FARMER MANAGED IRRIGATION SYSTEMS AND GOVERNANCE ALTERNATIVES

Proceedings of the Third International Seminar held on 9-10 September 2004, Kathmandu, Nepal

Edited by

Prachanda Pradhan

Upendra Gautam

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EDITORS' NOTE

We at Farmer Managed Irrigation Systems (FMIS) Promotion Trust, Nepal feel pleasure and privileged to have organized the Third International Seminar on *FMIS and Governance Alternatives*, the theme of this publication. The Trust had organized the First International Seminar on *Challenges to FMIS* in Kathmandu in March 2000. Its Second International Seminar entitled *FMIS in the Changed Context* was held in Kathmandu in April 2002. The third seminar organized in Kathmandu in September 2004 has generated interest among practitioners, policy makers, academics, farmers and people in general about the FMIS governance. This publication compiles the proceedings and papers at the seminar.

The term 'governance' in FMIS context implies certain notions of the right, which is legitimate and socially sanctioned as well to make decisions about the use of water and to derive benefit from the rightful use. Governance therefore includes the structures and methods of organisational effectiveness relative to water allocation and utilisation decision. Decisions are based on rules and collective action. FMIS as a form of such a decision system practiced in many parts of the world present a viable mode of governance of irrigation of variable sizes and types.

Historical evolution of FMIS in Kathmandu Valley (78 to 880 AD) indicates state recognition to water management as a public welfare activity where the issues were adjudicated by *Panchali* (assembly of local learned). In 1688, water guards were employed for better information about the irrigation affairs and enforcement of decisions taken. In 17th century, the Gorkha State chose not to interfere in the irrigation affairs, and categorized irrigation and conflict related with it as a matter within the jurisdiction of the community. Though resolution of such conflict had to take into account local power structures, it allowed community initiatives and governance structures to evolve[1].

Be it agrarian or industrialized society, what is noteworthy is the fundamental element of *socialness* or working cooperatively together for a purpose in any water management system, which is neither controlled by

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1 Prachanda Pradhan and Upendra Gautam, 2004. *Farmer Managed Irrigation Systems: Challenges and Responses*. FMIS Promotion Trust, Kathmandu, Nepal. Refer also to Dhundi Raj Bhandari, 1989. *Analytical History of the Origin and Development of Nepal (Nepali).* Prakash Publication, Kathmandu, Nepal; and Ganesh Khaniya, 2005. *Traditional Water Management Practices: A Case Study of Bhaktapur City, Nepal.* Jalsrot Vikas Sanstha/Nepal Water Partnership , Kathmandu, Nepal.

state nor private sector. The deliberations and papers compiled in this proceedings eloquently carry and convey this message.

Accordingly, we have, for the first time, echoed the voices of the farmers in the proceedings through a special farmers' plenary. This plenary having the representation of the central level of National Federation of Irrigation Water Users' Association, Nepal (NFIWUAN), its district unit and Chhattis Mauja Irrigation System and Panchakanya Irrigation System, Nepal's two exemplary FMIS in terms of their strong institutional set-up provided ample opportunity to the participants to know the farmers' perspectives at all levels-central, district and system, and to understand the governance modalities they have adopted in the changing socio-economic context. This plenary generated adequate interest, curiosity and confidence among the participants-both national and international-as regards to the farmers' activities and their grass-root governance roles.

On the other hand, the opinions expressed by the members of the expert panel for better irrigation management have provided guidance for future direction regarding rethinking and re-focussing in research agenda and action plans for alternative FMIS governance. This plenary spelt out the need of future research on FMIS in high mountains as well as cost-effective ways to harvest and store rainwater and other micro-irrigation. It also voiced concern over the increasing trend of youths' migration to the urban areas jeopardizing the sustainability of rural irrigation organizations. This panel appreciated some Nepali FMIS venturing into other allied income generating activities. "Farmers are the epicenter of learning". This voice was equally articulated in this panel. It also pointed out the need of demand-oriented irrigation services to promote crop diversification and commercialization.

The seminar had altogether 138 participants that included 58 scholars and 80 learners from 17 countries[2]. These countries included eight industrialized, five developing and four least developed ones from Europe, Asia, and America. The seminar offered a forum with congenial atmosphere for exchanging ideas and mutual learning through both formal sessions as well as informal interactions. There was a sizeable participation from the youths including both the students and young professionals who were enthusiastically taking part in the sessions of their choice during parallel

[2] For the purpose of making distinction between scholars and learners, senior and experienced researchers, administrators, and practitioners in community management are categorized as scholars whereas those relatively new and having limited experience in community management are considered as learners.

sessions. Dr. E. Walter Coward, Jr., former Professor of rural Sociology and Asian Studies, Cornell University and Senior Director of Ford Foundation, the United States of America; Mr. Charles Abernethy, Consultant in Irrigation and Water Resources Management, the United Kingdom; Dr. Nyoman Sutawan, Professor Emeritus, Udayana University, Bali, Indonesia; and Dr. Emmanuel Reynard, Assistant Professor, University of Laussane, Laussane, Switzerland who delivered the keynote speeches and shared their insightful experiences were indeed the "Icons" at the seminar.

Their keynote speeches suggested that governance is dynamic process where considerations are to be made from property relation perspective for effective participation of the actors and conditions for irrigation management transfer to ensure better productivity of irrigation systems. In their view, user-based governance mode like FMIS, which is going through a transition, requires appropriate institutional and legal systems. Examples of irrigation systems from Swiss Alps indicated that these systems go through a process of transition when the institutional and economic condition of the environment changes. Consistent with the directions as set out in the keynote speeches, the proceedings are based on the five important dimensions namely, reform, socio-economics, equity, eco-technology and education and information which can provide foundation for governance alternatives. Governance alternatives certainly are to be viewed from multi-dimensional and dynamic perspective along with the involvement of multi-stakeholders.

Before concluding, we would like to add few words on the editorial aspects. As regards the language and spelling structure, we have followed American grammar. Attempts have been made to arrange the proceedings in a standardized manner as far as possible as reflected in the organization of the papers and the associated references. In order to enhance the smooth readership, we have organized the proceedings into four parts. The first part **initiation and honor ceremony** consists of welcome address, the theme of the seminar, activities of the FMIS Promotion Trust in the past two years, bestowing of awards to the icons of honor, keynote speeches by the four icons of honor, closing remarks and vote of thanks. The second part **parallel sessions** consist of twenty-four papers presented in five different dimensions of FMIS governance. Eight papers were presented under reform dimension. They pertain to Asian irrigation governance that includes the situation of Nepal, India, Bangladesh, Thailand, Laos and Vietnam. Socio-economic dimension comprises of six papers about irrigation governance in Nepal and India whereas equity dimension finds one paper from Turkey and two from Nepal. Eco-technology dimension includes four papers dwelling on various ecological and technical issues in India and Nepal. Education and information dimension consists of three papers from Nepal that are focussed on the enrichment, enhancement and dissemination of knowledge-base on FMIS. The last two parts of this proceedings include **farmers' plenary** and **experts' plenary on FMIS governance**.

A team of enthusiastic professionals which painstakingly reviewed the proceeding materials and thus provided good editorial support deserves our heartfelt thanks. The team members all associated with Consolidated Management Services, Nepal (CMS) are: Pravin Ghimire, Water Resources Engineer; Sachin Upadhyay, Sociologist, Upendra Gupta, Irrigation Engineer and Rajesh Acharya, Environmentalist. On top of it, Ajaya Lall Shrestha, Director, CMS provided us with his valuable comment on structural consistency of the proceedings. Our thanks and appreciation go to Ganesh Khaniya, Program Officer, Samundra Sigdel, Assistant Program Officer, FMIS Promotion Trust and Indra Bahadur Rai, Computer Operator of CMS for their untiring and dedicated effort and assistance in bringing out this publication.

Prachanda Pradhan
Upendra Gautam

Part I : Initiation and Honor Ceremony

PART I: INITIATION AND HONOR CEREMONY

The initiation and honor ceremony of the Third International Seminar of the Trust on "Farmer Managed Irrigation Systems and Governance Alternatives" was chaired by Dr. Harka Gurung, senior Geographer and former Vice-chairman, National Planning Commission, Nepal. The reporting of this part of Seminar was done by Mr. Mahendra Bahadur Gurung, Ministry of Water Resources. Responsibility of conduction of the ceremony was flawlessly done by Mr. Ajoy Karki, Water Resources Engineer. Mr. Karki also introduced the chair.

After the introduction of the chair, Dr. Prachanda Pradhan greeted him by offering a welcome bouquet. Mr. Lava Raj Bhattarai, senior engineer and founder member of the Trust was later recognized by the chair by offering him a bouquet as a token of the Trust's hearty appreciation for providing the Trust a grant to support the Trust's best practicing FMIS award program in the name of his late parents Medini Nath Bhattarai, the first chief engineer of Nepal's Department of Irrigation and Kamala Devi Bhatarai.

WELCOME ADDRESS

RAJAN SUBEDI[1]

Chairman Dr. Harka Gurung, honorable keynote speakers Prof. E. Walter Coward Jr., Mr. Charles Lindsay Abernethy, Prof. Nyoman Sutawan, and Dr. Emmanuel Reynard, distinguished paper presenters, participants, representatives from the press, ladies and gentlemen.

On behalf of Farmer Managed Irrigation Systems Promotion Trust, I have the privilege to welcome you all to the "Third International Seminar on Farmer Managed Irrigation Systems and Governance Alternatives" in the capital city of Nepal. Previous two such seminars were also held in Kathmandu. First was on "Challenges to Farmer Managed Irrigation Systems" and the second one on "Farmer Managed Irrigation Systems in the Changed Context". Six distinguished scholars of international reputation from The Netherlands, the United Kingdom, the United States of America and Nepal were honored during these seminars for their outstanding contributions promoting the knowledge on FMIS.

1 Member Secretary, FMIS Promotion Trust, Nepal.

During the first seminar, Prof. Lucas Horst from Wageningen University was honored in recognition of his outstanding contribution in the area of farmer-centered research and development; Prof. Linden Vincent, also from Wageningen University, was honored in recognition of her outstanding contribution in the area of farmers-oriented human resources development; and Dr. Ujjwal Pradhan, from Ford Foundation, was honored in recognition of his research and continuous support in the promotion of FMIS heritage and culture. The first seminar was attended by 75 participants including 11 participants from 6 countries abroad.

Similarly, during the second seminar Prof. Elinor Ostrom from Indiana University, USA was honored in recognition of her outstanding contribution in synthesizing international learning and crafting institutions related to FMIS; Prof. Norman Uphoff from Cornell University was honored in recognition of his outstanding contribution in farmer-centered academic enrichment and knowledge building; and Dr. Robert Yoder was honored in recognition of his indigenous research and continuous support in promoting the best farmer managed irrigation system practices. The second seminar was attended by 130 participants including 49 from 14 countries abroad.

Nepal is well known for her tradition of collective management of common resources. FMIS, spread all over the country provide irrigation services to more than two-third of the country's total irrigated area. If the term governance in FMIS context is the process of effective service delivery characterized by accountability, equity, transparency and participation, it provides a considerable governance alternatives not only in irrigation management but also for the management of other natural resources as well. Of course, the good water governance requires effective and accountable socio-political and administrative systems based on integrated water resources management approach. But, the essence of FMIS governance has more to do with the socio-economic and cultural requirements together with the appropriate state-devolved set of policies and provisions. We, at FMIS Trust, hope this seminar would work as a forum to study and analyze the alternative governance mode in FMIS context.

Today, we have 138 participants including 40 representing 17 countries. The participating countries include: Bangladesh, Cambodia, Canada, Denmark, India, Indonesia, Japan, Laos, Nepal, the Netherlands, Switzerland, Thailand, Turkey, United Kingdom, United States of America and Vietnam.

We are indeed honored by the presence of Dr. Harka Gurung, renowned scholar, to chair the initiation and honor ceremony, a segment of the seminar.

Likewise, our warm welcome goes to keynote speakers Prof. E. Walter Coward Jr., Mr. Charles Lindsay Abernethy, Prof. Nyoman Sutawan, and Dr. Emmanuel Reynard for their presence to make this gathering a glorious moment.

Likewise, a warm welcome to the distinguished guests, paper presenters and participants, whose active participation would contribute to the success of the seminar.

To our distinguished participants, particularly those from abroad, we wish you all very pleasant, comfortable and memorable stay in our country.

We heartily welcome you all again. Thank you.

INTRODUCTION OF THE THEME OF THE SEMINAR

PRACHANDA PRADHAN[2]

Mr. Chairman, Keynote Speakers, Distinguish Guests, Participants and Friends of FMIS.

This is my honor to introduce you the theme of the Third International Seminar on "FMIS and Governance Alternatives".

FMIS represent democratic values at the grass-root. Many of them have long history of existence. The vibrant FMIS are the national heritage in Nepal. They are, with a few exceptions, good examples of natural resource management at the community level.

The theme of this seminar is selected based on the previous experiences of FMIST. In the first International Seminar, we selected the theme which showed that FMIS were at the crossroad and they were facing many challenges brought by ecological, technical, institutional and material changes. Hence, we tried to look at FMIS in the changing context in the Second International Conference. Changes in FMIS were brought by demographic shifting from rural to urban area, causing more burden to women and aged people for the maintenance of the irrigated agriculture in the villages. Other factors like the competition on water use among different sectors, centralization of water control by the state ignoring the traditional

2 Chairman, FMIS Promotion Trust, Nepal.

water rights of the community brought impact on the role of FMIS. The change of the role of the state and economic systems pushing toward market economy brought profound changes in the management of community based irrigation management.

The theme of the Third International Seminar is to look at the governance alternatives. The term “governance” implies certain notions of right to make decisions about the use of natural resources and to obtain benefits from the exercise of the right. Governance includes structures and methods of control which an organization makes decisions about resource allocation. Decisions are based on the rules and processes of joint decision-making.

Time has come to take stock of what has happened and look for possible alternative governance modes. We see the effort in some countries to strengthen the existing irrigation organization by providing legal and institutional recognition. Similarly, other countries are making efforts to transfer management responsibilities to the farmers organization, yet other alternative mode is to let the market economy take care of the performance of irrigation systems.

There is change from the state control of the economy and institutions to polycentric social structure giving more role to the community. Hence, the developing countries which can not have continuation of state control over economy and on the other hand, the economy can not support the market economy so “ neither the State nor the market economy but the community would be playing central role in natural resource management” as Elinor Ostrom observes.

We are very happy to have with us distinguished keynote speakers whose ground-breaking works started in Asia and Europe. Some of them have been influenced by the community organization of Laos, others have done intensive study of Sri Lankan irrigation systems, yet another keynote speaker tried to understand the intricacy of temple and water resource management at the community level. The study of mountain irrigation systems, bisses of Valais and its changing roles have relevance to understand the relationship between the local community, the state policy and local resource management traditions. They represent a host of governance alternatives and the lesson we learn is that there is no one and only one governance mode.

We tried to look at the governance modes from reform perspectives trying to define the role of the state and farming community, socio-economic and institutional aspects, eco-technological considerations, information and educational issues.

We are very much encouraged by the level of national and international participants in the Third International Seminar on "FMIS and Governance Alternatives". Many of those international participants who have come here had responded to the announcement put in a number of websites. Many of them have come on their own resources except a few who have been supported by InWent (International Capacity Development) of Germany and Ford Foundation, Indonesia. This shows that both researchers and practitioners of different disciplines have interest on this major issue of community based natural resource management, basically water which is going to be severely scarce within our life time.

I am proud to recognize here Dr. Robert Yoder who was one of the FMIST awardees of the Second International FMIS Seminar two years ago. There are several other participants who have been doing field work in Nepal for higher degree. Nepal abounds with different types of autonomous irrigation systems so she offers tremendous opportunities for learning.

I am sure our deliberations and discussions for next two days will be interesting and useful. I wish you for fruitful discussions and happy stay in Kathmandu.

FMIS PROMOTION TRUST IN 2002-2004

UPENDRA GAUTAM[3]

Respected Chairperson Dr. Harka Gurung, Honorable keynote speakers Professor Dr E. Walter Coward, Jr, Mr. Charles Lindsay Abernethy, Professor Dr. Nyoman Sutawan, and Dr. Emmanuel Reynard, special invitees, distinguished participants, friends and colleagues,

It is my privilege and pleasure to engage in dialogue with you on this auspicious morning. This morning, Kathmandu, which was prettier, and more pensive after a drizzle when I talked to you during the Second International seminar in April 2002, appears to have given in to ideology more than to beauty. Therefore, perhaps, at the hindsight, no other theme than this, that is, *FMIS and Governance Alternatives* could have been more meaningful and relevant to this seminar. My saying, I am afraid, may also hold good to

3 Vice-chairman, FMIS Promotion Trust, Nepal.

several states and their capitals around the globe. In such a situation dominated by ideology, the matter of immense value to us is your direct participation in this seminar. And we know this much for sure that wherever friends of FMIS go, they do bring with them immeasurable amount of social capital- succor, trust and co-operation, to be precise. .

The FMIS in Nepal have been risking an environment of the State, which has largely been rendered disable. A disabled State can not properly work and negotiate with internal, bilateral and multi-lateral actors. We would not have felt these risks if the state would have been an enabling one. In that enabling condition, not only two, even three, four systems can grow, thrive and regulate relations with each other within the framework of the enabling state. For us, governance is inherently plural-and FMIS represent a governance alternative, that too with tremendous variability, but it can not grow normally unrelated to the conditions of the state. Though for many the crisis, that has been brewed and is being spread over in its contents and structure, is because of the competition advocated and promoted by market. But at least for me, it is fundamentally the function of inequity inherent in the larger social fabric. The state has reached this state of disability as it mostly absorbed inequity, without putting up consistent and serious attempts to remedy it.

Philosophically speaking, Nepal today indicates a riskier situation where community based FMIS, private-interest based trade and industry, and party-based government are struggling on their own without a reference to a legitimate state. Therefore for the protagonists of FMIS, the struggle is to preserve the autonomy of FMIS in the relatively enabling conditions of the state where equity and plurality of governance are mature. This august gathering may agree with these words of wisdom of Mahatma Gandhi, "I do not know what it will be like in Heaven. I have no desire to know the distant scene. If the present is attractive enough, the future can not be very unlike."

Having said this let me turn to the Trust's completed/on-going activities in the period of May 2002 to April 2004. **Research** is one of the key areas of the Trust. The Trust supported research activities such as diversification of WUA functions, new FMIS and their dynamism, reforms in syllabus of undergraduate engineering students to transfer indigenous knowledge of managerial and technological practices in FMIS to the academic institutions, water allocation for multiple uses in a sub-watershed of Nuwakot district, innovative mechanism for effective FMIS communication, and district irrigation inventory preparation. The Trust had prioritized these areas of research activities on the basis of direction and lessons emerging out of the Trusts' previous research works, international FMIS seminars, best practicing FMIS award and training program, and interaction with FMIS representatives. The Trust undertook these research activities in collaboration with independent inter-disciplinary group of young professionals, the student researchers, senior professionals in the government and private sector agencies, several District Units of National Federation of Irrigation Water Users' Association, Nepal (NFIWUAN), and Nepal Engineering College/Pokhara University. A few of the Trust research and associated activities is being presented in this seminar.

The Trust in the last two and half years has completed inventory of FMIS in Bhaktpur and Dolakha districts. The findings of the inventory study shows that there are 91 and 347 FMIS in Bhaktapur and Dolakha districts respectively. The Trust has prepared a report on findings of preliminary district inventory in both English and Nepali languages and provided a copy of the same to the respective district units of NFIWUAN. Two more districts Kanchanpur and Okhaldhunga have recently completed the task of preparing irrigation systems' inventory and 128 and 298 irrigation systems were identified in these districts respectively. The data is being processed. Inventory preparation is underway in five more districts namely, Ramechhap, Banke, Kailali, Bajura and Mugu.

Best Practicing FMIS Award and Training at the national level: This is a regular program of the Trust. To recognize the best practices of the FMIS in a particular thematic area, this program was initiated in 1999 and since then three FMIS have been awarded. Hundred and ten FMIS had contested the award in 2003. In the reported period, SardiKhola-Puranchaur FMIS received best practicing FMIS award on the theme of diversification of FMIS functions. The fourth best practicing FMIS award program on “How Participatory is Your Irrigation Management” is underway.

After recognizing the best practicing FMIS, the farmer-representatives of award winning FMIS are further provided training on the theme of the award. In May 2003, 19 farmers including 3 women were given interactive training on the award theme. The Trust’s training to 16 farmers’ representatives belonging to Kathamndu District Unit of NFIWUAN helped the Unit to develop five facilitators out of the trained farmers’ representatives. The Unit involved these facilitators help formally establish and strengthen WUA in different parts of the district. The Trust supported the facilitators to undertake observation study of five exemplary FMIS in Nepal’s western and central development regions.

The Trust recognizes outstanding contribution on FMIS at the international level as well. In the last five years, the Trust has organized three international seminars in Kathmandu. These seminars did work as an appropriate venue to recognize and honor international scholars and experts on FMIS. We are very happy this time to have as our icons of honor Professor Dr E. Walter Coward, Jr, Professor Dr. Nyoman Sutawan, Mr. Charles Lindsay Abernethy, and Dr. Emmanuel Reynard with us.

Publication and dissemination: The findings of the Trust conducted research works and its other activities during the reported period have been regularly disseminated through the quarterly Newsletter Bio-gas and Natural Resources Management (BNRM- www.cmsnepal.org), the international seminars, and e-networks such as INPIM, www.nepalresearch.com, and www.cbnrm.net. During the reported period, the proceedings of the second international seminar entitled "FMIS in the Changed Context" has been published and 400 copies of this proceedings were distributed to the seminar participants, Kathmandu-based libraries of bilateral, multilateral and international non-governmental organizations, national engineering and social science colleges, as well as other relevant national and international institutions and individuals.

In the said period, altogether 7500 copies of *Chinari*, an introductory book on FMIS in simple Nepali language have been made available to FMIS, local government institutions (DDCs, Municipalities, VDCs), irrigation and agriculture related line agencies in the field. 250 copies of the proceedings of the Trust's second award and training program were disseminated to different government offices, NGOs, INGOs and other relevant institutions. The proceedings of international seminar and award and training program were also disseminated through the web sites. The proceeding of third best practicing FMIS award and training program in Nepali language has recently been published.

Dr. Prachanda Pradhan, Chairman of the Trust presented a paper on *FMIS: Challenges and Responses* in the Third South Asia Water Forum held in Dhaka in July, 2004. He participated in the third World Water Forum in Osaka, Japan and presented a paper on entitled *Self-management of Irrigation Systems: Experiences from Nepal* in a symposium organized by Kobe University, Japan in March 2003. Mr. Rajan Subedi, Member-secretary of the Trust disseminated its activities through a poster display in the same Forum. I participated in the international conference on *Water for the Poorest* organized by International Water Academy in Stavanger, Norway in November, 2003.

Financial Aspect: Now I would like to share a few thoughts and information with you about the Trust management. Volunteers manage the Trust. We in the executive committee of the Trust certainly charge a fee when we are assigned a professional task by the Trust. But the fee that we charge is returned to the Trust as donation. The initial Trust fund that was created out of our direct seed contribution was Rs. 80,000 in 1998. In April 2002, the contributions and support of the volunteers and friends of FMIS increased the size of the Trust Fund by 12 folds. Now the size of the Trust fund has almost doubled. The proclaimed policy of the Trust is not to accept any external support on a donor-driven project-financing mode. As such we highly appreciate Ford Foundation's support to the Trust and are grateful to it for partially funding this seminar. Indeed, we target to finance 80% of the Trust's regular program by our internal resources in the next three years. Presently we are able to support 55% of the Trust's regular program. The financial resources are also duly contributed by sources such as 8% of interest on our investment of Nrs. 370,000 in the Himalyan Bank debentures, Nrs. 175,000 in the Laxmi Bank's share, a small amount of service charge on poor-farmer targeted flow of the Trust's micro-irrigation line of credit through a local cooperative in the district of Dhanusha in the central development region. We are grateful to Er. Lava Raj Bhattarai, founding member of the FMIS Promotion Trust, and his junior brother Mr. Kush Raj Bhattarai, sons of Kamala Devi and Medini Nath Bhattarai, Nepal's first Chief Engineer of Department of Irrigation, for providing us a grant of NRs. 62,000 to support the Trust best practicing FMIS award program. He is effortful to increase this amount to Rs, 100,000. In appreciation of this grant, we have decided to rename the award as Kamala-Medini best practicing FMIS Award. We are committed to our policy of autonomous development. Autonomy is as a matter of fact a fundamental value of FMIS governance in this country. Now may I request Respectable Dr. Harka Gurung to offer a bouquet to Er. Lava Raj Bhattarai as a token of the Trust's hearty appreciation for his important contribution.

Ladies and Gentlemen, I would like to end my statement here. Thank you all for your patience and attention.

HONOR AWARDS

Continuing its tradition of honoring the distinguished scholars and participations who have made outstanding contribution to uphold the values of Farmer Managed Irrigation Systems (FMIS), the Trust this year, through ample deliberation among its members, unanimously had decided to recognize four scholars and practitioners as "Icons of Honor" in the seminar. Names of the four scholars honored were declared by Ajoy Karki, Master of the Ceremony. The declared names were: Prof. E. Walter Coward, Jr.; Mr. Charles Lindsay Abernethy; Prof. Nyoman Sutawan and Dr. Emmanual Reynard.

INTRODUCTION OF THE "ICONS OF HONOR"

Dr. Vijaya Shrestha, Executive Member of the Trust introduced the "Icons of Honor" by reading out the brief introductory notes as follows:

E. Walter Coward, Jr.: From 1973 through 1989, Dr. E. Walter Coward, Jr. was Professor of Rural Sociology and Asian Studies at Cornell University. During that period, he also served at various times as Chairman of the Department of Rural Sociology and as Director of the International Agriculture Program in the College of Agriculture.

His research interests were in the sub-field of human ecology and the interface between social organization and the physical habitat. Much of his work focused on irrigated regions, especially the locally managed irrigation systems of South and Southeast Asia. He has published extensively on that topic.

In 1990 Dr. Coward joined the Ford Foundation, based at the headquarters in New York. His initial responsibility was as Director of the Foundation’s Rural Poverty and Resources Program. Later he served as Senior Director of the Foundation’s then newly created Assets and Community Development Program. During his decade at the Foundation, Dr. Coward helped create and expand the Foundation’s work with natural resources management into a broad environment and development line of grant-making.

In 1999 Dr. Coward retired from the Ford Foundation and returned to Cornell for a two-year period to direct a research program focused on environment and development issues in mountain regions of the world. That work has resulted in research and publications on the western Himalayas, the mountainous regions of Yunnan of People's Republic of China and the southern Rock Mountains in the USA.

Dr. Coward is currently retired but continues research in Asia, serves on several NGO and foundation boards and spends increased time with his grandchildren and flower garden.

Charles Lindsay Abernethy: For about last fifty years, Mr. Charles Lindsay Abernethy has served in variable capacities, all of them, this way or other, rotated around water technology and management. He starting as a scientific officer, Wallingford, England in 1956, worked as engineer in Qatar, Dubai and Kenya. He was with Hydraulic Research Station, Wallingford from 1967 through 1984. He was consultant in irrigation and water management from 1984 to 1987. At International Irrigation Management Institute (now International Water Management Institute), he served as its senior technical adviser, director of programs, and special advisor to the Director General from 1987 to 1994. In the last decade or so, Mr. Abernethy has been contributing as an irrigation and water resources management consultant in South, South East, Central and West Asia as well as Africa.

He has helped transfer his hands-on technological and managerial experiences of irrigation and water to the academic and professional institutions like Asian Institute of Technology (AIT), Thailand and International Commission for Irrigation and Drainage (ICID). He visited AIT as a faculty from 1996 to 1999. He was member of Editorial Board of ICID Journal (Now "Irrigation and Drainage Journal") from 1987 to 2002.

Mr. Abernethy has authored/co-authored about fifty publications and conference papers. They include "Enabling Environments, Financing Mechanisms and Equitable Access to Irrigation", *FAO/IWMI workshop on private irrigation in sub-Saharan Africa, Accra,* 2001; "Effect of Gate Operation on Performance of Irrigation Systems: A Case Study of Khageri Irrigation System, Nepal", *ICID Journal, vol. 49, no3*, 2000; "The Concept of Flexibility in Irrigation Systems". *Conference on Irrigation Management,* Wuhan, China *September 1988;* "An Agenda for Future Research. *Asian Symposium on Irrigation Design for Management*, Kandy, Sri Lanka, *Feb 1987.*

He has co-edited several books including "Government Actions towards Effective Irrigators' Organizations, with special reference to Lao PDR and Vietnam", 1999; "Strategies for Intersectoral Water Management in Developing Countries: Challenges and Consequences for Agriculture", 1996.

In addition to his preoccupation in irrigation and water resources management, Mr. Charles Lindsay Abernethy is eternally interested in evening strolling.

Nyoman Sutawan: Dr. Nyoman Sutawan is Professor Emeritus, Agribusiness Study Program, Udayana University, Denpasar, Bali, Indonesia. From 1969 through 2004, he has been Academic Staff member of Agricultural Socio-economics and Agribusiness Department, Faculty of Agriculture, Udayana University. From 1978-1986, he was Vice Rector, then from 1993 to 1997 Rector of Udayana University. He concurrently held the position of Coordinator of Private Institutions of Higher Learning for Bali, Nusa Tenggara and East Timor. He continued to be Rector of Warmadewa University, Denpasar Bali from1999 -2003.

Dr. Sutawan has been involved in economic, social and political organizations. He was a Member of Indonesian Agricultural Economist Association (PERHEPI) since 1972. He was in Advisory Committee on Farmer Managed Irrigation Network of International Irrigation Management Institute (IIMI) Colombo from 1987 to 1990 and in the Steering Committee of Indonesian Irrigation Communication Network from 1991 to 1993. He was a Member of People's Assembly of Republic of Indonesia from 1993 to 1998.

In the last 10 years, Dr. Sutawan has been continuously engaged in action research for organizing Subak federations along two river courses in Bali and strengthening the role of Subak constituents in the economic activities.

Dr. Sutawan has several publications on community participation and empowerment primarily based on his action research of Subaks, which are the indigenous farmers' associations in Bali. They include "Negotiating Water Allocation among Irrigators' Association in Bali, Indonesia", in Ruth Meinzen-Dick and Bryan Bruns (Eds.), *Negotiating Water Rights.* International Food Policy Research Institute, 2003; "Managing Water Resource for Sustainable Agriculture: Problems and Policy Recommendation", *Journal on Socio-Economic of Agriculture and Agribusiness (SOCA), Vol. 2, No. 1,* January 2002; "Subak System in Bali : Its Multifunctional Roles, Problems and Challenges," *Proceedings of The Pre-Symposium for The Third World Water Forum , Japan,* 2002.

Emmanuel Reynard: Dr. Emmanuel Reynard has been serving as an Invited Professor at the Universities of Fribourg and Neuchâtel, Switzerland. His academic areas of interest include Geomorphology, and Water Management in the mountainous areas. In the last 10 years, he advanced his academic enrichment along with capability enhancement in environmental and natural resources management, and social management of irrigation.

In the last 10 years, Dr. Reynard has contrubuted 79 publications as author or co-authors. These publications are in French, English, Spanish, German and Italian. Most of his publicationas are in French followed by English. The focus of his publications are natural and water resources management, glacial history, geomorphological mapping and landscape assessment. The publications include “The Evolution of the National Water Regime in Switzerland”, Lausanne, Institut des Hautes Etudes en Administration Publique, Rapport (non publie), 2002; “GIS and Water Resource Management in Crans-Montana-Aminona (Switzerland)”, Universite de Lausanne, Institut de Geographie, Rapport de Recherche (non publie), 2001; “Institutional Resource Regimes. The Case of Water in Switzerland, Integrated Assessment”, 2002; “Hill irrigation in Valais (Swiss Alps): Recent Evolution of Common-property Corporations”, in Pradhan P., Gautam U. (Eds.): *Farmer Managed Irrigation Systems in the Changed Context, Procedings of the Second International Seminar,* held on 18-19 April 2002, Kathmandu, Nepal, Farmer Managed Irrigation Systems Promotion Trust; “Transformations of Fragile Environments in the Alps and in the Sahel”, *Geogr. Helvetica, Special issue* “*Geography in Switzerland*”, 2003; “Geomorphological Sites, Public Policies and Property Rights: Conceptualization and Examples from Switzerland”, *II Quaternario, special issue* (in press), 2004. Besides writing prolifically, Dr. Emmanuel Reynard favourate passion are traveling.

BESTOWING THE HONOR AWARDS

After the introduction, Dr. Prachanda Pradhan, Chairman, FMIS Promotion Trust, honored the "Icons of Honor" by presenting Dosallah (shawl), which is a traditional Nepali way of bestowing honors to the distinguished persons. Dr. Upendra Gautam, Vice-chairman, FMIS Promotion Trust, honored them by presenting commendation plaques, and Mr. Rajan Subedi, Member Secretary, FMIS Promotion Trust by offering bouquets. Mr. Govinda Das Shrestha, Executive Member of the Trust read out the citations inscribed in the commendation plaques.

Commendation plaque to Prof. E. Walter Coward, Jr. reads: This plaque of honor is presented to Professor Dr. E. Walter Coward, Jr. in recognition of his outstanding contribution in conceptualizing and integrating the values of the natural resources into the fields of environment and development through locally managed irrigation systems.

Commendation plaque to Mr. Charles Lindsay Abernethy reads: " This plaque of honor is presented to Mr. Charles Lindsay Abernerthy in recognition of his outstanding contribution in transferring the hands-on managerial and technological innovations in irrigation systems."

Commendation plaque to Prof. Nyoman Sutawan reads: "This plaque of honor is presented to Professor Dr. Nyoman Sutawan in recognition of his outstanding contribution in enriching the indigenous knowledge and practices of farming community with sustainable economic development activities."

Commendation plaque to Dr. Emannuel Reynard reads: "This plaque of honor is presented to Dr. Emmanuel Reynard in recognition of his outstanding contribution in interdisciplinary synthesis of geographic knowledge with water management in mountainous regions."

The glorious moments of honor award ceremony, captured in the photographs, are shown in the following pages.

Keynote Speeches

PROPERTY AND FMIS GOVERNANCE: TWO BOOKS THAT MAY BE UNFAMILIAR, BUT THAT INFORM THE DISCUSSION

E. WALTER COWARD, JR..[1]

INTRODUCTION

No doubt it is uncommon for a keynote speaker to use the dev ice of a book review for his presentation. But I have made this unusual choice because I want to have entered into our discussion of Farmer Managed Irrigation Systems (FMIS) governance with two quality analyses that I believe can help to significantly advance our goals. I suspect that many of you are unacquainted with the two books that I will refer to. In my judgment, these two analyses to date have been under attended by the group of scholars and practitioners concerned with FMIS.

Let us begin with some clarity about the notion of governance. Its sounds like the word government, and can be confused with that term. Dictionary definitions include statements such as: 1) the exercise of authority or control and 2) a method or system of government or management. The notion of governance seems to have arisen in part as an attempt by analysts to draw attention to the fact that governments are not the only entities that control and manage human affairs – that governance could be rooted in social entities other than states and their agencies.

A second useful point to clarify with regard to FMIS governance is to remind ourselves concerning what needs to be governed or controlled. Much has been written on this point. However, in brief summary we can note that an FMIS needs to govern internal actions such as building and repairing water works, allocating and distributing water and resolving conflicts and disagreements among water users. There also are important external activities to be organized including dealings with other irrigation groups, as well, as the state and its agencies. Finally, it is important to recognize that governance also is concerned with organizing group actions intended to deal with the vagaries of the environment – too little or too much rainfall, temperature extremes, stream hydraulics, even pest control.

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[1] Former Professor of Rural Sociology and Asian Studies, Cornell University and Senior Director, Ford Foundation.

FMIS governance, of course, is presumed to be of vital importance to effective and continuing operations. By definition, the governance of FMIS is not exclusively a function of the state and its agencies. The FMIS literature suggests that a variety of non-state entities are the controlling agents in the local irrigation systems we are here calling FMIS.

LANDSCAPES OF IRRIGATION

Recently, a new approach to the study of local irrigation works has emerged – what we might call the study of irrigation landscapes. There are two exemplars of this approach; Lansing's analysis of *subak* irrigation in Bali (1991) and Mosse's examination of tank irrigation in south India (2003).[2] These studies are quite different from the numerous, and useful, case studies of FMIS that have become a rather common research approach. The landscape approach also is different from various surveys of FMIS in a given country or region of a country in that they provide much more historical and contemporary context.

Landscape is a term associated with a specialty in ecology; predictably called landscape ecology. It has been difficult to define with precision the central concept, landscape. One definition that may help our discussion is this – "landscapes are the arenas in which humans interact with their environments on a kilometers-wide scale" (Wiens and Milne, 1989). Thus, when considering human-environment interactions, we see that landscapes refer to larger rather than small spaces. The second important aspect of landscape is that the usual pattern of such spaces is a mosaic of interacting ecosystem patches comprising a heterogeneous land area. In the case of an FMIS landscape we can imagine a large territory in which the patches are the various FMIS that are in interaction with one another and with other natural elements of the landscape. Examining an irrigation landscape can involve analyzing the workings of individual FMIS but also moves the discussion above this level to consider the interactions and ordering that exists among the various FMIS, if any. and, to search out the means by which these landscape interactions are ordered, or governed.

Each of the two books that I want to examine in this paper are concerned with understanding not just individual FMIS but with understanding the governance of irrigation landscapes, one in the northern Philippines and other in the US state of New Mexico. More on this will follow.

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2 Perhaps an earlier version of this approach is found in one of the books reviewed in this essay, Lewis' (1991) work on *zanjeras* in the northern Philippines.

THE CORPORATE RESOLUTION: WHAT IS IT?

In 1991 Henry T. Lewis published a monograph with the somewhat odd title, Ilocano Irrigation: The Corporate Resolution. I suspect there are two words in that title that raise questions – the meaning of Ilocano and the meaning of corporate.

First, let's take Ilocono which refers to the name of a prominent ethnic group in the northern Philippines. Much of Lewis' account is concerned with the social organization of local irrigation systems, called *zanjeras*, found in the province of Ilocos Norte at the far northern end of the main island of Luzon. The western edge of Ilocos Norte is defined by a mountain range and the eastern side by the coast and the Pacific Ocean. The irrigated fields of this landscape are found in the foothills, river valleys and coastal area that are flanked by the mountains and ocean. Irrigation is required because of the erratic nature of rainfall in the wet season and the prolonged dry period. Irrigation is complicated by the damaging typhoon storms that frequently occur and, particularly in the main rivers, the frequent change in course of these highly braided waterways. Crowded into this cramped landscape is a large rural farming population which for decades has been exporting young men and women to other regions of the Philippines, as well as, other parts of the world.

Second is the term corporate. Note that the word is not corporation, though the root meaning is the same. Lewis uses the term corporate in the anthropological, not the legal, sense. Lewis' corporate resolution is not about the ownership of irrigation by elite Filipino or foreign corporations. Here is the way in which Lewis employs the idea to understand the *zanjeras*:

(Ilocano) "Irrigation societies are what anthropologists and others refer to as corporate groups: social groups that control the use and inheritance of property, meet more or less regularly, and have representative leadership ..." (1991).

Note the centrality of the notion of property – social groups are corporate when they "own" property which they govern the use and inheritance of. As we will see subsequently, *zanjeras* own items such as dams and canals, water rights, common lands and meeting houses.

There are two large categories of *zanjeras* in Ilocos Norte – both of which have the characteristic of corporateness; they both have group-owned property. The first category is what Lewis calls the *inkapulo* systems – what we have seen elsewhere in Asia and around the world – local irrigation systems built, owned and operated by the landowners who use the system to irrigate their fields. The second category of *zanjeras* are uniquely Ilocano and Lewis has designated them, *atar*-based *zanjeras*. This requires some explanation.

Atar-based *zanjeras* were built not by the owners of the fields that are irrigated but by another group of irrigation-builders who joined together and entered into a contract with one or more landowners to build and maintain irrigation works to supply water to the owners' fields in exchange for usufruct rights to a certain portion of those fields. The lands to which the *zanjera* has use-rights are called *atar*.

The contemporary members of an *atar*-based *zanjera* are those whose ancestors were part of the original irrigation-builders group and who continue through inheritance to have rights to the *atar* lands. They are the members of the corporate group which owns such things as the diversion structure, the canals and canal rights, meetinghouses, sometimes small plots of common land and, importantly, use-rights to the *atar* lands. This last item is contingent on the continued delivery of water to the non-*atar* lands as specified in the original contract. *Atar*-based *zanjeras* supply irrigation water to the *atar* lands and the lands of the original owners (these lands are called *biang ti daga*[3]). In addition, some *zanjeras* provide water to landowners who are neither corporate members nor holders of *biang ti daga* lands. These landowners typically are at the tail end of a particular *zanjera* and make use of what is essentially "surplus" water.

Lewis concluded the following about the *atar*-based *zanjeras*:

"*Atar*-based *zanjeras* are important to understand not merely because they are so different from other examples of communal irrigation but, rather, because the difference represents a unique experiment in how peasant managers created their own corporate resources in both land and water" (1991).

He might have added that they also have put in place organizational entities to control and govern this valuable corporate property. Here is how that works. First, membership in an *atar*-based *zanjera* typically is limited to those persons who have inherited rights to the *zanjera's atar* lands from their ancestors. These rights were originally created by dividing equally the *atar*

3 The term *biang ti daga* is also used to refer to the agreements between the owners and the irrigation builders for sharing the rice lands (Coward and Siy, 1983).

lands obtained in exchange for delivering irrigation water among each of those who initially participated in building the system. These rights to the *zanjera's atar* lands are inheritable and contribute to the perpetuation of the *zanjera*.[4] Along with these rights are equal responsibilities to provide cash and labor toward the repair and operation of the *zanjera*.[5]

As has been observed in other locations, individual FMIS are often connected, formally or informally, with one another because of their dependence on common water sources or a common watershed. As would be expected, the governing of such federations or associations could be a complex undertaking. In the Ilocos region there are such *zanjera* federations. In an earlier analysis (Coward and Siy, 1983) it was shown that rights to *atar* lands can be used not only to organize water distribution and system maintenance activities within a particular *zanjera* but also to govern such processes among the independent corporate irrigation societies that are joined in a federation.

While, as Lewis has noted (1991), a *zanjera* federation is not a corporate group since it owns no property, it is composed of corporate groups, the *zanjera* members. In the case of the federation examined by Siy (1982) the corporate principles used by each of the member *zanjeras* were also applied to the ordering and governing of the overall federation. The principle of *atar* shares was found to be highly correlated with the amount of water received by the member *zanjeras*, as well as, the amount of labor contributed to system repair and maintenance.

Zanjeras, *atar*-based, and otherwise, are found throughout the present-day province of Ilocos Norte and a few other places to which persons from this region have migrated. Thus, one can speak of a *zanjera* irrigation landscape and the governance arrangements for operating individual *zanjeras,* federations of *zanjeras,* and *zanjera*-state interactions.

PROPERTY AND LOCAL IRRIGATION GOVERNANCE IN THE UNITED STATES

For some, the information that FMIS can be found in the United States may be a surprise. They do, and they contain some interesting information pertinent to our discussion of irrigation governance.

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4 The sustained connection between the current holders of rights to the *zanjera's atar* lands and the ancestral builders is manifested in ritual activities that appease the "ghosts" of the founding members who continually remind current members of the need for the *zanjera* to be well maintained (Lewis, 1991).

5 For details; in addition to those provided by Lewis, see Coward and Coward and Siy.

In 1998, Jose Rivera, a professor at the University of New Mexico, published an interesting book entitled – Acequia culture: Water, land and community in the southwest. This title, like Lewis' contains an unfamiliar term. *Acequia* (pronounced -- aah-sek-ia) is an ancient Spanish word of Arabic origin that refers to the earthen ditches and simple diversion structures used to direct water from small streams to pockets of irrigable (Rivera, 1998). Historically, *acequias* were found in several parts of the Spanish southwest of the US but now are most numerous in the state of New Mexico, especially its northern region. This is a relatively arid region, with long and cold winters located within the southern Rocky Mountains. A large portion of the area is forested and the cultivated lands are found in the lower portions of the main Rio Grande valley and its various side valleys.

In the late 1500s, Hispanic and Indo-Hispano settlers began moving north from what is now central Mexico into the region which presently constitutes the state of New Mexico to practice their agro-pastoral livelihoods. As part of its colonization project, the Spanish government provided land grants to these newcomers. Nearly always, a first priority for these settlers was the construction of an *acequia* – in some cases perhaps building on or extending irrigation works already created by the Native Americans settled in this region. *Acequias,* thus, originated as common-property institutions creating and maintaining water-related property intended to allow productive agriculture in an arid region. The *acequia* landscape and the culture that sustains it continue up to the present day. Within this landscape *acequias* persist as property-owning and self-governing irrigation associations.

The *acequia* culture that these new settlers brought with them was, as Rivera writes, "melded from diverse sources":

"Historians agree that these antecedents included the irrigation practices common to the arid regions in the south of Spain, particularly Andalusia and Valencia, based on traditions from the Roman period; the superimposition of Arabic customs and techniques used during the seven centuries of occupation of Spain by the Moors; and the influence of Pueblo Indian agriculture as observed by early Spanish explorers and settlement pioneers" (1998).

In 1846 following war with Mexico, and more than two centuries after the initial creation of *acequias* in this region, New Mexico became part of the territory of the US. Under the agreements settling the war the US government consented to recognize existing property rights, including water rights and the rights to construct and own *acequia* facilities.

