction with canal water. This will require some reorganization of the Department of Irrigation to end the isolation of the wings dealing with surface water and ground water.

- Where there is potential for effective conjunctive management, there is a need to develop the institutional resources to provide irrigation water from both sources at a cost considerably lower than the present cost of ground water. The best candidates to manage both sources effectively are the water user associations. However, the WUAs will require additional support in the form of institutional development, appropriate subsidies and technical assistance, and, perhaps, additional legal powers.

Where surface systems do not exist, conjunctive management is not an option and the broader issue of the economics of irrigated farming must be tackled. Clearly, the best overall solution is to devise policy and other means to raise the profitability of agriculture to farmers. Means to do so are beyond the scope of this paper.

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TABLES AND FIGURES

Table 1: Monthly Rainfall at Hardinath Agricultural Station: 1986-96 (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1986	0	15	1	47	82	27	386	371	152	122	0	70	1273
1987	1	40	1	78	12	223	529	913	423	168	0	2	2390
1988	0	58	38	108	52	303	670	609	139	59	0	24	2060
1989	14	12	21	0	132	122	539	193	352	16	0	7	1408
1990	0	23	23	37	211	55	445	160	391	5	0	16	1366
1991	54	1	14	30	25	217	303	235	180	24	0	8	1091
1992	0	3	0	10	260	122	208	170	83	176	2	0	1034
1993	5	2	27	156	89	162	292	575	129	0	0	0	1437
1994	45	37	6	12	90	60	366	284	303	0	0	0	1203
1995	9	20	7	0	21	324	231	551	85	19	28	11	1306
1996	33	3	0	1	14	309	651	254	80	116	0	0	1461
Avg	14.6	19.5	12.6	43.6	89.8	174.9	420.0	392.3	210.7	64.1	2.7	12.5	1457.2

Table 2: Jalad River Flows at the Headwork of the Hardinath Irrigation System (lps)

1998			1999	
Date	Flow		Date	Flow
17 August	1685		11 January	917
31 August	1760		15 January	596
15 September	1685		29 January	917
21 September	1282		10 February	783
1 October	2595		13 February	324
16 October	1282		4 March	917
18 October	596		12 March	596
4 November	1685		15 March	917
11 November	1124		19 March	596
17 November	917		26 March	426
1 December	1685			
11 December	2693			
20 December	783			
30 December	596			

Source: Dhanusha District Irrigation Office

Table 3: Shallow Tubewells in the HIS Command

No.	Village*	STWs**
1.	Baniniya	25
2.	Tarapatti	21
3.	Gopalpur	6
4.	Laxmipur	28
5.	Sapahi	20
6.	Therakachuri	2
7.	Mithileshwar	9
8.	Baghchaura	2
9.	Bengashivpur	2
Total		115

Source: Janakpur Agriculture Development Project and ADBN Office Janakpur, 1999.

* Village Development Council area.