While remaining largely intact, the *acequias* have evolved into somewhat modified organizations with new governance structures under US law:

"The granting of corporate powers to acequia associations in the 1895 laws established the modern framework of legal-political governance. Acequia commissioners would have to be elected by and held accountable to the irrigators on a formal basis; but they would also enjoy broad legal powers usually reserved for political subdivisions of the (state) government" (Rivera, 1998).

That is, while specifying procedures that reflected the "democratic" ideology of the federal government, the *acequias* were re-affirmed as legitimate self-governing entities. Today in New Mexico, most rural communities remain unincorporated entities – not legal components of local government. In these communities the only form of government at the local level, below the county government, are the *acequia* associations**.** Thus, *acequias* not only govern water matters, their central purpose, but provide a venue for discussion and action on other community topics. In 1965 the state legislature enacted an *acequia* law further stating that *acequia* and community ditch associations are political subdivisions of the state (Rivera, 1998).

Acequias also are "corporate" organizations in the way that Lewis identified *zanjeras* as corporate – they have created, own and manage property. In this case, the primary property owned includes the physical structures for diverting and conveying water and, very important, the rights of way associated with access to these facilities. Significantly, under the laws of the state of New Mexico, *acequias* themselves do not have water rights. Rather, the right of an *acequia* to divert an amount of water is determined by summing up the water rights of each individual landowner served by that *acequia*. – water rights are held by individuals and associated with the plots of land owned by that user.
These property rights, both the rights of the *acequias* and the individual water users, have frequently been contested and challenged as social and economic changes have emerged in New Mexico and in the larger US society. Some examples follow.

Currently, the state of New Mexico is conducting water adjudication in various water basins – a process in which the courts are asked to determine "the nature, ownership, and priority dates of all water rights in a stream or groundwater basin" (Rivera, 1998). This adjudication is seen as a necessary step in clarifying access to water from the various competing needs for economic growth, tourism, expanding residential areas and environmental requirements.

In the western US, a key component of a water right is the so-called priority date which derives from the principle of allocation captured in the phrase, "first in time, first in right". Priority rights become pertinent in times of water scarcity when the priority dates are used to form a sequence of delivery from the most senior to the most junior right holder. In most parts of the western US, priority rights are assigned to particular tracts of land and incorporated into the water right of that parcel's owner.

However, since a community ditch was built through collective labor and began to irrigate all of the fields it served more or less simultaneously, the *acequias* have preferred to have a single, ditch-wide priority date for all the rights holders. As Levine has stated:

"Tract-specific dates (that is priority dates for specific parcels rather than a single date for the *acequia* as a whole) make it impossible for *parcientes*, or ditch users, to unite for common defense if they disagree with the priority dates assigned to their property. It is a divisive tactic, making it more difficult for individuals and communities to protest effectively other uses that may infringe on more traditional uses. If tracts are the focus of the conflict, it reduces the power of the traditional acequia organization as an arbiter of disputes and as the organization that manages the distribution of available water. The long-term effect would then be to erode the social and political bonds that acequias have had in the agricultural communities of New Mexico" (1990).

Those that prefer the assignment of a ditch-wide priority date operate from a property perspective that sees the *acequia* simultaneously encompassing two forms of property – there is a collective element of ownership, the ditch-wide right, as well as, individual rights held by the owners of the various tracts of land served by the ditch.

While some agencies in the federal government have wanted to read traditional water rights as strictly individual and to assign priority rights tract-wise, the State of New Mexico argues that "ditch-wide dates are an administrative and practical means for setting priorities" (Levine, 1990).

However, setting ditch-wide priority dates creates another problem – potential conflicts among neighboring *acequias* sharing the same stream. In many cases, such *acequia* groups had already developed over time informal rules and procedures for sharing water in times of scarcity. The State of New Mexico has suggested that *acequias* remedy this dilemma by declaring their customary arrangements in written agreements and having those agreements included in the court's final adjudication decree. Irrigators in the Taos Valley of northern New Mexico have been especially assertive in arguing the need to continue the customary inter-*acequia* water sharing arrangements known as *repartimiento* (Rivera, 1998). Through the determined efforts of the Taos Valley Acequia Association, a federation of *acequias,* in the adjudication process these customary water-sharing arrangements are expected to be made part of the final adjudication decree.

In these instances, the State's interest in practicality aligns with *acequia* custom and tradition and it appears that re-making property is not occurring. However, the adjudication process does open the door to another challenge to these important water property rights – the matter of water markets. As rights are further legally strengthened through adjudication' the ability of low-income water owners and wealthy water buyers to make a deal is facilitated. This increases the possibility of water being transferred outside the service area of an *acequia* for residential or commercial purposes.

One possibly significant impediment to such water transfers relates to the repartimiento custom discussed above:

"Whereas the system of priority dates isolates each water right and therefore facilitates the transfer for development or other uses, the relinquishing of specific priority dates in favor of a shared water supply will probably discourage the sale of water rights outside the community when these practices are incorporated within the applicable adjudication decrees" (Rivera, 1998).

Acequias are struggling to find other incentives and enact legal rules that will stop, slow, or otherwise manage, this process of water property transfer.

Finally, the newest attempt to redefine water property is coming from parts of the environmental community, as well as parts of the tourism sector concerned with in-stream flow issues – retaining in the rivers themselves sufficient water to meet the needs of fish and other aquatic organisms or to support commercial activities such as rafting. In effect, those urging in-stream flow considerations are arguing for an increased priority for this water use and for a new property right – a right that would presumably be "owned" by one or more government agencies and deployed in support of various in-stream flow requirements – species protection, sports fishing, rafting and so on. This is an on-going issue.

These examples demonstrate the myriad of problems that can be faced by FMIS in a modern society. In the case of New Mexico's *acequias* their status as self-governing entities have provided a strong platform of defense against the numerous challenges to their property rights that have arisen.

Frequently, the response that *acequias* have taken to deal with these various challenges to property rights has been to assemble individual *acequia* groups into federations, as in the case of the Taos Valley Acequia Association (TVAA) mentioned above. These federations provide a bit more muscle in dealing with the politics of water rights. Federations such as TVAA also act in other ways to protect and improve *acequia* property – advocating for government funds to improve physical facilities, providing information to water users to improve water use and crop production, and proposing new state-level policies regarding water issues.

In sum, the form of governance associated with the *acequias* has given them the resilience needed to be effective through changes national sovereignty – Spain, Mexico and now the US – as well as huge changes in the technology and economy of agriculture and the larger political economy in which they are embedded. While the path has not always been easy, *acequias* remain active and viable FMIS.

PROPERTY AND GOVERNANCE

As we have seen from this discussion the corporate resolution constructed by Ilocano irrigators, as well as, the *acequia* culture of northern New Mexico are very much centered on property creation and continuance.
Elsewhere, I have attempted to draw out the importance of this property factor with regard to the governance of FMIS (Coward, 1986/1988/1990). One can view irrigation development as a property-creating or property-reproducing process (Coward, 1986) – clearly that is the case with the *atar*-based *zanjeras* and the *acequias* we have been discussing. Based on a review of various FMIS systems, largely in Southeast Asia, I wrote that:

"collective action in these systems is based on property relations. That is, that these irrigation groups formulated principles of action and acted out irrigation tasks in ways that reflected prior and continuing investments in their hydraulic property. It is this relationship of co-property holders that legitimizes and activates their solidarity" (Coward, 1986).

In commenting on the thorough research that Tan-kim-yong did on indigenous irrigation systems in northern Thailand (1983), locally called *muang-fai*, I commented on the meaning of the ritual activities associated with the *muang-fai* that she described:

“Tan-kim-yong (1983) indicates that the ritual has elements of both recognition of the ‘spirit of the weir’ and the ‘spirits of the former leaders’. The latter may be seen as representing the original property creators and the ritual serves to recall the investment efforts of prior generations and to confer the continuity between those previous property-creating activities and the contemporary ones. It can be suggested that the ritual activity provides the irrigation group legitimation for collective action not based on common biological ancestors but in common property builders. It is from actions of that prior group and the relationships that they created among themselves that the present group derives its own relationships, rights and responsibilities (Coward, 1988).

Investments to create irrigation facilities, it appears, always create, or rearrange, property relationships with regard to these new facilities. I might have concluded that these systems were organized as corporate groups.

The lack of hydraulic property on the part of the water users in the case of many agency-managed systems also is apparent. Many attempts at organizing water users' groups are premised on the notion of giving the irrigators a “sense of ownership” – when what actually is needed is explicit ownership. This idea has now been incorporated in some of the many experiments around the world with so-called irrigation system turnover.

Finally, before leaving the corporate resolution that Lewis has highlighted and the associated property factor, it is useful to take note of the contemporary interests among irrigation researchers in the idea of water rights as an important element of good irrigation governance (for example, Bruns and Meinzen-Dick 2000). One important set of issues related to this topic concerns how the state will, or should, treat the customary water rights (property) of FMIS. The general approach seems to be that to get along in the modern state traditional water access rules should be dressed up as state-sanctioned water rights. But there are three questions that require examination if this water rights approach is executed:

One – how can state legal processes formulate water rights laws that sufficiently capture the nuances, conditionality, and resilience of customary water access practices?

Two – what are the minimal capabilities (judical, executive) that a state must have to ensure that state water rights will serve local people and their water needs adequately?

Three – are there modern institutional forms other than water rights that a state could use to protect local irrigation investments while also providing opportunities for the future of all citizens? (Coward, 2000).

SOME CLOSING THROUGHTS ON IRRIGATION GOVERNANCE

These two books, which may be unfamiliar to many, remind us of how widely different governance existing arrangements are. From these two cases, I derive three points that may help advance our understanding of FMIS governance.

First, the analyses give attention to the need for careful identification of the key uncertainties associated with a particular irrigated landscape – environmental uncertainties or social and economic uncertainties. These uncertainties shape the collective actions that may be required to successfully deal with these hazards along with the governance arrangements needed to organize and sustain those actions.

Second, they underscore the property factor and connect the processes of property creation and property protection with governance.

Finally, they suggest the value of considering irrigation landscapes – landscapes help us view matters above the village level, without disregarding the local scene. This is significant because of the prevailing view among many FMIS researchers and practioners that FMIS are quintessential local entities – created and managed by the water users themselves or by the village(s) in whose domain they fall. Of course that sometimes is an accurate representation of the situation. But, the examination of irrigated landscapes can remind us that governance may be found at higher levels – some supra-village domain. Even in those cases where much of the governance responsibility lies at the local level it frequently is the case that those local governance entities are in some ways connected with and dependent on higher level authorities for aspects of their legitimacy or as providers of some resources – technical, financial, material and so on. Both the *zanjeras* of the northern Philippines and the *acequias* of New Mexico gained their legitimacy, in part, from the previous states in which they were embedded and the contemporary nations of which they are part.

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CAN PROGRAMMES OF IRRIGATION MANAGEMENT TRANSFER BE COMPLETED SUCCESSFULLY?

CHARLES LINDSAY ABERNETHY[1]

INTRODUCTION

Most countries in Asia, and many others in Africa, Latin America and Eastern Europe, now operate programmes for handing over public irrigation service-provision, partly or completely, to the users of those services. The objectives and the methods and many of the details vary, and each country has its unique policy ; but the general trend is quite clear.

This trend began in the mid-1970s, and in the Asian region the pioneer in establishing the trend was the Philippines. The idea was adopted rather gradually by other countries in the 1980s, but through the 1990s it accelerated, with many countries joining in. Most of the national programmes, of which there are now about fifty, are therefore still rather new.

An interesting feature of the older programmes is that they seem never to reach an end point. Although new countries continue to start down this pathway, it is difficult to think of any that say they have finished. Even in the Philippines, after nearly thirty years, processes of handing over are still in progress. Indeed, in that country it might be said that these processes seemed at one stage to have come to a halt. This observation may seem alarming to some of the countries that are newly starting on some similar policies. Their finance ministries may not be happy with the thought that the new programmes may still be in progress, and still need government budgets, thirty years ahead from now.

Currently, the national programme that is most often praised is that of Mexico, which began in the early 1990s ; and to a lesser degree that of Turkey is also viewed as good. These are countries of the World Bank's "upper-middle" income category. The issues that arise in less affluent countries, especially where personal land-holdings are very small, are not the same as in Mexico.

[1] Consultant in Irrigation Water Resources Management, United Kingdom.

Some countries are now starting these programmes, with the expectation that they will be accomplished in periods as short as five years. The evidence does not make that seem likely. Indeed, in a number of national programmes, the end of the first five years seems to mark a stage of disappointment and reappraisal, when it is discovered that the initial expectations of the programme are not being achieved.

At the level of individual irrigation schemes, outcomes vary, and there are usually some successful examples. It may sometimes happen that these more successful cases get more attention than the average. But success at the local level, which may be due to some fortunate local circumstance, such as some effective leaders, is a different matter from overall success at the level of national programmes.

Programmes that are begun with, in some cases, high levels of enthusiasm and commitment often seem to weaken after some years. The programme details vary from country to country, and countries often assert that they have tailored their programme to the national context ; yet the indications of programme weakness are rather uniform. These indications are, most usually, weak organisations among the irrigation users, with insufficient management skills and, most specifically, with weak financial systems.

Why is this? Can we identify factors that cause these programme weaknesses? Most important, can we propose ways in which national programmes of this kind could become more successful?

What is Irrigation Management Transfer?

Terminology needs to be defined first. Sometimes, the same words are used with different meanings in different countries, and this can be a source of confusion. I will use this definition :

irrigation management transfer means a process in which some functions and responsibilities of management, formerly exercised by a state agency, are transferred to an organisation of the users of the irrigation system**.**

The necessity for defining clearly what we are discussing can be seen by relating this definition to the programmes that have occurred in the Philippines. A new phase of programme, begun in that country in recent years, has been given the name "irrigation management transfer" in order to distinguish it from earlier programmes. The new programme is focussing on (among other things) promoting federations of smaller organisations to build larger and, it is hoped, more effective units. But according to the definition I am using here, the earlier programmes, which have been going on for over twenty years, were also management transfers, because they aimed at passing some tasks, formerly done by government agency staff, to the irrigators.

The above definition of irrigation management transfer also includes most of the programmes labelled “participatory,” except in cases where the role of the official side, in nominally joint decision processes, remains extremely strong, as in some countries of North Africa.

The history of joint management of irrigation in Egypt is interesting, for its lessons about the relationship between government agencies and the users of irrigation. A form of joint management was introduced in Egypt about a hundred years ago. The local co-operatives were managed by committees on which there were representatives of the users, and representatives of central government agencies and local administration. This seems to be a reasonable arrangement. Through this mechanism, the users could make government people aware of their concerns and problems, and the government agencies could bring advice and other forms of practical assistance.

But, through the passage of time, the roles and the character of these co-operative committees changed. By the 1970s, they had become a channel through which central government exercised control over farmers’ activities. An example of this was the control of crop patterns. Decisions about the national crop needs were made centrally, in the capital, and the duty of fulfilling these was distributed down through provinces and districts, ultimately to the co-operative committees, who were expected to allocate their crop production quotas among their members.

Joint management methods are likely to be taken over by the government side. The relationship between agency representatives and users’ representatives is not, normally, an equal relationship. The government people have more resources, and more authority. Most of the national programmes of irrigation management transfer, initiated in the past three decades, have not gone down this road. Instead, they have focussed on building organisations among the irrigation users. That does not mean that these organisations are truly independent from government. But there is not, usually, the organic linkage, in decision-making, which is the feature of joint management. Therefore, dominance of these organisations by government staff is not automatic.

Programmes of irrigation management transfer are initiated by governments. They are not, generally, the result of demands made by irrigators. Indeed, it usually seems doubtful that farmers like or want these programmes. It is the governments that decide to do it. In many cases, there is pressure of some sort on the governments, from international donors and lenders, including the major development banks. To a significant degree, the adoption of management transfer policies in recent times has been “donor-driven.” This pressure, or encouragement, to adopt such policies, seems to have two different causes.

One cause, or motive, for the recent wave of management transfer programmes is at the level of the irrigation systems themselves. It is thought that management will be better, in various ways such as equity, conflict resolution, and others, if the users take more of the management decisions.

The other cause, probably stronger, comes from broader financial considerations. Finance ministries could save a significant amount of money in national budgets, and could apply that in other directions, if irrigation systems were more self-managed and self-financed. This was the starting point of the reforms in the Philippines, in 1975, when the Congress gave the irrigation agency seven years to wipe out its deficit. In order to balance its budget, the agency had to collect fees from users ; it also had to try to reduce its own expenditure by transferring functions or tasks to the users ; in order to collect fees, and to transfer functions, it had to promote organisations on site ; and so on, through a long chain of consequences that have become well-known.

To some degree, donors’ enthusiasm for the transfer policy may lead to cynical behaviour by the implementing agencies. Burton (2003), reviewing 24 sets of comments on programmes in a wide range of countries, says that

“in some cases governments are paying lip service to irrigation management transfer in order to obtain funds for physical rehabilitation, without any clear intent of relinquishing control over the management, operation and maintenance processes.”

Where this pattern occurs, I think there are two reasons for it : first, because many irrigation agencies value technical skills highly, and are much less interested in, or knowledgeable about, the institutional or social dimensions of their subject ; and second, because, in countries where corruption is a common problem, physical construction projects offer opportunities for corrupt behaviour.

OBJECTIVES

What is Success?

When can we say that a programme of irrigation management transfer has succeeded? A normal way to address such a question would be to say : the programme has succeeded when its objectives are accomplished. But it is often quite difficult to identify clear objectives in these policies. Sometimes, as in the early Philippines programmes just noted, a clear objective of budget saving may be stated. But that cannot be a sole objective. It is reasonably obvious that a programme which aimed only at extracting payments from people who were accustomed to free service, and at making the jobs of many middle-level government staff redundant, would be resisted. Other benefits have to be identified if such a programme is to be viable.

This has however often led to confusion and obscurity about the true set of objectives of the policies. Perhaps governments feel some lack of confidence about their ability to deliver benefits that can counter-balance the negative aspects of the policies. For whatever reasons, the objectives of irrigation management transfer policies are often not stated as clearly as we might like ; and the time-frames within which those benefits will be delivered are also often vague.

At this stage I will assume that the objectives of the governments usually are some or all of the following set :

- To reduce public expenditures ;
- To improve irrigation performance and generate surplus production ;
- To enhance sustainability of irrigation facilities ;
- To conserve water resources and reduce resource consumption.

Social scientists point out other potential benefits of building successful local organisations. These benefits, for the local people, are in aspects such as empowerment, confidence-building, forming social capital and reduction of dependency. However, these effects are all hard to measure, and it seems to be an open question whether these results are really wanted, by certain actors in the process, such as middle-rank agency staff, whose job-security may seem to be threatened, or local officials such as district governors, whose power-base could be eroded.

Vermillion (1997), after a careful review of the evidence about the outcomes of management transfers, could not form firm general conclusions about impacts, positive or negative. He expressed doubt about whether the cases reported in our literature were truly representative of the whole scene : more positive cases might be reported because of “a bias in sites selected, or the possibility that many authors are promoters of the reforms.”

Before we leave this question of the governments’ objectives, we may notice a remarkable paradox. Substantial sums of money have gone into these transfer programmes, largely through loans and grants from the international agencies. If an important objective for the governments is to reduce their own expenditure, why is this new expenditure on the transfer programme necessary? An external observer might say : surely the programme can be self-supporting, since it is going to save money for the government.

Objectives of Government Irrigation Policy

The current wave of programmes for irrigation management transfer has to be seen within the overall context of the rationale that has caused governments to establish irrigation systems. There have been many different reasons. We might classify them broadly as welfare objectives, economic and financial objectives, demographic (or social-stability) objectives, and food-security objectives. Perhaps a mixture of all these categories has often been present, but they are not really so compatible with each other.

If we look, for example, at the world’s biggest irrigation system, the Gezira scheme in Sudan, we can see that objectives of under-pinning the national economy with export-oriented cotton, while stabilising and reducing conflict by settling previously semi-nomadic pastoral people, were important objectives, and were mostly achieved. But much has been written about the unsatisfactory welfare of the users. That implies that, in pursuing economic objectives, welfare objectives were not achieved. Later, that system became famous for the rigidity of its management system, and tight control over all aspects of farming activities. This can be interpreted as meaning that the state management system, for which the economic results of the system had become vital to the national balance of payments, could not risk allowing the users to pursue objectives of their own.

More generally, irrigation systems that have been established where users’ welfare objectives are predominant, such as small schemes in remoter regions, have difficulty in fulfilling economic objectives. They provide food for their own users, but the incentive to produce substantial surpluses is often limited, by constraints of transporting and marketing, and by the costs and difficulties of input supplies.

In the nineteenth century, revenue objectives existed, most notably in the Indian sub-continent, where installation of an irrigation system allowed local administrators to levy a higher scale of land tax. This perception of the rationale for installing irrigation systems has now more or less vanished. It is indeed, in a sense, the opposite of the irrigation management transfer policy, which aims at reducing government expenditure rather than increasing government revenue.

Social-stability objectives have also changed in modern times. Nowadays we see fewer cases where irrigation is used as a tool in the implementation of demographic management, through “re-settlement” programmes. But governments are still, to some extent, motivated by a wish to slow down urban growth and the flow of populations to the cities. The speeches of politicians in many countries reveal a belief that installation, or rehabilitation, of irrigation schemes can contribute to this aim.

Objectives of national and global food-security were brought to the forefront in the 1960s, under the pressures of population growth and urbanisation. Food security became a very dominant objective, which drove a global wave of investments in irrigation from about 1965 to 1985. Now, most countries seem (from this point of view) to have enough irrigation facilities, and in many places we see what, in an industrial production system, would be called “spare capacity” or “under-utilised capacity :” irrigation systems that are not being used at the intensity or productivity of which they would be capable. Rice prices, in particular, have been generally low since the mid-1980s. Obviously it is more difficult for producers to contribute strongly to system finances, in conditions where potential supply of their product exceeds effective demand.

Yet, because of the persistence of other objectives, especially rural welfare objectives, politicians continue to promise new programmes to create or renew irrigation facilities, even when food security issues have been greatly reduced, and when it is clear that it has become difficult to finance the management of facilities that exist already.

In this confusing context of complex and varying policy objectives, it is not surprising that it has often been difficult to sustain political consistency over the time-span that seems to be needed for implementation of management transfer. In the Philippines, after more than 20 years of such policies, a populist candidate won the presidential election, having promised to abolish the irrigation service fees which under-pinned the transfer policy. The fact that this was regarded as a politically popular promise must also make us wonder about the merits of the transfer policy. It does not seem that the irrigation users in that country are strong supporters of the policy.

What do the Farmers Want?

The government may have its own objectives ; but the concept of irrigation management transfer implies essentially a joint process, or a kind of partnership, between organisations of the farmers, and the agency that has hitherto made the management decisions. If this co-operation is to succeed, the farmers must see attractive objectives in the programme.

None of the governmental objectives stated above seems to ensure support from the users of irrigation. Even "generate surplus production" is interesting only if the marketability of those surpluses seems sure. "Sustainability of irrigation facilities" should be a concern of the users of those facilities ; but these programmes are generally applied in circumstances where the duty of sustaining the facilities has always been understood to lie with the government agency that installed those facilities. The users' reaction is therefore very likely to be : why should we apply our own efforts, to do what the government agency ought to do, for maintaining its own property?

There is no general answer to the question, what objectives will be interesting to the farmers. Each situation is different. This is true at the national level, and it is equally true at the local level, where every irrigation system faces its own problems and its own specific potentials. If we are in Thailand, farmers facing low rice prices and growing urban markets for fruit and vegetables may say, we want the system to be managed so that farmers can pursue varied crop strategies. If we are in Cambodia, farmers facing ill-designed irrigation facilities built in a past revolutionary period may say, we need remodelling of the canal layout. In every country, they may feel many other needs, about credit, equipment, marketing support, expansion of their irrigation system, input supplies, and much else.

There will often be important differences of objectives, within the users' communities. For example, in southern Sri Lanka, in recent years, weak rice prices and unreliable water supplies motivated many farmers to move from regular rice-production, to bananas. But starting a banana plantation needs investment, and some waiting time before a cash flow from the crop will be established ; so this change is more difficult for the poorer members of the irrigation users' community. The banana planters want a different irrigation regime : smaller flows than for rice, but continuing throughout the year. This kind of difference of objectives is appearing in more and more irrigation systems now, and is often correlated, as in this case, with some of the dimensions of poverty.

The essential point is, in order to establish a viable organisation, the official side must respect the irrigation users, and identify along with them some set of objectives that are sufficiently interesting to them (the farmers), in order to ensure that they will feel supportive to their own organisation.

But, in many programmes, this is not happening ; or not happening enough. In his conclusion about the water management transfer programme in the Red River Delta of Vietnam, Fontenelle (2000) says :

"*It seems that, more than a real questioning about the way water management could be improved through a full implication of water users, the State is trying to transfer cost responsibility to local levels, without giving them the possibility to manage properly their system*."

Many similar comments appear in the writings of external observers of irrigation management transfer programmes, in a wide variety of countries. There is a strong tendency in these programmes for the financial aspect to become too prominent, and the element of local decision-making to be at least partly suppressed.

In all this discussion, when we speak of the concerns of "the farmers," we should not mean just the concerns of some small group among them, who have been identified and selected by the agency staff as "progressive," "potential leaders," and so on. This is, unfortunately, quite often the case. But the objectives and changes that would motivate the farmers to support a new organisation among them can only be identified through wide-range consultations that involve all or most of them.

Interests of Different Groups of Actors

A programme of irrigation management transfer, in any context where irrigated agriculture is a central component of rural life (as it is in much of Asia), is going to have profound effects on many people. We can speak of it, for convenience, as a process with two parties, the government irrigation agency and the farming community ; but that is much too simple. Along with those two groups, many others will be affected, in terms of their jobs, incomes, power, and other important elements of their lives. Within the two main partner groups also, there will be internal groupings that receive very different impacts from the policy, and therefore have very different feelings towards it.

There is not space here to go into the details of these varying, sometimes competing, interests, but we may attempt a quick overview of some major features.

Senior managers in irrigation agencies are the group who, nowadays, seem most likely to be involved in determining the application of the policies. They are aware of budget difficulties, and may see this policy as a way of relieving these difficulties. Perhaps also they see the adoption of irrigation management transfer policies as a way of gaining favour with the donor community. In many cases, grants or loans are obtained from the international aid systems which include, alongside irrigation management transfer programmes, construction or rehabilitation components ; this kind of combination is based on the argument that the farmers would refuse to accept management of defective facilities, so they must first be rehabilitated, or field canal density must be brought up to better levels, and so on. In this perspective, agency leaders may see the adoption of an irrigation management transfer programme as a kind of price to be paid for getting the hardware improvements.

Field staff in irrigation agencies, on the other hand, have an obvious reason for feeling doubtful, or hostile, towards irrigation management transfer. It does not take careful analysis, to indicate to them that their jobs may be at risk. It probably does not matter how often they hear reassuring promises from leaders and politicians : they are still likely to feel vulnerable. But they may also calculate that it is in their personal interest that the programme should proceed slowly. Field staff therefore are often inclined to stress the negative aspects, emphasise that the farmers need more training, and so on.

Politicians have, as in other fields, varied interests. It cannot be assumed that everyone is wanting the irrigation management transfer programme to succeed. Local politicians, such as district governors, may see an erosion of their own influence. In some countries, there is also a fear (or hope) that, if the irrigators' organisations become effective, and a strong factor in local community life, political parties may seek to use them for their own objectives.

If it is perceived that irrigation farmers do not like the transfer policy, then, especially in the more democratic countries, opposition politicians may promise to change it, when the voters give them power. This may lead to inconsistency or instability of the policy application. The Philippines and Sri Lanka have had experiences of this.

Farmer-organisation leaders are, in many transfer programmes, accountable initially to the local officials of the government agency. In many cases, the agency that is promoting transfer selects the first generation of leaders itself. The processes and stages through which they become accountable to their members may be very long, and in some cases these processes seem never to reach completion. This seems inevitable, because most countries find it difficult, or perhaps illegal, to hand over government-constructed facilities completely. The close relationship with the government agency may easily lead to suspicions among the ordinary members. On the other hand, if participation in decision-making is regarded as one of the significant gains, for the irrigator community, from management transfer, then it seems clear that it is the leadership group that are most able to experience that benefit.

Ordinary farmers in the irrigation systems are by far the most numerous of the affected stake-holder groups, although agencies often show rather low interest for enquiring about their views. They often express feelings of alienation from the whole process. Obviously that depends, to a significant degree, on how skilfully it is implemented. But, when there is so often an emphasis on the financial side of the change, those negative sentiments are not difficult to understand. In the worst type of case (but nevertheless a common type) the farmer is not asked whether he or she wants to join the new organisation : they simply learn that, because they cultivate land within a certain command-area boundary, they are automatically members of the organisation ; and then they learn that they must pay a fee to it ; and that the level of this fee has been calculated by the government agency.

Angeles (2003) identified five problems affecting the success of the current phase of management transfer in the Philippines :

- The programme threatens the job security of the government agency's field staff. These staff feel that they will lose their jobs, if the programme is successful.
- The agency is supposed to undertake minor repair, restoration or rehabilitation works, as requested by the irrigators' associations, before transfer, but has insufficient funds to satisfy the actual requests.
- Some community organisers, temporarily employed to assist local organisational development, delay the organising activity, because their tenure will end on completion of these tasks.
- Farmers' interest in their association is reduced, due to suspicion of graft and corruption.

- Farmers are busy with their farming activity and have not much time to participate in system management activity.

Several of these items reflect the different interests of different participating groups.

We may note also that the final item, which represents a shortage of people who are ready to do the work of managing these rural organisations, is becoming quite rapidly more significant, due to urbanisation and the drift of young people away from agricultural activities.

PROCESSES OF ORGANISATIONAL FORMATION

Many of the problems that cause later weaknesses seem to be brought in, in the early stages of irrigation management programmes. Weaknesses tend to become established in this phase, often because of haste by the implementing agencies. This in turn may be connected to the time-frames that are set in agreements with donors.

A factor of a different kind is in the attitudes of staff of the implementing agencies, towards the members of the new organisations. It is often an unequal, or unbalanced, kind of relationship. There is frequently an attitude of superiority towards these members. The converse of that is, that the leaders of the new organisations may be too willing to act according to the wishes of the implementing agency's representatives. The agency has initiated the organisational development ; the leaders may feel accountable to the agency, more than to the members.

Task-based Formation

Yoder (1994) described the advantages of "task-based" formation of organisations, based on observations (largely in Nepal) of self-managed irrigation schemes. According to that analysis, the initial stages of organisational establishment are greatly enhanced by the members' awareness of a clear purpose – we can call it a challenge, or a goal – which the people, who will become the members, understand. Constructing, or extending, an irrigation system would be such an organisation-promoting objective. The participants must be conscious of some desired result, which would benefit them collectively and individually, and they must be aware that this result cannot be achieved by any of them individually, but can be achieved if everyone contributes their efforts.

In this context, a phase of negotiation can happen, within the community, as to how the shared task will be addressed. People, and households, are not simple units. Their capacities to contribute labour, money, or other resources vary. In most cases, the benefits they will expect to obtain, by completion of the scheme, also vary. Some may lose areas of their land, where new channels run across. Some may doubt that all their neighbours will truly perform the agreed amounts of work.

All these aspects, and many more, have to be addressed by developing rules of various kinds. But, if there is a real desire in the community for this shared task to proceed, the negotiation to resolve all these types of potential disagreement will be much easier, and the rules under which they will co-operate will emerge. A fundamental principle is that no one should feel that they will become worse off, if the task is done. To satisfy that principle may require considerable discussion, and time ; but it is a necessary process, as in the absence of this process there will be internal opposition to the organisation.

If the people agree, after discussion and negotiation, to proceed on the shared task, then, by the time it has been completed, they will already have established among themselves the main core features of an organisation :

- a system of collecting resources,
- a system of rules (including penalties for breaking or evading rules),
- a system for making decisions, and
- a system for keeping records about each of these things.

Unfortunately, in many programmes of irrigation management transfer, opportunities for task-based formation of organisations are missed. The implementing agency may perform a rehabilitation of the irrigation facilities, before transferring management. Money for doing so may be included in the programme's funding. It is said that rehabilitation, before transfer, will make the system's users happier, and thus more amenable to the transfer policy that the government agency is seeking to promote. Probably, the truth is the opposite of this. If a major, difficult task is performed for them, before their organisation exists, then the reasons and need for creating that organisation will seem so much less obvious to those who should become its members.

In many programmes of irrigation management transfer, the users do indeed contribute labour in these pre-transfer rehabilitation works ; and the government agency pays them. But just performing paid work does not have the organisation-forming impact, unless the government agency also allows the users to have a major share in deciding what works will be done, and how. The agencies are generally unwilling to allow this : it will be slow, decisions may not be made in a timely way, the users lack technical knowledge, and so on.

Even a rehabilitation is not necessarily valued in the same way by all the users. Consider a canal whose cross-section is silted, or whose flow is impeded by a lot of vegetation. The agency staff see a technically unsatisfactory facility. It needs to be cleaned up and brought back to its design capacity. But a user who draws water from near the head of that canal does not see it so simply. Cleaning that canal is going to mean that water can flow in it with higher velocity and shallower depth, over a lower bed-level. The head of water that will be available, at the outlet which serves that user, will be reduced. This head-end user loses, and does not gain, by cleaning the canal. If the community, in its own internal negotiating process, decides to do it, the upstream users may negotiate some sort of compensation, or trade-off, in return for helping the others to do the cleaning. They could, for example, request a change of rules, such as an extension of the time during which such an outlet is open.

If we neglect the necessary processes that must go on, within the community, in the search for agreement on an organisational system, then we end up with what I will call “paper organisations.” That means, organisations that exist on paper, but are not active in reality. The implementing agency may be able to produce, for visiting specialists, or even for the external donor, lists showing the names of presidents, secretaries, numbers of committee members, and so forth. But, unless the organisation has genuinely developed the set of four attributes listed above, this information is usually meaningless. The mere existence of some nominal leaders is not equivalent to having an organisation that is effective and brings benefits to its members.

Standardisation of Constitutions, Rules, and Fees

In contrast to the concept of task-based formation, where organisational characteristics evolve gradually, in response to problems as they arise, we more often see, in programmes of irrigation management transfer, the delivery of ready-made, standardised constitutions, which have been drafted by the government’s implementing agency.

The case for doing things in this way is sometimes stated on the basis that the irrigation users would not, themselves, know how to make an effective organisation. They are uneducated, they lack experience of organising, and it is the duty of the implementing agency to help them over these difficulties or disadvantages. Sometimes this is true, as for example in post-communist states, where there has been no recent tradition of autonomous local organisation. But on the other hand we can see plenty of cases where rural organisations have indeed been formed by local initiatives, without government people intervening or helping. It seems reasonable to think that the basic, underlying reason, why implementing agencies do these organisation-defining tasks themselves, is that the people who are designated as the future members of the organisation are not sufficiently interested in forming it.

A number of consequences flow from the procedure of standard constitutions. Sometimes it seems to obstruct any evolution of the organisation, or any adaptation of rules to fit a local context. In Niger, for example, one of the first clauses of the standard constitution stated clearly that it could be amended by decision of the members ; yet, during ten seasons of observations, no case of such amendment was noted (Abernethy et. al, 2000).

An explanation of this could be that the government-supplied constitution is excellent for every situation. That seems improbable, since irrigation systems vary so much that one institutional prescription is not likely to be equally suitable for them all. More probable explanations are either that the government-supplied constitution is not regarded by the irrigation users as an important document, that regulates an important aspect of their lives ; or, alternatively, that they regard a document that has come down from the government as somehow sacred, and that changing it would be improper. Quite possibly, also, they feel some concern, that by altering this governmental text they would incur the displeasure of officials.

Bureaucracies, of course, have some difficulty in seeing this problem at all. Government agencies think it is right, and normal, to standardise many aspects of their own procedures. But those who have studied and compared many self-governing organisations created by irrigation farmers have often expressed surprise at their diversity of rules and management systems, which is a response to the diversity of their physical and social contexts.

Along with standardised constitutions and rules come (very often) standardised financial procedures, including, in many cases, standard fee-rates that have been set uniformly at national or provincial level. No doubt the government agencies feel impelled to do this, in order to address the financial objective that is usually present. But this seems to remove a major item from the decision-making scope of the organisation. A general meeting of the members seems likely to be much less interesting, if members know that no reduction or adjustment of the fee can be discussed.

PROBLEMS OF ORGANISATIONAL STRUCTURE

Complexity

The kind of organisation that is needed for managing the affairs of an irrigation system is inherently complex.

An irrigation system, when it exceeds a scale of the order of 100 hectares, is likely to need more than one level of management. They do different things. At the lowest level, such as field-channel groups, they usually attend to manual work of cleaning channels, and they arrange water-distribution schedules among themselves. At higher levels the tasks become larger. Each level has to relate in some way to the next above and below : the field-channel group cannot arrange water-distribution unless its representative can liaise with the secondary-canal committee about the times and flows that are to be expected. In a management transfer situation, all of these levels probably also have some contact with people of the government agency.

Money must flow upward and downward. Contributions are normally collected at one specific level, but may be used, and stored, at other levels.

In most parts of the world, complexity in irrigation management is increasing, often quite rapidly, in modern times. In places where, not long ago, we would see rice as the sole crop, there is often substantial diversification now : this leads to demands for different schedules, both on the annual and the weekly basis. Water sources are diversifying too. Within an irrigation system, users may have their own ground-water sources. The kind of situation described by Molle, Chompadist and Sopaphun (1998) in Thailand, is appearing in many places now. People there used six different types of source obtaining water (canals ; ditches ; main drains ; farm drains ; tube-wells ; and ponds), in a system designed by the government agency to have a single, surface-canal input.

Faced with these growing complexities, management is difficult. In management transfer programmes, it would seem desirable to respond to this complexity by arranging the programme so that the new managers and new leaders can learn how to do it, gradually, working from the bottom upward. That would seem to indicate a stepwise scheduling of the programme, in which the lower management units are created first, and only when it is seen that these are working adequately, are the next larger units brought into existence.

Cernea and Meinzen-Dick (1994), reviewing experiences of formation of irrigators' organisations in World Bank projects, gave attention to the size of the "base unit" of organisation. They noted that such a unit should be big enough to perform group tasks, but on the other hand that the complexity of management increases with size. As they put it.

"if base water users' associations are too large, it is difficult for farmers to meet, because their numbers are too great. Large size compounds the organisational and managerial tasks, often beyond the capacity of the local leaders."

They did not recommend any optimal size, but they found that in the projects they studied the median base unit was 40 ha, which they considered to be reasonable figure.

Many management transfer programmes seek to create organisations much bigger than this, up to a thousand or more members. Such scales, for self-managed organisations with multi-tiered structures, are certainly possible; but they cannot generally be created quickly, and may require decades of gradual development.

Single and Multi-functional Organisations

The question, whether the new organisations that are formed under irrigation management transfer programmes should have the single function of operating and maintaining irrigation facilities, or should be encouraged to diversify into other activities, is a difficult one.

In Nepal, for example, single-function organisations have been promoted, and appear, at least in some cases, to be developing successfully. A single-function organisation, performing water distribution only, does not usually require to raise substantial amounts of resources, and its tasks are familiar ones, so the development of management skills should be quicker.

On the other hand, these new organisations do not have to contribute payments to the state. The funds raised by the organisation can be used within the irrigation system. The fees paid can therefore be kept at tolerable levels, even in pump-based systems where there is an energy cost to be paid regularly. This matter may seem different, in systems where the fee level is a bigger share of crop value, and where (as in the Philippines) most of it will be taken by the government agency.

A multi-function approach seems to address one of the basic difficulties, already alluded to : how to make the new organisation seem interesting to the members, and deserving their support. By taking up new activities that the members think they need, the organisation may obtain a higher level of support from the members. Such activities may be input supplies, transportation, refrigerated storage, credit, crop processing and so forth.

Major problems of multi-function schemes are insufficiency of capital, and lack of experience in managing commercial risks. The staff of government agencies are not, usually, the best advisors in these areas. There is a possibility of encouraging the inexperienced leaders into activities that may, eventually, incur losses. Such outcomes can greatly damage the members' confidence in the organisation, and the most likely consequence of such loss of confidence is reduction or delay of future contributions by members.

NEEDS OF THE LOCAL ORGANISATIONS

Training and Learning to Manage

Government officials are familiar with the idea that it takes a long time to become a manager. An official may work for twenty years before reaching the level of managing a staff group as large as fifty people. Most officials never reach the level of managing large groups of several hundred. In a large private-sector company, promotions may happen faster, but it still takes a long time to climb the management ladder. Yet we see, in many countries now, irrigation management transfer programmes in which new leaders are expected, almost immediately, to know how to manage organisations with a thousand members.

This is quite strange, and difficult to explain. People on the official side often show some feelings of superiority towards the irrigators, and indeed the officials are on average likely to be much better educated. How, then, do they suppose that the irrigators will produce leaders who can so swiftly develop management skills which the officials themselves would take decades to acquire?

Time is needed, and mistakes will be made. We can often see, in the early years of these new organisations, a kind of unstable behaviour. Indicators of success, such as the most readily measurable ones, the financial indicators like annual income or bank balances, fluctuate sharply. These things are signs of the process of learning how to manage. When there are downturns in this phase, we are likely to hear voices among the agency field staff, pointing out, not that the leaders are learning to manage, but that they are showing their lack of competence, and will need to be helped for a few more years.

But, in many cases, the basic mistake is a different one, and often begins farther back, in the programme planning phase. Due, perhaps, to haste, and a wish to promise a short time-frame for achievement of programme objectives, organisations are established in ways that seem to build inherent weakness into them. Foremost among these sources of long-term organisational weakness seem to be the following three. Other people may well identify different items for such a list ; these three represent my own deductions from observations :

- Programmes try to establish, initially, organisations that are too large.
- There is not an equal dialogue between officials and irrigation users.
- There is insufficient recognition that any organisation conducting a business needs working capital.

The first point, organisational size, is obviously related to the availability and development of management skills. It is normal to see, in the documentation and budgets of management transfer projects, items about training, especially for the new leaders. These training items are often quite large components of the overall project, and it is good that they should be so. But, just as we would not try to teach a child to ride a bicycle, or an adult to drive a car, by means of a training course alone, so management too has to be learned by doing it. The books and the classes can be useful, but are not a substitute for "on-the-job" experience.

This is one reason (and not the only one) why it is better to build organisations from the bottom up : through small units like field channel groups, up to secondary and then main canal organisations. Yet it is not uncommon to find that irrigation management transfer is implemented in the opposite way : overall organisations are put in place first, and the smaller units are viewed (from the official side) as subsidiary things that can come later, or perhaps not at all.

Managing a multi-tiered organisation is not an easy matter. Such an organisation is complex, and the possibilities of conflict or disputes are numerous. Roles and functions of each level must be clearly defined and distinguished from each other. Resources such as labour, money, and equipment must be shared or interchanged between levels, and between units of the same level, smoothly. That requires rules that are good, clear, and generally understood and supported. It requires communication, record-keeping, and processes for arriving at joint decisions.

All of these are skills that have to be learned, by those who will become managers of irrigators' organisations after transfer. The official side is not likely to produce the best teachers of these skills, because the bureaucracies, that are their own normal working environment, do not operate on similar principles.

Communication and Transparency

Communication is one of the principal management skills that are needed in these programmes. I believe it could be called the most essential single skill that the leaders should have. The reason for that is that the support of the members is essential ; and that support cannot be obtained if they do not know what their organisation is trying to do, and why. Moreover, support cannot be expected unless the members feel that their own voices can be heard, and that the leadership listens to them, and actually wants to know their views. That is to say, leaders must know how to operate a two-way communication system : both informing and listening.

Transparent behaviour is essential in organisations of this kind. The organisation has few means of compelling its members to do what it would like : it must gain their collaboration by persuading them that it is working in their interests, and using its resources wisely. They must, therefore, be able to know what is going on. Transparency depends on effective communication.

There must also be routes for making members' views, especially complaints, known, and these routes should be well known and easy to use. For this purpose, some kind of general meeting that all members may attend, seems necessary, at least at the level of the basic unit of organisation. In many programmes, the expression "general meeting" is used to refer to a different kind of event, such as a meeting of representatives from throughout a large system. Such meetings are necessary, but they are not a substitute for opportunities where any member may express a view, and where others hearing this view can say whether they agree with it. Mechanisms of this sort are vital for transparency, and become most necessary when there is any widespread feeling of dissatisfaction.

Burton (2003) states the case for communication very strongly, saying that

"In all successful cases reported, communication has played a central role…..The investment in communication is well rewarded, and conversely failure to invest results in lack of understanding and commitment to the irrigation management transfer process, and eventual failure."

In this, the term "investment" may include such aspects as time spent on training for communication skills, the application of time by organisational leaders, for example in going to attend lower-level meetings, and the development of communication media such as news-sheets and notice-boards.

Financial Needs

Financial issues are probably the most common source of difficulties for the users' organisations. They rarely have enough funds, to perform the functions that their members might like, and to satisfy demands made (in many programmes) by the implementing agencies. Collection of fees is often difficult, and the costs of collection may consume a significant proportion of the income. Oorthuizen and Kloezen (1995) described a case-history in the Philippines, where, over five years after initial transfer, the organisation's financial balance bounced up and down, from surplus to deficit and back again, as its leaders tried out different fee-collection policies. They thought that using paid collectors was unnecessarily extravagant, and that their members would surely be willing to bring the fees to their own organisation ; but this hope turned out to be wrong. Collection costs in the order of 15 – 25% of the total amounts collected are frequently reported.

The failures of payment are often attributed to the poverty of the irrigation users. Certainly, a great many of them are poor. But other evidence suggests that this is not the root of the non-payment problems. In Bangladesh, for example, privately-owned tube-wells sell water to individuals within a small perimeter ; and people are well aware of the value of such a service, and the improvement it can bring to their households, so they are willing to pay for irrigation water service at rates that amount to as much as 20% of crop value. Similar levels of payment are seen in Niger. In Iran, it used to be customary to pay to the owner of the water conduit a one-fifth share of the crop produced. If people in such diverse situations, all of them poor, recognised the value of irrigation service, we have to seek some reason, other than poverty, to explain why they are often unwilling to pay the fees requested by their own organisation, which are generally very much smaller than these.

I suggest that the likely reasons for these frequent failures of financial support from members are due to some, or all, of the following causes :

- The members do not perceive the organisation as their own. They see it as a creation of the government, and accountable to the government.
- The members do not think that the existence of the organisation is bringing them significant benefits, that they themselves want.
- The members do not feel confident about the way the fee will be expended.
- The members do not believe that, if they fail to pay, the government agency will really allow irrigation service to them to cease.

Obviously, there are many local variants. The above points are not universal, but they seem to be very frequent.

Regarding expenditure, it seems unfortunate that there has been a much greater focus (in many programmes) on collecting the fee, than on explaining how it will be applied. This tendency began with the Philippines, where, as we noted, the origin of the programmes was the need to balance the agency's budget. Even now, in the newly-adopted transfer programme in the large Upper Pampanga Irrigation System, the users' organisations may retain only 36% of the total that they collect. The major share goes to the government agency. It is difficult to generate enthusiastic support for this kind of policy, among the irrigators.

The problem of corruption is not often mentioned in writings about transfer, but there is no doubt that the problem exists, and has some effect in reducing willingness to pay. This is not a question of dishonest leaders, or dishonest officials. No doubt there will always be some of those. But the organisations are as likely to be damaged by the perception of corruption, as by the reality of it. If rumours begin to circulate, it may often be difficult to suppress them, whether true or false. If any significant proportion of members begin to believe that the money that members have paid is being improperly used, reduced willingness to pay will be the first indicator of that.

This is, therefore, the most vital area for building mechanisms of communication, transparency and accountability. Such mechanisms can include such measures as a seasonal or annual budget debate, in which expenditure proposals and potential income are given equal weight, and in which ways of obtaining the views of the ordinary members are sought ; careful maintenance of financial records ; and publicly-known procedures by which ordinary members can inspect such records.

MANAGING THE PROGRAMME

We have looked at various kinds of weakness that are frequently-observed characteristics of the users' organisations which are formed under programmes of irrigation management transfer. Also we have considered some of the sources or causes that tend to produce these unsatisfactory characteristics. Finally, we should consider the question : are these inevitable features of such a programme ; or, if they are not, what can we say about the role of the government agencies? Can we identify ways in which their procedures could be modified or improved, so that success would be more likely, and organisational weaknesses would be avoided?

Obviously, the answers to these questions vary, from country to country. National programmes are not all alike. But perhaps we can formulate some general guidelines.

Lessons from Existing Self-governing Schemes

A good starting-point is the set of eight principles that were set out by Ostrom (1992), as characteristics of long-established, self-governing organisations of irrigators. Those principles emerged from a large review of many such organisations, across many countries. They do not seem to be specific to any particular culture. They refer, generally, to organisations that local communities have constructed for themselves. It seems reasonable therefore to suppose that they represent an appropriate set of features that should, if possible, be developed in the new organisations that are formed for management transfer.

The eight Ostrom principles (summarised by the present author, for brevity) is:

- There are clear boundaries, and rules about who has rights to water.
- Rules ensure that each member's benefits and contributions are in balance.
- Rules can be modified by collective decision of the members.
- Monitoring of conditions and actions is done by users or by people accountable to them.
- Violators of rules receive graduated penalties, decided by other users or by people accountable to them.
- Arrangements exist for settling conflicts, among users or between users and officials, quickly and at low cost.

- Government authorities recognise the users' right to devise their own organisation and rules.
- There are different levels of organisation, which deal with different functions and decisions.

Unfortunately, there is often little or no awareness of these excellent principles, among the staff of agencies that are promoting management transfer. Moreover, many programmes seem to be structured and managed in ways that are opposite to several of these principles.

In a review of nine local organisations in two West African countries, it was observed that those organisations which complied better with these Ostrom principles also showed better general performance in their irrigation activities (Abernethy and Sally, 2000). However, in that case even the best of the organisations was estimated to show less than 50% correspondence with the Ostrom principles, and the least satisfactory ones were below 30%. I believe that in many management transfer programmes, the level of respect for the principles is very low. In some cases, it appears that not even one of the principles is reflected in the procedures of organisational formation and structure that the government agencies are trying to implement.

The words “people accountable to the users” which appear in the Ostrom principles are significant. They tell us why the agency should not select the organisations’ leaders ; or, if they feel that they must select the first set, in order to get the organisation started, then they should not intervene in further selections thereafter. If people who are given essential organisation-sustaining roles, such as monitoring rule-implementation and judging rule-breaking penalties, do not perform those roles satisfactorily, they are accountable to the members. That means, there is some procedure by which the members can remove and replace those leaders, when performance is not adequate according to the members’ opinions.

Time Required to Complete Transfer

How long is a transfer process likely to take? The first answer to that seems to be that it will usually take longer than was at first expected.

Burton (2003) found, in his review of programme experiences, that

“in general the time-frame for implementing the irrigation management programme was considered to be too short, with time-frames of 10 – 15 years being quoted as adequate.”

This comment refers to the “better-performing” half of his sample. The other half seem to be slower.

Perhaps there is some scope for accelerating this. It seems that a significant factor that often slows down the implementation of these programmes is the resistance of the agencies’ own field staff. We have noted already that these staff have, in many programmes, strong personal reasons to feel anxious about their job security. They may well feel that rapid completion of the programme is not in their own interest. Such staff will sometimes say (but not in any public way) that they hope that their programme will not end before their own retirement date. These fears seem entirely understandable, and it seems that it is the duty of the agency’s leadership to anticipate them, and address them, as early as possible in the programme.

However, it seems that programme durations of the order of a decade or more should be expected, because, on the analogy of other types of management activity, it is likely to take times of this order to develop the necessary skills to manage the irrigators’ organisations well. Efforts to reduce the period may well cause worse problems.

These time-scales should be flexible, and, if possible, gradual increase of the scope of responsibilities of the new organisations should be arranged. Ideally, the transfer of additional functions, or the stepping up of users’ control to higher tiers of organisational management, should occur when the users feel ready to request such changes.

Internal Attitudes

A management transfer programme, if it is to be completed successfully, will require large changes of attitudes within the implementing agency, as well as among the farmers. Therefore, there is a need to install new concepts among the agency’s own staff. Some would say that these changes within the agency are more significant (because they are more difficult to achieve) than the changes we have discussed among the irrigator communities. An important question is how these desired changes of the agency’s internal attitudes and culture are most likely to be arranged.

Some people advocate a training component for agency staff. Some training is undoubtedly necessary, but, if attitudes of opposition to the transfer concept are widespread in the agency, it seems doubtful that they can be changed by compulsory training programmes.

In Mexico, the agency dealt with internal resistance (partially) by dismissing staff who opposed the programme (Burton, 2003). However, that is a case of a programme undertaken to reduce budgetary pressures on the government, at a time when the country's finances had significant and well-known difficulties, so severe enforcement of the policy might be understandable. It seems very doubtful that the political context in Asian countries would allow this approach. Moreover, it is not easy to identify all those whose actions slow down such a programme. The resistance, within the agency's field staff, may not be overt.

Tough action, such as dismissals, does not seem right in the circumstances. The position of the agency's own staff could be considered more sympathetically.

It is obvious to everyone that, if irrigators' associations take over many field-level functions in operation and maintenance, and perform these functions adequately, then the agency will require fewer field staff. It is not at all reasonable to expect the agency's staff to like this prospect, or to work enthusiastically to achieve it. This reality should be faced at a very early stage.

One satisfactory way of addressing it would be through opening fresh career paths for such staff. There are many issues in the state's management of water that need increased attention in modern conditions : management of water quality, management of river basins, restoration of hydrological data networks, are some examples. The staff who will become redundant if irrigation management transfer succeeds, could in most cases be absorbed into better performance of these other functions. It seems quite possible to arrange this in such a manner as to cause these staff to feel an active wish that the management transfers will really succeed. To do this, the policy-makers of the implementing agency and higher levels of government must be able to communicate an attractive vision of the post-transfer conditions.

SUMMARY

To conclude this review, I will return to the initial question : "Can programmes of irrigation management transfer be completed successfully?" I think that the answer is "Yes," but I also think that in many of the existing programmes, the successful outcome will be possible only if there are substantial changes of procedures and of attitudes.

An alarming feature of many programmes is that they seem to lose sight of the need to provide benefits to the irrigator communities who are, or should be, the targets of the whole exercise. (By the term "benefits," I refer to things that these irrigator communities themselves want : which may be different from what the government agency thinks they should want.) Too often, programmes seem to be operated in the interest of the agencies and their staff, and the aim of delivering genuine benefits to some target group seems to become lost, or obscured.

A short list of the characteristics that should be incorporated into these programmes, to give them a reasonably high prospect of success, would include these :

- The real experience and characteristics of self-governing irrigation organisations should be used as the basic template for developing new organisations.
- The irrigators' organisations must develop transparent behaviour, and accountable procedures, so that the ordinary members can feel trust that the resources they are asked to contribute are handled correctly. For this purpose (and some others) training and development of skills in communication and in record-keeping are vital. Implementing agencies should recognise that the need for skills of these kinds has a very high priority ; higher than any needs for technical training.
- The personal interests and needs of the implementing agencies' field staff must be recognised, and treated sympathetically. They have obvious reasons for personal anxiety about the security of their own employment, and if these fears are not addressed at an early stage they are likely to slow down the programme implementation. Decisions about this aspect are needed at the beginning of the programme so that these fears are resolved before they have serious effects on programme implementation. A desirable strategy for dealing with such fears would be by adopting a policy of gradual transfer of affected agency staff to new sets of activities in the water sector. Important aspects of the water sector have been neglected in most countries, and the finance provided by external agencies could be applied towards re-training irrigation staff into these directions, which include most notably water quality management, river basin management, and hydrological data networks. The internal status of all these deserves to be raised in order to deal with current trends.
- The government agencies should not proceed in such a way as to remove important motivations for organisational formation. Especially, rehabilitation and improvement of system facilities should not be done by the agencies, in advance of the formation of the irrigators' organisations. Assistance, when it is given for such physical

improvements, should not be large, and the detailed decisions about what is to be done should be made, as much as possible, by the irrigators' organisations, and implemented, as much as possible, through their membership. The role of a challenge, or an objective, to stimulate the organisation-forming process, should be recognised by the agency.

- Programme time-frames should be flexible, and organisational formation and development processes should not be fixed to any rigid time-table. Organisations, and their activities, should be developed from the bottom upwards, beginning with the small-scale local units, and taking over higher functions by stages, as management skills and capacities grow. In general, the time-scales that have been adopted for many recent transfer programmes are probably too optimistic, and may need to be extended. However, we should also recognise that in many cases agencies' field staff have had a clear personal interest in delay, in non-completion of the programmes, and in demonstrating that the users are not ready to exercise management functions. If that factor can be removed, by addressing the problem of the legitimate interests of such staff, it seems possible that project time-scales could become significantly shorter.

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THE NEED FOR SUSTAINING FARMER MANAGED IRRIGATION SYSTEMS

NYOMAN SUTAWAN[1]

INTRODUCTION

Farmer Managed Irrigation Systems (FMIS) refers to the irrigation systems, of which are generally operated and maintained by the farmers themselves. The irrigation studies show that FMIS vary greatly across countries with regard to various aspects like the sizes of irrigated land (command areas), historical origins or ages, organization structures, governance structures, degree of performances, and many others. Though they are greatly diverse in many aspects, by and large traditional ones seem to have several features in common such as the simplicity of organizational structures and irrigation infrastructures self- supporting or without external assistance, and utilization of local wisdom or indigenous knowledge in irrigation and agricultural practices.

The importance of FMIS in providing staple food particularly rice for most of Asian people seems to be well recognized. It is not exaggeration to say that FMIS play a significant role as guarantor of food security in many countries. Sustaining irrigated agriculture and irrigation systems in general and FMIS in particular would also imply sustaining food security and rural livelihoods in many places of developing countries.

This paper tries to provide answers in a very tentative and hypothetical manner to the following three questions: (1) What can make FMIS sustainable? (2) What are the reasons as to why it is necessary to keep FMIS sustainable? and (3). What strategic measures are required in order to keep FMIS sustainable? These will be discussed in rather more detail below.

CONDITIONS WHICH MAKE FMIS SUSTAINABLE

Irrigation system can be viewed to possess several inter-related elements. Sustainable FMIS should be perceived here as prolonged existence and functioning of a number of important inter-related elements of an irrigation system. In other words, sustainability of FMIS should encompass the sustainability of the followings: (1) irrigator's association or institution (*institutional sustainability*); (2) irrigation networks (*technical sustainability*);

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[1] Professor Emeritus, Udayana University, Bali, Indonesia.

(3) agricultural production (*economic sustainability*); (4) irrigated land ecosystem (*ecological sustainability*); and (5) social and cultural values and traditions linked to the rice cultivation (*socio-cultural sustainability*).

However, the sustainability of these five elements of FMIS also depends on the local natural environment especially upstream watershed and the quality of up stream river water (*environmental sustainability)* which are external to the FMIS concerned. An individual irrigation system is also an element or sub-system of the entire systems within a watershed or along a river course. This implies that the performance of individual irrigation system drawing water from lower stream may also be affected by the system getting water from the upper stream. The sustainability of the FMIS and its local environment is also affected by various external forces like demographic, social, economic, cultural, political, industrial development, tourism, government policy, etc.

Which conditions then can make FMIS sustainable or viable? According to Ostrom (1992) there are eight factors or conditions that characterize long-enduring and viable FMIS namely: *(1) clearly defined boundaries with regard to service area and membership;(2) fair proportioning between rights and duties of each member; (3) collective decision- making arrangement: (4) accountable monitoring: (5) graduated sanction against rule infractions: (6) conflict resolution mechanism: (7) recognition as formal organization having status as legal entity; and (8) multilayered organization.*

The eight criteria of sustainability as proposed by Ostrom seem to a greater extent representing the criteria of institutional sustainability. In the context of sustainable FMIS, it seems necessary to add some more criteria such as: *(1) appropriate technology which ensures fair and transparent water allocation and distribution; (2) financially capable to shoulder the required cost for major rehabilitation, operation and maintenance; (3) mutual trust, harmonious interaction, mutual help and mutual benefit relation among members; (4) rural social stability brought about by regular religious ceremonies and community festivals tightly linked with irrigated agricultural activities; (5) ecological balance within irrigated land ecosystem; and (6) well-preserved watershed upstream where water resources of the FMIS come from.*

RATIONALE FOR SUSTAINING FMIS

Multi-functionality of Irrigated Agriculture: Irrigated Paddy Farming

Irrigated agriculture, irrigated paddy farming in particular, possesses multi-functional roles with positive externalities. Irrigated agriculture does not only produce food and fiber but also other intangible "goods" which are quite difficult to quantify or evaluate in economic term. The multi-functional roles of irrigated agriculture are: provision of agricultural production to ensure food security, flood preservation, soil erosion control, groundwater recharge, water purification, air cooling effect, provision of habitat for various tiny living creatures that can create ecological balance or biodiversity preservation, provision of beautiful landscape that can be quite potential for eco-tourism, provision of drinking water for rural people and domesticated animals, provision of additional source of water plant and animal protein, provision of a place for duck raising, provision of a place for religious rituals and rural festivals, usage for water wheel and small-scale hydropower generation (Mizutani, 2002; and Kwun, 2002 and Groenfeldt, 2003).

We can not imagine, how much money we need to combat flood and soil erosion, to purify water, to clean the air and numerous problems that could emerge if the next generation abandon rice farming. Kwun (2002) provide important information on estimates of economic values of several multi-functional benefits of irrigated agriculture in Korea and Japan. For example just for the flood control function of paddy farming it ranges from 16.27 billion to 23.99 billion US dollars in Japan and from 1.11 billion to 1.32 billion US dollars in Korea.

Local Wisdom and Socio-Cultural Values Attached to FMIS

Local wisdom or indigenous knowledge and socio-cultural values are inherent in FMIS for irrigated agriculture especially rice culture. Local wisdom has been employed in irrigated rice cultivation from generation to generation and proven effective and efficient. Rural traditions and various kinds of rituals and festivals associated with rice farming can bring social stability and social harmony. Agronomists and engineers who got training in modern industrialized countries may regard the agricultural and irrigation practices of traditional farmers as primitive and unscientific. However, if studied in depth, it is quite probable that what looks as primitive and unscientific might contain scientific truth.

Before the advent of Green Revolution, irrigated agriculture in many developing countries were rich in a wide variety of genetic resources. There were numerous local rice varieties. Modern agriculture has replaced local varieties with their associated local wisdom by modern rice variety requiring expensive agro-chemical inputs which in many cases beyond the capacity of the local farmers to purchase them. Moreover, the trade related intellectual property rights recently implemented through international trade arrangement has put the farmers of developing countries into further difficulties. They would not get access to such costly technology crucial to enhance agricultural development in their countries.

Technical, Managerial and Financial Constraints Faced by FMIS

After the implementation of irrigation management transfer program in many countries, the farmers must be responsible for shouldering the cost burden for repairs, operation and maintenance of the systems that were formerly managed by the government. However, many of the rice farmers are lacking of technical, managerial and financial capacity. They still need external support to be able to manage the irrigation system properly.

Threats to the Sustainability of FMIS

There are several conditions or factors that may severely threaten the sustainability of irrigation system for irrigated agriculture especially rice culture namely: *(1) declining interest of rural youth to work as farmers particularly as rice farmers; (2) declining of irrigated land areas due to the conversion for non agricultural uses; (3) increasing conflict in the use of water resources; and (4) deforestation and pollution of irrigation water.*

STRATEGIC MEASURES FOR SUSTAINING FMIS

Some of the strategic measures required for sustaining FMIS are proposed below:

<u>Minimizing irrigated paddy land conversion</u> through the following approaches: (1) careful spatial and land use planning taking the water resource availability into consideration; (2) creation of legal framework prohibiting the use of paddy land within the prescribed zone for non farming activities with strict law enforcement in its implementation.

<u>Narrowing the rural- urban gap</u> through (1) pro-paddy farmers related agricultural policy to be encouraged such as price policy and international

trade policy that ensure the enhancement of farmers' income and term of trade of farm products; (2) agricultural-based rural industrial development efforts for rural employment and income generation; and (3) improvement of rural infrastructures.

Empowering Water Users' Associations (1) provision of support services for FMIS such as agricultural credit, market information, agricultural extension service, and agricultural inputs; (2) provision of training and education for the WUAs especially the leaders in order to increase their skills and knowledge in various fields; (3) facilitating and motivating the potential FMIS to perform income generating activities beyond irrigation management to enhance financial capacity of the organizations; (4) external support for selected FMIS which are badly in need for major rehabilitation of infrastructure through participatory approach ; and (5) government recognition for WUAs as legal entity wherever possible so that they can make economic transaction and assess credit from financial institution if they are supposed to take additional income generating activities.

Reducing water conflict can be endeavored through: (1) creating legal frame work for clearly defined water rights for different users; (2) promoting good coordination among existing WUAs both within a large-scale irrigation system and inter-system coordination along the watershed if it is really required and potential for equitable water allocation and distribution; (3) mobilizing and organizing dialogue among stakeholders particularly water users of different sectors to develop mutual understanding on how to use water as common property for the benefit of community as a whole; and (5) promoting more efficient use of available water for agriculture, domestic use and industry.

Protecting upstream watershed and irrigation water quality from further degradation can be done through the following measures: (1) imposing strict punishment for water polluters and illegal woodcutters in the protected watershed; (2) refusing the issuance of permit for any project investment which from environmental impact assessment criteria is not feasible since the project may potentially pollute natural resources; (3) implementing "polluters pay principle"; (5) strengthening the roles of the existing "community-based" forestry if any; (6) considering the possibility of transferring government-managed forestry to local communities whenever needed; (7) reducing the excessive use of chemical farm inputs and application of organic farming; and (8) improving and strengthening inter-agencies coordination in handling water problems.

CLOSING REMARKS

Numerous FMIS are found in many parts of the world. They are extremely diverse. Sustainability of FMIS should encompass: the technical, institutional, economic, environmental and ecological, and socio-cultural sustainability. In this way, it would enable us to: (1) better understand the location specific nature of greatly diverse FMIS in a rather holistic perspective; and (2) formulate agricultural and irrigation policy best suited to specific conditions of a given country.

One of the greatest threats to the prolonged viability of irrigation systems is rapid conversion of paddy fields to non agricultural uses. Considering that irrigated agriculture, paddy culture in particular, plays multi-functional roles with positive externalities; irrigated paddy farming should be preserved. Effective and appropriate policy options need to be taken to restrict the changing uses of irrigated paddy fields.

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GOVERNANCE OF FARMER MANAGED IRRIGATION CORPORATIONS IN THE SWISS AND ITALIAN ALPS: ISSUES AND PERSPECTIVES

EMMANUEL REYNARD[1]

INTRODUCTION

Farmer Managed Irrigation Systems (FMIS) represent *"the decentralised natural resource management by the local community […] that has developed its own organisation system, norms and values governing the management of water resource, resource mobilisation based on obligations and right to use the natural resource"* (Pradhan, 2001). But, FMIS are not closed systems. They are to be considered as one of the multiple water resource management subsystems integrated within larger systems, as the agricultural system and the water management system (**Figure 1**). They are also connected with other economic systems and natural systems. For example, we may think of the tourism system, as in the Alps, where irrigation channels are also used as hiking paths (Reynard, 2003), and of the geomorphological system, that has a large influence on the building techniques, as is shown by the development of wood channels along the cliffs of the lateral sides of the glacial Rhone Valley (Reynard, 2002).

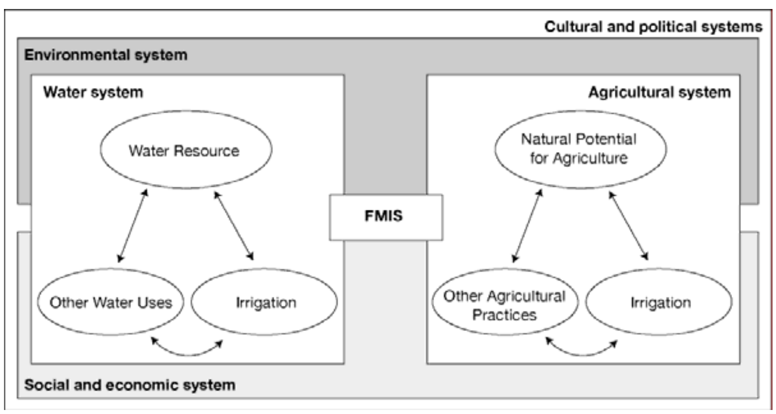

Figure 1: Integration and Interactions of Farmer Managed Irrigation Systems with Other Natural and Economic Systems.

1 Assistant Professor, Institute of Geography, University of Lausanne, Lausanne, Switzerlands.

All these interactions need to be regulated by a large palette of rules, which can be classified into two types, the public policies and the property rights (Reynard, 2002), and which we proposed to group within the generic denomination of Institutional Resource Regime (IRR) (Varone et. al, 2002; and Reynard, 2002). Both types of rules concern the internal functioning of the irrigation system, as well as the regulation of the relationships between irrigation and other systems. It is what I propose to call **the internal and the external governance** of irrigation systems.

Because of the rapidly changing world, FMIS face several challenges that concern technical aspects, internal organisational features, as well as integration and interaction with larger systems. In her key-note speech to the First International Seminar on FMIS held in Kathmandu in 2000, Linden Vincent addressed a series of issues concerning FMIS in a changing world (Vincent, 2001). Two of them are related to governance challenges:

"What are the links of FMIS with wider civil society? How are FMIS transforming in the face of wider agrarian, political and environmental change?

Why, and how, have the policies and programs for FMIS evolved over time and how does this shape the opportunities for FMIS to evolve?"

More precisely, in terms of governance, I think that three issues are of great interest to be studied more in detail: *How the national governing system – centralised or federal –, and ow the regional and*

national policies regulating agriculture and water management influence the functioning of FMIS?

What are the respective roles of public policies and property rights in the functioning of FMIS? Are common-property associations susceptible to be developed in all contexts or, at the contrary, are there some regulative conditions necessary for FMIS to function well?

How can FMIS influence the development of water policies at a regional or national scale? Are these small-scale systems able to be heard by the regional and national administration? Are they able to play a role in the evolution of water management at the regional and national scale?

These preoccupations are well addressed by the recent book edited by Boelens and Hoogendam (2002) concerning irrigation in the Andes: *"To find the starting points for strengthening users' organisations, it is fundamental* *to understand the dynamics of water rights and indigenous normative systems. It is therefore necessary as well to understand their interaction with other normative frameworks and with the different institutions that make up the institutional context".*

In this paper, I will first propose an analytical model for studying governance of FMIS. After briefly presenting irrigation in the Rhone and the Aosta valleys, I will analyse two regional cases. They concern the evolution of the internal governance of FMIS in a context of rapid changes in agricultural and economic frameworks. The *Ru Neuf*, in the Aosta valley, is the last irrigation corporation in the Aosta Region, where all the other farmer managed irrigation systems have been integrated in larger agricultural corporations highly supported by the Regional Administration. The *Bisse du Torrent-Neuf*, in the Rhone Valley, is a case where the irrigation corporation continues to exist only because of high financial and organisational support by the local administration. In the area, new corporations are created in suburban zones for irrigating private residential properties.

INSTITUTIONAL MANAGEMENT OF WATER RESOURCES AND IRRIGATION

The Institutional Resource Regime (IRR) concept was developed for analysing the institutional management of natural resource in a systemic way (Kissling-Näf and Varone, 2000; Knoepfel et. al, 2001; and Varone et. al, 2002). The focus is on the natural resource and not on a specific use. The model considers that a renewable natural resource is generally exploited by more than one type of use (e.g. water for consumption, irrigation, industrial production, energy production, pollutant absorption, support for navigation, fishing or gravel extraction, recreation, medical uses, religious uses, reserve against fire and biodiversity conservation (Reynard et. al, 2001). It can be considered therefore that natural resources create goods and services for the society. One of these goods is water for irrigation.

An institutional resource regime is defined as the combination of the property regime and public policies that regulate the natural resource management (Knoepfel et. al, 2001; and Varone et. al, 2002). The property regime is analysed through three types of property rights (formal property titles, disposition rights and use rights) and two categories of public policies are considered: exploitation and protection policies.

In every process of resource exploitation, the *stock* of the resource and the *yield* are distinguished (Ostrom, 1990). In the case of water, the stock is the quantity of water involved in the natural water cycle of a watershed. The yield is the amount of water that is available to humans for satisfying their needs for consumption, irrigation, industrial production, etc. (**Figure 2**). When the total amount of water uses is higher than the yield, there is overexploitation.

Water uses result in a range of actions made from the water resource by three types of actors: the *owners*, the *managers* and the *users*. All three types may be in the hands of a same actor. This is the case when a spring owner uses and manages the spring for his own uses. Although, in most of the cases, the owners, the managers and the users are composed of different actors, this requires institutional regulation. Such an institutional regulation may be very different from one case to another. Differentiation depends of various types of property and use rights, public policies, political institutions, and cultural norms and values (**Figure 2**).

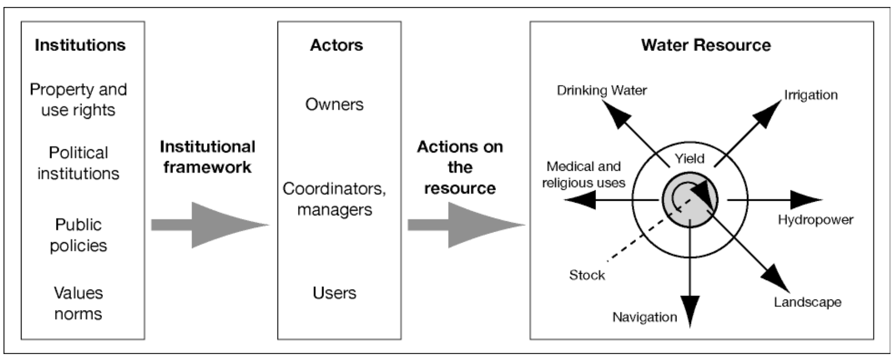

Figure 2: Conceptual Model Describing the Relationships between Institutions, Actors and Water Resources.

IRRIGATION IN THE ALPS

The Alps are considered as the water tower of Europe (Viviroli et. al, 2003). Because of their geographical position at the contact of Northern Europe and Mediterranean climatic systems, the mountain chain has a relatively high amount of precipitations. Because of the absence of a dry season, irrigation is generally not necessary in large parts of the mountain massif. Nevertheless, some dry islands exist, due principally to rain shadow effect and to geological characteristics (karstic areas), in several parts of the Alps. Irrigation has therefore been developed at large scales since the Middle Ages in the French Alps (Briançonnais, Lubéron), in the Swiss Alps (Rhone Valley, Graubünden Alps), and in the Italian Alps (Aosta Valley, Piemonte, Venosta Valley) (SHVR, 1995; Aubriot, and Jolly, 2002; and Vauterin, 2003a). Most of these systems, which were principally managed by irrigation corporations, have been abandoned or have drastically evolved during the 20th century (Aubriot and Jolly, 2002; and Vauterin, 2003a). The examples presented in this paper are all located in the Rhone and the Aosta valleys.

The Rhone Valley is situated in the South-Western part of Switzerland, and is boarded by two high mountain ranges: the Penninic Alps in the South and the Bernese Alps in the North. Because of rain shadow effects, the climate is relatively dry and annual rainfall is not more than 600 mm at 500 m ASL and 800 mm at 1600 m ASL. On the southern facing lateral valleys, the dry climatic conditions are accentuated by high insulation and evaporation. Because of these climatic conditions, irrigation has been carried out almost since the 13th century (Mariétan, 1948; Ammann, 1995; and Reynard D., 2002). The irrigation channels are called *Bisses*. Most of them were cut directly into the valley side, but in some sectors, because of the presence of high rock cliffs, wood channels were also constructed along the cliffs. Until the 19th century, irrigation was limited mainly to the meadows. In the 19th century, it was extended to vineyards and orchards. Gravitational techniques tend to be replaced by aspersion irrigation. Micro-irrigation is very limited. Since the first decades of the 20th century, in relation to the decrease of mountain agriculture, channel irrigation has been in regression. The *bisses* network, that represented more than 1400 kilometres of principal channels at the end of the 19th century, is currently about 600 kilometres long. Recently, the channels were integrated into the tourist industry as paths for hiking (Reynard, 2003).

The Aosta Valley is a relatively isolated region of North-Western Italy, boarded by the Penninic Alps in the North and the Grand Paradiso massif in the South. The double rain shadow effect provokes a reduction of annual rainfall to about 650 mm in the bottom of the valley (550 m ASL), and not more than 900 mm in more elevated sites (1500-2000 m ASL). Because of the relatively high mean altitude (2100 m), the principal farming activity is livestock production. Vineyards are also cultivated at low elevations. Both are irrigated (Gerbore, 2003). Irrigation channels are called *Rus*. The majority of them were built during the climatic optimum of the 13th – 14th centuries (Gerbore, 1995; 2003). Internal water right distribution was fixed in documents called *Egances* (Gerbore, 1995). During the 17th century, several of them were abandoned because of the Plague in the 1630's and/or climate cooling of the Little Ice Age (1600-1850 AD). The abandoned *rus* were not reconstructed, and now their number is estimated to be about hundred. No statistics exist on their length because no systematic inventory was carried out and most of the channels were transformed into underground channels

(Filipponi, 2003). Since the mid-1970s, due to the regional policy, gravitational irrigation has been progressively replaced by aspersion (Vauterin, 2003c). Like in Valais, because water is sufficient, micro-irrigation is poorly diffused.

PROPERTY RIGHTS AND WATER POLICIES IN THE RHONE AND AOSTA VALLEY

Rhone Valley (Canton of Valais)

In Switzerland, surface water bodies (rivers, lakes and glaciers) are public waters (art. 664 Swiss Civil Code) and underground water bodies and springs are private waters (art. 704 SCC). The Swiss Civil Code, adopted in 1912, did not cancel all the former historical rights and even now there still exists several cases of private property of rivers or glaciers, especially in the Alps. The public property of rivers means that the State can dispose of the water and give concessions for water use, e.g. for irrigation or hydropower production. Because of the federal structure of the Swiss political system, public property is organised at three levels: the Confederation (central State), the Cantons (26 regional, relatively autonomous states) and the Communes (local municipalities). In the Canton of Valais, the principal river, the Rhone, is property of the Canton, whereas the other rivers are property of the Communes. During the Middle Ages, the period when most of the current *bisses* were constructed, surface waters were property of Landlords, principally the Duke of Savoy and the Bishop of Sion (Reynard D., 2002). Irrigation systems benefit from *access or use rights* ("concessions") to river water accorded by the Lords (Middle Ages and Ancient Regime) or by the Communes (in more recent times). The duration of these use rights is generally unlimited (the so-called *droits perpétuels* in French). Because of the high costs of construction and maintenance, the channels were constructed by the entire local community or by corporations of farmers called *consortages* (Reynard D., 2002).

The *consortage* is an example of a common-property corporation (Reynard, 2002; and Reynard and Baud, 2002). The maintenance is carried out by the members themselves in the form of workdays (the so-called *corvées*). Rights and obligations are generally calculated according to the surfaces to be irrigated. Sometimes water rights are independent of surface (personal rights). The members, called *consorts*, elect their own committee and people for various specialised functions like the allocation of water, the control, the responsibility of maintenance work, etc.

The *water policy* in Valais depends on the water policy at the national level and of specific cantonal laws. The Swiss water policy is regulated by several laws, resulting from a long and complex evolution concerning three principal domains: protection against floods, hydropower production, and protection of quantitative, qualitative and dynamic natural features of water resources (Reynard et. al, 2001). Due to the small geographic extension of irrigation, which concerns only the canton of Valais, no specific regulation on irrigation was developed at the national level. In the canton of Valais, a decree in 1924 fixes the period of irrigation from 15th April to 1st October. The cantonal legislation on hydropower production (three successive acts adopted respectively in 1898, 1957 and 1990) protects the former use rights, as irrigation rights, when new hydroelectric concessions are accorded. The Swiss agricultural policy (1951) introduced subsidies for the so-called *améliorations foncières*, that means all the technical innovations aiming to improve agricultural productivity, especially allotment reshuffling. In the Valais, where irrigated agriculture had a strategic importance, this type of subsidy was introduced in 1924 already, to improve the *bisses* productivity by replacing wood channels by tunnels or concrete channels. With the new agricultural policy (1999), subsidies are now redirected to the ecological functions of agriculture. The main instruments are the ecological direct payments that aim to pay the indirect services offered by the farmers to the whole society (landscape and nature management). They are normally calculated on the basis of the surfaces that are farmed with respect of natural processes (e.g. few entrants). No subsidies however are provided to linear infrastructures like traditional *bisses* or stone walls that still play an important function in rural landscapes and nature conservation. The *bisses* are also concerned by the tourist policy because of their use as hiking paths.

Aosta Valley (Autonomous Region Aosta Valley)[2]

Since 1948, because of the cultural exception (French language), the Aosta Valley has a status of autonomy that provides specific financial incomes and the possibility of regulating all the political domains at the regional level.

In the Aosta Valley, the rivers were property of the Duke of Savoy until 1773, when the feudal system was partly abolished and the Communes were forced to buy the waters from the Lords (Rio, 2001; Gerbore, 1992; and Vauterin, 2003b). Since the 1910s, in the context of development of the hydroelectricity industry, the Central State has tried to appropriate the surface water of the Aosta Valley with the objective of receiving the water

[2] Partly according to an interview of Giovanni Vauterin, Office of Irrigation, Assessorate for Agriculture and Natural Resources.

use fees (Rio, 2001). Finally, the Autonomous Region received a concession on all the waters for 99 years in 1948, date of the creation of the status of autonomy (Rio, 2001). The Region can give subconcessions on these waters to various users like hydropower companies and irrigation corporations. A subconcession is given against the payment of a fee, except for irrigation and drinking water uses. In 1994, a new law, called the *Galli Act (L. 36/1994, Legge Galli)*, was adopted at the national level, which considers that all the surface waters are property of the Central State. However, the 1948 concession to the Regional government was not abolished because of the status of autonomy of the Aosta Valley.

At the end of the 18th century, following the acquisition of the river waters, the local municipalities also began to manage the irrigation channels until the beginning of the 20th century, when they were yielded to corporations, called *consorzi d'irrigazione* (Vauterin, 2003b). Only one channel, the *Ru Herbal*, continued to be managed by the local municipality. With the adoption of the Royal Decree 215/1933, the creation of large land reclamation consortia *(consorzi di miglioramento fondiario)* was possible. The difference between the irrigation corporations and the land reclamation consortia is that the former are created for managing the water used for irrigation in a specific channel, when the latter are geographical areas, in which all the terrain owners are involved in order to improve agricultural productivity. Progressively, the irrigation consortia were transformed in land reclamation consortia (Vauterin, 2003b). Currently, 170 land reclamation consortia are accounted for in the valley, when the *Ru Neuf* is the only irrigation corporation still in activity.

Italy is a relatively centralised country. The history of the Italian legislation on water has been characterised by a great deal of fragmentation across laws dealing with water use, water quality and hydraulic works (Goria and Lugaresi, 2004). Concerning water uses, the first water law dates back to 1865 *(L. 2248/1865)*, after the Italian unification, and defines a regime of water use authorisations. It was renewed in 1933 *(L. 1775/1933)*. During the 1970's, some State functions were transferred to the Regions. That is the case of concessions for water use (through *L.616/1977)*. In 1994, the *Galli Act* introduced the principle of integrated management in Optimal Territorial Area (not yet fully implemented), and finally in 1999 a new act *(L. 152/1999)* was developed for implementing the European Union Water Directive, that aims at the integration of environmental, health, economic and productive policies in the perspective of a global policy on water resources management.

At the regional level[3], the Law 30/1984 on regional intervention on agriculture allows financial contributions for irrigation (art. 7): 95% of investments and 60% of management costs. The recent *Regional Law 3/2001* related to the organisation of land reclamation consortia reconstitutes the status of self-organisation of the consortia and their function of public interest. These consortia are considered to be one of the key-structures for implementing a sustainable rural development and their investments may be completely covered by the Region Aosta Valley. The current objectives of the regional administration are to re-organise the highly fragmented consortia into larger and much more rational entities.

EXAMPLES

I have selected two examples to illustrate the evolution of internal and external governance of irrigation in the 20th century. For each example, I briefly present the system of irrigation and the current institutional situation. Then, I try to reconstruct the principal steps of evolution of the corporation.

The Ru Neuf[4]

The *Ru Neuf* is the last irrigation corporation still in activity in the Aosta Valley. It is situated in the Communes of Etroubles, Gignod and Aosta in the North-Western part of the Aosta Valley, near the main city of Aosta. It diverts the water of the Artanavaz River, at 1280 m ASL and is 12.850 km long. The total irrigated area is 424 ha, partly by traditional gravitational techniques, partly by aspersion. Some sectors of the main channel have been replaced by an underground pipe, but over most of the course, the channel is still an open-air channel.

The *Ru Neuf* received a concession for the derivation of water by the Lord of Savoy the 22 March 1401 (Glarey, 2003). In the 1770s, the feudal system was abandoned and in 1818, the Commune of Aosta approved the Rules regulating the utilisation of the *Ru Neuf*. These rules are still in use (Glarey, 2003), but have been partly adapted. In 1944 and in 1954, the water derivation in the Artanavaz River and the rules of the corporation were successively approved of by the President of the Republic. Recently, in 2004, the rules have been adapted to the Regional Law of 2001.

3 According to written documents by Tiziana Brix, Office of Consortia, Assessorate for Agriculture and Natural Resources and an interview with Giovanni Vauterin, Office of Irrigation, Assessorate for Agriculture and Natural Resources.

4 According to an interview with Lino Grimod, Secretary of the *Ru Neuf* Corporation.

The irrigation system is divided into four zones, corresponding to the three communes (the Aosta section is divided into two sectors). In the upper part (Etroubles), irrigation is free in compensation for the land given by the inhabitants of Etroubles for the construction of the channel. In the lower zones, the irrigation is ruled by a 16 day long turn called *Journal*. Currently, the corporation is composed of 1786 users. The corporation is organised into an assembly of users and a directive council. In contrast to the majority of the consortia, where each member has one right, here the rights depend on the time of irrigation (one right for 2 hours, 2 rights for 6 hours, 3 rights for 10 hours, and 4 rights for members with more than 10 hours of irrigation per turn). The directive council is composed of 8 people (4 for the section of Gignod, 2 for the section of Exenex, and 2 for the section of Arpouilles).

Until 1948, all the investments were financed directly by the members. As in the other channels (Gerbore, 1992), the maintenance was made directly by the users. Now, the heavy investments are financed by the regional administration. The current costs (guardian, secretary, minor work) are partly paid directly by the members. The annual fee is about 18 €/ha/year (with some variations because each year the distribution of the costs is calculated according to the duration of irrigation of each member), which has to be considered as very low. There is no fee for the use of water.

This example shows the complexity of a self-organised corporation with a history of more than 600 hundred years long. The internal distribution of rights goes back to the Middle Ages. The feudal concession for the water derivation was recognised by the new unified state in the 1860s and by the Italian Republic after World War II. Because of their status of public interest, the activities of the corporation may be partly financed by the central state (since 1933 law), and by the regional administration (currently 100% of the investment costs). The administration has recognised the importance of the self-organised corporations for insuring the sustainable development of this rural region, and therefore massively subventions their activities. It has to be noted, however, that the *Ru Neuf* corporation is the last one to be dedicated only to irrigation, and that most of the rural development is now carried out by more integrated consortia.

The Torrent Neuf in Savièse[5]

Savièse is a Commune situated in the center of Valais, near the city of Sion, in the driest part of the Rhone valley. Until the middle of the 20th century,

5 Partly according to an interview with Bernard Luyet, Chief of the Public Works Service, Municipality of Savièse, and Frédéric Varone, Civil Engineer, Technical Service, Municipality of Savièse.

most of the population was composed of peasants practising a mixed agriculture (livestock, cereals, vineyards, orchards). Since the 1960s, as in most of the country, agriculture has decreased drastically. Livestock production is carried out by some tens of people, cereal production has almost completely disappeared, and people generally cultivate vineyards during their free time. The population has rapidly increased because of the vicinity with the main city of the Canton and large residential areas have been built on former agricultural land during the last three decades. This has produced a complete transformation of the irrigation system.

Because of the position of Savièse, irrigation has been carried out in the meadows since the Middle Ages (Roten Dumoulin, 1995; and Reynard D., 2002 and 2003). In 1430, the entire community built one of the most impressive channels of the Canton, called the *Torrent Neuf*. Contrary to other cases in Valais (Reynard D., 2002), the channel was managed by the whole community (Reynard D., 2003) and not by a specific irrigation corporation. The water rights of the community members were fixed in a document called *Ratement* and a local community statute of 1447 regulated the complex organisation of irrigation (Reynard D., 2002). During the 17th century, several new restrictive articles were added because of the demographic pressure on the water resources (Roten Dumoulin, 1995). Finally, in 1810, the community transferred the management of the *bisse* to a corporation, still existing, the *Consortage du Torrent Neuf*.

Because of high costs of maintenance, a tunnel cut into the mountain replaced the wood channel in 1935. The municipality financed the costs of the project. A contract was therefore signed in 1929 between the municipality and the corporation. The new owner of the irrigation system was the municipality that would continue to provide water to the corporation during the irrigation season (10th April to 20th September). The corporation would pay the Commune 8360 Swiss Francs during 35 years to contribute towards the communal investment. In exchange, the maintenance and the payment of the guardian is the responsibility of the Commune. In 1952, the rules of the *consortage* were renewed, and in 1959, a hydropower concession was signed by the Commune of Savièse reconstituting the former rights of irrigation corporations.

These two events (replacement of the former channel by a gallery in 1935 and the hydropower concession given by the Commune in 1959) have drastically changed the organisation of irrigation in the area. The *consortage* is still in activity, but its rights and activities have been very much reduced. The water capture is undertaken by the hydropower company. The transport of water is the responsibility of the Commune as well as the distribution of water to irrigators. The corporation pays about 8000 Swiss Francs per year to the Commune for these services.

The *Torrent Neuf* corporation has the responsibility of the irrigation of meadows. Several small *consortages* also exist for the irrigation of vineyards. In 1974-1975, the municipality created an irrigation system by aspersion for the whole of the vineyard area. Several of these *consortages* disappeared at that time; others are still in activity, but do not work very well. One of the problems is that wine production in the area is mostly a part-time activity. During the last two decades, overproduction has provoked a lowering of prices and a large population of owners no longer work their domains. Most of the new wine workers do not know the irrigation system whose maintenance progressively diminishes. One solution should be the dissolution of these *consortages* and the replacement by a communal management, a solution that the Commune does not agree to because of the costs implied.

The last tendency concerns the urban extension of the Commune. Population has drastically increased during the two last decades and a shortage of drinking water is not uncommon. Most of the new population has built individual houses with lawns that require a high amount of water for irrigation. For this reason, the Commune proposed the creation of new *"urban" irrigation corporations*. Since this, more than ten *consortages* have been created. Payment of the infrastructures and management are the responsibility of the corporation members. The Commune proposes only its technical help for the planning phase.