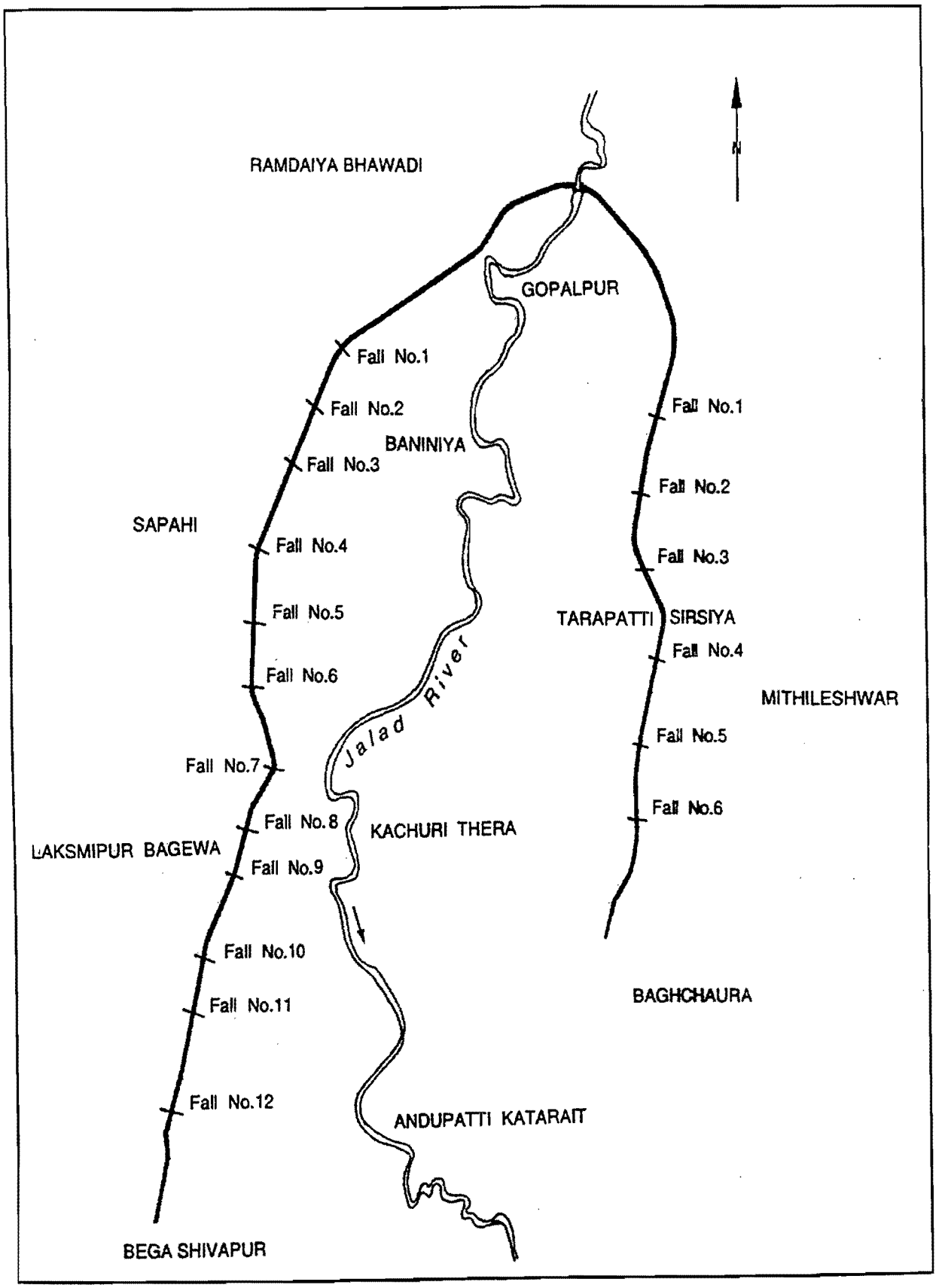
** These do not include STWs installed without subsidy, a very small number.

Table 4: Per Hectare Costs and Revenues of Production for Irrigated Paddy and Wheat

Item	Unit	Quantity	Price (NRs.)	Value (NRs.)
Monsoon Paddy				
Revenue				
Value of production	metric ton	3.0	10,000	30,000
Costs				
Seeds	kg	45	20	900
Chemical fertilizer	kg	150	17	2550
Insecticides	sum	-	-	750
Hired labor	person-day	75	50	3750
Bullock/tractor rental	sum	-	-	900
Gross Profit				21,150
Winter Wheat				
Revenue				
Value of production	metric ton	2.4	7,000	16,800
Costs				
Seeds	kg	120	7	840
Chemical fertilizer	kg	120	17	2,040
Insecticides	sum	-	-	150
Hired labor	person-day	60	50	3,000
Bullock/tractor rental	sum	17	-	850
Gross Profit				9,920
Annual				
Gross Profit				31,070

Source: These figures are based on interviews with farmers, at some of which several farmers discussed the questions and reached representative answers. The figures should be considered farmers' expectations rather than averages. Prices are from the 1998 monsoon season for paddy and from the 1998-99 winter season for wheat.