DISCUSSION

These two relatively contrasted examples allow some general comments:\

Physical Conditions of Irrigation

The two valleys are almost identical in respect to climate and topographic conditions. Agriculture practices are quite similar: although, in the Aosta Valley livestock production is the principal activity, in Valais livestock, vineyards and orchards are much more evenly distributed.

History of Irrigation

In both valleys, irrigation systems date from the Middle Ages. The conditions for their development seem to have been the same: concession of water for irrigation by Landlords, concentration of channel building during the 13-15th centuries. The reason for enlarging the irrigation system seems to have been the same in both valleys, that is a conjunction of dry climatic conditions and the development of cattle livestock due to urban demand in Northern Italy and Central Plateau of Switzerland. However, in Italy, the 1630 Plague seems to have produced a large decrease of the channel network, which is not the case in Valais.

Corporations

In both regions, irrigation corporations have existed since the Middle Ages and some of them have been in activity for more than 600 years. Nevertheless, the history of corporations is very complex and different models of evolution exist. It is therefore not possible to produce general conclusions by only analysing two cases. In the two regions, there has been a balancing out of management by corporations and by the local municipalities. A same observation was made by Ruf (2002a and 2002b) in the Central Pyrenees (France) and in Ecuador. What is interesting to note is that there is no historic coincidence in the two areas (**Table 1**). The current tendency seems also to be a decrease in the force and autonomy of the corporations in both regions.

Table-1: **Balance between Public and Corporate Management of Irrigation in the Two Studied Regions.**

	Aosta Valley – Ru Neuf	**Rhone Valley – Torrent Neuf**
15th – 18th century	Common-pool management (*Consorzi*)	Public management (*Communautés*) or Common-pool management (*Consortages*)[6]
19th century	Public management (*Communes*)	Common-pool management (*Consortages*)
20th century	Common-pool management (*consorzi*), and then, since 1933, integration in larger land corporations (*consorzi di miglioramento fondiario*). Exception: Ru Neuf.	Complex integration of the roles between the local municipalities and the corporations.

6 In most cases, a specific corporation was created; Savièse is perhaps an exception, even if the links between corporations and communities are difficult to evidence (Reynard D. , 2002).

Property Rights

In both valleys, the rights on water were in the hands of Landlords during the Middle Ages. For financial reasons, they gave *perpetual* concessions to local communities or to corporations of irrigators with the obligation for them to build and manage irrigation systems. In the 18-19th centuries, the feudal system was progressively abolished in both countries and most of the rivers became public water bodies, generally in the hands of the local communities. In Italy, with the development of the hydropower industry, the central State tried to transform these public waters into State water with some success. That is the reason why in the Aosta Valley, the Region has a concession of the State on the waters. In Valais, the Communes are proprietors of the rivers except the Rhone river that is the property of the cantonal State. The development of hydropower industry shows the importance of property rights. In both countries, former irrigation rights were protected and these rights are generally written in the hydropower concession contracts.

External Governance

The Regional Government of the Aosta Valley has developed an active policy aiming to support the activities of irrigators. The current irrigation system is the result of thirty years of investments for developing a rational system. The national law of 1933 and the regional land policy have produced a progressive integration of irrigation corporations into more general land corporations. In contrast, in Valais, there is no specific policy for the development of irrigation. Nevertheless, the federal law on agriculture and the former cantonal rules (1924) have allowed the support of various irrigation projects. Because of the federal structure of Switzerland, the role of local municipalities is much higher than in Italy. For this reason, each irrigation corporation is quite specific. In the Aosta Valley, the role of the central State, especially in the fascist period, in the development of irrigation contributed to a much more centralised system than in Switzerland.

Internal Governance

One fact is that the corporations have drastically evolved during the 20th century, and especially during the last two decades. Most of them have disappeared, but not for the same reasons in the two regions: in the Aosta Valley, they have been integrated into the land corporations, whereas in Valais they have been replaced by municipal management (Reynard, 2002). Because of the reduction of agricultural activity in the Alps, most of the very precise rules regulating the water distribution and the maintenance of the infrastructures are no longer in use and it is quite difficult to find people to participate in the management structures (presidency, secretary, guardians). In the Aosta Valley, the regional administration supports not only the investments, but also the management of the corporations, a situation that is of great interest for the future. But it must be highlighted, that all the corporations are not in crisis and as we noticed two years ago some of them are quite dynamic with good organisational and financing structures (Reynard, 2002). The new *consortages* of Savièse, responding to new needs, are also a good example showing that FMIS is not limited to traditional agriculture.

Finance

In comparison with the Valais, irrigation in the Aosta Valley Autonomous Region is much more centralised. Each corporation is composed of an assembly of members and a committee. The financing of the activities by the members is very low (US$5-10 per year to US$100 per year depending on the situation[7]). All the *consorzi d'irrigazione* and *consorzi di miglioramento fondiario* are therefore massively financed by the Regional State. Until the year 2000, 95% of the costs of an improvement project were financed for by the Regional State; the five remaining percent were paid by the local municipalities. Since then, all the costs are covered by the Regional State. In Valais, public support is much more reduced and limited to the costly investments.

The Future

Certainly that the tendency to a reduction of the number of corporations will continue, especially in Valais, where the system is very complex. I think that a sustainable management of the infrastructures, for example the traditional channels, will not be possible without financial support by the public sector. In this sense, in Switzerland, new modes of financing the services proposed to society by the *bisses* need to be paid by sectors other than agriculture, for example by the tourism industry (Reynard, 2003). In the Aosta Valley, there is an active policy developed by the Region for supporting its agriculture that includes irrigation systems.

CONCLUSIVE THOUGHTS

It has been demonstrated that the good functioning of irrigation systems is not only dependant on the physical structures but also (and may be more) on

[7] These charges are used for paying the secretary. The president usually works for free.

social structures (Boelens and Davila,1998; Rivière-Honegger and Ruf, 2000; Pradhan and Gautham, 2002; Shivakoti and Ostrom, 2002; Boelens and Hoogendam, 2002; and Aubriot, 2003). Therefore, the *social capital*, that is all the formal and informal rules, the oral tradition, the symbolic views, the integration of irrigation practices into larger social rules, etc., is one of the key-factors for understanding sustainable functioning of irrigation systems. This social capital is certainly one of the elements that explain that Farmer Managed Irrigation Systems often have a better productivity than Agency Managed Irrigation Systems that are not really appropriated by the local population (Shivakoti and Ostrom, 2002; and Ostrom, 2002).

Switzerland and Italy are to be considered as post-modern societies where agriculture occupies a very minor part of the population. The former social capital that was formed by all the irrigation practices, the knowledge of the complex organisation of irrigation at local scale, the knowledge of the territory, of the natural processes, etc. is quite reduced now. A lot of farmers no longer carry out their activity because they are too old and they have not passed down their traditional knowledge, which is not always perceived as knowledge by young generations. The less productive areas, for example in the Alps, have been given up due to the process of intensification of agriculture, and with them also the irrigation systems.

But this is not an irreversible tendency and several signs show that common-pool irrigation, and more generally common management of landscape and territory, may be an adequate tool for improving sustainable management in rural areas in the Alps. I have mentioned in this paper the creation of suburban common-property structures in Savièse. Other studies show the interest of developing common-property management of territory by creating new common institutions. Nevertheless, crafting new institutions may need the integration of new actors, not originally involved in the irrigation. That is the case where irrigation channels assume tourist functions. I have demonstrated that new actors, external to agriculture, are involved in the promotion of channels as tourist infrastructures (Reynard, 2003). Certainly that in the future, irrigation corporations will include these new actors or will be included in more integrated territorial institutions. And certainly this tendency will transform the internal governance of FMIS.

All the studied cases show the importance of the links between the State and FMIS. In the framework of a global economy, where agriculture produces few economic incomes for farmers, especially in the Alps, it is necessary that the State finance part of the means that are used for improving productivity. I think not only to contribute to the infrastructures, but also to the social capital, for example in the domain of transferring traditional knowledge to younger generations. Such public aid has, for example, already been used with good success in Valais for developing management of traditional stone walls by using traditional practices.

There is currently, after decades of disinterest, a new interest for traditional and more ecological agriculture, and more generally for traditional ways of life, in the Alps. On one hand, this tendency is of great interest for irrigated agriculture because it should produce money transfers to the mountain areas. On the other hand, there is the risk of producing false models, especially regarding participation in or sustainable management of the common-property institutions. I think that currently a "romantic" view of the functioning of common-property corporations is largely diffused in the "urban" circles, a view that no longer corresponds completely to the reality and that we cannot demonstrate because research is too limited in this area.

In fact, because mountain irrigation is not a big issue in countries like Switzerland or Italy, precise research on the current (and former) functioning of FMIS institutions is not very well diffused in our countries as opposed to other parts of the world. Because the study of the social capital, management institutions or relationships between irrigation and other land management practices is of great importance in order to understand how sustainable rural development will be crafted in the Alps during the 21st Century, I hope that the important knowledge that has been developed in countries with a long irrigation tradition like in Asia, in Africa or in South-America, will be used more in our countries.

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CLOSING REMARKS

HARKA GURUNG[1]

Since I am a novice to this seminar theme, I had to reflect on the key-word irrigation. On referring to a dictionary, it is said to be derived from Latin word irrigare which means 'to supply water by artificial means'. Generally, the device involves construction of canal. The regional variation of native terms for canal seems interesting: qanat in Baluchistan, kuhl in Lahul, kul in Kumaon, and kulo in Nepal. Cultivated land in Nepal is classified as khet for irrigated one and pakho for rain-fed. However, their etymological sources are indeed diverse. Khet is derived from Sanskrit chhetra (area) and pakho is derived from Persion bakhs (unirrigated). The elaborate field terraces are landscape expressions of the irrigation system.

The four icons you have just honoured seem an interesting variety. Dr. Coward is a sociologist; Mr. Abernethy, an engineer; Prof. Suwatan, an economist; and Dr. Reynard, a geomorphologist. This is an evidence of the inter-disciplinary approach of this gathering. Their keynote speeches were based on long experience in irrigation management from diverse perspectives. I can try only a superficial gist.

Dr. Coward's irrigation landscapes of zanjeras of IIocano and acequia of New Mexico are based on two books. Incidentally, both these places had a heritage of Spanish conquistadors. The main points he made were identification of key uncertainties of the landscape, importance of property rights and consideration of supra-village governance factor.

Mr. Abernethy poses the question on transfer of irrigation management and opines the need for substantial changes in attitudes and procedures. The five characteristics he identifies for prospect of success are: real experience, transparency, gradual transfer, local motivation and flexible time-frame.

Prof. Suwatan makes a case for holistic approach by stating that FMIS to be sustainable should encompass technical, institutional, economic, ecological and socio-cultural aspects. He is also concerned about the rapid conversion of paddy fields to non-agricultural use.

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[1] Senior Geographer of Nepal and Former Director of Asia and Pacific Development Center, Kuala Lumpur, Malaysia.

Dr. Reynard compares Alpine case studies from Aosta (Italy) and Rhone (Swiss) valleys. According to him, good irrigation system depends not only on physical structures but also more on social structures. His observations indicate the destabilisation of earlier social capital in highly developed economies that are less dependent on agriculture.

According to the Seminar programme, there will be 30 paper presentations grouped under five themes: (i) reform dimension; (ii) socio-economic; (iii) equity; (iv) eco-technology; and (v) dissemination. Of these papers, half are on Nepal experience. Other case studies include three each from India and one each of Bangladesh, Cambodia, Lao, Pakistan, Turkey, and Vietnam.

Incidentally, one paper is on traditional water sources of Bhaktapur city. This reminded me of a recent article in Mountain Research and Development on "urban agriculture" in Nairobi. This is, blurring of functional definition of urban versus rural settlement. It is also true that many Bhaktapur residents are engaged in farming.

The Seminar's over-arching theme is farmer managed irrigation systems and governance alternatives. It is obvious from the objectives of the FMIS Promotion Trust that you are advocating for participatory management at the local level (FMIS). Thus, the governance alternative part is addressed towards reform in the large system (AMIS). The basic problem seems to be one of scale: micro FMIS and macro AMIS. Or how to integrate community level management approach on a wider scale? I hope your two days deliberation will be fruitful to resolve the problems.

Thank you.

VOTE OF THANKS

LAVA RAJ BHATTARAI[1]

On behalf of Farmer Managed Irrigation Systems (FMIS) Promotion Trust, we would like to extend a vote of thanks to all the participants for their valuable time and contribution. This seminar is a generous collaborative product of several contributors from 16 countries. In this regard, we are specially thankful to Dr. Harka Gurung for Chairing the Initiation and Honor ceremony of the seminar.

We express our deep gratitude to our distinguished guests Dr. Walter Coward, Mr. Charles Lindsay Abernethy, Prof. Nyoman Sutawan, and Dr. Emmanuel Reynard,for enlightening us with their key note speeches and accepting Trust Honor.

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We are grateful to Mr. Binaya Shah, Integrated Consultant Nepal (P) Ltd (ICON), Mr. Suman Sijapati, Department of Irrigation, Dr. Divas Basnyat,

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[1] Senior Engineer and Founding Member, FMIS Promotion Trust, Nepal.

Institute of Engineering (IOE), Mr. Sushil Subedee, Researcher, Mr. Naveen Mangal Joshi, National Water Plan WECS, Dr. Dhruba Pant, IWMI, Nepal, Dr. Rajendra Adhikari, Nepal College of Information Technology (NCIT), Dr. Narendra Man Shakya, Institute of Engineering, Mr. Surya Nath Upadhyay, Honorary Member, FMIS Promotion Trust for coordinating the sessions.

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Nepal Engineering College/NCIT deserve special thanks for their valuable multimedia support along with experts Mr. Prem Sharan Shah and Mr. Saroj Shakya.

We want to express our sincere thanks to Mr. Ganesh Khaniya, Mr. Samundra Sigdel and Mr. Hari Upreti, the Trust staff for their untiring efforts in the preparation and organization of the seminar. Hotel Yak and Yeti deserves a thank for providing the seminar venue and conference services.

Thank you all once again.

Part II : Parallel Sessions

PART II: PARALLEL SESSIONS

The Trust's two-day long seminar was conducted in two parallel sessions in which altogether twenty-six papers were presented on reform, socio-economic, equity, eco-technology as well as information and communication dimensions of FMIS governance. The two parallel sessions were conducted by two overall session coordinators Mr. Ajaya Lall Shrestha, founding member of the Trust and Mr. Ajoy Karki. Mr. Binaya Shah, Dr. Vijaya Shrestha, Mr. Rajan Subedi, Mr. Sushil Subedee, Dr. Druba Pant, Dr. Narendra Man Shakya, Mr. Ajaya Lall Shrestha, Mr. Suman Sijapati, Mr. Abinash Pant, Dr. Divas Basnyat, Mr. Naveen Mangal Joshi and Mr. Rajendra Adhikari were the session coordinators. Mr. Sheetal Babu Regmi, Dr. Banayak Bhadra, Dr. Shree Krishna Shrestha, Mr. Arun Kumar Shrivastav, Mr. Som Nath Poudel, Dr. M.A. Quassem, Mr. Iswer Raj Onta, Mr. Ratneshwor Lal Kayastha, Dr. Emmanuel Reynard, Mr. Charles Lindsay Abernethy, Prof. Deepak Bhattarai and Prof. Nyoman Sutawan made their contribution as session chairs. Mr. Shiva Kumar Sharma, Mr. Basistha Raj Adhikari, Mr. Ajay Chandra Lal, Mr. Ram Prasad Khanal, Mr. Pradeep Mathema, Mr. Amod Thapa, Mr. Ganesh Khaniya, Mr. Tula Narayan Shah, Mr. Shushanta Adhikari, Mr. Pravin Ghimire, Mr. Upendra Gupta and Mr. Rukmanath Paudel played their roles as session reporters.

Reform Dimension

LESSONS OF FARMER MANAGED IRRIGATION SYSTEMS PROJECTS IN NEPAL: TOWARDS IMPROVED GOVERNANCE

KENICHI YOKOYAMA AND AVA SHRESTHA[1]

INTRODUCTION

Nepal remains one of the poorest countries in Asia. In 2002 some 39% of the population lived in poverty, and 48% of children under 5 years were chronically malnourished. Over 90% of the poor live in rural areas, and characterized by social and ethnic diversity with ethnic minorities and *Dalit* who account for 36% and 13% of the total population. Agriculture plays a central role in the livelihoods of the poor, and provides employment for over 80% of the active workforce and meeting their nutritional needs. Yet productivity remains low and largely subsistence oriented. Irrigation is an essential input to improve agriculture in Nepal, due to highly erratic rainfall pattern across the year.

Farmer managed irrigation systems (FMIS) have been a focus of external assistance in Nepal irrigation sector since the late 1980s. Given that the productivity of many FMIS, despite their sustained indigenous management system, remains low and at subsistence level due to unreliable water supply and high maintenance costs associated with their fragile diversion and rudimentary distribution structures, they offer a good scope for adopting modern agriculture with relatively low cost, short lead-time, and building on existing water users' association (WUA) capacities through a participatory approach. According to the statistics by the Department of Irrigation (DOI), there are some 620,000 ha of FMIS in Nepal, including those constructed by DOI and transferred to the WUAs, accounting for 55% of the country's irrigated area of 1.13 million ha, and 23% of the net cultivated area of 2.64 million ha. At present, there are over 0.3 million ha of FMIS requiring urgent rehabilitation.

The Asian Development Bank (ADB) has assisted four FMIS projects since 1987. They have contributed, along with the programs supported by other external funding agencies, to progressive improvement of policy and institutional framework and organizational capacities. The evaluations have

[1] Senior Water Resources Specialist, Agriculture, Environment and Natural Resources Division, South Asia Regional Department, Asian Development Bank (ADB), Manila, The Philippines; and Gender Specialist, ADB, Nepal. The views expressed in this paper are those of the authors and do not necessarily reflect the views of ADB.

also indicated that many WUAs were capable of generating returns that justify investments by increasing command area, crop intensity, and crop yields. However, there are still significant gaps against the potential productivity attainable in the progressive farming practices. Many FMIS have also fallen non-operative after external support was completed. These are largely attributable to insufficient project design and weak governance to address a number of constraints in enhancing agriculture productivity and WUA sustainability. The paper aims to present the impacts and the lessons learned in the previous ADB-assisted FMIS projects, and approaches and measures to address those lessons, being incorporated in the design of the proposed Community Managed Irrigated Agriculture Sector Project (CMIASP).

ADB ASSISTANCE FOR FMIS DEVELOPMENT

Projects Assisted

The irrigation sector has received substantial ADB assistance since 1971. A total of 16 projects had been financed by ADB as of 2003, including five agriculture and rural development projects having irrigation as a main component. A total approved loan amount totals to $297 million. Initial efforts were directed towards new and complex large-scale schemes and capital-intensive investments that substantially transformed the existing FMIS. These generally suffered from poor performance due to insufficiency in addressing the remaining production bottlenecks, and in particular lack of local institutions to support effective O&M, and limited attention to gender issues and understanding of local practices determining access to irrigation water.

Starting the late 1980s the Government shifted its attention to participatory improvement of existing irrigation systems building on the local capacities, in particular FMIS. DOI prepared a participatory irrigation guideline in 1987 that culminated into the Irrigation Policy in 1992. DOI's institutional structure was also improved, with the establishment of irrigation management section in its central and field offices, with deployment of socio-economists and association organizers. Building on these developments, the 20-year Agriculture Perspective Plan (APP), which was launched in 1996, accorded high priority in participatory irrigation development as a core element of its investment plan to provide foundation to modern agriculture practices.

ADB assisted four projects since 1987 for participatory FMIS renovation while supporting for the improved enabling policy and institutional environment and capacities. The **Table 1** below summarizes their specific scope.

Table 1: FMIS Projects Assisted by ADB

Project Name [Year approved]	Key Scope	Irrigated Area Ha	Cost (ADB) US$ million
East Rapti Irrigation Project (ERIP) [1987]	Rehabilitation of 116 FMIS with WUA strengthen-ing; 10km of flood protection dikes; 60km of farm and service roads; agriculture extension	8,516	12.3 (10.4)
Irrigation Sector Project (ISP) [1987]	Rehabilitation/ development of 277 FMIS (109 new); flood rehabilitation; training of WUAs	57,600 (13,000 new)	35.9 (26.6)
Rajapur Irrigation Project (RIP) [1991]	Rehabilitation and consolidation of 6 FMIS; 18km flood protection works; 40km of service roads	12,000	20.4 (13.5)
Second Irrigation Sector Project (SISP) [1996]	Rehabilitation/ development of 276 FMIS (117 new) with WUA strengthening; agriculture extension	39,700 (13,700 new)	29.6 (22.2)

Development Impacts

This section describes the key development impacts of the ADB-assisted FMIS projects based on the available information such as project completion reports (PCRs) and project performance audit report (PPAR).[2] In general, these projects did not necessarily have sufficient systems for baseline survey to establish benchmarks and benefit monitoring and evaluation to follow up on the progress and impacts, an area still requiring major improvement. Accordingly, evaluations had to rely mostly on information collected from the beneficiaries with a certain limited crosschecking with district agriculture data, and thus have not been fully verified.

[2] Specifically, PCRs for ERIP, ISP and RIP, and PPAR for ERIP were utilized. As to SISP, the report mainly used data included in the Government's PCR and those collected during the socioeconomic survey of seven completed subprojects during the project preparatory technical assistance for CMIASP.

Agriculture Productivity

Cropping Intensity and Pattern. **Table 2** summarizes the cropping intensity before and after the project, and changes in the cropping pattern.

Table 2: Cropping Intensity and Pattern

Project	Cropping Intensity		Key changes in Cropping Pattern (Contribution in cropping pattern change)	Surveyed Area
	Before	After		
ERIP	164%	228%	Spring and monsoon paddy (+44%), lentil (+18%), vege-table (+2%), mustard (+2%), wheat (+1%), maize (-2%)	14 subprojects
ISP (terai)	125%	192%	Paddy (+20%), wheat (+44%), others (+3%)	Rehabilitation subprojects
ISP (hills)	118%	173%	Paddy (+45%), wheat (+21%), others (-11%)	
RIP	186%	187%	Paddy (+11%), others (-10%)	RIP area
SISP	157%	199%	Paddy (+30%), wheat (+17%), other foodgrains (-4%), pulse and oilseeds (+4%), potato (+1%), vegetable (+1%)	7 subprojects (951ha)

In general, FMIS intervention led to increased cropping intensity, induced by the increased reliability of water and its distribution associated with the improvement in diversion and distribution network. RIP is an exception, since the project aimed to prevent the intrusion of excessive floodwater into the system that had frequently caused widespread crop damages. Despite the general positive impacts, lack of available water at diversion is a major constraint in further increasing cropping intensity for many FMIS in particular in the terai.

As to the cropping pattern, farmers have responded to the improved physical conditions of FMIS by increasing the cropping of foodgrains, in particular paddy (in monsoon and spring) and wheat (in winter). On the other hand, impacts on crop diversification is limited, although there are some systems showing dynamic response, such as in ERIP that showed an increase in lentil production along with other non-foodgrains. Aside from water availability during the dry season, farmer response towards diversification is also dependent on the accessibility to output markets through roads, availability of inputs (seeds, fertilizer, etc.) and extension services, and other incentive factors (e.g., opportunities for seasonal migration) in the rural areas.

Yield Levels. **Table 3** summarizes the estimated impacts on the crop yields.

Table 3: Crop Yields of FMIS Projects

Project	Paddy t/ha	Wheat t/ha	Lentil t/ha	Potato t/ha
ERIP	3.4 (+26%)*	2.1 (+29%)	0.5 (+24%)	n.a.
ISP (terai)	2.7 (+13%)	1.9 (+12%)	n.a.	n.a.
ISP (hills)	3.1 (+35%)	2.2 (+38%)	n.a.	n.a.
RIP	3.3 (+32%)	1.9 (+12%)	0.5 (+67%)	6.3 (+15%)
SISP (terai)	2.5 (+33%)	1.6 (+19%)	0.6 (+23%)	12.9 (+9%)
SISP (hills)	3.0 (+17%)	2.4 (+8%)	0.8 (+22%)	14.1 (+13%)
*** Parenthesis indicates the percentage increase compared with the pre-project level.**				

While FMIS improvement has led to increased crop yields by roughly 10-40% for all major crops, the achieved levels are much lower than the potentials attainable under modern agriculture practices.[3] The incremental yields are attributable to improved availability of irrigation water and increased application of agriculture inputs such as seeds and fertilizer. Although the evaluation reports do not refer much to the changes in input use, farmer response appears marginal in most FMIS even after renovation, due to insufficient extension and unavailability of inputs caused by various supply constraints.[4] Available SISP survey data indicate that fertilizer dosage remains far below the level recommended by Department of Agriculture (DOA). While many are using improved seeds, they are not properly replaced due to meager public supply and little production and delivery mechanism through the private sector. These calls for strategic provision of critical public services with concerted efforts in facilitating the delivery of key inputs and support services with careful assessments of the post-harvesting marketing opportunities.

Household Incomes

Table 4 presents the impacts of FMIS projects on household income levels.

Table 4: Impacts on Households Incomes

Project	Average Farm Size (ha)	Incremental Income* (NRs)	Incr. Income Small Farmers* (NRs)	Year of Survey
ERIP	0.75	7,600 (12,900)	5,100 (n.a.)	2002
ISP	0.67	5,000 (10,000)	n.a. (n.a.)	1999
RIP	1.93	27,300 (n.a.)	15,200 (n.a.)	2003
SISP	0.87	n.a. (14,216)	n.a. (14,000)	2003
*** Excluding family labor as cost of production. The number within the parentheses includes incremental agriculture labor income.**				

3 According to the annual report of Nepal Agriculture Research Council (1998/99), the yield levels achieved in research stations for paddy, wheat, pulses, and potato were 5.62-9.46t/ha, 4.74-6.46t/ha, 2.31t/ha, and 23.0-31.0t/ha, respectively.

4 These findings are largely consistent with the information provided in *U.Parajuli* et. al, *2001*.

Compared with the pre-project levels, the beneficiary households have an estimated incremental net farm income of roughly NRs 7,500-14,200 per ha, along with family or hired agriculture labor income of NRs 5,000-7,100 per ha. The incremental farm income (including net farm income and labor income) represents 25%, 30%, and 35% increase for ERIP, ISP, and SISP, respectively, although this remains a rough estimate and more rigorous baseline and monitoring data is needed to undertake meaningful assessments.

Poverty and Social Aspects

Quantitative data on project impacts on poverty is limited in the evaluation reports. However, incremental income indicates that the FMIS interventions have certain positive impacts on the incomes of small and marginal farmers, although the impacts on the landless people would be limited. A socioeconomic survey of 84 sample households that was undertaken in 7 FMIS renovated under SISP indicated that marginal farmers have more than doubled their income and exceeded the calorie-based national poverty line **(Table 5)**. The survey indicated that livelihoods of small and marginal farmers were improved through direct (via crop intensification) and indirect impacts. The latter notably increased (i) wage labor opportunities; (ii) livestock production (via higher fodder availability), and (iii) rental lands from larger farmers (due to their labor shortages to expand crop intensity).

Table 5: Impacts on Income in Seven SISP Subprojects

Farm Size	Household Size	Income before subprojcts (NRs.) per				Income after subprojects (NRs.) per			
		Crop	Livestock	Total	Capita	Crop	Livestock	Total	Capita
Marginal	5.16	10,500	2,900	13,400	2,597	28,200	7,500	35,700	6,919
Small	5.87	36,800	9,100	45,900	7,819	45,600	7,700	53,300	9,080
Medium	7.87	43,700	13,800	57,500	7,306	52,500	15,100	67,600	8,590
Large	8.83	45,600	10,200	55,800	6,319	82,800	7,000	89,800	10,170

In relation to other social implications, the purpose of an irrigation system from a user perspective is to deliver water from the source to the farm plots, which immediately brings to the forefront the issue of water rights defined as privileges, e.g., the power to take part in collective decision-making about system management and direction, and obligations certified by an authority. Locally this authority is the WUA responsible for overseeing water distribution, infrastructure maintenance, and conflict resolution with norms to regulate irrigation related activities. Since WUA membership is based on landownership, access to irrigation water is linked to land titles. In a patriarchal, largely illiterate rural population the choice of such criteria simply reinforces traditional power structures. 91% women are engaged in agricultural activities (irrigated and rain fed) compared to men's 64%, but less than 11% women own land.

Institutional Performance and Sustainability

Institutionally, sustainability of irrigation systems critically depends on the effectiveness of arrangements for system O&M including efficient and equitable water distribution, and proper and timely routine and non-recurrent maintenance. In general, the substantial majority of the assisted FMIS have functioning WUAs that organize regular O&M of irrigation structures, although their status is quite varied. On the other hand, there are also a number of FMIS that have become inoperative or partially operative, due to the difficulties to manage the systems in association with natural disasters and other social factors, including inappropriate design and social process management.[5] There is also a tendency that WUAs become less active or dormant once the system improvement has reduced the routine maintenance needs.

The WUA institutional structure and O&M arrangements have mostly inherited those that existed before physical renovation of the FMIS, with some capacity strengthening support provided under the projects. While WUAs have an executive committee and a general assembly consisting of all water users, there are cases where internal solidarity is yet to be well established in particular between the old irrigated area and expanded command area. Women representation in general assembly and executive committee remains mostly low and ineffective, with only a small proportion of WUAs having 20% representation in the executive committee (mostly in the hills), the stated objective in Irrigation Policy 2002. Even where women's representation in the WUA meets the Government's minimum, their participation in the WUA produced more symbolic than real benefits. The Panchankanya FMIS demonstrated the need for a critical mass of women in the WUA to secure women's effective participation. The revised Irrigation policy (2003) accordingly requires minimum 33% women's representation in the WUA.

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[5] About 25-30% of subprojects completed under ISP have been affected by floods or landslides and remain non-operational or partially operational as of 1999. 49 FMIS (18%) were rehabilitated using the loan fund of SISP, with an average cost of NRs. 600,000 per subproject. As to SISP, a similar proportion of the subprojects appear non-operational or partially operational at completion.

In Panchakanya FMIS (supported under the Irrigation Management Transfer Project), literacy and land ownership was used as criteria for WUA executive committee membership, which restricted women's participation. Following a pilot Gender and Development (GAD) project supported by the ADB, this FMIS which is fully managed by WUA demonstrated how changes to the requirement that WUA members are landowners had a positive impact on women's water share holding. Mandatory requirement of women's representation at every tier of the WUA increased women's representation to a record high of 60%, and water rights were seen as belonging to the family as a whole. The number of women water shareholders doubled over the course of the GAD project. There was increased support for regular canal cleaning activities resulting in increased water productivity and reduced operation and maintenance costs, and construction of an additional 500 m length canal exceeding the project objective of total irrigated by 50 ha. Water thefts were controlled as both women and men exerted coordinated social pressure, and there was greater equity between the head and tail ends of the irrigation system and improved agricultural production. At present 100% beneficiary households are paying the irrigation service fee. The pilot initiative demonstrated how a program designed to raise the technical knowledge of women can contribute to building women's confidence to participate more effectively in mainstream irrigation projects. The intervention resulted in capacity building at different levels, viz. WUA constitution, operational, organizational, resource mobilization, and networking and alliance building. Lessons learned from the pilot project highlights the gender gap in rights to resources for the specific case of water. It spotlights the critical importance for women to secure access to irrigation water usage through the normative elements governing the WUA.

As to system operation, it has been reported that WUAs of operative FMIS are managing the facilities, but there are cases where operations of structures such as weirs, offtakes, and gates remain inefficient and ineffective, due to insufficient training. This is prevalent in RIP where larger structures were built, but is also seen, although to a lesser extent, in many small and medium-scale FMIS. In terms of water distribution, WUAs mostly follow conventional practice of irrigating in the order of canal reach, i.e., head, middle, and tail. Some WUAs are hiring gatekeepers and irrigators to undertake more disciplined water distribution.[6] Yet not much information is available how efficiently or equitably water is distributed in particular in the dry seasons when the stream water is not sufficient to irrigate all the

6 Among the 30 operational FMIS assisted under SISP and a survey was undertaken, 13 WUAs have hired gate operator and/or watchmen to support the facility operation.

command area, due to the lack of attention on the post-completion performance, a major area requiring improvement.

Regarding system maintenance, it has been reported that most WUAs are undertaking routine maintenance works (cleaning and minor repair of headworks and canals, lubrication of gates, etc.) by mobilizing local labor and cash from the farmers, although there is a tendency that WUAs defer necessary maintenance.[7] In addition to routine maintenance, WUAs need to prepare for and conduct emergency maintenance work that may be necessitated by natural disasters such as landslide and floods. Renovated structures may also require higher costs for rehabilitation once it is damaged, as they are generally more capital intensive. While farmers are aware of the risk of major damage to the FMIS with some WUAs having established and built up reserve funds (through annual irrigation service charge collection) to prepare for the calamity, the proportion of such WUAs are small and the amount insufficient to meet the emergency needs, calling for stronger motivational efforts and follow-up.[8]

PROGRESS AND LESSONS UNDER FMIS PROJECTS

Enabling Environment

Along with prioritizing FMIS interventions since the late 1980s, the Government has established and progressively developed policy and other enabling framework to support participatory irrigation, including the Irrigation Policy and regulation, Water Resources Act and regulation, and long-term investment plans. Strategic directions are also provided in the Agriculture Perspective Plan (APP) that was launched in 1996, the National Water Resources Strategy (NWRS) in 2002, and the Poverty Reduction Strategy Paper (PRSP) in 2003. As a most recent development the Irrigation Policy was revised in 2003, incorporating the key NWRS and PRSP principles such as river basin-based planning, WUA empowerment with a stronger poverty focus and mandatory women’s representation, and devolution to local governance institutions (LGIs) including capacity building. PRSP also called for stronger public governance, private sector and NGO engagement, and community participation in rural services.

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7 In the above 30 FMIS, 18 WUAs have established and are collecting irrigation fees from beneficiaries in cash and/or in kind. The rest are mobilizing labor for routine maintenance, or undertaking little maintenance works.

8 Following the SISP procedural guideline, these 30 WUAs have established bank accounts. However, only one has fund above NRs. 100,000, although 11 have a balance above NRs50,000. Four have less than NRs. 10,000.

Past interventions assisted by external funding agencies including ADB have contributed to the development and operation of the enabling framework. However, there has been a sizable gap between the policy developments on the one hand and field-level project operation/ implementation on the other. Overall, more attention is needed to proceed with FMIS project preparation in a conducive manner for the further development of these policy, strategy, planning and regulatory frameworks, and project implementation should place stronger emphasis to pilot test and operate those principles, where substantial gaps exist. Operational arrangements should also be regularly improved through a system of learning by doing approach, by regularly incorporating the findings into the operational systems adaptively.

Project Institutions

The key institutions associated with promoting FMIS and their agriculture development are DOI, DOA, LGIs including district development committees (DDC) and village development committees (VDC), WUAs; and private sector (including contractors and consultants) and NGOs. Under the recently completed SISP, DOI took lead roles in planning and implementation, with responsibility for agriculture extension accorded to DOA, and WUAs acting as service recipients. LGI roles remained nominal, given the recent process of devolution, which was promulgated in the 1999 Local Self-Governance Act (LSGA). Consulting services were used for institutional capacity strengthening, and monitoring and quality control of selected FMIS. Finally, external funding agencies including ADB played substantial roles with certain influence on the behavior and attitudes of the sector institutions through their financial and technical support.

Government Agencies

<u>Department of Irrigation</u>. Department of Irrigation (DOI) is responsible for planning, implementation, and monitoring and evaluation of irrigation projects. Under Director General, it has four technical divisions (planning, design, monitoring and evaluation; surface water irrigation; irrigation management; and groundwater irrigation) in the headquarters, and five regional irrigation directorates (RID). Under RID, there are 26 irrigation development divisions (IDD), 20 irrigation development sub-divisions (IDSD), and 29 unit offices that are located in districts having no IDD or IDSD. Each RID is headed by a regional director, and is staffed with 17-20 professional staff including a socio-economist and an agriculture officer. IDD (headed by sub-divisional engineer) and IDSD (headed by engineer)

have about 18-20 and 9-10 professional staff, respectively, including one or two association officers responsible for social mobilization.

In FMIS interventions, IDDs/IDSDs have day-to-day implementation roles under RID supervision, while DOI took on overall coordination and management roles. At the field level, there are engineering capacities for irrigation planning and supervising civil works. Yet the past interventions had a tendency that constructing structures was taken as the objective of FMIS renovation, in lieu of facilitating farmer efforts towards achieving maximum agriculture returns. DOI's non-engineering staff and skill are not sufficient to facilitate the process of WUA social mobilization, either.[9] Effective mechanisms are also needed to ensure IDDs/IDSDs carry out (i) sufficient participatory activities in planning and implementation, including the supervision of contractor works and O&M monitoring; (ii) sufficient coordination with district agricultural development offices (DADO) for planning and delivering agriculture programs, and (iii) stringent financial management with due linkage to subproject progress recording. RIDs should also be provided with adequate human and financial resources to undertake due supervision of IDD/IDSD activities to ensure effective operation of internal quality control systems.

Department of Agriculture. Department of Agriculture (DOA) has five regional Directorate of Agriculture (RDA), and 75 DADOs in each district. Each DADO has 5-7 agricultural service centers (ASC) and additional 5-7 agricultural service sub-centers (ASSC), which provide extension services at the field level. DADO is headed by chief officer and has one agriculture development officer and eight subject matter specialists. It delivers specific crop promotion programs that last about 2-3 years in each location. In general, staff has sufficient technical know-how on modern cropping practices, but their orientation and skills are generally insufficient in social activities including farmer group formation and delivering services with effective dissemination and targeting to diverse stakeholders including ethnic minorities and marginal and smallholders. Monitoring also needs strengthening to ensure due service delivery to the targeted farmers.

Local Governance Institutions

The 1999 LSGA defines the structures, functions, and operating mechanisms of Local Governance Institutions (LGIs). The LSGA stipulates that DDCs will take over the district level development activities of line agencies by

[9] IDDs/ IDSDs have only 1-2 association officers to cover 2-3 districts. Their incentives (currently ranked in the lowest non-gazetted class) and recognition within the office also need upgrading based on performance.

setting up sectoral units to work under DDC supervision (with the line agencies assumed to take on the roles of regulatory functions, technical backstopping, and sectoral programming). In this relation, following the Decentralization Implementation Action Plan (DIAP) in 2002, DADOs have been placed under the supervision of the concerned DDCs, although DDCs have taken only nominal roles so far.[10] Decisions have also been taken to establish district technical offices (DTOs) to cover rural roads, small-scale irrigation, rural water supply, and other district infrastructure. Yet approved DTO staff number is still limited to 7-10 in each district, staffed mostly by seconded personnel from Department of Local Infrastructure and Agriculture Road (DOLIDAR) and having large vacancies. While there is a need for promoting devolution of small-scale FMIS interventions including their associated development planning and works to DDCs, this would call for significant strengthening in their resources and capacities, as well as monitoring and quality control systems to ensure the quality of services.

Water Users' Associations

Water Users' Associations (WUAs) are informal and functioning farmer irrigator groups, which have often evolved over generations since construction and subsequent O&M of the irrigation facilities by mobilizing their own resources. Typical groups regularly elect leaders, hold meetings, and have working rules and water sharing arrangements. They have a proven track record of sustained O&M, and have had the capacities to do the same for the renovated FMIS. As farmers, they also have strong interests in getting essential inputs and necessary extension services. While WUAs are registered in DDCs when FMIS assistance is provided, most remain routine maintenance agents only, with some tendency to become less active where O&M requirements declined after structure improvement. There is a scope to sufficiently train them so that they can become effective community organization to liaise with input and other service providers and farm output marketing agents with collective bargaining power, building on the farmer interests and willingness to this end. Their capacity also needs strengthening to be more inclusive and meet the interests of poor men and women and vulnerable groups.

With the assistance of international NGOs, WUA federations have also been formed at the national and some district levels. There are scopes that these

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[10] There are no elected representatives in LGIs since 2002 after expiration of the terms of the elected officials and cancellation of new elections. While DDCs have delegated authorities for district-level planning, implementation, and expenditure, they are passed on to DADOs that continue to operate with linkage to the RDAs and DOA.

federations take on, with necessary capacity strengthening, active roles in information dissemination and WUA training, and as a lobby to monitor and promote effective FMIS program operations.

Private Sector

Government technical staffs generally have constraints in handling social preparation activities such as group formation and participatory interventions, although there are a number of managerial staff who can manage the process well, due to resources and incentive constraints. On the other hand, private sector providers including NGOs and community organizers (COs) are playing effective roles in increasing number of development works facilitating group processes involving target groups such as women and poor households, on a contractual basis that provide sufficient incentives for accountable service delivery. This was also tested in 64 subprojects in SISP and effectiveness demonstrated. There are also NGOs and private agents providing agriculture extension services. In irrigation sector, DOI sometimes engages private consultants (mostly based in Kathmandu) for feasibility studies and designs, although service quality is not necessarily up to standard, calling for sufficient motivation to adopt more upgraded and low-cost technology manageable by local people, with effective integration with agriculture, social and institutional development planning. In general, NGOs, COs, and other private sector agents in particular those locally-based may not have the required skills, but their capacity can be built through training from national NGO and national/ international consultants.

External Funding Agencies

In general, external funding agencies including ADB have provided considerable amount of financial and technical assistance to support the development of FMIS sub-sector including the enabling policy and institutional environment. In terms of ADB, while the assistance has been effective in generating economic financial and economic returns to the concerned FMIS, the implementation of past projects has demonstrated that (i) attention and resources provided by ADB for policy and institutional strengthening were not so sufficient, and (ii) more intense monitoring and quality control support would have been appropriate. Specifically, ADB, through FMIS project assistance, could have been more active in recommending specific policy and institutional changes that are necessary in transforming the approach of FMIS development towards more stakeholder-driven and participatory direction, as well as in promoting further development of irrigation related water resources sector policies and more strategic FMIS investment plans. Second, widely dispersed FMIS subprojects and the number of public and private organizations (whose performance and capacities required sizable support) called for more intensive monitoring of subproject implementation, as well as support for establishing and operating more effective internal quality control systems, along with regularly improving them.[11]

Project Cycle and Management

Overall Management

At the time of initiating the SISP, DOI with the assistance of the technical assistance (TA) consultants had established an operational procedural manual (OPM) that laid out 13-step procedures from information dissemination to O&M/ monitoring and evaluation along with their institutional responsibilities, which were to be operated through the institutional arrangements described above. While the OPM provided due procedures and arrangements for demand-driven and multi-disciplinary FMIS renovation, these were not necessarily complied effectively at the field level, affecting the quality of subprojects.[12] This indicates that motivation, time, and/or resources were often insufficient at the IDD/IDSD level, as well as the coordination with the relevant collaborating agencies such as DOA. Monitoring and quality control systems were also deemed not sufficient at the RID/DOI level in ensuring the process compliance. The stipulated procedures were not consistently integrated into the financial and administrative management systems (including budgeting, recording, reporting, and monitoring and internal/ external auditing arrangements) of DOI and DOA, either, which also had gaps to ensure quality of subproject implementation and outputs.

This poses very critical challenges for achieving and sustainable maximum benefits from future FMIS interventions. To address the challenges, the OPM should define more effective procedures and arrangements where subprojects are implemented with definition of effective and monitorable output targets

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11 In particular, monitoring by ADB during the initial implementation period of SISP was not sufficient, despite the retroactive financing arrangements incorporated in the SISP, which had called for intensive monitoring and quality control support for subprojects prepared. Consequently, initial performance of SISP subprojects was not so satisfactory.

12 There were incidents where subproject preparation process was driven by the interest of constructing structures, for the sake of which planning parameters such as command area and crop yields were adjusted to meet the objective, with insufficient consideration of the cost-effectiveness and local manageability of the structure design.

at each step of subproject implementation, the achievement of which should be made as a strict condition to initiate the activities in the next step. At the IDD/IDSD level, clear recording and reporting systems should be established for subproject's eventual and annual targets and progresses in financial, institutional, physical and economic aspects, with provision of sufficient time and resources to manage subproject participatory processes, and outsourcing to NGOs and the private sector (for activities with limited human resources and capacities). The number of subprojects ongoing under each office should also be controlled following their implementation performance. Monitoring and quality control systems should be strengthened, by providing RID/DOI with sufficient resources and incentives for undertaking field verification of key progresses, with engagement of private sector monitors/ consultants as necessary. WUA roles should also be strengthened to regularly monitor the quality and quantity of services provided.

Planning and Beneficiary Mobilization

Identification and Screening. SISP OPM has stipulated (i) information campaign to VDCs/ DDCs; (ii) farmer application with upfront cash deposit (NRs50/ha); and (iii) identification survey by field IDD/IDSD and DADO staff for prioritization of feasibility studies. This was to be accompanied with water resources assessment on water availability and possible downstream impacts. While the stipulated process was generally followed, quality of subprojects was often affected by difficulty in effectively involving DADO staff, limited hydrological data to undertake water resources assessments, and lack of consultation with the concerned WUAs (not just their representatives but also general members across the FMIS and proposed new command areas) and downstream users. Prioritization efforts were limited, with most subprojects taken up on an ad-hoc basis and without strategic guidance in terms of the opportunities for post-harvesting marketing and year-round irrigation, and for poverty reduction in areas dominated by ethnic minority populations.

Feasibility Studies. Scheme screening was followed by subproject feasibility studies undertaken by IDD/IDSD and DADO staff with involvement of local consultants in some cases. During SISP, the quality of feasibility studies was poor in particular at the initial stages. This was improved to a certain degree after the mid-term stage with the support of the consultants, but significant scope of improvement was still noted, in terms of (i) ensuring sufficient consultation with WUA beneficiaries with their endorsement (including the farmer contribution requirements); (ii) engaging DADO staff or agriculture consultants (for agriculture assessments) and social scientists (from private sector and NGOs for socio-economic assessments); (iii) undertaking due geological, topographic, land, and other technical surveys; (iv) doing sufficient socioeconomic surveys and establishing accurate beneficiary records and benchmarks; (v) setting out realistic targets for command area, cropping intensities and yields; and (vi) carefully identifying low-cost and locally manageable structure design. The study reports primarily focused on economic feasibility of the FMIS structural interventions only, without any clear specification of the targets for WUA institutional development and agriculture development, and of the specific programs, actions, inputs and their schedules to achieve those targets.

Sub-project Appraisal and Approval. During SISP, subproject approval authority was initially decentralized to the district and regional levels, but was raised to regional and central levels due to the lack of capacity to soundly undertake the process. While RID were to conduct field verification of the feasibility studies, not all subprojects were visited due to the resource constraints. More attention is needed to recognize the critical importance of the planning documents in laying out realistic, feasible, and locally manageable intervention targets, and program inputs and schedules. From this perspective, field verification by the qualified specialist team mobilized from RID is essential in ensuring and sustaining subproject quality. Existing human resources should also be supplemented with additionally deputed staff, the private sector consultants and NGO staff as necessary, and with capacity strengthened by competent consultants.

WUA Institutional Development. Ensuring WUA competency in equitable, efficient, and sustainable O&M and in facilitating highly productive irrigated agriculture is a critical requirement for successful FMIS interventions. Organizationally, they need to be represented by all users across the command area including women, ethnic minorities, and *Dalits*. Operationally they need effective rules for water allocation and distribution, and maintenance, which call for mobilization, collection, and recording of labor and cash contributions. They could also facilitate farmer communication with LGI, line agencies, private input/ service providers and marketing agents with a collective bargaining power. Given that many existing WUAs are essentially informal groups that meet when needed and undertake O&M activities to meet minimal needs of subsistence level farming, this would require substantial support in terms of farmer awareness and capacity strengthening to play these functions.

One of the major lessons in past FMIS projects is that sufficient institutional development support should be provided and their specified targets achieved prior to the start of physical works. This is essential in (i) motivating the line agencies to provide sufficient attention and efforts to WUA development (before interest is diverted to structure works), and (ii) motivating WUAs to make due self-help efforts to strengthen their organizational functions and capacities. However, during the SISP, while OPM stipulated the preparation and implementation of WUA institutional development plans (IDPs), it was over-focused on meeting the mere procedural requirements towards registration, such as establishing committees and preparing constitutions/ by-laws, with little attention to strengthening the field operations and capacities of the envisaged functions, such as promoting more efficient water distribution through better system O&M works (e.g., simple canal cleaning, expansion of field channel networks, etc.). Time and resources provided for WUA institutional development was insufficient, with only one DOI association organizer placed in each district having had to cover a number of schemes with limited capacity, incentives, and funding.[1] As a result, not many assisted WUAs have achieved more than marginal gains in their operational functions, despite their formal registration on paper. Construction activities were also started before IDPs were completed in many subprojects.

Important implications for future FMIS interventions drawn from the experience are that (i) clearer IDPs should be set up, setting out effective operational/ functional (in addition to procedural) targets with monitorable indicators; and (ii) sufficient time, resources, and monitoring/ supervision should be provided to support the WUA development process, with outsourcing to NGOs and COs, and with mainstreaming the activity as a critical process. External monitoring through a mobile team from RID would also be needed for quality assurance.

Irrigation Infrastructure

Design Selection and Detailed Design. In SISP, structure selection and their designs were undertaken following the DOI design standards, and in consultation with WUAs. However, existing standards are not necessarily up to date and aimed for larger irrigation schemes, which have a scope for improvement taking into account national and international best practices to promote more cost-effective design. In fact, FMIS projects are sometimes characterized with heavy permanent headworks (in the terai) and with long lined canals (in the hills), but more careful selection of structure site and of design would need to be ensured, taking into account the affordability and manageability of local farmers. In general, DOI engineers and private sector consultants tend not to have incentives to adopt lower-cost and labor-intensive works unless sufficiently motivated by competent supervisors. There is also a need to ensure careful analysis of the measures to deliver a small amount of water (available at the diversion point) for dry season irrigation, in accordance with the water allocation plan of the FMIS/WUA. Finally, intensive consultation with WUAs regarding the choice of structures, designs, and associated beneficiary contribution requirements is critical, which could be confirmed by its endorsement at a forum such as WUA general assembly.

WUA Contribution. WUA contribution of labor and/or cash for structure works is an essential element of the FMIS projects, to confirm the demonstrated willingness of the WUAs to sustain the improved structures. However, the management of the process was not necessarily effective, with records often lacking in the sources and amounts of labor or cash contributed, quantity and quality of the works undertaken, and their processes. There were also a number of WUAs that did not complete the stipulated tasks more than 30% that was required prior to the start of the civil works. More stringent management on this account is essential to ensure the subproject viability and mutual trust between the WUAs and the project authorities.[13] It would also be necessary to institutionalize an arrangement in which a certain percentage of WUA works and contributions should be completed prior to the initiation of project-assisted structure works, and fully done before structure works are completed.

Construction Works. In SISP, most civil works were done by contractors engaged by DOI field offices. While the quality of construction works was generally acceptable, there were sporadic incidents where it was low, in particular in remote areas. The quality was better in subprojects implemented in the later part of SISP implementation where WUAs were trained and involved in monitoring the works. Overall, the lessons have indicated the need for (i) training WUAs and involving them for construction monitoring; (ii) providing sufficient incentives and resources for construction supervision by DOI field staff; (iii) strengthening internal quality control mechanisms, including office inspection of IDDs/IDSDs by RIDs and improved code of practice for field and regional staffs; and (iv) introducing external technical auditing that had been pilot tested in the road sector. In addition, there is a need and scope for increasingly delegating the tasks of construction works to the concerned WUAs with necessary capacity strengthening support and work quality monitoring/ support by DOI field staff.

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[13] Sub-project viability should be in question if the contribution requirements exceed farmer affordability.

Agriculture Development Support

Planning. SISP included the provision of agriculture extension that was delivered through DADO in consultation with the concerned WUAs. However, coordination between DOI and DOA encountered difficulties in terms of activity programming and their timely delivery. The OPM did not have any guidelines for agriculture development support services, a critical shortage. Thus, consorted efforts were generally lacking to improve the existing technological base through comprehensive package of support including extension, inputs, credit, and marketing (through delivery or facilitation under the project). Future subproject planning should follow (i) accurate estimation of the existing technological base (command area, crop intensity and patterns, input use and yield levels); (ii) realistic estimation of targets in terms of these indicators; and (iii) clear stipulation of the programs and their schedules provided under the project, along with the arrangements for the delivery of non-project supported inputs and services, and for output marketing. Training should also be arranged for WUAs to become effective local agents to facilitate the process of service/input delivery and marketing through collective efforts. These should be established clearly as subproject agriculture development plans (ADPs). Inputs by competent DOA staff or private consultants would also be essential at this stage.

Support Service Delivery. SISP experience has indicated that (i) subprojects located near ASC/ASSC received better services from DADO, and (ii) there are NGOs that can deliver effective agriculture development services with capacity strengthening as appropriate. Delivery should be arranged on the basis of the availability of the staff of DADO and NGOs, or private agents to undertake the planned activities in the FMIS area, as well as of the WUA preference. WUAs should also be involved in the monitoring and confirmation of the quantity and quality of the program delivery as per the specified ADPs. For the purpose of cost-effectiveness, it is also suggested that the cost recovery norm should also be introduced as to the demonstration materials provided to the selected farmers.

Enhancing Livelihood of the Poor

Although FMIS interventions are generally beneficial to all subproject population including marginal farmers and landless people, experience from FMIS demonstrates that equitable benefit distribution is not automatic because access to irrigation water has a close relationship to the social context and power structures. Differential access reflects existing social relationships, both in terms of castes/ ethnicity and gender, and these in tern determine the distribution of water, and subsequent benefits accrued from irrigation. From a gender perspective, the powerful place held by the idea that "farmer" is a male has meant that women's active role in irrigated agriculture has been socially and statistically made invisible, particularly among the poor. But little attention is given on the relationship between poverty reduction and gender, undermining the magnitude and value of women’s unpaid work and commensurate contribution in food production. Despite the low pay women receive, their economic contributions are a critical element of the survival strategy of poor households. While poverty has forced male migration, and diversified men's wage labor, women remain largely concentrated in rural areas. The major constraint to increasing women's participation in irrigated agriculture is that access to water rights is tied to landownership.

Past FMIS interventions including SISP did not have specific targets and programs to specifically empower women and disadvantaged groups such as ethnic minorities and *Dalits*, nor were there any delivery of services to them. As a result, representation by women and other disadvantaged groups remain marginal in many WUAs. More concerted efforts are needed to promote the due representation of women, ethnic minorities and *Dalits* people in the WUA general assembly and committees as per the requirement of the Irrigation Policy 2003, through the engagement of women facilitators and other means. Specific programs to support their livelihood enhancement could also be prepared and stipulated in the subproject planning documents, including the activities and schedules, which could be effectively implemented by qualified NGOs. The concerned vulnerable groups could also be empowered to monitor and confirm the program delivery. Along this process, the commitments and capacities of the sector institutions to address gender and poverty agenda within FMIS projects should be strengthened.

Sustainable O&M and WUA Organizational Management

<u>Commissioning and WUA Training for O&M</u>. According to the OPM, after completion of the construction works, district level DOI and DOA offices were to (i) organize a joint walk-through (with WUAs) to identify any defects and operational problems, (ii) provide O&M training with system performance monitoring, and (iii) prepare a subproject completion report and issue subproject completion certificate. However, compliance level was low, with the first two steps not having been undertaken in many schemes, and with substandard quality of data in subproject completion reports. This was associated with the insufficient resources, and lack of incentives of the field staff whose interests had been mostly shifted to the construction of structures

for new subprojects by that time. These essentially call for (i) preparing the O&M plan at the inception stage and assisting the plan implementation by the WUA with training starting at the pre-construction stage; (ii) providing sufficient resources and supervision to undertake necessary post-construction activities including O&M training and accurate performance data collection; (iii) empowering WUAs to monitor and confirm the services provided; (iv) engaging NGOs and private agents for activities for which human resources in IDD/IDSD and DADO are limited; and (v) ensuring a project management practice that field offices take up new subproject after all processes of the ongoing subproject are completed, with confirmation by RID**.**

Efficient/Equitable System Operation, Sustainable Maintenance, and Effective Organizational Management. In retrospect, the resources and supporting arrangements for effective O&M and WUA organizational management are deemed insufficient in the past FMIS projects including SISP. It was assumed that physical improvement is sufficient to induce the necessary capacity of the users to manage the renovated FMIS, which are not fully verified given the level of impacts and performance of the completed schemes. Little support was provided to monitor how equitably and efficiently water is managed in the improved system, and to identify and address any remaining weaknesses in a participatory manner, which call for close monitoring prior to subproject completion. WUA capacity for routine and non-recurrent maintenance should also be ensured with sufficient motivation and on-the-job training, including the establishment and build-up of a reserve fund for non-recurrent maintenance works, with specific targets set up as conditions for such steps as subproject approval, initiation of civil work, and provision of follow-on support activities. In addition, WUA organizational management and performance should also be monitored and supported in the light of the set institutional development targets as stipulated in the IDP.

Regular Monitoring and Support. Despite the OPM requirements that the concerned WUAs undertake monitoring and evaluation of their performance, the overall performance remained rather weak, with lack of attention paid by and resources provided to the project staff during the implementation stage, and lack of incentives provided to WUAs to undertake the tasks with insufficient orientations. This needs to be effectively operated, with an arrangement to provide further support services to address the specific performance concerns. It would also be necessary to operate annual social, institutional, and financial audit to promote effective WUA performance, with the possible engagement of NGOs and NFIWUAN for this purpose.

IMPROVING APPROACHES FOR SUSTAINABLE FMIS RENOVATION

The achievements, impacts, and lessons of the past FMIS interventions have indicated that, while the interventions have been generating positive impacts, there are still large gaps between what has been achieved and what can potentially be achieved, due to the insufficient project design and governance. Ensuring maximum and inclusive growth and poverty reduction impacts through FMIS interventions is thus still a work in progress, calling for comprehensive improvements in the enabling policy environment, institutional framework and capacities, and intervention procedures and their managerial arrangements. Continuous improvement is also needed through regular learning and adapting to emerging findings and lessons. This section highlights the key measures being incorporated in the design of the CMIASP, a forthcoming project to support further FMIS renovation in the central and eastern regions.

Enabling Environment

The preparatory process for the CMIASP coincided with the Government's preparation of the Irrigation Policy 2003, and the former contributed to the incorporation of several important policy elements, including (i) incorporation of 33% representation of women in WUAs, as well as representation of ethnic minorities and *Dalits*; and (ii) clarifying DOI roles in promoting devolution process in terms of DDC capacity development and quality assurance support. As an important step to improve quality control and governance of infrastructure agencies, the Government also decided to establish Technical Audit Division in the National Vigilance Center to start operating external technical auditing in irrigation and rural infrastructure sectors, with ADB assistance. Full operation of these principles will be pursued under the CMIASP.

To support the further improvement of the enabling environment, the CMIASP has also included provisions for (i) supporting policy and guidelines preparation for non-conventional minor/ micro irrigation; (ii) advising on the progress of ongoing water sector reforms, including the preparation of the integrated water resources management (IWRM) policy, long-term national water plan, and institutional framework for IWRM and sustainable service delivery, which are being pursued by the Water and Energy Commission; (iii) reviewing and advising on the progress of agriculture sector reform measures initiated following the 1996 APP; and (iv) supporting other irrigation sector policy actions to be taken in association with the PRSP, five-year planning process, and decentralization programs.

As a forum to exchange information and facilitate discussion and learning on progress and issues on sector reforms, institutional and investment strategies and plans, and specific programs supported by external funds, DOI is also to establish a stakeholder group with the participation of the concerned sector institutions, external funding agencies, NFIWUAN, and relevant research organizations. It is expected that the group would serve as catalysis for strategic promotion of critical institutional activities and investment operations.

Project Institutions

The achievements and lessons learned under the previous FMIS interventions have clearly demonstrated the need for establishing sound institutional foundations in the concerned sector institutions in terms of resources (human, financial, physical), management infrastructure (structure, management systems, strategies), performance and output targets, leadership and vision, and behavior and values. CMIASP will support further institutional development of DOI on these accounts and resources and capacity development of LGIs as critical elements in strengthening the performance and impacts of FMIS interventions. Consorted efforts are also made to strengthen the capacities of other organizations including DADO, WUAs, NFIWUAN, NGOs, and private sector consultants and contractors.

Department of Irrigation

While there is no doubt that DOI capacities have progressively developed over the years, with increased number of engineers fully acquainted with the participatory processes of FMIS development, there are still areas that need to be addressed, as briefly explained in paragraph 25 above. In the context of CMIASP preparation, DOI is in the process of preparing a draft institutional development vision and strategy, based on which specific institutional development action will be promoted with the advisory support of the CMIASP. With a possible vision to become a genuine demand-driven service-oriented facilitator (as opposed to a conventional implementer) to provide services in due response to diverse stakeholder needs, possible action agendas include (i) setting out institutional development strategy; (ii) preparing and carrying out action plans for improved human and financial resources management; (iii) strengthening operational guidelines and manuals (including planning and design standards for more cost-effective

FMIS interventions, and construction management guidelines); (iv) strengthening generic internal quality control mechanisms and management information systems; and (v) preparing and implementing DOI action plans for promoting devolution of small-scale FMIS development operation to LGIs.

Local Government Institutions

In view of the need for encouraging specific steps towards devolution in the irrigation development operation amidst the current resources and capacity constraint of DDCs, CMIASP promotes the implementation of small scale FMIS renovation by DDCs by delegating the authority once adequate irrigation implementation team can be formed with an engineer and overseers in DTO irrigation sections, and an account officer and a social mobilizer. The engineers and overseers may be assigned from IDD/IDSD staff as necessary. At least several districts will be selected to initiate the operation as a learning exercise, which will be culminated into a devolution action plan to be prepared by the mid-term, and operated thereafter.

Asian Development Bank

On the basis of the lessons of past projects, ADB would provide more intensive monitoring and support for (i) policy and institutional development of FMIS subsector and the relevant institutions, and (ii) operation and regular improvement (through systems learning approach) of the FMIS development services, which include clear output targeting in individual subprojects; WUA participation in key project decisions; information disclosure on subproject financial, institutional, and physical progresses; and stringent and performance-based process management (as explained below). ADB would also facilitate the organization of the aforementioned stakeholder group.

Project Cycle and Management

Overall Project Management

Existing public sector organizations have institutional constraints in staff resources, skills, and arrangements for (i) agency coordination; (ii) participatory service provision; and (iii) monitoring and quality control. Implementation procedures and arrangements should also ensure that subprojects would be driven by interests to improve FMIS agriculture productivity as opposed to constructing structures, while transforming public agency roles to genuine service-oriented facilitators. Specific measures being incorporated in the CMIASP include the following**.**

Coordination. In each district, a subproject management unit (SMU) will be formed with the assigned staff of IDD/ IDSD, DADO, and DDC, to plan and supervise implementation of subprojects.[14] At the outset, the SMU will prepare a concise but comprehensive subproject implementation plan (SIP) that specifies individual programs including their schedules, institutional responsibilities, and output targets.[15] SMU will engage private firms, to prepare SIPs using inputs provided by the specialists (in IDD/ IDSD and DADO) designated by SMU as available, and through a fully consultative process.

Participatory Implementation. Services are provided following the SIP and subproject work plans prepared by SMU. To ensure participatory processes, WUAs will endorse SIP and periodic work plans including detailed design. For social mobilization, NGOs will be engaged and work with the community organizers recruited from the locality to implement institutional development plans in SIP. As to irrigation works, WUA will implement simple structures with technical support by IDD/IDSD staff, and be trained to monitor contractor works for complex structures. For agriculture and other programs, private sector/NGOs will be engaged to address constraints in DADO and IDD/IDSD.

Monitoring and Quality Control. The SMU will strengthen its budgeting, recording, and reporting systems (for financial, institutional, and physical progresses with clear eventual and annual targets for each subproject), and regularly hold progress review (and joint decision-making) meetings inviting WUAs that monitor the delivered services. For quality control purposes, the RID will field mobile teams including the consultants to verify the key field outputs such as SIP. RID will also monitor SMU operation through regular management review (with SMU staff) and office inspection.[16] Along with these, an external technical audit is also operated through the National Vigilance Center.

Individual Subproject Cycle Management

The following **Table 6** summarizes the specific arrangements incorporated to address the lessons learned during the SISP and other previous FMIS interventions assisted by ADB and other external funding agencies.

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14 This follows the arrangements proven effective in other ADB-assisted projects in livestock sector.

15 This will also include specific arrangements for the delivery of non Project-assisted services such as fertilizer.

16 This will ensure that subprojects taken up in SMU are in line with their absorptive capacity, and in accordance with the stipulated procedures.

Table 6: Specific Measures Incorporated for Improved Subproject Cycle Management

Subproject Steps and Issues	Measures To be Incorporated
A. Identification and Screening ▪ Ad-hoc selection of subprojects to be avoided ▪ Sufficient identification survey with DADO/ private agriculturalist involvement ▪ Water assessments and user consultation	▪ Preparation of district irrigated agriculture development strategy to guide prioritization process ▪ Priority to areas of high poverty incidence, ethnic minority and *Dalits* population ▪ Sufficient resources for identification survey with engage-ment of private sector and NGOs as needed ▪ Updating of FMIS inventory and water availability
B. Feasibility Studies ▪ Sufficient WUA consultation ▪ Sufficient involvement of agriculture and social scientists (DADO, etc.) ▪ Accurate estimation of command area, agriculture indicators, and unrealistic post-project estimates ▪ Identification of most appropriate irrigation structures that is low cost and locally manageable ▪ Clarity in subproject targets, program delivery and schedules	▪ WUA consultation and endorsement to be mandated ▪ Resources to engage private consultants/ NGOs as necessary ▪ Resources for technical and socio-economic survey with engagement of private consultants/ NGOs ▪ Improvement of design standards ▪ Preparation of comprehensive subproject implementation plans (SIP) that set out specific targets, activities, inputs, and their schedules
C. Appraisal and Approval ▪ Ensuring the quality of feasibility study report (FSR) including the SIP	▪ Sample FSRs and SIPs prepared with CMIASP consultants with training of field staff ▪ Quality confirmation at site by mobile team including RID staff and CMIASP consultants ▪ Approval at the central level, with the engagement of DOI and DOA specialists and ISPM consultants
D. WUA Institutional Development ▪ Sufficient time and resources for facilitating the process ▪ Specific targets be established not just procedural requirements but also operational functions, which should be achieved prior to initiating construction works	▪ Sufficient resources for facilitation provided through NGOs and COs, and training by CMIASP consultants ▪ Specific procedural and operational targets set (membership, registration, actions to improve O&M, etc.), with monitoring, supervision, and training ▪ Promoting concrete WUA actions in improving system operation, field channel networks, removing silts, etc. ▪ Promoting clear water distribution rules, participatory decision making,

	and transparent management ▪ Achieving targets fixed as a condition to initiate subproject implementation
E. Detailed Design ▪ Sufficient consultation with WUAs ▪ Sufficient field survey and investigation ▪ Adoption of less capital intensive, low-cost, and locally manageable structures ▪ Careful design for distributing small dry-season water to the command area	▪ WUA consultation and endorsement to be mandated ▪ Resources for survey and investigation, which could be outsourced to private firms ▪ Improvement of design standard and staff training for better structure design ▪ Design checked by RID staff and CMIASP consultants
F. WUA Contribution ▪ WUA compliance of required contribution ▪ Ensuring the quality of works	▪ Promote 50% contribution prior to start of procurement process, and 100% completion prior to 50% progress of civil works, with accurate recording arrangements ▪ Regular field inspection and confirmation by IDD/IDSD engineer with records, occasionally inspected by RID
G. Construction Works ▪ Ensuring quality of construction	▪ Minor works to be undertaken by WUAs with IDD/IDSD engineer support, supervision, and recording ▪ Resources for sufficient field inspection, which could be contracted out ▪ Training and operating WUA construction monitoring committee ▪ Construction quality monitors recruited in RID, to sign off the work quality in all works before final payment ▪ External technical audit to be applied to selected works
H. Agriculture Development Support ▪ Achieving the intended targets in terms of irrigation intensity, cropping pattern, and yields (and input use) ▪ Sufficient delivery of intended programs for agriculture development support ▪ WUA roles strengthened to facilitate networking with input/service providers and marketing agents ▪ Ensuring the quality of	▪ Specific targets, and delivered programs to be clearly specified in SIPs, with initial support by consultants ▪ Training provided to WUAs to take on agriculture development roles through CMIASP consultants ▪ WUAs to monitor the quantity and quality of services in light of SIPs and confirm delivery before program completion

programs	
I. Livelihood Enhancement Support ▪ Increase WUA participation of women, ethnic minorities, and *Dalits* ▪ Achieving the input and output target for livelihood enhancement of the vulnerable people ▪ Ensuring the quality of works	▪ Specific targets set for vulnerable group participation in WUA and committees in the IDP, and facilitated by NGOs and COs ▪ Specific targets, and delivered programs to be clearly specified in SIPs ▪ WUA vulnerable sub-group will monitor the quantity and quality of services and confirm the delivery
J. Work Completion with O&M Training ▪ Ensure defects and operational problems are addressed before completion ▪ WUAs to be sufficiently trained for efficient operation, sustainable routine and non-recurrent maintenance, and organizational management ▪ Ensure operation of effective monitoring and evaluation mechanism ▪ Sufficient delivery of services by project authorities	▪ WUAs authorized to sign infrastructure completion certificate to IDD/IDSD ▪ Resources for O&M training that focuses on on-the-job implementation of actual works, and organizational training that could be contracted to private agents/NGOs ▪ Establishment and buildup of non-recurrent maintenance fund, included as conditions for implementation ▪ Resources for operational and benefit monitoring, to be contracted to private agents/NGOs ▪ WUAs to monitor and confirm the services provided before subproject completion certificate (SCC) is issued ▪ IDDs/IDSDs to start new project after SCC is issued
K. Post-completion O&M and Monitoring ▪ Operation of performance monitoring by WUAs ▪ Operation of auditing of WUAs for technical, eco-nomic, financial, social, and institutional performance	▪ Training, incentives, and resources provided to WUAs to undertake monitoring and reporting ▪ Resources for regular auditing, which can be contracted to private sector/NGOs, or NFWUAN

SUMMARY AND CONCLUSION

Since the late 1980s, FMIS development has been a focus of irrigation development in Nepal. There has been a progressive improvement in policy, planning and regulatory framework, and in the capacities of the public and private sector institutions to enhance the FMIS productivity in a participatory and sustainable manner. ADB has contributed to the process by assisting four FMIS rehabilitation/ development projects since 1987.

While these projects have provided positive socio-economic impacts in the concerned FMIS, with most WUAs having been able to increase command area, crop intensity, and yields, to a degree to justify investments, there are still notable gaps against the potential attainable in productive agriculture. Access to extension and other inputs often remains a constraint. WUA roles are largely confined to routine irrigation O&M only, despite their potential to become useful agents to drive local agriculture development process. These are attributable to insufficient project design and weak governance mechanisms to effectively achieve the intended outputs.

Key lessons indicate that interventions should be driven by the aim of improving water use and agricultural production as opposed to constructing structures. Second, strategic site selection is needed to tap existing marketing and poverty reduction opportunities, along with careful planning to facilitate the delivery of extension, inputs, and credit. Third, sufficient resources should be provided for non-structural works including agriculture programs and WUA strengthening as capable agents to liaise with necessary agriculture service providers with collective bargaining power. Fourth, improving overall quality control and monitoring is essential to ensure participatory processes at all stages. These call for the further improvement in the enabling policy environment, and generic changes in the management and behavior of the public institutions from conventional implementers to genuine service-oriented facilitators.

The proposed CMIASP is being formulated with the Government to address these challenges while building on the achievements made so far. To improve the overall policy and institutional environment, it has supported the development of the 2003 Irrigation Policy that incorporated the principles of river basin-based planning, WUA empowerment with pro-poor and gender focus, and devolution, to be operated under the project. Second, assistance is provided to promote the formulation of vision, strategy, and actions for DOI strengthening in terms of its resources and management infrastructure. Third, it will support the recent Government decision to set up external technical auditing in NVC by supporting its operation in the irrigation sector. Fourth, the project will also advise on the progress of further reforms in agriculture and water resources sector including the IWRM policy and NWP that are now being prepared.

Within this framework, strengthened mechanisms are being pursued, for more effective FMIS project management by incorporating the above lessons, in terms of WUA strengthening, increasing agriculture and poverty impacts, and improved quality control. Specifically, WUA will be provided with sufficient facilitation through outsourcing to NGOs and COs. Increased agriculture impacts are pursued through strategic site selection and program delivery defined with monitorable input and output targets, and delivered through NGOs and private service providers as needed. Poverty focus is sharpened by prioritizing FMIS in poverty pockets, enrolling vulnerable groups, and delivering specific services to them. For output quality, stringent internal quality control systems will be strengthened with resources provided under the project, to which an external technical auditing is applied. WUAs are also empowered to monitor and report provider performance. Specific progresses on these accounts (i.e., policy and other enabling environment, institutions, and management procedures and arrangements) are now critically needed, in order to renovate the remaining FMIS suffering from low productivity and poverty and attain their maximum sustainable benefits in particular those to the poor and the disadvantaged, with better and sound sub-sector governance. CMIASP is now being prepared to address these challenges, with an intention to continuously improving the policies, institutions, and delivery systems by incorporating the further lessons through a systems learning approach.

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RESPONDING TO THE CHALLENGES OF ASIAN IRRRIGATION IN TRANSITION[1]

GANESH P. SHIVAKOTI[2]

INTRODUCTION

More than twenty years ago, Walter Coward (1980) argued that irrigation is more than a technological process. Successful irrigation management requires that human relationships, both among irrigators and between irrigation officials and irrigators, be successfully managed so that they are complementary to the operation of irrigation infrastructure. He called for serious research on the “human” dimension of irrigation management. Over the last several decades, Coward’s call has been answered positively. Research on irrigation management has cumulated a rich body of knowledge on irrigation institutions and management. This new knowledge has provided the basis for major changes in irrigation policies in the last two decades, including management transfer programs, assistance to farmer managed irrigation systems, and irrigation financing.

In the beginning of the twenty first century, however, additional broader water related issues have surfaced which include: How to respond to the competition for water resource itself among different sectors? What aspects of institutional reforms deal with related to governance and management of water resources? Who should be the new partners in managing water resources? and How irrigation management can be made pro-poor responding to livelihood sustenance; among others? (Shivakoti et. al, 2005).

Governments in many countries, often with the assistance of international donor agencies, embarked on various intervention programs with the aim of improving the institutional frameworks for irrigation management. Recognizing the limitations of a bureaucratic mode of irrigation management and the value of local governance, for example, opened the way for transferring responsibilities from irrigation bureaucracies to users groups. Recognition of limitations to a state-centered mode of irrigation management is not sufficient, however, for developing effective institutions. Solutions require a nuts and bolts understanding of institutional design, as well as the dynamic of institutional development (Lam, 1996/1998; Ostrom, 1990/1992;

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1 For detail of issues discussed in this paper please see Shivakoti et al. 2005.

2 Associate Professor, Asian Institute of Technology, Bangkok, Thailand.

Ostrom, Lam, and Lee, 1994; Pradhan, 1988; Shivakoti, 1992; and Shivakoti, and Ostrom, 2002).

The ineffectiveness of many bureaucratic modes of irrigation management does not mean that the state is irrelevant and or that it should be excluded from involvement in governance. Studies investigating social capital and development have proposed a theoretical foundation suggesting the importance of synergy between the state and society in materializing development potentials. Empirical studies on irrigation management in East Asian countries have shown a positive relationship between institutions relating the state and local farmers in a complementary manner on irrigation performance. Effective irrigation management requires that we understand the diverse roles of the state that may enhance the performance of irrigation systems, and how the state could be related to society through effective institutional arrangements (Lam, 2000).

The continuously changing environment in which irrigation systems operate constitutes another challenge to irrigation management. Rapid economic development, competitive uses of water and associated changes in the political and social setting in much of Asia have posed new challenges. As industrialization becomes established and economies develop, irrigation becomes more than simply delivering water to the fields in an orderly manner. In Taiwan, for instance, irrigation officials currently spend more of their time fighting competing uses of available water, controlling pollution, and handling legal conflicts over use of irrigated land, than on water delivery (Lam, 1996).

Economic development has drastically changed farmers' cost-benefit calculus of irrigation management. As agriculture becomes less lucrative, farmers are facing fewer incentives to make contributions to irrigation management. In various Asian countries, as elsewhere around the world, it is not uncommon to find a reduction in collective action for irrigation system operation close to urban areas. The lack of incentives is not only confined to farmers. Governments in many Asian countries are becoming less willing to invest in agriculture. This lack of attention is often untimely since government support may be essential to enable necessary institutional change.

From the past experience we know that better irrigation performance is one of the major factors contributing to agriculture development in much of Asia. Between 1960 and 1995, world food prices declined by 50% because of production increases; and child malnutrition declined from an aggregate 45% to 31% between 1970 and 1995 (Itty, 2000). As Pingali and his colleagues

(1997) argue, two decades ago policymakers and academics were worrying about food crisis across Asia, nowadays the words “Asia” and “famine” are rarely used in the same sentence. Yet complacency is unwarranted. Food security, especially for the poor, is still fragile. Increase in grain supply is slowing down, partly due to the decreasing amounts of input in agriculture in many countries, and partly due to decrease in productivity. Global food projections indicate that food prices in the next three decades are likely to decline with slow progress in reducing malnutrition in developing countries. Small shortfalls in crop productivity growth would lead to rising food prices and worsening malnutrition. Irrigation still has an important role to play in sustaining food security and maintaining the livelihood of the rural poor.

CHALLENGES OF ASIAN IRRIGATION

Irrigation management in Asia in the new millennium, however, is facing new challenges that were unknown to irrigation policymakers and irrigators two decades ago. Some of these new challenges are simply the result of the very success of irrigation management in the last several decades; others are the consequences of the rapid political-economic changes in the last several decades. Yet all these challenges have to do with the fact that irrigation management is becoming more and more integrated with its environment—political, socioeconomic, and global. An implication of the increasing integration of irrigation is that irrigation management can no longer be considered as merely the delivery of water to farmers’ fields with the right amount at the right time. In fact, in many countries where the economy is highly developed, irrigation is no longer about agricultural production. Moreover, irrigation cannot be understood only with reference to what happens at the local level. With high degrees of integration in economic and social activities, how irrigation is managed in a particular irrigation system is often affected by factors that are remote from those who are managing or using the system. How to cope with the increasing integration is the major challenge. The increasing integration of course happens in different domains. In this paper we first highlight and explain some of the major phenomena in these domains. The problems involved are discussed, issues identified, and major areas of research and policy issues over next two decades are put forward. All of the problems that are associated with higher degrees of integration have serious implications for the design of irrigation institutions. A major proposition of this paper is that whether irrigation management in Asia is able to sustain itself under the higher degrees of integration depends on whether researchers, policymaker and irrigators alike are able to develop better irrigation institutional designs that enable them to cope with these problems.

The Challenges of Global Integration

With the advance of technology and the increasing interaction among peoples around the world, physical distance no longer poses as big a constraint to human cooperation as it did in the past. Yet perhaps an even more important driving force for a higher degree of integration is the development of trade that allows the economic activities in different countries to complement with one another. The advance of the WTO is a strong push for a more integrated economic system.

For farmers in Asia, however, agricultural trade is a two-edge sword. On the one hand, rural regions are not likely to generate economic growth in agricultural demand unless they trade. Without improved demand for developing countries' agricultural products, the agricultural growth needed to generate employment and reduce poverty in rural areas will not come about. On the other hand, agricultural trade also means connecting local agriculture to the division of labor of the global economic system, and hence making local agriculture subject to world competition. Whether the benefits of agricultural trade can be reaped depends on whether the countries are able to make necessary adjustments to their agriculture sectors so that they are able to find a niche in the global economic system. For many Asian countries with an agriculture sector dominated by grain production, agricultural trade often means lower grain prices. On the one hand, the labor-intensive mode of farming and the generally small landholding size do not give these countries' agriculture sector much competitive edge in the international market. On the other hand, the rapid growth in rice production in much of Asia in the last decade also generates tremendous pressure for grain prices to fall. A result is that grain production in many Asian countries will become increasingly non-viable.

In countries where the industrial and business sectors have developed, farmers will not have incentives to put too much effort in agriculture. For those who are more willing to take risks and have the necessary capital, they will shift to commercial crops. But for the majority of farmers who are not well prepared for a shift, they will tend to give up on full-time farming. Perhaps what has happened in rural Taiwan is a case in point. Full-time farming has ceased to exist. Although farmers are still growing paddy, it is often not for agricultural production but for the sake of keeping the land cultivable. No matter whether a shift to commercial crops has happened or not, irrigation management is posed with great challenges. In areas where agricultural production has shifted to commercial crops, irrigation operation that was mainly designed for grain production will need to make necessary adjustments. The irrigation cycles and water needs of commercial crops are different from those of subsistence grains. In general commercial crops are more sensitive to the timing and amount of irrigation water. On the other hand, in areas where a shift to commercial crops has not happened, irrigation management faces the problem of a lack of incentives on the part of irrigators, or even government, to engage in irrigation operation and maintenance.

In less-developed countries where agriculture is the economic lifeline of the economy, the adverse impacts of agricultural trade are particularly significant. Farmers in these countries find that their agricultural production is not competitive and hence the agricultural produce is worth less and less. With falling grain prices, farmers are getting worse off by the day. What is more worrisome, however, is that the economic incentive for shifting to commercial crops is likely to drive away small-scale grain production. In countries where a large proportion of rural population lives on subsistent farming, widespread poverty could be expected.

The Challenges of Economic Integration

Rapid economic development in much of Asia has brought about a new setting to irrigation management. As industrialization sets in and the economy develops, irrigation is no longer simply about water delivery to the fields, but a coherent component of the economic system. Perhaps the thorniest issue is the increasingly fierce competition for water among different economic sectors. Traditional irrigation management focuses on the operational question of how to best utilize available water so as to maximize agricultural production. Management focus has been put on the costs incurred in making water available, the value of water per se is seldom a major concern. So in systems where an irrigation fee is levied, the level of fee is calculated largely on the basis of the costs of operation and maintenance involved in managing water delivery.

In many Asian countries, however, fresh water is scarce and getting scarcer. Growing populations, industrialization, and environmental concerns have all put pressure on the water consumed by agriculture. The situation becomes more complicated as the industrial sector develops and hence requires increasingly large amounts of water. In economic terms, the productivity of each unit of water for industrial use is much higher than that for agriculture. Water has come to be considered to be a scarce production factor for not only agriculture, but also for other economic activities. Hence the allocation of water, as many argue, should be made in accordance with the criterion of efficiency. The agriculture sector often finds itself in a weak position in this debate because in many Asian countries, irrigation does take up a major proportion of available water. In Taiwan, for instance, while irrigation takes up more than 50 percent of the country's available water resource, agriculture only contributes less than 5% of the country's GDP.

In those countries where the economy is more developed, more and more fields are left fallow. The simple logic is that as the size of the irrigated land shrinks, less water will be needed by agriculture. The irrigation sector should be able to transfer the surplus water to other sectors. Knowledgeable irrigation managers will quickly respond by pointing out the fallacy of such a simple logic. Shrunk irrigated land often results in a more scattered command area that often means a higher level of wastage in water delivery. Also, even if paddy fields are left fallow, irrigation is still needed to prevent salinity of the fields. So the need for irrigation water does not decrease simply because the size of irrigated land gets smaller.

So far the debate on whether water should be transferred from the agriculture sector to other economic sectors has largely been framed as a choice between economic efficiency (water to industries) and livelihood of rural population at the cost of an efficiency loss (water to agriculture). What has not been given as much attention is the possible complementarity between irrigation and water use in the other sectors. Although irrigation systems are built to produce irrigated crops, many irrigation systems are to a certain extent "integrated" into broader water management in many Asian countries. These systems not only provide water to non-agricultural uses, in some instances they are even an integral component of the cycle of water use. In the Chiayi area in Taiwan, for instance, the irrigation canals are connected to the sewerage system of the Chiayi city so that recycled domestic waste water can be used for irrigation purposes. In the Yunlin area, the irrigation association there helped deliver water to industries through its sophisticated canal system. It is noteworthy that the "service" provided by the irrigation association would not have been provided even by any other organizations, not even the water supply company. Recognizing the possible complementarity between irrigation and other uses of water is of major importance in designing water policy. It not only facilitates better utilization of water resources, but also takes the true social value of irrigation water into account.

Of course the complementarity cannot always be materialized. Whether irrigation managers or users are willing or able to engage in possible collaboration with actors in the other economic sectors depends on the design of institutions. Where the water rights to irrigation are well-defined and protected, the competition for water is played out under the framework as defined by the water rights. Irrigators and actors from other economic sectors are then able to try to come up with mutually beneficial solutions in water allocation. In places where water rights to irrigation are unclear or not well-protected, however, the competition for water often takes the form of a scramble for water. In these instances, industrial development has brought along with it the degradation of water catchments. What has happened to many groundwater basins is a case in point. As the property rights of groundwater are usually harder to define, irrigators have the incentive to over-appropriate groundwater. A result is falling water tables and, in some areas, land subsidence.

The Challenges of Political Integration

The last decade has witnessed seemingly contradictory phenomena concerning the relations between the state and the irrigation sector. On the level of irrigation management, there has been a retreat of the state from the irrigation sector in many Asian countries. The treatment is both in terms of financial commitment and the involvement in the actual operation of irrigation systems. On the policy level, however, irrigation, as a major production factor of agriculture, continues to be a major policy issue dwelled on by politicians. In some countries, the politicization of irrigation has already brought about considerable disruption.

Reasons for the retreat of the state from irrigation management are many. Yet a major one is the failure of the state to find a proper role for itself in irrigation management. The failure of the bureaucratic mode of irrigation management has led many to conclude that the state is inconsistent with effective irrigation management. The fad of implementing management transfer in many developing countries is to a large extent a response to the excessive state intervention in irrigation management in earlier times. That the bureaucratic mode of irrigation management fails to work, however, does not mean that the state is irrelevant and should be excluded as much as possible. While studies of social capital and development have laid down the theoretical foundation suggesting the importance of the synergy between the state and society in materializing development potentials in various domains of collective action, empirical studies on irrigation management in East Asian countries have shown a positive relationship between institutions relating the state and local farmers in a complementary manner and irrigation performance. In fact, in those countries that have gone through the process of industrialization and become new members of the developed world, the role of the state in irrigation management, as well as many other activities in the domain of agriculture, has become increasingly more prominent. Effective irrigation management requires that we understand the proper role of the state, and how the state could be related to society through effective institutional arrangements.

In the Asian countries where the economy is developed, the retreat of the government from irrigation is largely based upon political-economic calculations. In these countries the government's support to the irrigation sector is often a component of a broader rural-biased policy package that aims to support agriculture. A major characteristic of a support policy is that, given the subsidy is given on the ground of some political reasons instead of economic efficiency, there is no "objective" way for the government to determine the "right" level of subsidy. A consequence is that the level of government investment in irrigation in these countries is often an outcome of political bargaining and exchange, and subject to the influence of any changes in these countries' political economy.

To continue to support the agriculture sector (and hence irrigation) that is of itself economically non-viable, governments in these more developed countries are facing increasing pressure to justify the subsidy. In the irrigation sector, it is rather unrealistic to expect any meaningful increase in government investment. This is unfortunate because even in those countries where farmers have long been playing a key role in irrigation management, the financing of irrigation infrastructure has always been heavily dependent on government funds and maybe international donations. Whether irrigation is going to be sustainable or not depends on whether the financing irrigation is properly managed.

Brisco (1999) suggests that a possible way out is to encourage private investment in public infrastructure, including irrigation systems. Institutional arrangements such as BOT (build, operate and transfer) should be considered. Yet unlike many other types of infrastructure such as telecommunications and power that have the characteristics of a toll good, irrigation involves serious collective action problem in both provision and use. In other words, the effectiveness of irrigation systems is highly dependent on how irrigators behave and relate to one another. So the problem of financing irrigation needs to be considered in conjunction with irrigators' incentives. Yet in many systems where farmers are not even willing to pay for the operation and maintenance cost, designing a financing arrangement based upon the principles of self-governance and user-pay is a substantial challenge.

How rent-seeking plays out in irrigation is well-known in the literature. The potential threat of this kind will not go away as long as irrigation involves public investment. Yet in recent years, democratization in many Asian countries has posed additional challenges to irrigation. When election games are to influence the distribution of power among politicians, politicians will have incentives to dwell on any issues that could help them achieve their political purposes. Since irrigation affects the livelihood of a majority of the rural population, it is not surprising that irrigation issues have been used by politicians as a tool to mobilize farmers' support. In fact, as water has become a scarce production factor, it takes on even higher political values from the perspective of politicians. Politicization often brings about disruptions in irrigation management. What happened in Taiwan is a case in point. Farmers in the countries had long been paying irrigation fee to cover the operation costs of their irrigation associations. The fee implicitly stipulates farmers' ownership over their associations. Politicians then came in and "successfully" fought for the cancellation of the irrigation fee, arguing that the government should lessen the farmers' burden. The effect of the cancellation of the fee is disastrous. Farmers' participation and concern has waned rapidly.

ISSUES OF CONTEMPORARY RESEARCH AND POLICY FOR RESPONDING TO THE CHALLENGES AHEAD

Accomplishments of the past two decades in understanding and modifying governance and management of irrigation systems have been considerable. The twentieth century brings new challenges. Population growth and urbanization place municipal, industrial, and environmental water needs in competition with water previously allocated for food production and increases the need to use water more efficiently for food production. While management responsibility is being transferred to local users' groups, property rights and rights to water often remain unresolved. The transfer of irrigation system governance and management has often overlooked the need to modify information systems and access to information necessary for responsible governance. These challenges are not only limited to the major irrigated paddy producing areas and commercial horticultural producing peri-urban areas but are widespread even in the remote upland areas where nearly 35 percent of the Asian population lives.

The anticipated problems in these upstream (and also in the downstream and peri-urban areas) can be illustrated by the situation in the Fang and Thai Yai districts in Chiang Mai Province of Northern Thailand where there are still several traditional community managed irrigation systems. While some irrigation systems have received government assistance for repair and maintenance of the intake and main canals, others have been deprived of such assistance due to absence of land entitlement certificates (only use rights) of the users. This lack of specificity of property right emerged during last few years when the government declared the adjoining forest area as a protected area, including the community and farmland within these protected areas. As an example of two systems in these two districts, although the Mae Sao community irrigation system with intake below 500 meters has received assistance from Royal Irrigation Department (RID) for construction of permanent weirs and partial canal lining, including a technician posted for the system maintenance, the upstream Thai Yai community irrigation system on the other hand did not receive any assistance from RID due to its location within the so called protected area. While the traditional system of labor contribution for maintenance of the irrigation system continues in the upstream irrigation system it has been replaced by RID maintenance of the main system. Hardly any collective action exists at both the main and branch canals.