Figure 1: The Hardinath Irrigation System



Annexes

Annex 1

Program for Workshop on
Evaluation of Irrigation Management Transfer Process and Performance

Venue: Himalaya Hotel, Lalitpur, Nepal

Day I: 11 October 1999 - Monday (24 Ashwin 2056)

Activity	Time	
	From	To
Registration	8:45	9:00
Opening Session: 9:00 – 10:00 Chairperson: R. L. Kayastha		
Introduction on workshop and welcome by R. P. Satyal	9:00	9:10
Inaugural speech by the Chief Guest – B. N. Sapkota	9:10	9:20
Few words by R. L. Kayastha	9:20	9:30
Background on the research project – David J. Molden	9:30	9:50
Vote of Thanks – K. R. Sharma	9:50	10:00
Tea Break: 10:00 – 10:15		
Session I: 10:15 – 11:55 Chairperson: M. M. Shrestha		
1. Performance and Impacts of IMT – Charlotte de Fraiture and K. C. Prasad	10:15	10:40
2. Experiences on Developing Monitoring and Evaluation system for IMT – T. P. Sharma and S. K. Shrestha	10:40	11:05
Discussion on the presentations	11:05	11:45
Summing up by the Chairperson	11:45	11:55
Lunch: 11:55 – 13:10		
Session II: 13:10 – 14:50 Chairperson: R. P. Yadav		
3. Institutional Development Processes for IMT: A Review – Sanju Upadhyay	13:10	13:35
4. Assessment of Rehabilitation Processes for IMT – Hari P. Hemchuri	13:35	14:00
5. Operational Practices in Khageri Irrigation System – V. S. Mishra	14:00	14:25
Discussion on the Presentations	14:25	14:40
Summing up by Chairperson	14:40	14:50
Tea Break: 14:50 – 15:05		
Session III: 15:05 – 17:00 Chairperson: Keshav Neupane		
6. Women in West Gandak WUA – Jacobijn van_Etten	15:05	15:30
7. Step by Step Approach to IMT: Manushmara – S. Sijapati	15:30	15:55
8. Role of WUA National Federation in IMT – T. R. Dahal	15:55	16:20
9. Analysis of IMT Process in West Gandak, Khageri and Panchkanya – A. Shukla, N. N. Joshi and B. Devkota	16:20	16:30
Open Discussions	16:30	16:50
Summing up of Day I by K. R. Sharma	16:50	17:00

Day II: 12 October 1999 – Tuesday (25 Ashwin 2056)

Activity	Time	
	From	To
Tea: 9:00 – 9:15		
Session IV: 9:15 – 12:00 Chairperson: R. P. Satyal		
10. Conjunctive Water Management in Hardinath Irrigation System – K. R. Sharma	9:15	9:40
11. Summary of the Research Works and Recommendations – David Molden and K. R. Sharma	9:40	10:05
Open Discussion	10:05	11:00
Group Formation	11:00	10:10
Group Discussions	11:10	12:30
Lunch: 12:30 – 13:40		
Group Discussions	13:40	15:30
Tea: 15:30 – 15:45		
Group Presentations	15:45	16:15
Open Discussions	16:15	16:50
Wrap up of Day II and Call for Closing Session – David Molden	16:50	17:00
Closing Session: 17:00 – 18:00 **Chairperson: R. L. Kayastha**		
Views of a Farmer Representative – R. P. Sah	17:00	17:10
Views by Workshop Coordinator – K. R. Sharma	17:10	17:20
Comments by R. P. Satyal	17:20	17:30
Views by M. M. Shrestha	17:30	17:40
Remarks by the Chairperson – R. L. Kayastha	17:40	17:50
Few words and appreciation - David Molden	17:50	18:00
Workshop adjournment – K. R. Sharma	18:00	
Cocktail and Dinner	18:00	

Topics for Group Discussions for Institutionalizing Research Recommendations

A. Monitoring and Evaluation System for IMT Impact Assessment
B. Farmer and Agency's Institutional Strengthening
C. Rehabilitation Processes
D. Post - IMT Supports