The transitions that are taking place in these two communities capture the contemporary issues and challenges that need to be addressed by the research and policy over next two decades or so. The down-stream system due to security of land ownership has been transforming the farming system from upland paddy cultivation to the orchard establishment and lowland vegetable cultivation from the irrigated paddy cultivation. Due to this shift, water demand has been very high. Farmers have started pumping water both from the main canal and sub-surface below. This has reduced the level of drinking water source for the upstream community. The situation has further been aggravated when the contract farmers from central province of Ratchaburi started contracting the transfer of use rights of Thai Yai community and established orchards in the upland. These farmers diverted the water to their orchards from several springs and the drinking water source started drying for the community and the water flow in the Mae Sao River started declining. This has not only created conflict between these two communities but also tension among the indigenous people and the outside contract farmers. On the labor demand side, the upland farmers, who were depending upon the forest products and upland paddy, are now moving to the downstream due to restriction on forest activities and high demand for labor in the downstream orchards and vegetable farming.

Orange and tea have dominated the orchard farming and the product is transported to the neighboring district of Chiang Mai and then further exported to neighboring countries. Thus, not only the national but also the regional and global demand affects the price of the product in this small community.

There is a system of contract farming developing both for the orchard planting and vegetables as well. The agro-processing units and the retailers provide the inputs and other required technical advices to the farmers. For these, the farmers are paid in advance both in kind and cash with pre-determined price for the product. This puts the farmers in disadvantageous position for the higher prices in the market. Similarly, vegetables need a lot of input and cash is needed heavily during the production process. The middlemen take advantage of this situation and advance the money and inputs, including technical advices. Thus, there is changing role of private entrepreneurs which are not yet regulated by the government and, thus, the farmers are the losers. The farmers are not only losing their share but due to heavy use of insecticides and pesticides, the quality of water is deteriorating every year. Over the years, this can lead to serious environmental degradation and the society has to pay high cost for managing the environment. Therefore, in order to address these emerging issues, the following three cross-cutting themes carry considerable importance over the next few decades:

- Responding to Competition;
- Accountability and New partnerships; and
- Reform, Synergy and Economic Productivity

Responding to Competition

The foremost issue of concern in responding to competition is the transfer of water and irrigated land from agriculture to other municipal and industrial uses. This issue is further aggravated by aquifer depletion, water quality degradation and water reclamation. While reclaiming water, the issues of trans-basin and trans-boundary transfer have surfaced in many regions of Asia. These problems have further been tied to the fundamental issues such as property rights with respect to water, land and infrastructure including the planning, information and administrative requirements of these resources. Recently, many countries in Asia have put emphasis on integrated watershed management in their development planning which calls for design of mechanism to link downstream and catchment stakeholders in watershed and basin management. In order to facilitate downstream and catchment stakeholders, it is also equally important to regulate and maintain sustainable use of groundwater. Further, to respond to the issue of competition properly, the role of information and communication has become instrumental and innovative experimentation of several Asian countries such as *Gramin* (Rural) Bank of Bangladesh on empowering the poor by providing cellular phones in the remote areas to respond to the market competition underscore such importance.

Accountability and New Partnerships

The second issue relates to the shift on accountability and with this shift, responsibilities have to be redefined and new partnerships emerge in managing the irrigation systems in Asia. In doing so there is a need for transfer of authority for irrigation system management which calls for changes in government roles from that of manager to that of regulator and facilitator in providing support services. Therefore, the capacity-building process has to be based on the principles of co-management and polycentric governance by integrating farmers' institutions of irrigation management. This calls for new accountability mechanisms such as service agreements, management audits, asset management plans including information requirements. Ultimately, there is a need to redesign government subsidies through alternate steps such as matching investments, transparent and agreed allocation criteria and incremental infrastructure improvement.

Reform, Synergy and Economic Productivity

Once the principles of co-management and polycentric governance are applied in managing Asian irrigation, new opportunities prevail through scheme-level WUA federations and prospect for WUAs hiring their own agricultural/agri-business development agents increases. This calls for new information/communication systems for market identification and networking which opens up new avenues for using new demand-oriented irrigation services to promote crop diversification and commercialization. The issue of expanding the economic niche of farmers beyond cultivation to agri-business so called second generation problems such as input production and supply, crop processing, production of manufactured agricultural/horticultural products has to be addressed properly. These problems can be solved through joint monitoring for irrigation operation which calls for diverse methods of data collection, storage and processing into information for easy public access and sharing of information.

In an effort to address these challenges thoroughly so as to provide a firm foundation for confronting them effectively, following five themes need to be addressed:

- The processes of globalization, industrialization, and urbanization are all generating immense pressures for a *transition* from earlier political, economic, and social institutions to new arrangements in all sectors.

- *Competition* for resources – particularly water – will increase throughout the world over time leading to immense conflicts unless substantial innovations occur.
- *Institutional reforms* are among the most important innovations that are needed to meet these challenges.
- *Markets* will be a more important aspect of water management in the future than they have been in the past.
- *Strategic policies* conducive to govern and manage water resources effectively in light of transition, competition, institutional and market reform era.

These themes can be addressed properly by identifying and documenting the changes of the context of irrigation management in Asia; assessing how these macro changes affect the incentives, opportunities, and constraints of farmers at the local level; and explaining how and why farmers in different settings have adjusted, or failed to adjust, their local irrigation institutions in response to the changing context. While doing so it is possible to capture the dynamics of institutional change at varied level of economic changes taking place in Asia, and propose alternative policies based on the findings from above which are conducive to the development of institutions specific to the particular country situation. The policy implications of these rich information making public are equally important because Asia has a significantly large irrigation sector which constitutes a major component of the political economy of the countries. Asian countries are representative of the wide spectrum of varying degrees of economic development in the continent and these countries have very different macro irrigation management regimes, while some countries like Nepal famous for its farmer managed systems, other countries like Thailand known for a state-oriented approach, and on the other spectrum Taiwan, for example renowned for its semi-governmental irrigation associations.

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PROMOTING GOOD GOVERNANCE OF WATER USERS' ASSOCIATIONS IN NEPAL

SIMON E. HOWARTH, UMESH NATH PARAJULI, J.R. BARAL, G.A. NOTT, BASISTHA RAJ ADHIKARI, D.R. GAUTAM AND MENUKA K.C. [1]

INTRODUCTION

There is a major emphasis on participatory irrigation management world-wide. This is widely seen as fundamental to improving the performance and sustainability of irrigation, and it has been incorporated in the water resources policies of many countries. Despite this effort and some significant achievements over the past two decades, progress has been less than had been anticipated.

This paper describes a new approach to strengthening Water Users' Associations in Nepal, on three schemes: one modern jointly managed scheme (Sunsari Morang - SMIP), one smaller agency managed scheme (Bijaypur Irrigation Project - BIP) and one traditional farmer managed scheme (Kamala Uttarbahini - KUIS). A central element in this undertaking is getting the active involvement of all water users, working with them to identify problems, derive and implement solutions, and monitor progress. This work was undertaken as part of the DFID knowledge and research programme, and is being implemented through the Department of Irrigation of Nepal by Mott MacDonald (UK) and Development Pioneers Consultancy Services (Nepal).

In accordance with the national irrigation policy, water users' associations (WUAs) have been set up on these projects, or are in the process of being established. The water users were not involved in preparing the policy and may not fully agree with it – particularly as one aim is to transfer costs and maintenance responsibilities to the users. Many, however, do agree with the concept of participation in water management and recognize that it can have significant benefits for them.

After a wider review of the issues on about 20 projects in Nepal and five in

[1] Senior Irrigation Engineer, Mott MacDonald Ltd, UK; Senior Divisional Engineer, Department of Irrigation, Nepal; Institutional Expert, Development Pioneers Consultancy Service, Nepal; Social Anthroplogist, Mott MacDonald Ltd, UK; Engineer, Department of Irrigation, Nepal; Sociologist, Development Pioneers Consultancy Service, Nepal; and Sociologist, Development Pioneers Consultancy Service, Nepal.

China, we selected the three projects and WUAs to work with intensively for about one year, to pilot our approach of participatory diagnostic studies followed by ‘water users’ schools’. As this was a research study we documented the processes systematically throughout the project, and we are now analysing these findings and observations systematically in order to draw wider conclusions on appropriate methods for promoting sound management and good governance on irrigation systems.

STUDY SITES

Three projects (**Figure 1**) were selected to represent a range of different conditions. A shortlist was made from those considered in the Stage 1 study

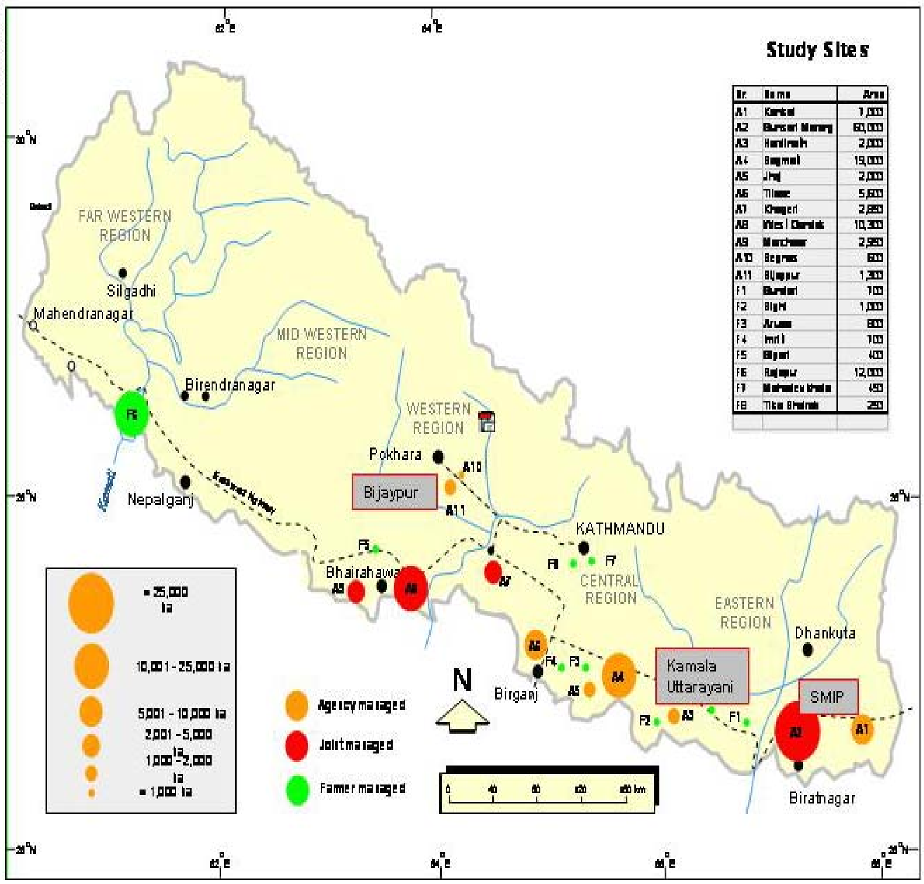

Figure 1: Study Sites in the Map

on the basis of 8 criteria. The aim was to include schemes that:

- represent a range of management arrangements from fully agency managed to fully farmer managed;
- have an area of more than 500 ha;
- do not have an ongoing rehabilitation programme;have cropping and climatic conditions result in a strong need for irrigation;
- are likely to have WUAs and farmers interested in cooperating with the study,
- indicate room for institutional improvement and/or can shed light on elements which are conducive to strong water management institutions, and
- indicate that the study team is unlikely to encounter security problems in the course of its work.

Three projects were selected on this basis: one modern jointly managed scheme (Sunsari Morang - SMIP); one older but smaller agency-managed scheme (Bijaypur Irrigation Project – BIP); and one traditional farmer managed scheme (Kamala Uttarbahini - KUIS).

The following sections describe the basic physical and institutional characteristics of these schemes at the start of the study. Interventions to improve management required a more subtle understanding of the social context, but developing the process for understanding this was itself part of the intervention and is described in the next chapter.

Sunsari Morang Irrigation Project

Introduction

Sunsari Morang Irrigation Project is the largest in Nepal and was built in the 1970s with Indian assistance to irrigate 66,000 ha, using water from the perennial Koshi River. At that time only the main canals were built and there was no concept of participatory irrigation management. Command area development followed on almost immediately (with World Bank support).

This entailed construction of tertiary canals and watercourses, with outlets to serve 4 ha blocks. At the same time parts of the main canals were rehabilitated and the design concept was changed in order to simplify management (**Figure 2**). It was originally designed as a fully flexible gated system for management by DOI, but this was changed to a ‘structured’ and ‘joint-managed’ system. These concepts are important to understanding performance of the project, and are described further below.

There was small-scale indigenous irrigation in parts of the command area, but this just used local streams and was inadequate for the whole command area. Nevertheless, some farmers are dissatisfied with the change as they used to get sufficient water. The new layout also ignored the old canals, as this made it possible in theory to simplify the layout and increase coverage but this benefit has not been realised in practice.

Figure 2: Tertiary Canal of SMIP

This is a supplementary irrigation project, designed to provide water to complement the unreliable monsoon rainfall. Rainfall, and thus potential benefits vary considerably from year to year. The greatest benefits should be expected in very dry years, but the projects is designed on the basis of providing sufficient water in a 1 in 5 dry year. This inevitably means that there is insufficient water in more extreme droughts which is just the time farmers most need (and expect) it. Such resource limitations are inevitable, but many farmers are unaware of the basis of design and have unrealistic expectations. Farmers’ aspirations may also be reinforced by recollection of better times in the past when the population and water demand was lower.

Institutional Arrangements

A hierarchy of water users associations has been set up, to suit the requirements of joint management as laid down in the Irrigation Policy. Although broadly in accordance with Ostrom's (1992) principles, this was established in a fairly standard ‘top-down’ way. Each type of canal has a corresponding type of users’ organisation. There are two organisations with responsibilities for management below the structured level - the water users committee (WUC) for the sub-secondary canal (typically 200-700 ha), and the water user groups (WUG) for watercourses (30ha). Higher-level associations have duties for co-ordination with different levels of the project authority for jointly managing the main and secondary canals – these are known as the water users’ central co-ordinating committee (WUCCC) and water users’ co-ordinating committee (WUCC) respectively. Each layer is formed of representatives from the layer below, and the hierarchy as a whole has been registered as a legal entity. In practice, the users were not involved very effectively, and they do not appear to understand the role of the institutions clearly.

The WUA has been assigned noble tasks: improving management of water; resolving disputes and conflicts; mobilising resources (cash, kind and materials); and undertaking system maintenance and repair. But they appear to do little in practice, and all activities have been carried out on an *ad hoc* basis (mainly on the initiative of tail-end farmers who are the first to suffer from system inefficiencies, leakage etc.).

The WUA are generally considered by the users to be moribund. They have few systems or rules, and those that they do have are not acted on. Using the terminology of Krishna and Uphoff (1999), DOI focussed on promoting the institutions or structural social capital. They gave less attention to developing the shared values and norms of cognitive social capital which are necessary to make the institutions function. The WUA was created on paper and constitutions and bylaws were prepared, but little was done to stimulate the shared values and commitment needed to make the institution work.

Water Distribution

SMIP was designed as a “structured irrigation system” (Albinson and Perry, 2002), which is intended to be a simple way of managing large-scale irrigation. The approach is based on a clear delineation between the part of the irrigation system that is actively managed (at various flow rates and water levels) and the part of the system that operates *either* at full supply level (with proportional division of water down to the level at which farmers rotate among their individual farms), *or* is completely shut. The point of transition is referred to as the *structured level.* The government is responsible for the actively managed part of the system down to the head of sub-secondary canals (typically serving from 100 to 1,250 ha). There are no gated structures below this level – all flows are shared proportionately down to the head of the watercourses (30ha) via open channel proportional dividers. The turnouts into watercourses are fitted with adjustable proportional modules (APMs): these are intended to be fully open or fully closed, and when open should deliver water proportionate to the area irrigated even if the watercourse water level varies. SMIP was originally designed as a fully-flexible system, but the structured design was introduced in the second phase because of poor performance of the first phase, This was at the same time as the concepts of participatory management were introduced, although (at least in theory) the new design reduced the requirement for active involvement in management.

The flow into the main canal system is very variable since although the intake is on a very large perennial river there is no weir and thus the level fluctuates both seasonally and diurnally due to rainfall and snow melt. This severely affects the amount of water that can be diverted into the main canal. The upper part of the irrigation system is fully gated so that the supply to each secondary and sub-secondary canal can be controlled by DOI. There is usually too little water for continuous supply to each sub-secondary canal, so there is a system of rotations to ensure that each gets a supply corresponding to its irrigated area. Thus the main system above the head of the sub-secondary canal (which is the formal interface between DOI and the WUA) needs to be fully regulated and actively managed. To cope with this situation, each sub-secondary canal receives water for alternate four-day periods (although this may be varied in practice). Informally, the interface for managing water distribution is at the head of the secondary canal since the WUCC makes the key decisions regarding water-sharing between sub-secondary canals. However, DOI remains responsible for maintenance of the secondary canal.

Central management of the main system works relatively well at SMIP at present and ensures fairly reliable and predictable flow into the sub-secondary canals. However, the situation may deteriorate as larger areas are rehabilitated and competition for water increases. There are already problems of communication as it is such a large system, so that users may not be aware of the reasons for canals being closed or gates adjusted. Users are familiar with the standard schedule, but there may be unexpected closures due to rainfall or sediment load in the river which encourage farmers to steal water.

More serious problems occur at a mid-level in the system: there are major deviations from the schedule below the sub-secondary canal head. The flows into some tertiary canals may be adjusted illegally by individual users and may greatly exceed that designed, and there may be additional illegal direct outlets, so that much less water reaches the tail of the sub-secondary canal. As the sub-secondary canal is below the structured level and intended to be fully automatic, the management organization (WUC) has a limited role and is quite weak. It is unable to police the canal and prevent illegal offtakes and checks in the canal – it has inadequate legal authority and little incentive to carry out this task.

The flows into the head of the watercourses are thus not at all equitable, and some face severe water shortages. However, management within this lowest level in the system is slightly better. WUGs were set up to manage flows within a watercourse, since some active management is needed for opening and closing the APMs. It is interesting but not surprising that, of those studied, it is the watercourses which have the greatest shortage, such as T3-4, that have developed the most effective organisations. Such WUGs rarely act in accordance with their constitution or by-laws but may be effective on an informal basis. Elsewhere the WUGs are dormant.

Kamala Uttar Bahini Irrigation System

Introduction

Kamala Uttarbahini irrigation system nominally serves about 500 ha on the edge of the *Terai* adjacent to the perennial Kamala river. It irrigates what used to be a *birta* landholding granted some 50 years ago. The land was jungle at the time, and was cleared and irrigated by workers brought in by the landlord. Through a gradual process of land reform, immigration and settlement, it is now a densely populated smallholder irrigation system. Irrigation institutions have evolved to manage the system through these fundamental changes. At first they were informal but had strong powers to manage the system and enforce its rules. More recently they have been formalised and registered but paradoxically have lost some of their power to control the system. Nevertheless it continues to function and most farmers are actively involved in and benefit from the system (**Figure 3**). A much larger irrigation system (25,000 ha) has been developed over the past 30 years by the government immediately downstream, and is now in the process of management transfer.

Figure 3: Main Canal of KUIS

It is conveniently located on the main east-way highway, giving it access to markets, some opportunities for local off-farm employment and easing seasonal migration opportunities. Although most of the community are immigrants to the area and came because of pressure on land in the hills, this land too is now over-populated and most farmers depend to some extent on non-farm income.

Institutional Arrangements

There are two levels of institution, one for the main canal, and one for the 10 branch canals. Each branch canal (irrigating 20-100 ha) is managed by an ‘in-charge’, some with one or two assistants. Each in-charge and, in the case of large branch canals, one or two others are members of the main committee. The main challenge to management is to capture water from the river. The river is in a wide cobbled-filled bed, so it moves in both level and location, requiring large numbers of labourers to work to divert water into the canal. Work is required before each crop season and often several times during the season, as floods can destroy the temporary intake. There are times when there is a shortage of water in the canal and thus the committee must be able to allocate water between the branch canals and ensure that those who steal water are punished. The management of the branch canals is the sole responsibility of the branch ‘in-charge’.

This structure is simple, and has developed to suit the tasks required. There has been a more recent attempt to impose a standard WUA, which was registered with the District authorities but this was done as a bureaucratic requirement to ensure external financing for some improvement and has had little impact. Key features of the actual management system are:

Strength and authority of leadership, even though not usually democratically elected.

Continuing ability to manage large numbers of labourers (*urdi)* to maintain the intake which is the most critical communal challenge facing the system. This is a major strength, since without this there would be no irrigation system, but is facing challenges now.

A system of sharing water at times of shortage – not in a formally documented rotation with strict order and duration of irrigations, but more as an understanding and agreement of how to resolve the issues as they arise. This depends on the authority of the branch and main canal leadership, and is flexible to cope with differing needs (due to soil type, crops, topography, rainfall etc.), with norms established when community cohesion was greater.

Disputes and penalties. There are penalties for failing to contribute labour for maintenance and for taking water out of turn or from unauthorised locations. Earlier these were considered very onerous and infringements were rare as the formal punishment was strictly enforced and accompanied by social ostracism. Now infringements are more common, and not consistently enforced. Defaulters may pay the fine more as a fee for obtaining water when they need it than as a punishment.

Procedures are simple and understood for labour-based management. Management of finances is however, more contentious and leads to distrust in the WUA.

It relies more on strong cognitive social capital, than on formal institutions. This approach does face many challenges – due to migration, changing social norms (such as the *Dalit* movement), etc. Although the institution has so far been sufficiently robust to withstand these, they were aware of growing weaknesses and were enthusiastic in taking part in our study. We examined the nature of these challenges and helped the users and WUA to tackle them during the second stage of the study.

Water Management

There is no permanent intake and several different arrangements have been made at various times. There was an attempt to make a single reliable intake during rehabilitation under the Irrigation Sector Project (ISP) in the early 1990s but this was not successful. Thus the situation is very fluid and the monsoon may cause major changes to fundamental features of the river, necessitating changes to the location and layout of the intake. A key task of the management institution is to plan and implement the necessary changes each year. If this is not done well, the system could totally fail to supply water. The WUA thus has significant responsibilities, which require skill and imagination to solve. They may involve technically more sophisticated tasks than those required of WUAs after management transfer (such as at SMIP). Conversely it is a small scheme and thus a simple structure of WUA is sufficient.

Operation and maintenance of the main canal is the responsibility of the main committee. At times of shortage the branches are divided into two groups and irrigated alternately. It is not possible to allocate water very accurately: some permanent structures were built recently to help with this but they do not divide water proportionately (nor measure it) as there is insufficient head available. The allocation is not equitable – crop water requirements vary, and different crops are grown to suit availability of water in different parts of the system. This can be contentious, as farmers monitor the situation closely at times of shortage and no accurate system is possible. Use of the new structures gives the WUA some help in sharing water but more depends on the credibility of the WUA to enforce the rotation durations and prevent disputes. This indicates that there is a higher level of cognitive social capital than at SMIP. If water is severely short the main committee organise farmers from the whole command area to work at the intake to augment the supply at the system. Farmers who are facing water shortage may request the WUA to arrange this.

Water sharing between farmers along branch canal is even more subjective. Variations in topography make water sharing difficult to manage objectively; some land is difficult to command without checking the canal or using pumps, and water requirements vary as the soil types change significantly towards the tail. There are nominally agreed rotation schedules, but it is difficult to find instances of these being followed rigidly in practice. Instead, the branch 'in-charge' makes an informed judgement of the best allocation at the time and may adjust the rotation accordingly. Given the state of the infrastructure and the variability of water requirements this may be the simplest approach. However, his judgement may take account of an informal system of priority of rights for different users – recent immigrants to the area, at the tail of the system may have secondary rights to water as they have not contributed so long towards development and maintenance of the system. As these are at the tail-end, are ethnically distinct and generally poorer, this approach appears rather inequitable.

Bijaypur Irrigation Project

Introduction

Bijaypur Irrigation Project (BIP) is a small project serving around 1,000 ha in the hills and lies alongside the Pokhara - Kathmandu Highway on the left bank of Bijaypur River on the outskirts of the Pokhara valley. It was initiated around 200 years ago, but has been upgraded and extended several times – most recently in 1983 although there has been continuing small-scale Government investment on maintenance and minor improvements since then. It is fully agency-managed but a WUA was recently set up with a view to management transfer. The water source is the small but perennial

Figure 4: Main Canal of BIP

Bijaypur *khola*, which can be augmented via a link canal from the Seti River (**Figure 4**).

The main canal passes through an army barracks, which uses some of the water in the canal for internal consumption and vegetable production. The command area lies with the boundaries of the rapidly urbanising Lekhnath municipality which means that many residents are not formal users of the system although they may make occasional use for washing or bathing, and they may pollute the canals. Urban waste blocks canals and causes other problems at the tail of the system.

Institutional Arrangements

A WUA was formed in 1995 but quickly lapsed; it was reformed in 2001 and registered in District Water Resources Committee with a standard constitution to suit a hierarchical organisation. There is a general assembly (GA) with one representative for each 200 ha of irrigated land. The main committee has responsibilities for the main canal, 4 branch committees look after the four branch canals; *toli* committees are the lowest level and cover the sub-branch canals (typically 10 ha). As the WUA is new, it nominally complies with the provisions of the irrigation policy for women's participation. There is provision for one male and one female member per household and two women have been elected on to the main committee.

Since the project has not been handed over to the users, the WUA does not have formal responsibilities for maintenance. It has however, been active in assisting DOI in planning maintenance, and it has also mobilised local labourers to provide unpaid assistance for emergency repairs (a perennial requirement for the main canal which passes along an unstable hill slope. The WUA also undertakes maintenance as a contractor to DOI, acts as a line of communication between DOI and the farmers, and assists in managing water distribution and resolving conflicts related to this.

DOI retain responsibility for management of the project and employ eight *dhalpa* who manage the canals and structures. These *dhalpa* are formally responsible to the district irrigation office in Pokhara but co-ordinate directly with the WUA or individual farmers on a daily basis. The budget expenditure by DOI is less than Rs 100 per ha on average over the last seven years, and this is mostly spent on paying the salary of operational staff.

Water Distribution

With the combined sources of water in the Bijaypur and Seti rivers, there is an adequate total resource, but the main canal passes through an unstable section of the hills and cannot deliver the design discharge. There are also problems with the quality of Seti water, so that is only used at times of greatest shortage.

There are four branch canals off-taking from the main canal. The distribution of water between branch canals is carried out by *dhalpas.* The basis for water distribution is area to be irrigated, availability of alternative sources and demand of the farmers. This flow is controlled by gated head and cross regulators at each bifurcation. Almost the entire length of the branch canals is lined with stone masonry and is aligned on a ridge irrigating from both banks. Each branch canal feeds several sub-branch canals and direct outlets.

Sub-branches are earthen canals and face significant water loss. They are managed, in practice, by informal groups of farmers. As there are no dividing structures within the sub-branch canals, water management is *ad hoc* and is not arranged in the same way in all sub-branches. There are also some gated or un-gated piped offtakes **-** locally known as *pyans*. There are also many obstructions (known as *thel*) in the canal to raise the water level to command flows into the *pyans*. These *pyans* and *thel* are an important but unofficial feature of water management of BIP, which cause many problems to downstream farmers.

The operation of headworks, sand traps and branch canal gates is done by the *dhalpa*s, but farmers operate structures within the branch canals. Farmers may have some informal discussions with respect to the date of planting and planning distribution water for irrigation, but formal rotational practices are lacking and there are often conflicts during paddy transplantation especially at middle and tail parts of the canals. An interesting feature of this project is the system of *panibause* who form a well-armed labour force dedicated for providing water for their employers. They are employed individually by small groups of farmers, but generally only the richer farmers can afford them. This system thus reinforces the prevailing *might is right* principle of water management.

Maintenance of both the headworks and the main canal is quite demanding. The headworks were partly washed out a few years ago and the main canal often breaches – both requiring occasional emergency maintenance. But due to delays in budget release such emergency works cannot be done entirely by the government budget, and the farmers have become active in initiating such emergency maintenance works. Routine maintenance is carried out during canal closures each *aunsi* and *purne* (new and full moon), which are days when ploughing is traditionally not permitted. Such routine maintenance is mainly concentrated at low levels in the system - cleaning silt traps and small channels - by voluntary labour (known as *jhara)*. The mobilisation of *jhara* is based on the household, irrespective of the area of land cultivated.

APPROACH TO INSTITUTIONAL DEVELOPMENT

The first part of the intervention was a diagnostic learning and action planning stage, in order to understand the various interests as highlighted above. Key features of this stage are to:

- Engage with all categories of water users, including all parts of the system, male and female, direct and indirect users, landowners and landless;
- Provide opportunities for expressing divergent views in informal settings;
- Understand the problems of the system from the perspective of these users, and in the context of their livelihoods, which involve many other issues as well as irrigated agriculture; and
- Develop an action plan, which aims to resolve these issues.

The second part was to run a series of "water users' schools", which provided a wide range of water users with the opportunity to discuss these problems and develop potential solutions. In the course of these schools they also developed links with outside agencies and stakeholders who should be able to help in supporting the users in many ways. These schools were run for one morning per week throughout the cropping season so that the participants were able to work through the problems as they occurred and develop their own solutions. The participants included both executive members of the existing water users' organisation and ordinary users, so that the solutions could be introduced into the WUA.

Diagnostic Learning and Action Planning (DL/AP)

Methods

Large scale irrigation poses great challenges for participatory studies. There are large numbers of stakeholders and many are not locally resident or only occasionally live in the area. Not all have a long-term interest in irrigation –

sharecroppers may change each year. Many people use canal water for other purposes (such as watering livestock) or are affected by the use of canals (for example, for access or grazing along canal banks, or due to the influence of canals on groundwater levels and quality).

We used a number of techniques, aimed at engaging as wide a range of primary stakeholders as possible and gathering sufficient knowledge to plan the WUS, on the understanding that gaps in knowledge would be filled during the WUS or even later as both sides gained confidence in each other. After an initial reconnaissance and discussion with the WUA to understand the irrigation layout and settlement pattern, the total system area was divided into hydrological units of about 30 – 50 ha together with the villages where the farmers of this land lived, as this was felt to be the largest number of people who could reasonably be covered at a time. In some villages up to 50% of the population was found to be landless, but many of them are involved in irrigated agriculture (they may have close links with particular landlords, but in general they are not restricted to a particular watercourse command area).

We used well established PRA principles and techniques (such as those outlined in the IIED Participatory Methodology Series – Pretty et al, 1995, and the FAO SEAGA Guidelines – Jordans, 1998), with minor adaptation to suit the requirements of large scale irrigation in Nepal. We coined the term DL/AP in this project to avoid stereotyped application of methods used in earlier projects

There were four overlapping stages to the fieldwork:

- Introductory visits,
- Reconnaissance and mapping
- Small group meetings, and
- Feedback and verification meetings.

We developed our methods slightly as we worked through successive projects. The following description is thus a generalised synthesis of these methods. The various steps are described in greater detail in Gautam, 2003.

The introductory meetings were a very important part of the process. They were essential for building rapport with the community and ensuring that both the existing WUA and some ordinary farmers understood the objectives and approaches of the project and were willing to participate in it. This was done in two parts – an initial visit to the WUA to ensure that they were willing, in principle, to participate. In some cases more than one visit was necessary, as there have been many attempts at institutional development in some of the schemes and we often had to overcome a sense of resigned cynicism before we could get down to details. Following a successful outcome to this visit, we collected whatever secondary data was available, including maps and reports, so that we could prepare ourselves for the fieldwork. The next visit involved a larger general meeting to which all farmers were invited, during which we explained and discussed the programme with a larger group of stakeholders. This meeting concluded by preparing a plan for the fieldwork, including identifying the locations and participants for the initial meetings and activities

The general meeting led directly on to the reconnaissance and mapping stage, during which we aimed to get a general overview of the system by brief walks along some canals and preparation of maps (**Figure 5**). We asked a group of farmers to prepare a map showing the canal system and village, either as a sketch map on paper or on the ground using stones, chalk or marks in the soil. We asked them to do this without reference to topographical or cadastral maps, as the main purpose of this map was to understand irrigation in its social context, and to lead on to discussion of the system and its problems. An important requirement was to understand who is involved in the system including, for example:

Figure 5: Social and Resource Maps

- People who live and farm locally
- Short term tenants (either in the village or nearby)
- Local farmers who normally reside in adjacent towns
- Absentee landlords
- Landless

We followed this mapping with preparation of household lists and collecting some basic information on household composition, education and land. This was a lengthy and quite difficult exercise, and sometimes rather contentious.

In some cases we did not attempt to collect details of landholdings to avoid these problems, but just recorded whether or not people had land. Once we had a stakeholder list we could do a well-being ranking exercise so that we could categorise stakeholders for the next stage of fieldwork.

We then worked with relatively large informal groups to prepare general information such as seasonal calendars, a mobility map, Venn diagrams to understand institutional relationships, and transect walks. Our team worked together on the mapping, but then divided up into three groups (social, engineering and agricultural) for the remaining activities.

Well-being categories
(as defined by tail-end stakeholders on KUIS branch 5)

Very poor:	Landless Uneducated House on *ailani* land Agricultural labourer No livestock	*Poor*:	less than 6 *katha* Sharecropper small house on own land food secure 4-5 months own hand pump
Medium:	land up to 1 bigha Sharecropper Laborious Food secure 6-9 mths	*Well-off*:	Own farm Laborious in farming Food secure 12 mths less land than highly well-off
Very well off:	Large landholding Son has a shop Government job holder Educated Food secure for whole year		

For other activities, small groups were set up to look at specific issues from the point of view of different social or interest groups. These groups were stratified in various ways according to the objectives, but generally by well-being and gender. Techniques such as water use matrix, gendered task analysis, time trend analysis, a timeline for the system and focus group discussions were used in these groups.

We used local social mobilisers and field assistants to help in the fieldwork and to encourage local people to participate in these exercises. Social mobilisers were given an allowance roughly equivalent to the local agricultural labour rate, but we did not given any compensation to farmers or other participants – apart

Figure 6: Pictorial Techniques of DLAP

from occasional cups of tea or light snacks. We tried to keep the meetings as short and interesting as possible, using pictorial techniques wherever possible (**Figure 6**). All observations were recorded on large sheets of paper, which were later given back to the community. Some secondary information (such as meeting minutes) was also collected during this field work, or from the WUA.

The findings from this study were presented back to the group as a whole, in an 'open day' during which our materials were presented and people invited to make their observations or corrections[2] (**Figure 7**).

We then repeated the exercise in the next canal, until we completed a larger hydrological unit (typically 120-150 ha) which was the level we proposed to intervene at in the water users' school programme. In the case of SMIP the field work was done by watercourse (25-30ha), of which 3-4 formed one tertiary canal.

Figure 7: Presentation of Study Materials

We then called a meeting at the larger canal level, during which we did a simplified PCPS[3] exercise in order to prepare an action plan which would form the basis of the issues to be discussed in the water users' schools. We grouped areas together because although different parts of the same project may have slightly different requirements there is a lot of overlap, and they would be covered by a single WUS. This ensured that the stakeholders could have a real input into planning without the process becoming too drawn out and repetitive.

We concluded this phase by writing up our findings as a concise report. The sustainable livelihoods framework is a valuable for pulling this information together in a coherent and useful way - this is described further in section. We gave a copy of the report to the WUA for their own records, but it should be noted that this phase of the study was not aimed at gaining knowledge for its own sake. It was primarily a way of engaging the users and planning the WUS. We perceived DL/AP as part of the capacity building and

2 In some cases this meeting was combined with the tertiary level meeting (see below).
3 Problem census-problem solving technique.

empowerment process so that farmers felt part of the process rather than be regarded as providers of data.

Practical Problems and Solutions

Although the techniques are not in themselves new there are many difficulties in applying them in the field particularly in the context of large scale irrigation:

- It is not possible to involve all people during the familiarisation meetings, so the DL/AP team have to explain the project frequently;
- The study needs to be timed to suit the planning of a water users school which will run during a cropping season, but this may be a busy time when it is difficult to get active participation by farmers
- Social, administrative, topographical and hydrological boundaries rarely match, so social and resource mapping and preparation of stakeholder lists is very difficult.
- Land tenure patterns are often complex and people are reluctant to give reliable data. They may be suspicious of the motives for collecting data (perhaps worrying about Irrigation Service Fee (ISF) payments) and they may be concerned about the legal implications of tenancy arrangements.
- Farmers are often more concerned with attracting investment for infrastructure than with institutional development, particularly in the early stages of the study. This is a particular problem when discussing the problems which they face with the infrastructure (**Figure 8**).
- Local power relations affect attitudes towards the study, and influential individuals who felt that their interests might be compromised by the study

Figure 8: On-site Discussion on Irrigation Infrastructure

sometimes became over-dominant and tried to divert attention to factors outside the village (often management of the main system by DOI).

These difficulties could easily undermine the whole approach so it was important to take very careful account of them, and adopt a flexible approach whilst remembering the overall objectives of the study:

There should first be a transect walk with key informants to become familiar with the local context as well as the boundaries of the social and hydrological units – it may be necessary to do further or more detailed transects, and possibly with other stakeholders.

Sensitive issues such as well-being should not be investigated until after the transect walk and mapping to allow time to build up trust with the community, and to clarify the purpose of the ranking (eg that it is not going to be used for ISF assessments, etc.). Participants gained some ownership of the well-being exercise by identifying their own indicators (rather than using a ready-made format of indicators).

Land ownership data is sensitive, so it is better to concentrate initially on identifying the stakeholders according to land tenure and well-being status, without being too concerned about actual land areas. It is more important to identify all categories of users, than to collect all details of each individual - further details can be collected later once the team has been able to build better rapport with people, or even later by the WUA itself once they recognise and accept the need for this.

Other household data is usually less sensitive, but it can become tedious if too many variables are collected in the household profiles – people can lose their enthusiasm if this process becomes too lengthy.

Sometimes too many people want to join the transect walk. This can hamper progress by making it difficult to talk meaningfully and the main transect walk should be done with a small number of knowledgeable key informants. Sometimes it is useful to look at specific problems with different groups later.

Breaking the programme up into a series of short exercises with different small groups, with careful facilitation, helped to keep the discussions focused on our wider objectives.

In all, the DL/AP process was liked by farmers as they were entirely involved in the whole process and remained enthusiastic throughout and they did not feel the frustration that they had with past more ‘extractive studies’, although it still required skill and sensitivity to retain their interest throughout the process.

It was always important to remember that the tools were a means to an end – for involving people and finding out information. It was not the map itself, for example, that was important but the way that preparing the map involved local people, made them feel that their knowledge is respected and important, helped in building our understanding of the system, and enabled us to plan the WUS curriculum.

Water Users' School[4]

Approach

Water Users' Schools were envisaged as an entry point activity for involving local stakeholders in improving management and governance of the irrigation system. More specifically they were expected to:

- Increase the practical knowledge of users in sustainable irrigation management, by helping them to identify and solve problems themselves
- Help users and WUAs to identify and introduce practical measures to promote good governance in the WUA and their sub groups
- Increase participation of vulnerable stakeholders such as female-headed households and landless farmers in irrigation management
- Encourage links between water users and WUAs and other local institutions and agencies
- Make users more aware of the role of Government, and the relevant policies, legislation, rules and regulations regarding water management.

It should be stressed that they were intended to strengthen the WUAs and not to work as a substitute for them. They were only run for a short period (one or at most two seasons), to help the WUA to work effectively and in the interests of all stakeholders. This accounts for the intensive nature of the WUS and does not imply that the WUAs will need to continue to work on the same basis once the WUS are complete.

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[4] Basistha Raj Adhikari had presented a paper entitled "Towards Good Governance: Water Users' School in Kamala Paini" in the Seminar. For elaborate information about the Water Users' School in Kamala Paini, interested individuals can approach Mr. Adhikari at e-mail: basistha@wlink.com.np.

The concept of a water users' school is not a new one, but it was adapted from the farmers' field school approach (FAO, 2001) with some key modifications for this project. The fundamental approach is one of learning by doing. This has previously been used in integrated pest management schools (1995 onwards), and later adapted to irrigation through the on-farm water management (OFWM) in 1997 and integrated crop and water management (ICWM) programmes in 2002 run through various DOI projects – particularly the Nepal Irrigation Sector Project. These all aimed at developing skills amongst the farmers, through an effective programme of transfer of knowledge, using adult learning techniques (**Figure 9**).

Figure 9: Sub-group Exercise of WUS

The WUS in this project differed in some key respects from previous FFS. They were:

- Planned on the basis of the DL/AP studies in each project, so that the approach and curriculum was tailored to local needs
- Required purposive selection of participants to ensure representation of all stakeholder groups
- Included group activities (for institutional development, management of canals etc)
- Aimed to enable participants to identify, understand and solve problems, not teach them solutions – the WUS is based on the concept of problem identification and solving, rather than transfer of knowledge
- Specifically aimed to disseminate knowledge and findings to non-participants, using the concept of Minor Schools, which also helped ensure a cyclic learning process.

The "catchment" for each WUS was a sub-unit within the sub-project irrigation system identified during the DL/AP, and the WUS provided a forum for weekly meetings in the field, to solve problems as they occur. It ensured a basis for free discussion of the issues and enabled the stakeholders to get to know each other better and understand the problems in a non-threatening environment. Field activities were chosen so that the participants would learn about the most important features of their system and would be helped to understand and solve problems about these.

Although the emphasis was on the participants working together to solve problems of managing the whole unit, rather than to learn individual skills, some agricultural sessions and a demonstration plot are included so that they could learn agricultural techniques.

Each school was managed by a locally-based NGO. About 25 participants were selected by the community using criteria agreed during the diagnostic phase to be representative of all groups, and including some committee members of the WUA. We aimed at 30-50% participation by women, with each ‘well-being’ and ethnic group being represented proportionately, thus ensuring a significant involvement by landless farmers (**Figure 10**). The school was held at a central location and there was a small field plot (0.2 ha) associated with it.

Figure 10: Women in WUS

The main WUS was supported by three or four minor schools – one in each of the communities studied separately at the diagnostic study phase. Members of the main school acted as resource people for the minor school, which were run on the following day. These schools helped to develop the shared understanding of the issues and potential solutions, and also to disseminate the outcomes of the major school.

For each issue, the WUS participants were divided into smaller groups to discuss it from their different perspectives, and then report back their observations and findings to the WUS as a whole. This process was supported by specialist facilitators and technical resource people. Where possible resource people were selected from agencies with whom the WUA needed to develop better linkages, such as irrigation or agricultural extension offices. These resource people were more used to traditional training techniques and therefore had to be made fully aware of and in agreement with the approach. In some cases they were involved in the diagnostic phase as well, but in others they were briefed subsequently.

Achievements: Self-evaluation

We included a participatory self-evaluation in the curriculum. One of the first sessions involved the participants evaluating their existing system – both the performance of their institution and the standards of water management, using criteria which they first decided amongst themselves. They then repeated the process at the end of the school, enabling them to assess the changes over the season. This was useful for several reasons

- It introduced the concepts of monitoring and evaluation
- It enabled the participants to understand the impact of the school objectively
- It led directly into a discussion of the issues which were identified as useful criteria

Although the process was not objective, and there were biases because people were likely to state that conditions have improved, it did enable people to look at the process in a rational and impartial way. The concept of indicators was a difficult one to introduce, so the list of indicators had to be modified slightly for the post-evaluation. Results for the head WUS at KUIS are given below.

Indicators	This Year	Last year
Ability to divert more water in the canal from the river.	2	1.75
Ability to protect the canal from uphill stream's damage by diverting water in proper drainage	1.25	1
Equitable water distribution	4.25	2.75
Ability to make users participation in O&M / *urdi*	2.25	1.75
Clarity and acceptance of rules and regulation	3.5	2.25
Ability to implement the decision	3.25	2
Opportunity to take part in WUA activities openly	4	2.25
Record keeping ability	3.75	1.75
Communication ability	4.5	3.25
Ability to enforcement of the rules and regulation.	2.75	2
Co-ordination and linkage ability	2.25	1

In some areas the improvement was small, but much greater changes were observed in other areas. It was an exceptionally difficult year in terms of the physical conditions in the river for diverting water, and thus only a very small improvement (15% change in score) was observed in this. However, they made good progress (50% increase) in sharing out this limited resource in a more equitable way. The ability to manage large numbers of labourers (*urdi*) for maintenance of the intake is a long-established feature of this WUA so again there was a small change (30%) in this, but they made greater improvement in procedural aspects of resource mobilisation – for example developing and enforcing rules (50%) in an inclusive way. There are an increasing number of women-headed households in this area, as a result of seasonal male migration. Before the WUS women were excluded from both decision-making and participation in O&M which meant that they were subject to penalties and fines. As a result of the school, the committee of the WUA was informally enlarged, pending elections, with five women, and women were included in the General Assembly and permitted to take part in routine O&M activities

We also undertook a 'community impact assessment study' to assess the impact of the school more widely than on the direct participants. This concluded that the WUS had:

- improved irrigation management at BIP and SMIP, particularly by improving standards of maintenance, and helped the WUA at KUIS to cope better with unusually adverse river conditions, by developing better procedures and involving women in a more substantive way;
- a positive impact in the way the various committees worked, and in the quality of the rules and regulations

There was a major impact in terms of the awareness of the participants in a broad range of issues related to irrigation management, but of course we are mainly interested in moving beyond awareness to actions. We did observe some significant improvements:

BIP: sub-committees were formed to manage sections of the branch canal; procedures and record keeping were improved; ability to mobilise farmers for collective work was increased; and leadership became better motivated to manage the system.

SMIP: responded to pressure from members to organise some meetings at WUG and WUC level, but most people felt that new elections are essential to give the WUA credibility; as this could not be arranged because of the political situation, they relied on more informal arrangements for improving management.

KUIS: branch committees gained status and became more active and responsive to farmer needs; the main committee improved its procedures and was able to mobilise exceptional resources for maintenance; and women were included in decision-making as well as being permitted to participate in field activities (previously they were obliged to pay penalties).

Comments on the Approach

The WUS proved to be very popular, and appeared to have a very beneficial impact. There are, however, several areas where further comment is appropriate

<u>Participant Selection</u>. It is important that participants are chosen carefully, to ensure that all sections of the community are represented. We developed a series of criteria for selecting participants, but special care is needed to ensure that some groups are not omitted – for example women from certain ethnic groups. Landless men were also generally too busy to attend on a regular basis, but we were able to get participation for specific sessions – so the curriculum design needs to take this into account. The status of participants within their household is also important, and some household heads sent children to participate but were not willing to act on their learning. The mix of ‘ordinary farmers’ and WUA members is important, in order to ensure that views are both understood and acted on. It is, however, not possible to come up with rigid selection criteria: it is more important to get ‘buy-in’ to the concept of the school and to be flexible during the first few sessions when some people will drop out and others will join. The criteria we adopted are given below.

Criteria	Requirement
Total Number	25 to 30 participants
General Personal Characteristics	Interested, self-motivated, respected, committed to participate in the school for the full duration of the WUS, active in farming/agriculture, willing to disseminate what they learn
WUO Office Bearer	between 6 – 9 out of the total number of participants; they should make up no more than 1/3 of the total number of participants
Position on Branch/Tertiary canal	number of participants from each cluster should be proportional to the number of households in each cluster (as defined in DL/AP, eg watercourse)
Age	aged between 22 – 60 years
Ethnic Group	number of participants from each ethnic group should be proportional to the ethnic distribution of households in each grouping by cluster
Women	minimum 10 women participants in each WUS; number proportionate by cluster and well-being category
Well-being Category	Representation proportionate to number in each well-being category.

It is important also to remember the purpose of wanting wide participation – ultimately we want the WUA to be inclusive (reflecting the interests of all stakeholders) and we believe that it will not be sustainable if it is not. This will not be achieved if we have to coerce people to participate against their will. We need to encourage all categories, by making the WUS serve their interests, so that they see the benefit of participating.

Timing of WUS Sessions. The timing of the WUS and duration of each session is difficult to optimise. We wanted to run the schools throughout the main cropping season, which meant that we asked people to devote significant time to the WUS during the peak agricultural time. Some people requested that we should run the school during the winter when there is some agricultural activity but it is less intensive. However, this is a time of year when many people (including some of those we most wanted to help) go elsewhere in search of work. As a compromise, we adjusted the timing of some sessions – those during paddy transplanting at some schools were kept shorter.

Curriculum. There is scope for refining and improving the curriculum. This was based on the findings of the DL/AP, but this still needed to be translated into a curriculum. In some aspects, we anticipated the methods required by the solution and ran sessions, for example, on improved record-keeping and on communications. We then found that these sometimes duplicated aspects of sessions on maintenance which concluded that there needed to be better communication and record-keeping for organising maintenance labourers. A more rigorous ‘end product’ based curriculum (ie recognizing that, for example, rules and procedures are a means to an end and should be discussed in the context of the required output) would have avoided this problem. This is illustrated in the figure (for SMIP).

Understanding of the Approach and Facilitation Skills. The approach relies on well-motivated facilitators, with a good understanding of the approach and objectives as well as strong facilitation skills. This is quite a demanding requirement and means that everyone involved in the process needs some degree of re-orientation. This may take considerable time. We allowed for this by developing the study programme itself in a participatory way, initially with the central study implementation team, and then with the locally-based NGOs.

We were fortunate in that there are many experienced IPM trainers in many parts of Nepal who are able to run FFS effectively. However our objectives and approaches were subtly but significantly different and it took some time to reorientate them to the requirements of a WUS. Nevertheless the network of professional IPM trainers and more junior ‘farmer trainers’ who have 3 months training is an invaluable resource. Where such skills were not so readily available, we used local NGO personal who had developed comparable ability in facilitation through other work.

Despite the large number of training manuals, there are still some gaps in the availability of suitable training materials. Materials from other sectors (particularly agriculture and forestry) should be drawn on to adapt the more conventional irrigation training guidelines to suit this new approach.

Minor School. Minor schools are an essential part of the programme, but tended to be misunderstood. The choice of nomenclature ‘minor’ proved to be unfortunate, and a suitable word should be adopted so that participants do not regard them as inferior in any way. The ‘major schools’ are longer and more comprehensive, but they also require a greater commitment by the participants to spread the word, to discuss the findings and to facilitate the minor schools. The minor schools are essential for ensuring that the views of all are understood, including those who are unable to make the commitment needed from major school participants but who may be the people we most want to engage with.

Agriculture. There is a strong demand for agricultural training, and FFS provide an excellent means of achieving this. We included a demonstration plot in each school and included a short period on agricultural topics in each weekly session. This was highly valued and we faced repeated requests to increase this. It became clear that WUS do provide an ideal forum for combining agricultural extension with irrigation management development. However, there are a number of options for either including agriculture in the same programme or managing them separately but in a co-ordinated manner by the Department of Agriculture which would need to be considered further. This is also closely related to issues of the duration and curriculum for the school, and follow-up activities

WUS in Context of Long-term Support Requirements for WUAs. A single season WUS had a profound impact on the WUA and on the way the system is managed, but it should not be regarded as sufficient. There will need to be some follow-up albeit on a much more limited scale. This would include:

- Support with monitoring implementation of action plans agreed during the school
- Acting as a catalyst for solving problems encountered, such as facilitating discussions with WUA committees which sometimes reach deadlock over perceived problems in the past (particularly related to financial matters)
- Providing further technical assistance to resolve problems encountered, such as improved systems for water distribution
- Providing specific training, such as financial administration for WUA committee members
- Providing additional agricultural training and support

This could be provided by some combination of further WUS, facilitation of periodic meetings (probably monthly), routine follow-up by line agency staff, and specific short training courses. We do not envisage running two seasons of WUS as the normal solution: we feel that the existing curriculum can be refined so that it can cover the important topics more effectively within the same time frame. Nevertheless a two-season programme may be appropriate in some cases. This will also depend, for example, on the extent to which agricultural extension is built in to the curriculum. Another consideration is the complexity of management which varies from scheme to scheme reflecting a range of issues – from physical scale and layout, to social characteristics and institutional history.

Water Users' Schools in A Livelihoods Context

The sustainable livelihoods framework (section is useful for helping to understand irrigation systems. This framework also provides a key to targeting interventions in a way that will enhance people's livelihoods. The water users school provided a forum for investing in human capital in a way that would help build social capital. This process would also enhance development of the other capital assets – physical, natural and financial. The livelihoods framework, with the understanding built up during the DL/AP phase, makes it possible to design a WUS curriculum which is targeted to the needs of the individual farmers and suited to the context of the irrigation system (**Figure 11**).

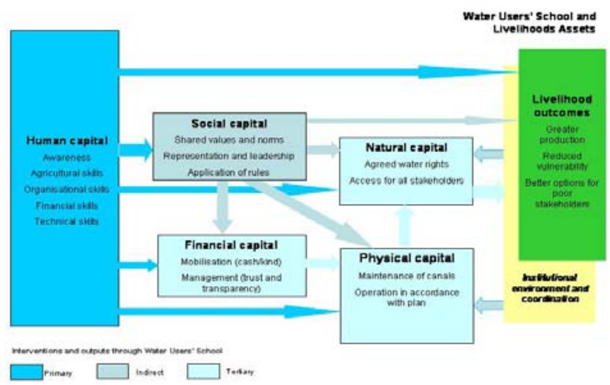

Figure 11: Water Users School and Livelihoods

This is illustrated in the figure above. Our primary activities (shown in darker colours and broader arrows) were targeted at developing human capital, but we did this with the specific objective of building social capital. This in turn had impacts on financial, physical and natural capital. We aimed to develop skills which would directly develop the financial, natural and physical assets, but the impact of this skill-based training component was greatly enhanced through the measures to build social capital, which is needed to help manage other assets.

The interpretation of DL/AP findings using this framework makes it possible to target interventions to suit each project. This guided us in developing the different emphases in the three case study projects we worked on. For example:

- At SMIP we stressed developing the awareness and skills which would encourage shared values for making and following rules. We anticipated that this would lead directly to improved maintenance by the users and then more gradually towards reduced water theft, greater transparency in financial management, and a more equitable distribution of water. Each step in this process would result in reduced vulnerability and enhanced livelihood outcomes

- At KUIS we gave greater focus on representation of users to enable a more equitable distribution of water, and on managing the transition from labour-based to cash-based maintenance

- At BIP we supported the newly registered WUA and helped to give it direction, by emphasising the need for rule-based water management rather than reliance on employing individual water guards, and thereby reduced water theft and introduced a rotational system. We promoted improved communication with other water users for encouraging better maintenance and reduced pollution of the canals.

SYNTHESIS OF FINDINGS IN CONTEXT OF INSTITUTIONAL DEVELOPMENT

Introduction

Through this process of DL/AP and water users' schools, we are developing a framework for promoting WUAs. We have identified six elements which we see as fundamental for this:

- Tailoring methods to local conditions: each scheme is different and needs solutions to be identified individually;
- Organizing our understanding: irrigation systems are complex and multidisciplinary - we need a comprehensive understanding without being overwhelmed in data. The Sustainable Livelihoods Framework is valuable for this
- Working with water users: we need to work with the users to involve them understand their issues and help them to develop an action plan. This requires an inclusive and participatory approach
- Investing in Social and Human Capital: through a "water users school" we have helped develop human and social capital and thereby enhanced development of the other capital assets. The nature of this school will depend on the needs of the individual scheme
- Providing O&M for institutions: WUAs will continue to need support
- Having a supportive policy and legal environment: implement policy and laws that enable the WUAs to carry out there function.

Tailor to Local Conditions

Irrigation is not simple and homogeneous: projects are all different and most have had a complex history, and have many facets. We have to recognize and work with this diversity, but we do need guidelines to help institutional development. In doing so, we should remember that:

- The guidelines should provide a framework – not a straightjacket
- We need a multi-disciplinary team to bring a range of perspectives
- The slate isn't empty – we must recognize the need to work with what is there
- We should adapt the timetable as necessary, and go at a sensible pace without being a slave to targets

It is easy for outsiders to forget that irrigation schemes have changed a lot within the memory of the direct stakeholders. The history of development of the scheme, past attempts at institutional development, and changes in policy and approaches all have an impact on local people which may be missed by outsiders who view the scheme at a single point in time.

Organizing Our Understanding

We have stressed the multi-faceted nature of irrigation – social, technical, institutional and agricultural. But we need to bring some order to this complexity. The sustainable livelihoods framework, illus-trated here, is very useful for this (IDS, 2003). This framework (**Figure 12**) is a useful and

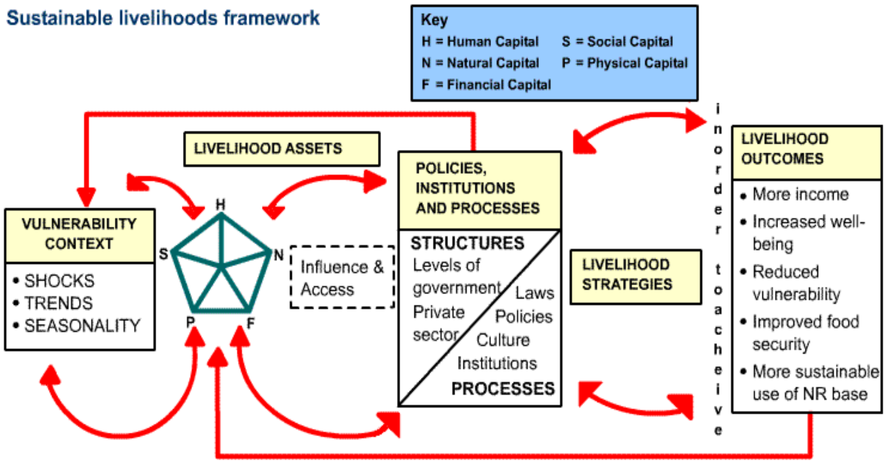

Figure 12: Sustainable Livelihoods Framework

powerful tool, but it is still unfamiliar to many field workers and they may be reluctant to use it. We have therefore attempted to simplify the application of the framework.

Our emphasis in the diagnostic phase was to understand the five assets and the vulnerability context from the perspective of different users so that we could gain an understanding of their livelihood strategies. This enabled us to identify, with the users, the key areas and methods for intervention during the water users' schools.

We presented this in a simple matrix to make it easier to understand and summarise:

- Human capital – education, knowledge/understanding, skills (agricultural, technical, organisational, financial), labour/time
- Social capital - values and norms, organisation, power
- Physical capital – access to infrastructure, standards of maintenance, appropriateness of design
- Natural capital – access to water and land, protection of resources

- Financial capital – income from employment, other economic activities, ability to contribute resources for management and maintenance
- Vulnerability context – seasonal variations in rainfall and, river morphology; agricultural prices and access to inputs; seasonal employment and migration; trends in community cooperation, etc.

Stakeholder Category	**Human capital**	**Social capital**	**Natural capital**	**Physical capital**	**Financial capital**	**Vulnerability Context**	**Contribution of Irrigated Agriculture to Livelihoods**
Poor - tail							
Poor – mid /head							
Poor female-headed households							
Medium							
Well-off							
Short term informal tenants							
Non-resident farmers							
Absentees							

The matrix provides a simple checklist to help verify that we covered the most important issues with each group. In some cases the information was indirect, or incomplete (such as for absentees), but the framework helps put all available information into context.

During the WUS stage, we targeted interventions at key areas which were identified in this, as illustrated below:

Human capital	**Social capital**	**Natural capital**	**Physical capital**	**Financial capital**
Awareness of programme and activities Skills in agriculture, institutional management, water management, infrastructure maintenance	Representation of stakeholders, development and application of rules, improved communication systems Collaboration on water management, cleaning canals, control of illegal outlets, field channels, etc Enforcement of	Better access to water (due to improved schedule, rotations, well-maintained canals etc)	Better maintained canals, existence of field channels	Ability to collect *bighatti* and manage resources transparently

	rules			

It is also possible to use a similar approach for evaluation of the impact of the school, and we can analyse the changes in assets, vulnerability and impact on contribution of irrigated agriculture to livelihoods for the same stakeholder groups using a similar matrix. The way that stakeholders have been able to enhance their assets, or recover from shocks and stresses will give an indication of the sustainability of the intervention in terms of the impact on their livelihoods.

Our focus in the water users' schools was on developing social and human capital (see section, which had an immediate impact on physical capital, through improved collective action on maintenance of infrastructure. Thus further notes on relevant aspects of these assets are presented below, together with comments on the institutional environment within which people lived and worked at the time of the DL/AP.

Human Capital

Human capital represents the skills, knowledge, capacity to work, and good health that together enable people to play a part in the good governance of the irrigation system, and to make effective use of the other four types of livelihood assets. Key aspects related to irrigation management include:

Literacy/access to public information about the activities and decisions of the water users' institution. Poorer households and women are more likely to be illiterate (25% female illiteracy cf 50% for male at SMIP, and 25% of households have no literate member (85% of these poor or very poor). Thus literacy must be considered for communication systems and training programmes

Knowledge (and skills to apply the knowledge) of the rules, procedures, technologies that apply to the operation and maintenance of the irrigation system and its institutions, and to the effective use and husbandry of the water resource. In the past, WUA training has had limited impact, as it has been brief and stereotyped, with little reinforcement or follow-up and no dissemination so the knowledge did not get beyond direct participants. It was mainly given to office holders, but made no provision for turnover in office holders. It was clear that despite some strengths in collective action and indigenous skills to run the irrigation system, there are significant weaknesses in knowledge/understanding/skills for institutional development and governance, including roles and responsibilities of members and officers, system financing; system operation and water management; infrastructure maintenance; and agricultural practices

Time/labour available to participate in the management of the irrigation system, since many stakeholders have other priorities and demands (e.g. migration, off-farm employment, household tasks) which compete for the time available to participate in irrigation management activities such as attending meetings, holding office, participating in training, keeping informed about system O&M developments, participating in *jhara / urdi*; etc :

Social Capital

Social capital relates to the formal and informal social relationships (or social resources) which contribute to desirable governance outcomes: These social resources are developed through investment in values and norms, organisations and structures; and power and processes.

Values, Norms and Rules for Good Governance. Communities of water users share norms, rules, and sanctions about how resources should be shared, and how they should organise themselves to use and manage the irrigation resource. This includes relationships of trust that facilitate co-operation.

Heterogeneity and migration may weaken social ties, although in some cases a mixed ethnic composition is seen to be a source of strength (probably related to the relative numbers in different groups, their duration in the area, and factors which encourage them to work together in other fields). In some groups there are customs and values that discourage women from speaking in public, and from influencing irrigation-related decisions. In many cases users have little sense of identity with the irrigation system – even in cases where they actually owned the system. Some individuals feel they are entitled to meet their full water demands rather than be obliged to share a limited water supply in an equitable manner. They believe it is the responsibility of a higher authority to supply sufficient water to meet everyone's full requirements.

There are few practically agreed rules. Responsibilities are ambiguously defined and may be contested – or even if defined they may be ignored. The WUA has no capacity or legal power for enforcement. Poor communication, financial recording and management contribute to unaccountability and lack of trust.

Organisations/Structures. Recognised and socially sanctioned water users groups/organisations in which relationships are governed by accepted rules and norms of entitlement, participation and spheres of activity are needed.

There is weak membership identity, as land holdings are fragmented in different areas, there are many absentees and short term unregistered tenants; and there is incomplete stakeholder representation. Although the legislation permits all users to be WUA members, the constitution restricts this to land owners (including absentees). This thus excludes sharecroppers (who have no formal right to land), landless water users and most women (since only 5% of land is registered in women's names). More recent constitutions (such as BIP) specifically provide for one male and one female member per household.

The structure of WUAs is standard and there is minimal stakeholder involvement in devising their institution. This is normally of a "nested" structure (although traditional irrigation tends to have a simpler, "flatter" structure), and this may not meet the needs of all parts of the system equally well – there was a gap at tertiary level at SMIP.

Power and Processes. All water users need to be able to have influence or exercise power, and to have claims, or obligation for support, from others.

The leadership is often disconnected, with limited water user involvement in initial selection of leaders and subsequent elections postponed. Decision-processes tend to exclude most water users, as meetings are irregular, decision-making processes are not transparent, and there is poor communication of formally and informally reached decisions. Individual connections often provide advantage and those who can, use personal relations to solve water needs. On a positive note, key individuals (who may be, but are not necessarily the WUA chairmen) are able to exert a powerful influence to influence performance of the system. Collective networks are not strong and there is little mutual reinforcement between the WUA and other community based organisations (CBOs).

These observations can be summarised in a matrix to put them into context of the system as a whole, as shown below:

Ranking	DL/AP Wellbeing Indicators	Social Capital/ Irrigation Institutions	% of Area farmed	% of HH
Landless Family				
Poor Family				
Middle class Family				
Wealthier Family				
Female headed household			–	

Physical Capital

Physical capital in the context of irrigation management cannot be considered in isolation. There are overlaps with social capital (for example how is maintenance organised, or canals protected) and natural capital (eg the need for infrastructure related to provide differing water requirements to suit land type and level). However, it is important to understand the nature and condition of the infrastructure in this wider context.

<u>Nature of infrastructure</u>. We need to understand the existing infrastructure in its developmental context, including history and changes in size, layout and design philosophy; expectations for farmers to construct certain parts (field channels, watercourses themselves); the size of the scheme; the type of design – including operational requirements and complexity; arrangements for alternative sources of water (wells, drainage, reuse/seepage); and understanding of the design principles by the users. At SMIP traditional small-scale FMIS were replaced by a flexible but incomplete modern large-scale system, which was then completed to a new design concept, yet still relying on farmers to build field channels.

<u>Condition of infrastructure</u>. Maintenance depends on institutional arrangements (division of responsibilities between DOI and WUA); willingness of users to collaborate in maintenance; resources that they can mobilise for this; the approaches they adopt for protection of canals, removing weed growth and sediment and structural repairs; maintenance skills. This may have different impacts on different users (perhaps according to their location and socio-economic status – although this is very variable). Standards of maintenance are often poor and vary according to the location in the system, and there have been many 'illegal' adjustments to the system (additional uncontrolled outlets, informal checks etc) at SMIP either because of perceived deficiencies (incorrect outlet location, inadequate provision of cross-drainage) or reluctance to commit resources to maintenance. Cattle

may also be grazed or crops grown on canal banks. At a local level, users may do just sufficient to keep the canal operational, but maintenance at higher levels is more likely to be neglected.

Institutional Environment

WUAs do not exist or operate in isolation. The internal structure of the WUA and relations between tiers of the organisation (and between individuals and the WUA) is discussed under social capital. In this section, the relations of the WUA with external institutions and the direct links between water users and other institutions are considered.

Joint management arrangements – the division of responsibilities, the clarity of and agreement with this, the resources available for discharging responsibilities. At SMIP there is some reluctance for the WUC to take on their formal responsibilities for canal maintenance, and all levels of the WUA consider that their resource base is inadequate for these tasks. They also reluctant, and perhaps have insufficient authority, to take on their role of policing water theft.

Relations with VDCs and DDCs, and role of VDCs in system management (both formally and informally). As there is no elected local government it is difficult to assess this at this stage. At SMIP the VDC is barely involved, and perhaps feels excluded. In other schemes the WUA chairman may also be a VDC member, but VDCs appear to take little formal role in irrigation management, despite the provisions of the local self-governance act. They are reluctant to take on responsibilities for fee collection, as they see this as an unrewarding task which may affect their ability to collect land revenue. DDCs have responsibilities which impinge on irrigation management – for example award of contracts for quarrying, which affected water acquisition at KUIS.

Informal local institutions. There are established local practises (known as *panchayati)* for resolution of minor conflicts in many places, which appear to be more important than the formal procedures through the VDC – although the individuals involved may often be the same.

Support services. Both the WUA and the farmers require a range of support services. The WUA needs support in institutional development, technical design and management. This is usually channelled through the WUA chairman and is not necessarily communicated much more widely – farmers at SMIP appeared not to know much about these interactions. Farmers may seek support directly from DOI, and are less likely to do this via. By contrast, links with DOA are on a more individual basis, and the DOA has its own network of lead farmers – connections between WUAs and DOA tend to be weak. WUAs may get assistance from many other agencies, and it appears that leaders are chosen partly because of their external connections and their ability to form these links. At KUIS, for example, the WUA had links with the Ministry of Water Resources, District Soil Conservation Office, the local MP, DDC/VDC members and others.

Work with Water Users

We stress the need throughout the programme to work with water users, to understand their situation, help them identify solutions to the problems they face and then implement these solutions. There are three steps to this:

- Diagnose the current situation - the first part of DL/AP;
- Develop an action plan – the conclusion of the DL/AP; and
- Implement the action plan – initiated and facilitated by the WUS, but continued after the end of the WUS by the WUA and the users themselves, possibly stimulated by some additional external support.

The framework described in section provides a convenient way to summarise the present situation, identify potential solutions, and target interventions (both during the WUS and afterwards) so that they have maximum impact on livelihoods.

Invest in Human and Social Capital

The key to improving irrigation management is to strengthen human and social capital, and to do so in a way that develops the other capital assets. It is important to note that different stakeholders may have different values or viewpoints – and this should be apparent from the livelihoods analysis described earlier. For example, rich farmers may not share the belief of others that they should share water in a equitable manner; landless people may anticipate that ultimately their views are not taken into account, and so may not consider it worth investing the time in participating in the programme.

The method of learning is important, and we stressed the need to:

- See learning as mutual and to be shared;
- Be aware of how people learn, both individually and collectively;

- Keep an open mind;
- Learn by doing;
- Encourage reflection and innovation;
- Maintain flexibility and openness; and
- Learn from unforeseen events and incidents.

Participatory learning methods are the most effective in this context, but it is important to remember the diversity of educational backgrounds and levels of literacy which affect willingness to participate and choice of techniques

Provide Continuing Support for Institutions

There is always a temptation to leave WUA too soon – one of the drivers for participatory irrigation management is to reduce the government involvement in irrigation, but this will not be achieved effectively with just a short programme. Although the WUS is a key element, there will need to be some follow-up – probably at a much lower level of investment. This still requires intermittent involvement and commitment to supporting the WUA, including technical backstopping and some training. This will have financial implications which must be budgeted for.

Supportive Policy and Legal Environment

Water users' associations do not exist in isolation, and their ability to function and continue to perform their role effectively depends crucially on their institutional environment. Policies and legislation are never perfect: progress towards the ideal is gradual. Two particular areas where responsibilities are unclear or contested are collection of financial resources for operation and maintenance, and dispute resolution. The WUAs have inadequate powers either to finance O&M or resolve conflicts. Although there are deficiencies in other areas, there is a greater problem with implementation of the policy than with the policy itself.

In general, there should be:

- Clarity and consistency of legislation;
- WUA should have sufficient powers and enforcement authority enable it to carry out its duties;
- Legislation and by laws which are suited to local needs and circumstances; and

- Supportive institutional priorities and incentives.

CONCLUSIONS

Although the initial review of WUAs carried out at the start of this project showed that they are often ineffective, the methods which were tested and have been outlined in this paper have been found to be effective as a way of strengthening management of irrigation projects. In particular, we have shown that:

- Institutional development for irrigation needs to be tackled very sensitively; it should be tailored to the needs of the individual project, and should not be rushed but with care WUAs can be very effective;
- Participation is essential, but it must be broadly based – without excluding some categories of stakeholders – and there should be a real involvement in decision-making
- The process of diagnostic learning / action plan (DL/AP) followed by a season-long water users' school (WUS) is a very effective way of strengthening WUAs. These build the commitment to participation in irrigation management, an understanding of the issues and ways to solve problems, and ensure that the process of institutional development is embedded in the community rather than being externally driven
- The DL/AP is short but of critical importance: irrigation schemes are different and face different challenges; it is difficult to understand them and to summarise this complexity in a way which is helpful for improving their management; and there are numerous stakeholders who need to be aware, informed and involved effectively. However, we did find that the methods adopted were effective in engaging the stakeholders and in gaining sufficient understanding of the system.
- The final output of the DL/AP took the form of a locally-specific action plan, but there were some common themes which led to our plans to develop human and social capital through the medium of water users' schools:
  - The need for technical support and training in a wide range of topics cutting across several domains
  - The need for a greater awareness of issues affecting the irrigation system (including roles and responsibilities, and the ways individual actions affected others)

- The need to take remedial measures themselves, which would depend on the users co-operating actively, which will depend on first strengthening or modifying social bonds and norms

- Through the method of running the schools (including minor schools) and the selection of participants, the WUS were effective in change perceptions significantly, and in a way which led directly into action in critical areas. The impacts varied according to the project, and there was a difference in emphasis in the three case study projects we worked on. For example:
  - At SMIP we developed the awareness and skills which would encourage shared values for making and following rules, leading to improved maintenance by the users
  - At KUIS we encouraged broader representation of users to enable a more equitable distribution of water, and on helped in managing the transition from labour-based to cash-based maintenance
  - At BIP we introduced rule-based water management rather than reliance on employing individual water guards, and thereby reduced water theft and introduced a rotational system.

- Continued low-level support will be needed to ensure the benefits are sustained, particularly in the following season to ensure that activities agreed at the end of the WUS are implemented. The WUS should be the first step in providing "O&M" for the institution – it is not sufficient simply to establish and give initial training to a WUA. This approach will also only work if there is a supportive policy and legal environment, where the policy and laws enable the WUAs to carry out their functions, and where government institutions support individuals and WUAs.

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SURFACE WATER MANAGEMENT AND POVERTY ALLEVIATION IN THE INDIAN SUB-CONTINENT

DIRK R.FRANS[1]

INTRODUCTION

The Research Context and Problem

Wars over water? In 1995 the then World Bank Vice-President Dr. Ismail Serageldin, in an interview in Newsweek, stated that *"Many of the wars this century were about oil, but those of the next century will be over water."* He added that he made these remarks in order to *"ring the alarm bell for the impending water crisis"*. Since then much has been said about how to avoid such a water crisis.

Serageldin of course looked at water from a global perspective. However for billions, living today, possible future wars are irrelevant as their main concern is surviving right now. Of the 2.8 billion individuals surviving on less than 2 US $ a day at the turn of the millennium, many face water related disasters. At the end of the last millennium 1.1 billion people lacked access to safe drinking water and over 2.4 billion adequate sanitation (UNESCO, 2003). In rural areas, where the majority of the poor live, poverty is often related to lack of food security, itself due to insecure access to water for irrigation.

Many industrialized nations have worked for generations to manage the quantity and quality of their water resources in a sustainable way. Compared with developing countries, industrialized nations are relatively well endowed with physical, social and financial 'capital' necessary to invest in sustaining their water resources. However, in the context of developing nations, that have much less 'capital' to work with, how does one organize water resources management in a sustainable way? Given the prominence of the nation-state, what institutional arrangements, from the international to the grassroots level, need to be in place to facilitate sustainable water resources management, and what are the major obstacles in doing so? And last but not least, how can direct stakeholders regain their lost voice in the water management decision making process, so that interventions are more useful to them to begin with (Cornwall and Gaventa, 2001)?

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[1] Freelance Participatory Development Advisor, The Netherlands.

Aims and Objectives

Within this overall, complex context, this paper focuses on the poverty alleviation potential of sustainable water resources management in the Indian Subcontinent. The overall goal is to identify the main institutional factors that enhance, and those that obstruct the process of making water resources management contribute to sustainable poverty alleviation. 'Success' is here defined in relation to and as perceived by the direct stakeholders and their livelihoods. The outcome of the research is expected to inform strategies for poverty alleviation through water management in rural areas of the Global South.

To ground the research in reality and to identify potentially positive factors, it focused on three relatively successful and sustainable water schemes, covering the local, meso and macro levels of each of those schemes. To get variety in the (inter)national level framework, schemes were taken from three countries in the Indian Subcontinent, one each from India, Nepal and Bangladesh.

STATE OF THE ART IN WATER MANAGEMENT

A Brief Historical Overview

While there was a lot of variety among early civilizations, they had one thing in common; they thrived where water resources were secure. Millennia later this basic fact was well summarized in the title of a publication called "*No water, no life*" (Orange, 2002). After the initial phase of hunting and gathering, mankind slowly moved towards agriculture and animal husbandry. Initially rainfed agriculture resulted in food production leaping forward. The new found food security triggered population growth, itself leading to specialization, accumulation of surpluses and socio-economic and administrative diversification.

Wittfogel, in his seminal book 'Oriental Despotism', describes how water resources management, food production, administration and systems of control and power constantly interacted with each other leading to some of the most complex ancient water management works and administrative systems (Wittfogel, 1957). From the time when mankind started recording history in writing, we know much more about the two-way interaction between water management and development of society. Among others this slow moving process is well documented for the last seven centuries in The Netherlands (Ven,1993).

In the last three centuries, water resources management has changed considerably due to the industrial revolution. In particular the availability of new power sources such as steam, internal combustion engines and electricity allowed interventions previously only dreamed of. Water in turn powered and facilitated part of the industrial revolution through water mills, navigation, cooling of thermal power plants and later electricity production through hydro power.

The Last Three Decades

If anything, water resources management in the last three centuries was engineering and technology-driven, which resulted in many large scale infrastructural interventions. Typically such interventions followed a project cycle approach as depicted in **Figure 1**.

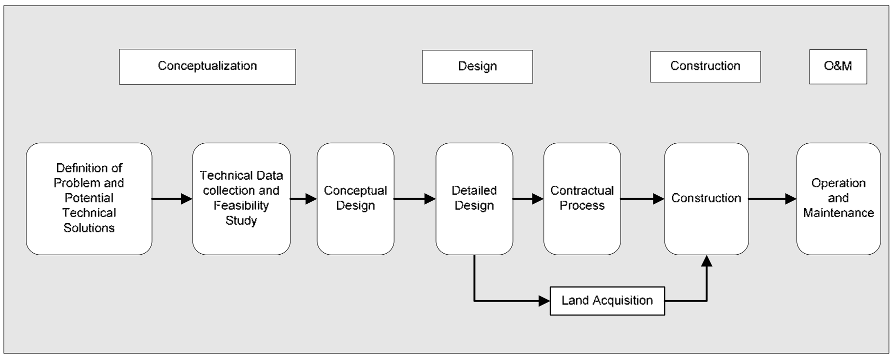

Figure 1: Traditional Engineering-driven Project Cycle Approach

The last three decades of the 20-th century saw a questioning of this approach along several lines. The main criticism was that it had major negative impacts on both people and the environment. For instance, a comprehensive review of the impact of dams concluded that in the 20-th Century worldwide 40-80 million people had been displaced by dams (World Commission on Dams, 2000). Many of these were not compensated and ended up poorer than before such 'development'.

One of the most telling examples of the environmental impacts of large scale water resources management systems is the case of the Aral Sea. In 1956 the former Soviet opened the Kara Kum Canal, which allowed large amounts of water from the Amu Darya River to be diverted into the desert of Turkmenistan to grow cotton. As a result, millions of hectares of land came under irrigation after 1960. In the early 1980's the devastating consequences to the Aral Sea and its surroundings became clear with the surface area reduced from 65,000 km^2 to 28,500 km^2 and the volume reduced by 75% (UNESCO, 2003[2]).

Furthermore, at the close of the 20-th century, it became painfully clear that traditional water management approaches had largely bypassed the world's poor. While impressively gains had been made in drinking water supply and sanitation, with over around a quarter of a million people gaining access every day during the 1999s (UNESCO, 2003), mainly the richer groups in society had benefit. A series of international conferences such as the UN Conference on Water at Mar de Plata (1977), the Earth Summit in Rio de Janeiro (1992) and the three World Water Forums (1997, 2000 and 2003) finally succeeded in placing water on the world's development agenda, clearly linking water to poverty alleviation and environmental sustainability.

Main Issues

Given this international context and the purpose of this research (see above), there are three major issues:

- how to bring the high ideals expressed in international water management debates down-to-earth;
- how direct stakeholders can regain their voice in decision-making about water management, and
- how to make sure that the poor in particular benefit from improved water management.

These three issues have guided the research.

RESEARCH CONCEPTS AND FRAMEWORK

Society's Structure

To analyse the questions posed above, this research uses a number of research concepts, brought together in a framework. The first concept is that of the structure of society. While individuals no doubt play a role in what does and does not happen, it is one of the fundamental assumptions in sociology that the way society is structured plays a major role. Marx, quoted in Layder, said that *"people make their own history, but not in circumstances of their own choosing"* (Layder, 1994) and this summarizes reality quite well.

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2 For more details on the other environmental impact, see http://www.american.edu/ted/ARAL.HTM

How then should we see those ‘circumstances’ in which individuals act? Those ‘circumstances’ are captured in the sociological concept of ‘structure of society’. Structure is defined as “*the interrelation or arrangement of parts in a complex entity”* while society is *“both an identifiable cluster of socially constructed individuals, institutions, relationships, forms of conduct, material and social practices and discourses that are reproduced and reconstructed across time and space, and the conditions under which such phenomena are formed”* (Johnston, Gregory et. al, 2000) . For the purpose of this research that ‘society’ is rural society in the Indian Subcontinent at the turn of the millennium.

Human Agency

Some theories, in particular structural Marxism, give the impression that individuals have to no freedom of action; everything is determined by the structure of society, i.e. by the system as a whole. Many social scientists disagree with this deterministic view of society and stress that individuals and groups of people can and do cause change. They argue that the ‘system’ is nothing more than the collection of individual actions and that the stress should therefore be on the individual. In this ‘macro versus micro’ debate the capacity of individual beings to make a difference in their own lives and that of others is often referred to as ‘human agency’. This is the second research concept used in this research.

Structuration Theory

There is an ongoing debate among social scientists about how the structure of society and human agency are related. This debate, often referred to as the macro versus micro debate, has led to various theories, among them the structuration theory of Giddens. The core of Giddens’ theory is that he does away with the idea that human action and the structure of society are completely separate entities. In other words, he rejects the dualism that many social scientists have assumed exists between the two levels of analysis. Instead Giddens sees ‘structure’ as implicated in action, as nothing more than the continuous series of actions through which it is both reproduced and transformed (Giddens, 1984). Human agency and structure therefore form a ‘duality’, the opposite sides of the same coin. In this research structuration theory is used to investigate to what extent grassroots experience feeds back into the structure of society and related policies, guidelines and institutional structures.

Sustainable Livelihoods Framework

In this research people at grassroots level are central. The 'success' of interventions is measured in terms of positive change in their lives and livelihoods. The research uses the sustainable livelihoods framework, defined as: *"A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base."* (DFID, 1999) The research used the livelihoods framework to analyse the impact of external water resources management interventions on the various aspects of lives and livelihoods at grassroots level.

Relevant Perspectives

Finally, the research is informed by two more perspectives, namely governance and that of institutional transaction costs. Governance and related concepts such as fairness are relevant because they help see water management in the wider context of how society is governed. The theory of institutional transaction cost looks at how difficult it is for people to work together to achieve things that individuals cannot achieve on their own.

Research Framework

The above mentioned concepts and theories are interrelated as shown below in **Figure 2**. The framework, like all models, is a simplification of reality, but seeks to capture the main linkages. In the framework the external intervention is central. The basic flow is related to structuration theory and depicts the flow from the top, through the external intervention, via the livelihoods framework to 'outcomes' and then through human agency back to the structure of society.

The external intervention is usually designed to directly impact the livelihood capitals and vulnerability context of local people. If all goes as intended, the outcome of these impacts is an increase of income of the local people which they can use in a number of ways (bottom of the figure). Usually people consume a considerable part of the income they earn. People normally reinvest part of their income, through locally applied human agency, in the various livelihood capitals at household level, i.e. their physical, human, social/institutional and financial assets. People invest another part of their

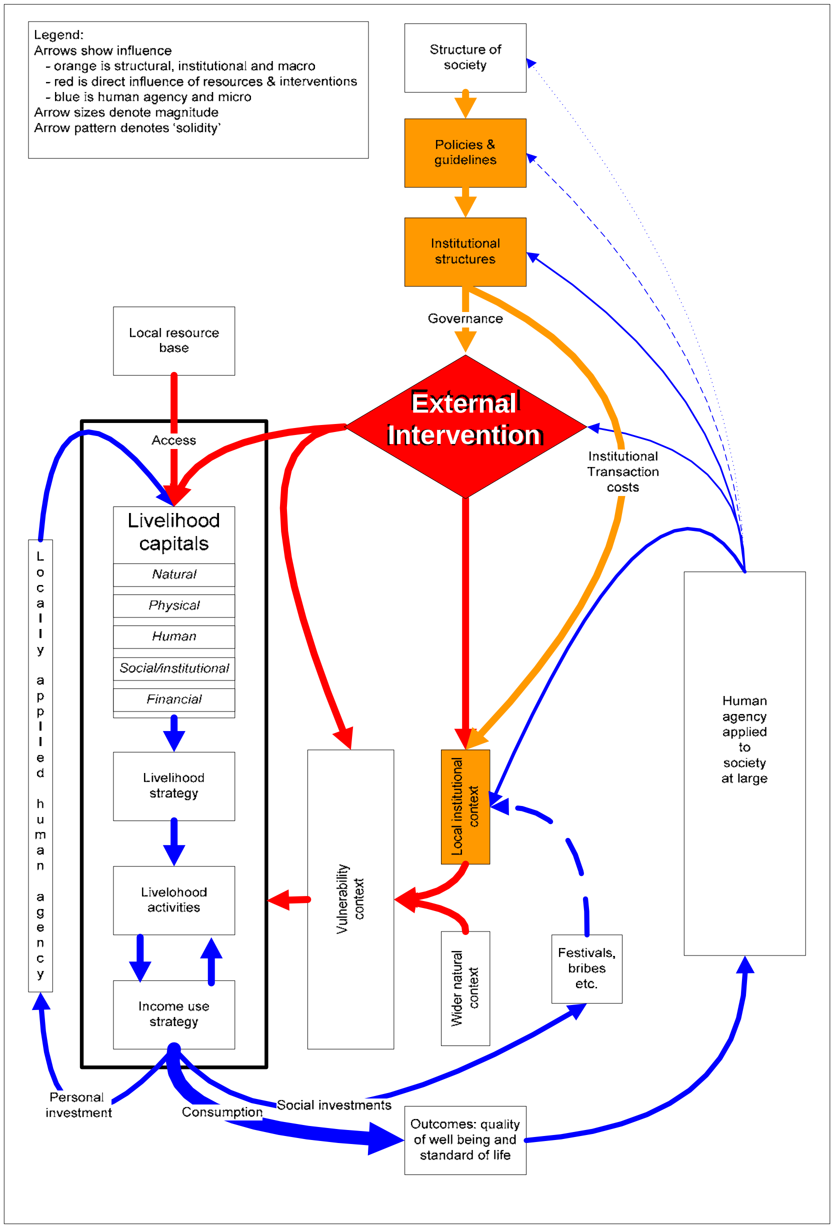

Figure 2: Research Framework: Livelihoods Framework, Structuration Theory and Human Agency

income in local social areas, such as festivals, bribes etc. This normally results, via the local institutional context, in a reduced vulnerability context.

Finally part of the income is 'invested', through human agency applied to society at large, in what is the feedback loop of the structuration process. Normally the effectiveness of this type of human agency is highest where it is aimed at influencing the local institutional context, somewhat less when aimed at 'redirecting' the external intervention and even less when targeted at the institutional structures, policies and guidelines and finally the structure of society.

RESEARCH METHODS

Qualitative and Applied Research

This paper is based on research which seeks to explore, to understand. Therefore it follows a qualitative and applied research methodology. In line with Maxwell's approach (Maxwell, 1996) the research design is interactive in the sense that it dynamically links the research questions, with on the one hand the purpose and the conceptual context and on the other hand the methods used and the validity of the data.

In the fieldwork three methods have been used:

- Open-ended interviews are central to the research, giving the perspectives of the key stakeholders;
- Document analysis is used to complement the stakeholder's view by the 'official' or 'formal' view;
- Direct observations are used to verify statements, facilitate interview selection and compare cases.

Data Validity and Reliability

Qualitative research requires particular care to ensure data validity and reliability. Of crucial importance is the perspective of the researcher and transparency concerning his/her points of view. In this case the author is a middle-aged, male westerner with what Hoekstra calls an 'egalitarian worldview' (Hoekstra, 1998), who has lived and worked in the Indian Subcontinent for over 17 years.

During the research, iteration and triangulation have been used to ensure the reliability of the study. Iteration was applied in particular by making three separate research trips to each of the three case studies. The first trip focused on collecting documents and interviewing a few key informants. After analysing the data, the author drew up the list of interviewees and main questions. After analysing those interviews the author wrote up and analysed his findings and drew tentative conclusions. During his third field trip, the author presented these findings and conclusions to the key stakeholders for verification and feedback. Only then was the report finalized and did the researcher make an analysis across the three cases, synthesizing the findings.

Triangulation was used by selecting three different methods of research, by choosing schemes from three slightly different yet similar backgrounds and by verifying findings from interviews of the various stakeholders and other sources with each other.

Research Case Selection

The three water resources management schemes studied were selected on the basis of four criteria, namely that the schemes must be:

- among the best in their field, indicating what is possible (though not yet probable);
- informative about the whole institutional context, i.e. including the national level policies, laws etc;
- comparable, i.e. from a similar context such as from three countries in the Indian Subcontinent, and
- relatively easily accessible and also well documented from an institutional point of view.

By interviewing experts with an overview of water management schemes in India, Bangladesh and Nepal, for each country a list of ‘successful’ schemes was drawn up. These criteria were then applied and this led to the selection of the following three schemes:, in Bangladesh Polder 55/1 in Pathuakhali, in India the Marrimakulapalli Watershed in Anantapur (Andhra Pradesh) and in Nepal the Andhi Khola Irrigation Scheme in Syangja district.

CASE STUDY FINDINGS

Polder 55/1, Bangladesh

Polder[3] 55/1 protects an inland island of roughly 12 by 8 km, in the delta area in the south of Bangladesh about 35 km north of the Bay of Bengal. The polder was one of the first of 140 polders built since the end of the 1960s in an effort to prevent the loss of life and property from flooding seen regularly before empolderment. The infrastructural works consisted of a 45 km long embankment, as well as drainage and flushing sluices.

The implementing agency was the predecessor of the Bangladesh Water Development Board (BWDB), a governmental engineering agency. Its setup was different from other government agencies in that its divisions followed hydraulic rather than administrative boundaries and in as much as its Chairman was of the same status as the then Governor of East Pakistan. The BWDB has been described as ‘a kingdom within the kingdom’.

During the initial infrastructural works, local people had no role, or, as one interviewee described it: *“the role of the people was to stay out of the way”*. Only during the 1990s, following donor pressure and the emergence of a competing government agency, the Local Government Engineering Department (LGED), the BWDB started to change its approach. It is slowly becoming more participatory and also interested in cooperating with other development agencies. Broadly both agencies now follow a project development process similar to that developed by LGED under the Small Scale Water Sector Development Project (Frans, Akhter et. al, 2000) shown in **Figure 3**.

The original empoldering had a major positive impact on the security of life and property of those living inside the embankment. Agriculture too benefited much as the pre monsoon and monsoon rice crops no longer faced ruin by saline water intrusion. Landless household benefited from the increased volume of work in agriculture and for a while the area shifted from out-migration to in-migration of labour. Subsistence fisheries suffered as the inland waters were disconnected from the surrounding rivers but professional fishermen found alternative fishing grounds in the adjacent rivers.

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[3] The Dutch word “*polder*” refers to an area enclosed on all sides by an embankment with in- and outlets to control the water inside the embanked area. “Polder’ is now part of the Bangladesh water sector vocabulary.