Annex 2

List of Participants

1. Dr. David J. Molden, Program Leader – Nepal Program, IWMI-HQ
2. Dr. Doug Clendon, TA-NISP
3. Dr. I. L. Kalu, TA-IMTP
4. Dr. K. R. Sharma, Chief, Research and Technology Development Branch, DOI
5. Dr. N. H. Hari Gajurel, Senior Statistician, DOI
6. Dr. N. M. Shakya, Institute of Engineering, Pulchowk
7. Dr. R. P. Yadav, Winrock International
8. Dr. Suresh Chalise, ICIMOD
9. Mr. Ajay K. Pokhrel, Coordinator, SISP, DOI
10. Mr. B. N. Sapkota, Secretary, Ministry of Water Resources
11. Mr. Bel Bahadur Gurung, Khageri WUA
12. Mr. Bharat Devkota, IAAS, Rampur, Chitwan
13. Mr. Bishnu Hari Devkota, Secretary, Panchkanya WUA
14. Mr. Bob Nanes, IDE, Sanepa
15. Mr. Chandra B. Shakya, APTEC Consultancy
16. Mr. G. R. Pathak, WUA Chairman, Narayani Lift Irrigation Project
17. Mr. Hari Hemchuri, Engineer, IMD, DOI
18. Mr. Hem L. Sharma, Chairman, WUA Central Committee, BLGWP
19. Mr. J. L. Shrestha, Coordinator, Ground Water Resources Development Project
20. Mr. J. R. Sharma, Coordinator, Irrigation Management Transfer Project, DOI
21. Mr. K. C. Prasad, Research Coordinator, IWMI Nepal
22. Mr. K. P. Timilsena, Coordinator, Nepal Irrigation Sector Project, DOI
23. Mr. Keshav Neupane, Chhattis Mauja IS, Rupandehi
24. Mr. Krishna B. Kunwar, Agriculture Development Bank, Nepal
25. Mr. L. C. Pradhan, Chief, Human Resources Development and Training Branch, DOI
26. Mr. M. M. Shrestha, Joint Secretary, Ministry of Water Resources
27. Mr. N. B. Shrestha, Section Officer, NPC, Singh Durbar, Kathmandu
28. Mr. Narayan Upadhyaya, Manager, West Gandak WUA
29. Mr. P. R. Khanal, Doctorate fello
30. Mr. Padam Pd. Aryal, Chair Aandhikhola WUA
31. Mr. R. L. Kayastha, Director General, Department of Irrigation
32. Mr. Rajendra L. Shilpakar, Office Manager/Research Assistant, IWMI Nepal
33. Mr. Ram P. Satyal, Deputy Director General, Irrigation Management Division, DOI
34. Mr. Rajendra P. Baskota, Secretary, Kankai WUA
35. Mr. Ram Ashray Prasad Sah, Chairman, Bangeri WUA
36. Mr. S. K. Adhikari, Chief, Agriculture Engineering Division, NARC, Lalitpur, Nepal
37. Mr. S. K. Shrestha, Economist, SMB, DOI
38. Mr. S. P. Rajbhandari, Chief, System Management and Training Program, DOI
39. Mr. S. Sijapati, Senior Divisional Engineer, DOI
40. Mr. Saleem A. Sial, ICIMOD
41. Mr. Sanju Upadhyay, Engineer, IMD, DOI

42. Mr. Shantam Singh Khadka, Doctoral fellow
43. Mr. Shital B. Regmi, SE, DOI
44. Mr. Sukhdev Neupane, Sorah mauja IS, Rupandehi
45. Mr. Surendra Adhikari, RTDB/DOI
46. Mr. T. P. Sharma, Chief, Management Information Unit, DOI
47. Mr. T. R. Dahal, Chairperson, WUA Federation, Nepal
48. Mr. Tajmul Musalman, Chairman, Marchwar WUA
49. Mr. Tika Prasad Adhikari, Chairman, Bhutlung WUA, Jhapa
50. Mr. Tribhuvan Poudel, Sociologist, IMD, DOI
51. Mr. Umesh Parajuli, SDE, DOI
52. Mr. V. S. Mishra, Engineer, DOI
53. Ms. Amita Tuladhar, Field Researcher, IWMI Nepal
54. Ms. Charlotte de Fraiture, Research Associate, IWMI-HQ
55. Ms. Hannehe Chin, Masters fellow
56. Ms. Prabina Bajracharya, Field Researcher, IWMI Nepal
57. Ms. S. Upadhyaya, Agri. Economist, Ministry of Agriculture, Kathmandu, Nepal
58. Ms. Shuku Pun, Field Researcher, IWMI Nepal
59. Ms. van_Etten, Jacobijn, Research Associate, IWMI-HQ