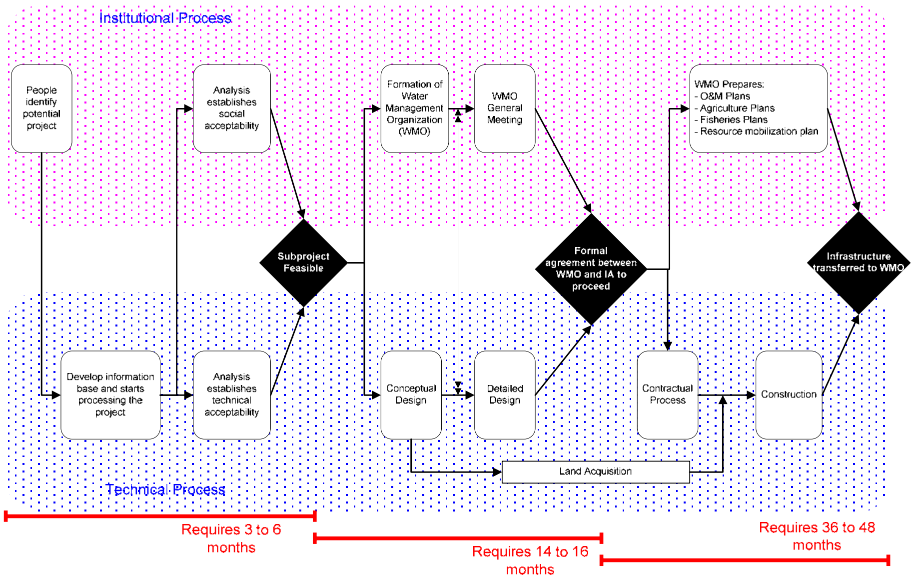

Figure 3: Combined Technical and Institutional Development Process (SSWRDSP, 1997)

After a decade or so, lack of water management arrangements and maintenance led to water logging and saline water intrusion and agricultural production declined. In the mid 1980s a rehabilitation project tried to solve these problems, aiming at a combination of infrastructural and 'software' measures. The hardware improvements lasted for quite a while but the new, participatory management arrangements stopped almost as soon as the project finished. As a result the benefits remain unsustainable.

Following a taxonomy of failed projects outlined by Gisselquist (Gisselquist, 1991) the field work suggests the following. The project's basic concept of empoldering was and still is sound as was the technical design. Construction quality was up to the mark, but the scheme in its totality fell short due to lack of operation and maintenance.

The main findings from Polder 55/1 are:

- polder planning and design was too narrowly focused on protection from flooding and on monsoon crops, overlooking the fact that people’s lives and livelihoods are multi-dimensional and changing ;

- the lack of institutional arrangements of direct stakeholder participation led to lack of O&M;
- BWDB’s lack of cooperation with other development agencies led to many missed opportunities.

Marrimakulapalli Watershed, India (AP)

Marrimakulapalli watershed covers 2,260 ha in the semi-arid district of Anantapur of Andhra Pradesh (India) close to the boarder with Karnataka state. The average rainfall is only just over 500 mm per year and lack of water resources characterizes the lives and livelihoods of the local population.

An NGO, Rural Development Trust, has implemented a participatory watershed development programme in the village since the mid 1990s. Two things are particularly noticeable in this scheme. First of all the NGO started its multi-facet development work in the area in the 1970s, long before it got into watershed development. Secondly the NGO interventions in Marrimakulapalli watershed went much beyond water, covering a wide variety of activities and thus simultaneously enhancing people’s human, social, physical and financial capital. This broad approach of RDT is referred to as the ‘watershed-plus’ approach.

Before the mid 1990s RDT was also involved in watershed development in the same village. At that time, the approach was not really participatory. A change in the government guidelines prompted the change towards more participation. Since then the direct stakeholders have been organized into various institutions, amongst them a Watershed Committee (WSC). Through this WSC, direct stakeholders have been involved in the different stages of watershed development.

Scheme impacts can be divided between short and long term impacts. During construction, many landless and small and marginal farm households benefited considerably from the cash they earned working on the infrastructure. As middlemen were left out of the loop and the WSC supervised the quality of the work, cost was much lower than in similar schemes implemented through the traditional governmental procedures. As such the project had a major impact on poverty alleviation.

The field work suggests that the basic concept of the Marrimakulapalli watershed programme, reducing people's vulnerability to lack of water, is sound. The participatory design of the watershed programme too leaves little to be desired as is the case with the participatory implementation. It is as yet too early to evaluate the sustainability of operation and maintenance. Indications are that individual activities will survive but that joint and communal activities might be less sustainable.

The main findings from Marrimakulapalli watershed are:

- water resources development can be a good entry point for pro-poor, all round rural development;
- the development of institutions is crucial to long term development;
- a participatory approach yields benefits through more appropriate selection of interventions, better targeting and increased efficiency.

Andhi Khola Irrigation System, Nepal

The Andhi Khola Irrigation System in Syangja district, in the mid region and mid hills of Nepal has a command area of 282 ha. As in many similar areas of Nepal, agriculture in the area in the 1980s was rainfed and partly dependent on irrigation from small natural springs. The irrigation scheme uses surplus water of the hydro scheme securing water for the pre-monsoon and monsoon crops. During the lean season, a limited but crucial amount of water is used to facilitate a winter crop.

The scheme was implemented by an international NGO, the United Mission to Nepal (UMN). UMN is one of the oldest and largest NGOs in Nepal. In the 1970s and 1980s UMN was involved in both rural development and small hydro projects. However, the focus of UMN and its foreign donors was on the poor and therefore the original Andhi Khola hydro scheme as only hydropower scheme was dropped as not being pro-poor enough.

The UMN staff then proposed to broaden the hydro scheme to include an irrigation and a rural development component, aiming to bring some benefits to the local people rather than only supplying electricity to more urbanised settlements through central grid. Furthermore special provisions were made to benefit the poor, namely land redistribution and a water-rights arrangement based on labour input in the construction of the irrigation infrastructure. The latter replaced the more common arrangement in which water rights are proportional to land ownership. Finally the scheme involved arrangements through which the beneficiaries would pay all O&M expenses as well as repay the original investment in infrastructure over time. With all these innovative equity provisions the scheme was then approved by UMN and financed by NORAD.

The impact of the irrigation scheme on agricultural production was significant. Before the scheme was implemented, lack of secure water supply had clearly become the main bottleneck to increasing agricultural production. With irrigation secured in two seasons and a minimum supply secured in the dry seasons, agricultural production went up to 3-4 times. Partly due to these high returns, the irrigators are able and willing to pay the very high O&M cost per share as well as repay the original investment.

Not only farmers benefited, but labour households as well. Before the scheme, up to 40% of the men migrate out of the area in search for work, but after implementation, increased agricultural production led to much additional employment and a reduction in out-migration by half. However, the special pro-poor provisions were less successful than planned. The land redistribution, which should have been completed before construction started, was delayed by a decade and is technically still incomplete. While the aim was that 50% of the work would be done by landless households, earning 50% of the water rights, the actual achievement was only a few percent.

The direct stakeholders operate and manage the irrigation scheme through a three tier system of committees. While they do so effectively, the control over the irrigation system has fallen into the hands of the local elite. As a result the poorer farmers tend to receive less water than they are due while they pay a relatively larger share of O&M expenditure.

Overall the concept behind the schemes, reducing the vulnerability of farmers to ensure a stable water supply is valid. The 'foreign' equity provisions introduced by UMN have however not fared very well. The design of the scheme's infrastructure is rather high-tech, making use of pipe-bridges made of Indian materials and seals. While they reduce immediate maintenance they will make the scheme expensive to maintain once they are worn out.

The Andhi Khola Irrigation Schemes yields the following lessons:

- irrigation schemes can increase agricultural production considerably making it possible for farmers to pay not only O&M but also repay the original investment over time;

- introducing ‘foreign’ ideals in a different socio-economic and cultural context is possible but the chance of success and sustainability is low;
- the development of local capacity to operate and manage irrigation schemes is crucial to their success and sustainability.

CASE STUDY ANALYSIS

Polder 55/1

The structure of society in the coastal belt of Bangladesh is basically still feudal and the underlying worldview is still widely held. The government system in the area has only slowly become operational and the lack of law and order make the poor lay low. Corruption and misuse of power are widespread and transaction costs are high. Many of the BWDB staff are ‘detached’ from rural live and reality. These different elements of the structure of society explain to a large extent why the elite have managed to control the water management infrastructure to their own advantage for all but a brief period in the 1990s during the Systems Rehabilitation Project.

There are many signs of human agency in Bangladesh. However, most of the action is to the benefit of a few and at the expense of the masses. Because of the high institutional transaction costs, most Bangladeshis have little faith in joint action and opt for individual action. Shallow tubewells and micro credit are the positive examples of this, lack of participatory operation of polders is a negative example.

The water sector related structuration process seems to suffer from a glass ceiling which prevents the voices from the grassroots level being ‘heard’ by those with the power to change policies, strategies and guidelines. This is quite obvious not only in the BWDB, but also in slightly more people-oriented agencies such as LGED. While all water sector donor subscribe to participation, some donors suffer from an apparent inability to adjust their approaches and internal procedures and criteria to the reality in the field and to real participation.

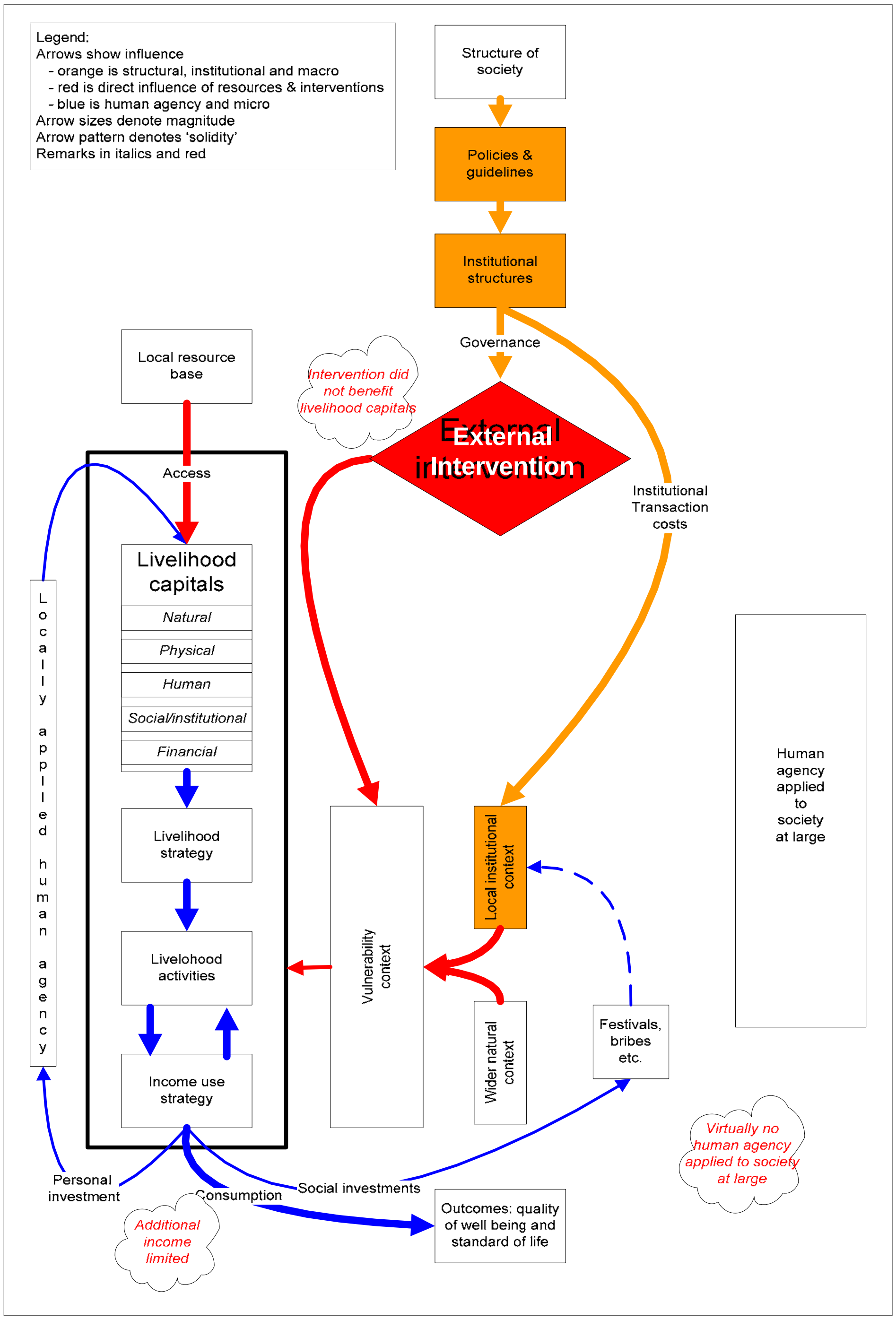

Figure 4: Actual and Broken Links in Polder 55/1

From a livelihoods perspective, it is clear that empoldering has greatly reduced the vulnerability of the inhabitants of Polder 55/1 to the havoc and destruction caused by saline water intrusion, floods and cyclones. Apart from the very little has been done to improve the other elements in people's livelihoods so that they could make better use of the improved security. As a result, there has been too little lasting benefit and this in turn resulted in a lack of commitment from local people to operate and maintain the infrastructure.

Land acquisition in Polder 55/1 is a classic example of poor governance. Not only was far too much land acquired but the process of paying compensation took far too long, lacked transparency and resulted in hundreds of families receiving far less than they were due by law. The set-up of the BWDB, detached from the other government agencies and a law unto themselves too bode little good for governance. Also in other areas such as corruption, lack of law and order and the disjointed system of representative governance in Bangladesh much needs to change to achieve good governance, one of the stated aims of the government and the donors (ERD, 2003).

In the case of Polder 55/1 few of the links defined in the research framework have worked out. While the external intervention did considerably reduce the vulnerability context, the livelihood capitals of the direct stakeholders remained virtually unaffected. As a result the extra income was limited and so were the investments. Because of the structure of society, the human agency applied to society at large was all but absent as was the bottom-to-top feedback of the structuration cycle. A graphical presentation of the actual and broken links is given in **Figure 4** above.

Marrimakulapalli Watershed

The structure of society in Marrimakulapalli is a-typical for India in that there are few caste differences. While there are class differences, the elite are relatively benign and interested in development of the village as a whole. Due to years of drought the economic position situation of the farmers has deteriorated as many are unable to repay the loans they took for cultivating crops. Labour households on the other hand have been able to make maximum use of the lucrative infrastructural works contracts. Local culture, including a gender bias and the treatment of certain individuals as 'gurus' is visible even in the NGO. Corruption in government circles is still rife as is a dependency mentality amongst the poorer villagers who look to government and non-government agencies for assistance.

Many interviewees have mentioned examples of human agency. There is a link between the ability of individuals to exert human agency and their socio-economic position in society; those higher up the ladder are usually able to apply their human agency most effectively. People are well aware of what they expect of their leaders and they see many desirable characteristics in the NGO staff. The NGO leadership has achieved much through their commitment to the poor, their example and their hard work. Negative human agency, such as seen in corruption and dishonesty are also found in and around the village.

Marrimakulapalli is no longer isolated as it was in the past. People now feel the impact of GoI and even WTO decisions. At the same time there are examples of the structuration process working from bottom to top for instance through the inclusion of the RDT director in a government committee revising the state guidelines on watershed development. However, recently developed watershed guidelines from the national level seem to overrule this feedback from the grassroots. Functional groups in the village too facilitate the structuration process by on the one hand giving government agencies an easy entry point in the village while also giving villagers scope to give the government agencies feedback on their activities in the area.

From a livelihoods perspective the Marrimakulapalli watershed programme is very informative. Over the centuries the local people have done a wide variety of things to make the most of the rather difficult local physical conditions, particularly water shortage. Labourers used to be 'bonded' but have become 'free' over the last few decades and many have made use of the employment opportunities created by the watershed programme. With the active support of the NGO, households have been able to simultaneously increase their human, social, physical and financial capital. Overall the livelihood assets of the people in the watershed have increased as have their livelihood options.

The Marrimakulapalli watershed committee shows many signs of good governance as the members know what they want, impose fines on those who violate agreements and have become more and more independent from the NGO. The village also benefits from a number of other local functional committees through which the village affairs are managed. Interviewees highlighted the corruption which is rife in government agencies. People are hopeful that pressure from above and below will gradually reduce the level of corruption and increase the usefulness of government programmes.

In Andhra Pradesh the absence of a well functioning local and to some extent state government system means institutional transaction costs are high. NGOs have tried to fill the vacuum and the best, such as RDT, have been able to lower

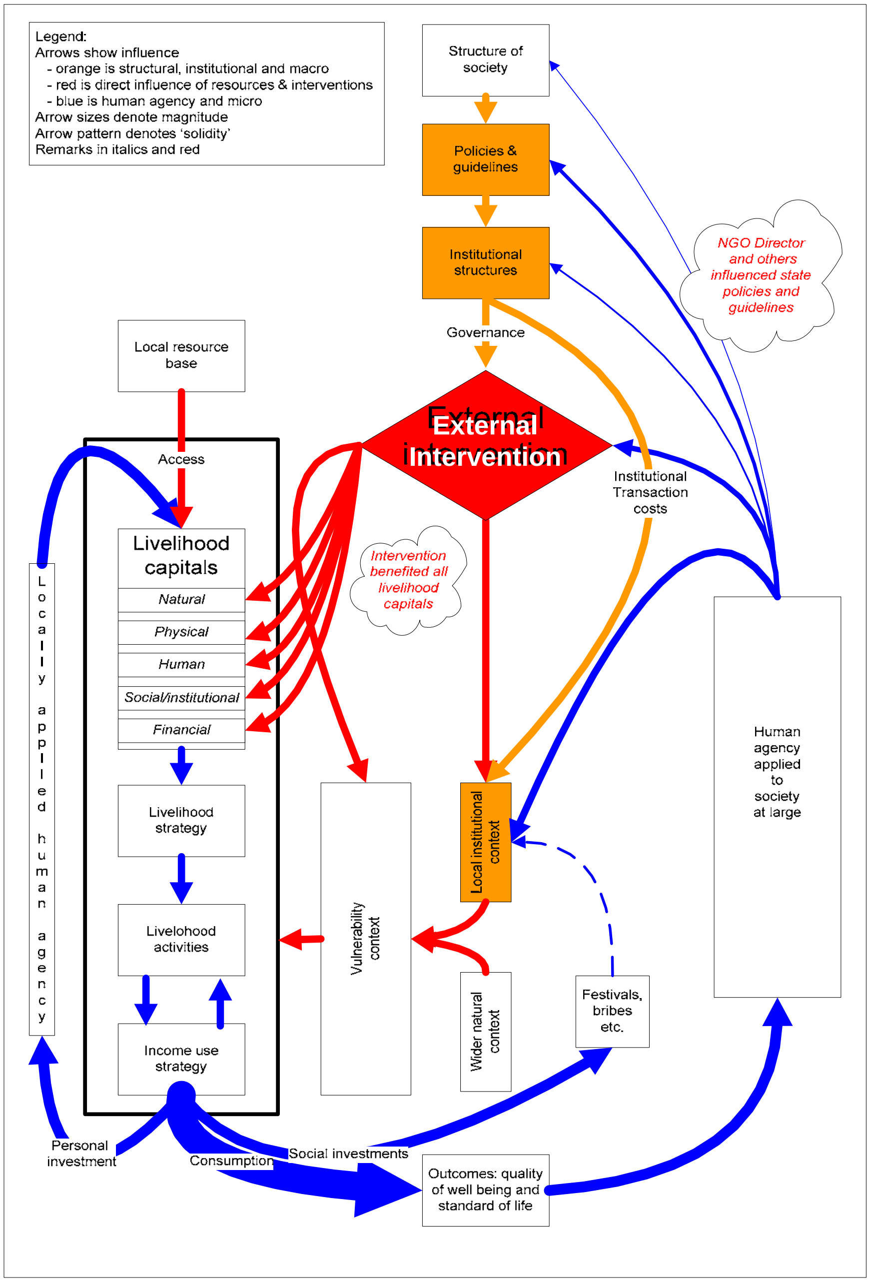

Figure 5: Actual Links in Marrimakulapalli Watershed

the institutional transaction costs. However, many so called NGOs that have sprung up only use that name as a front. The favourable climate for NGOs was partly due to support from the Chief Minister. Whether this will continue following the 2004 elections is to be seen.

In Marrimakulapalli watershed is an example of a case where many of the links in the research framework have actually worked out. Most obvious is the fact that the external intervention improved not only the vulnerability context but also all five livelihood capitals. This led to considerable extra income, investments and levels of human agency. Via the Director of the NGO, the human agency applied to society at large has even resulted in more appropriate policies and guidelines. Marrimakulapalli is thus an example of the bottom-to-top feedback loop of the structuration cycle. **Figure 5** above presents the analysis of the case graphically.

Andhi Khola Irrigation Scheme

In the case of the Andhi Khola Irrigation Scheme, the worldview of most people and the structure of society is heavily influenced by caste thinking and the view that the status-quo is pre-ordained (Bista, 1994). This view suits the elite, who are in control, quite well and they like this to continue. When the implementing NGO tried to introduce new, more equitable values without much effort to mobilize the poor, the elite more or less successfully sidelined these efforts.

The scheme yields examples of both human agency and the lack of it. A number of local and international individuals played a crucial role in getting the scheme approved and implemented. In the process those with a more social orientation, concerned about developing institutional capacity before getting into construction were clearly overruled by the engineers, the donors and the government, who all wanted to ‘get on with the work’. In two adjacent areas the people want the scheme to be expanded. In one there is an individual to lead the process, in the other none. Human agency is also visible in the way vested interests try to ‘re-write’ government guidelines to make them less participatory and ensure that agency staff remain in control.

The Andhi Khola scheme shows few signs of the structuration process. This is most likely the case because the driving forces were related to a foreign worldview, policies and institutions while the local institutional arrangements more or less stayed out of the picture. Nevertheless, the scheme did not operate in a total vacuum as farmers are well aware that they pay far more for their irrigation water than farmers from government sponsored irrigation schemes. Indirectly the scheme might contribute to the bottom-to-top feedback loop of the structuration process as one of the leaders of the scheme has been instrumental in setting up the 'National Federation of Irrigation Water User's Association, Nepal' (NFIWUAN, 2000).

The livelihoods perspective helps explain why some households benefited considerably from the scheme while others did not. While the assumption was that landless households would do most of the labour, earning water shares in the process, most of them apparently found the process to risky. Time has proven them right as the market for water shares has not developed and many shares are not used. The livelihoods framework also helps to explain why the poor were slow in reaping the benefit of irrigation; they lacked access to the capital necessary to invest in levelling their sloped fields to make them fit for irrigation. The better off farmers cleverly made use of their superior social capital in the form of connections with those on the various irrigation committees. As a result they got more water than they were due and paid less for O&M than they should have. Water in the command area is not only used for irrigation but for a wide variety of domestic and productive activities.

Also from a good governance perspective the scheme is interesting. Formally the scheme fulfils all the legal requirements; the committee is registered, books are maintained, audits done and AGMs held. However, the committee has not hesitated to break its agreement with UMN concerning repayments and when questioned about that a leader in Andhi Khola Water Users Association (AKWUA) laughed and said *"they cannot do anything about it!"* Furthermore the actual water delivery differs from the official volume with the better off households receiving more and the poorer households less than they are due. However, the actual delivery figures are not known to the farmers, only to outside researchers (Van Etten, Koppen et. al, 2002) and the AKWUA leadership.

In the absence of equitable irrigation arrangements the NGO tried to impose foreign values but this was unworkable due to high institutional transaction costs. Farmers are reluctant to join branch committees because it is very time consuming to manage water delivery at that level. Adjacent areas that want to join the scheme have until now not been successful, not least because of the very high institutional transaction costs involved in finding the necessary capital to invest in expansion of the irrigation infrastructure.

Andhi Khola Irrigation Scheme is an example of a case where the external intervention has been quite successful in improving some of the livelihood capitals, resulting in a substantial increase in income and as a result

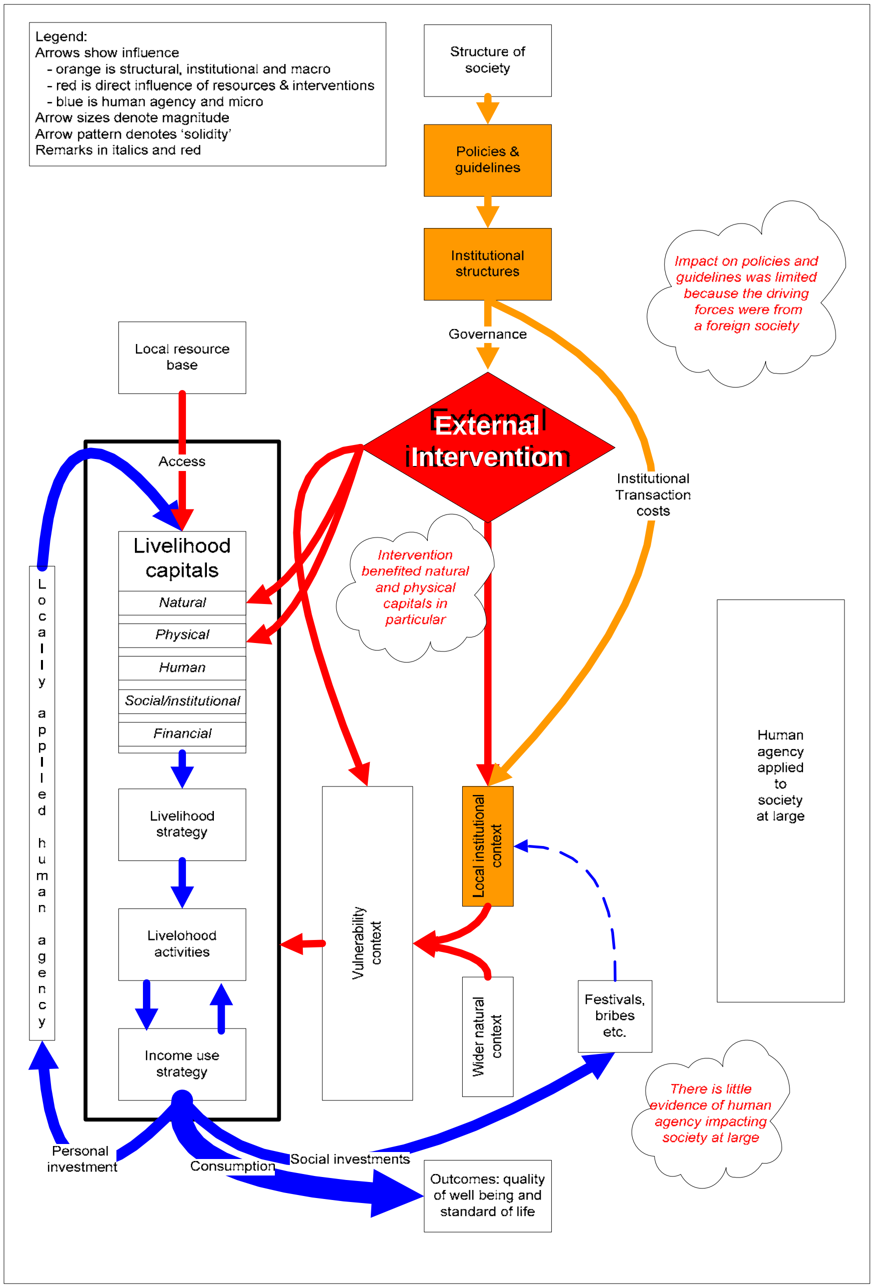

Figure 6: Actual and Broken Links in Andhi Khola Irrigation Scheme

considerable human agency has been applied to keep the system operation. However, at the same time there is little evidence of human agency impacting society at large while there is virtually no upward structuration link at all influencing institutional structures, policies and guidelines or the structure of society. This linkage is absent because the driving forces in the scheme were related to a foreign society and they were not locally embedded (**Figure 6**).

CROSS-CUTTING AND SYNTHESIZING ANALYSIS

Structure of Society

From the case studies it is clear that the structure of society is a determining factor when it comes to what can and what cannot be achieved. If removing crucial bottlenecks in people's livelihoods through water resources management involves going against the prevailing structure of society, then short term success is possible, but sustainability doubtful. Sustained support of the necessary changes in society will be needed to ensure sustainability. In other words, if better water management involves going against the structure of society and the prevailing culture, there are no quick-fixes.

Human Agency

In all three case study areas people were, and to some extent still are, faced with a hostile geographical environment. In those circumstances, particularly when it comes to sheer survival, human agency is all present. In those circumstances it is also relatively easy for people to overcome differences and work together. However, when survival itself is no longer at stake, human agency seems available only to the happy few who have the social, institutional, physical and financial resources to put their ideas into practice.

Structuration Perspective

Overall the three cases highlight that from a structuration perspective of the water sector in the Indian Subcontinent, there is a clear discontinuity between the grassroots and policy making level. In one sense this is not surprising as structuration theory has been developed in a totally different setting, namely the rather democratic and well organized institutional setting of socialist/capitalist Britain. While structuration theory does throw some light on where the bottlenecks are, it has little to offer in the way of solutions.

Livelihoods Perspective

In the three case study schemes, improved water resources management has reduced the water related vulnerability of the population. As such the schemes are crucial because they create the preconditions for survival and lay the foundation for local people to improve their livelihoods. However, the three cases also overwhelmingly show that while improved water resources management is a necessary precondition for households to develop, on its own such an improvement is insufficient to improve livelihoods. Much more is needed, particularly productivity enhancing inputs, for people to make use of better water management to improve their livelihoods. The livelihoods perspective also highlights that the necessary additional inputs are not only material, but social and institutional as well. If the productivity enhancing facilities are available but certain sections of society lack access, then those facilities are of no use. In summary, the livelihoods perspective draws attention to the fact that a narrow, water resources management approach is unlikely to be successful in improving people's livelihoods or be sustainable. To achieve lasting benefits, water management must be part of a much wider approach in which "all routes matter" (Government of the People's Republic of Bangladesh, 2002).

Governance

When it comes to 'good' governance, much remains to be desired in both Andhi Khola and Polder 55/1. In both schemes the elite are in control using the new water resources management infrastructure to their own advantage. In Marrimakulapalli there are more indications of good governance, including the fact that the poor have both a place and a voice in deciding on water management issues. In Nepal and in Andra Pradesh (A.P.). changes in society in general pertaining to good governance are slowly creating a more favourable environment for transparency and accountability of those in power.

Institutional Transaction Costs

Much of what to an outsider seems possible in the water sector in the Indian Subcontinent is not achievable in practise because of the high institutional transaction cost. There seem to be few internal forces that drive towards lowering these transactions costs. Outside forces, such as externally funded NGOs and/or donors funding large-scale interventions, can temporarily ensure a certain level of compliance and/or fulfil the role of a third party enforcing agreements between the main parties. It seems that a major shift in the current cost/benefit ratio of water resources management will be needed before the institutional transaction cost is lowered enough to make large-scale interventions sustainable.

Obstructing Factors

Summarizing the analysis, three factors stand out as obstructing improvements towards successful and sustainable rural livelihoods through improved water resources management:

- Lack of time, before and during construction, to develop and nurture the institutional side of water resources management;
- Lack of real people's participation, i.e. decision making influence, by the direct stakeholders at both the scheme and the policy/guideline level;
- Implementing agencies not geared up to ensure high quality, multi-disciplinary development.

Enhancing Factors

The analysis also indicate the factors that stand out as enhancing improvements towards successful and sustainable rural livelihoods through improved water resources management:

- Direct stakeholders having a decisive voice in all stages of problem solving, from identification to operation and maintenance;
- Capable individuals at all levels, from grassroots to the national level, committed to poverty alleviation;
- Complementing improvements in water resources management with broad-based rural development, including productivity enhancing activities.

CONCLUSIONS

What overall conclusions can then be drawn from this research? Seven conclusions come to mind. First of all the case studies show that in certain areas of the Indian Subcontinent water resources management is a precondition for sustainable livelihoods. However, the case studies show that improved water resources management will only contribute to people's livelihoods if two other facilitating factors are present. The first and foremost enabling factor is involving the direct stakeholders in identifying the (water management related) problems, making an inventory of possible solutions, deciding which intervention is most desirable, contributing to the implementation of the intervention chosen, deciding on how to operate the infrastructure made and contributing resources to the O&M of the system. The second, almost as important contributing factor is ensuring complementary services such as productivity enhancing technologies, access to credit, market facilities etc to ensure that direct stakeholders can reap maximum benefit from better water resources management. In short, water resources management is a necessary, but on its own insufficient precondition for improved livelihoods.

Secondly, the research shows that traditionally successful water resources management arrangements may yield interesting principles that can be applied at other times or places. A good example is the 'water right by labour input' principle copied from the Chherlung scheme and applied in the Andhi Khola irrigation scheme in Nepal. However, it is highly unlikely that those traditional ways of managing water can be applied elsewhere lock, stock and barrel. Present circumstances are so different from what they were 50, 100, 500 years ago that the institutions that worked then are no longer viable. Almost everywhere population pressure has increased considerably, movement of goods, services and labour has increased enormously and new technological options, crops and inputs have emerged. Circumstances have usually changed so fundamentally that the wholesale 'import' of institutional arrangements from another time or locality is unlikely to work. In other words, while there is no need to idealize traditional water management arrangements or options of reverting back to long-established institutional arrangements, they may provide valuable insights that are relevant here and now**.**

Thirdly the research informs us about the relationship between the scale of interventions and the chances of success. Water resources management activities can be divided into at least two categories; activities that can be done individually and those that require joint action. People in the Indian subcontinent opt for the individual action when they can, mainly because the institutional transaction cost of joint action is relatively high. People therefore opt for individual solutions even when slightly larger scale interventions would appear to be be far more cost effective, such as is the case in the trade-off between shallow tubewells and treadle pumps for irrigation in Bangladesh. The reason is clear; as the scale of the intervention grows, the institutional transaction costs grow exponentially. Large scale water resources management are institutionally so demanding that people will only take it up if the benefits are substantially higher than living with the status quo and if the benefits are more or less guaranteed. Government agencies may of course implement large scale interventions, even if local people are not interested, but usually such schemes turn out to be unsustainable. In other words, as far as the direct stakeholders are concerned, small is beautiful unless proven otherwise.

Fourthly, the research highlights that water resources management is a dynamic activity and the level and kind of interventions needed over time will vary. In the medium to long term the infrastructure needed to accomplish the desired water resources management will also change. The shift from the original need to exclude saline water from polders in Bangladesh, to people now letting such water in for shrimp cultivation, is an example of this. Even under the most stable conditions the technical/economic life of infrastructure is only 20-30 years. What remains even in the very long term, that is for more than 30 years up to centuries, is the organizational ‘infrastructure’ that allows continuous involvement of the direct stakeholders in all stages of water resources interventions. To ensure improved success and sustainability of water resources management it is necessary to focus attention, interventions and funds on building this institutional capacity. To facilitate success and sustainability in water resources management nothing less than a paradigm shift is needed among the indirect stakeholders. Indirect stakeholders will have to move away from the current focus on hardware, with the institutional arrangements tagged-on and described as the ‘software’ to an understanding that sees the institutional side of water resources management as the long-term core with infrastructure as the temporary building blocks in a very long term process of constant change. **(Figure 7**).

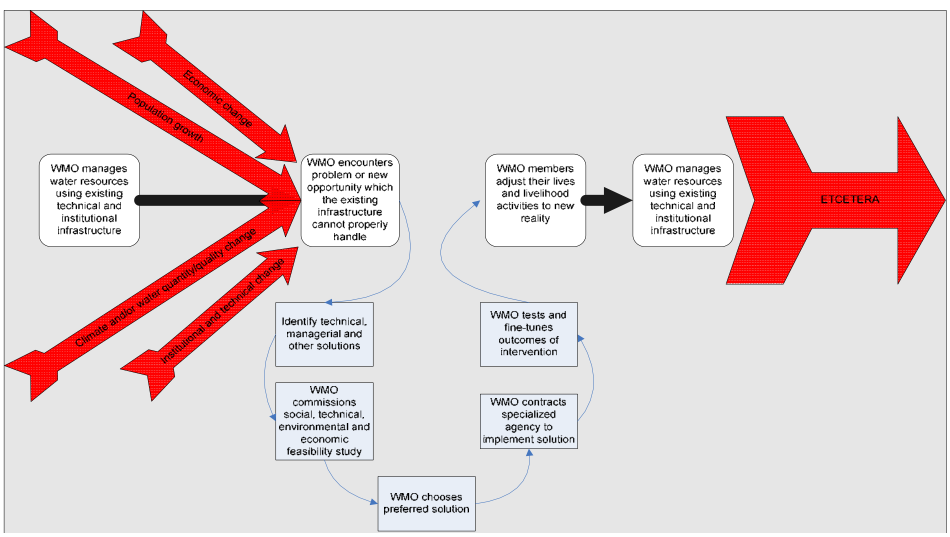

Figure 7: Institution-centred Water Resources Management Process

The case studies also show that there is a large gap between policy and practice at grassroots level. The author's experience in the Indian Subcontinent is that this gap is not limited to the water sector, but that it is symptomatic for much of the government system (Hall, 2003). The research also indicates that policies and guidelines must be made more relevant to the direct stakeholders. Nevertheless, it seems that in the short run the biggest improvement in people's livelihoods can be achieved by making sure that the current policies and guidelines are implemented as intended. Based on the experience gained from that process, policies and guidelines can then be fine-tuned and/or radically updated.

The sixth conclusion from the case studies is that human agency is very important. This conclusion may be partly due to the fact that the schemes chosen for the research were all 'cutting-edge'. One can therefore argue that by nature such schemes would exhibit a more than usual level of human agency. By contrast, one would expect 'run-off-the-mill' schemes to depend much more heavily on effective policies and standard procedures of the implementing agencies. However, the schemes indicate that even standard interventions benefit a lot from having the right people in the right positions**.** In other words, having the right people may well be as important as having appropriate policies.

Finally, the research shows that the prevailing institutional arrangements are preferred, maintained and replicated by vested interests. These vested interests will resist, openly or in the background, any shift towards more participatory, transparent and effective institutional arrangements. In both Bangladesh and Andhra Pradesh the government bureaucracy is trying to regain control over water resource management. One of the indirect ways in which this is done is by changing policies and guidelines in such a way that elected representatives and their institutions are supposedly given more responsibility. However, because these institutions and individuals are relatively weak, in practice this allows agency staff to regain control for themselves. In Nepal too the bureaucracy attempts to regain control by proposing apparently minor, yet crucial changes to draft policies and guidelines. In other words, improving water resources management is not (only) a matter of raising awareness, training, increased budgets etc, but of redistribution of power. Vested interests are unlikely to allow this to happen without putting up stiff resistance. For the redistribution of power to succeed a comprehensive change management approach will be needed, including both the carrot and the stick. Vested interests will have to be offered alternatives that will allow them to make a more meaningful contribution to society than through rent-seeking, misappropriation and corruption.

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PATICIPATORY WATER MANAGEMENT AND GOVERNANCE

MOHAMMED ABDUL GHANI[1]

INTRODUCTION

Water management approach for Bangladesh should be based on water availability conditions and improvement potential of different regions of the country and integrated management of flood control, drainage and irrigation (FCDI) infrastructure. The country may be divided into zones depending on water availability, land capability, subject to annual flooding and agricultural practices.

Surface water availability and distribution pattern of annual rainfall (BMD, 2000) over the year makes a complex water environment in Bangladesh since there is possibility of flooding almost every year sometime during June to September and drought/semi-drought during March to May (**Table 1**).

Table 1: Average Monthly Rainfall Data of Bangladesh for 1986 to 1998 Period (in mm)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1986	3	1	14	116	146	363	438	315	497	189	131	5	185
1987	1	5	4	148	113	237	779	450	320	93	31	16	183
1988	2	41	58	122	336	551	474	429	236	164	98	2	209
1989	2	13	7	76	203	344	526	134	289	237	0	3	153
1990	0	50	121	133	245	334	586	206	253	238	60	30	188
1991	7	19	33	58	274	461	378	341	460	268	3	52	196
1992	8	54	4	21	187	264	398	254	274	150	9	3	136
1993	22	57	109	124	367	599	464	434	341	148	18	0	224
1994	11	27	106	157	183	407	280	309	164	90	8	0	145
1995	6	28	23	47	216	416	366	392	238	268	45	0	170
1996	10	23	68	118	211	337	583	357	446	27	12	18	184
1997	27	19	121	113	223	299	559	3018	277	29	7	22	393
1998	28	39	101	150	251	219	697	657	117	161	86	0	209
Normal	8	15	42	111	265	506	537	429	304	186	35	9	204

Source: Bangladesh Meteorological Department.

[1] Manager, PETRRA, International Rice Research Institute, Dhaka.

Therefore, agricultural production of the country varies from year to year. Annual rainfall distribution and surface water availability pattern of the country indicate that provisions of flood control, drainage and irrigation (FCDI) are essential for increasing agricultural production. Through conjunctive use of ground and surface water, about 76% of the cultivable area can be irrigated (MPO, 1991; WARPO, 2000), of which about 60% are presently under irrigation.

For protecting lives and properties of the people, Bangladesh Water Development Board (BWDB) has created FCDI facilities. Up to June 2003, BWDB has created facilities for about 5.4 million-hectare (Mha) against potential requirement of 5.76 Mha (BWDB, 2003). During infrastructure development for providing FCDI facilities, BWDB has constructed about 9000 km of embankments of which 4000 km are in the coastal area and 5000 km are in the non-coastal area. BWDB has also created water bodies through construction of 5096 km irrigation canals, 3538 km drainage channels, barrages and river closures. These infrastructures are mostly used for saving lives and properties and creating favorable environment for increasing agricultural production.

Most of the groundwater based irrigation through tubewells and part of surface irrigation through LLPs are operated and managed by the private sector which cover about 90% of the present irrigated area. The remaining 10% of the irrigated area is covered by public agencies, BWDB and the Local Government and Engineering Department (LGED) but mostly by BWDB using surface water through lift cum gravity irrigation systems. This type of irrigation presently covers about 0.5 Mha (BWDB, 2002) against facilities created by BWDB for about 1.2 Mha (**Table 2**) which indicates utilization level of about 42%. Unfortunately, most of the irrigation facilities in Bangladesh are operating at about 50% of their rated capacities (BWDB, 1995 and Ghani, 1996). This confirms that irrigation facilities created in Bangladesh with scarce resources are utilized much below their rated capacities irrespective of private or public operations (Ghani, 1996; MOA, and 1997 FAO, 1998).

Participatory water management through improved governance is therefore, required for best utilization of irrigation systems. In this paper, few cases of farmer managed successes are cited for further expansion over the country. In these approaches, users and researchers identified prospective development areas through water resources management at local level, but can be used on larger scale.

Table 2: Achievement of Bangladesh Water Development Board in Completing Flood Control, Drainage and Irrigation Projects since 1944-45 to June 2002

Batch	No. of Completed Projects	Benefited Area (ha)			
		Irrigation	Drainage	Flood Control	Drainage-Flood Control
A01 (1944-59)	33	4,053	39,450	20,811	56,627
A02 (1960-70)	102	59,910	861,510	503,348	907,228
A03 (1871-74)	20	-	177,819	204,197	205,007
A04 (1975-78)	46	79,675	378,933	187,126	409,684
A05 (1979-80)	37	73,278	300,209	269,921	329,654
A06 (1981-85)	153	176,010	400,462	463,116	571,553
A07 (1986-90)	47	139,466	454,225	522,663	529,764
A08 (1991-2002)	190	810,725	1,603,710	1,275,194	2,376,815
TOTAL	628	1,343,117	4,216,318	3,446,376	5,386,332

Source: List of Completed Projects of Bangladesh Water Development Board (BWDB), 1998 and Updates of 2002.

PROCEDURE

Land area especially cultivable area and water resources, which include rain, surface, and groundwater for each zone to be carefully estimated. Land area of each zone should further be estimated in relation to flooding conditions, consulting **Tables 3** and **Table 4** for Fo to F4 types of lands (BARC, 1988 and WAPO, 2000). Potential crops for the zones and its specific localities to be selected reviewing farming system research data from the research institutes and extension department.

Table 3: Rice Land and Flood Regime Data of Bangladesh

Flood Depth (Meter)	Area (Million Hectare)	Percent of Total	Remarks
Less than 0.3	3.74	36	Cultivable and Irrigable Areas of Bangladesh are 9.03 and 6.90 million Hectares respectively.
0.3 to 0.9	3.62	35	
0.9 to 1.8	1.70	17	
1.8 to 3.0	1.07	10	
Over 3.0	0.23	2	
Total	10.36	100	

Source*:* Bangladesh Agricultural Research Council, 1988.

Table 4: Major Sources of Flooding in Each Regions of Bangladesh

Region	Major sources of flooding	Remarks
SW	Tides and cyclonic rainfall	NE=Northeast, NC=North Central, NW=Northwest, SW=Southwest, SC=South Central, SE=Southeast, RE=Rivers and Estuaries, EH=Eastern Hills.
SC	Tides, cyclonic rainfall and surges, and overspill of Lower Meghna	
NW	Local intense rainfall, impeded drainage, breaches in the Teesta and Brahmaputra Right Embankments and breaches in internal polder embankments and drainage congestion preceded by high flows in the major rivers	
NC	Local intense rainfall, impeded drainage, spillage from the Brahmaputra and congested drainage on the Meghna	
NE	Flash floods on transboundary rivers, local intense rainfall, impeded drainage and drainage congestion on the Meghna	
SE	Flash floods on transboundary rivers, local intense rainfall, impeded drainage and drainage congestion on the major river	
EH	Flash floods and cyclonic rainfall	
RE	High inflows through the Ganges and the Brahmaputra and surges	

Source: National Water Management Plan Project, WARPO, 2000

Production maximization packages to be developed with assistance of the farmers and extension agents. Government machinery to provide advisory services for input supports and market information. No price support or subsidy is expected from the government but facilitating roles are expected. Agricultural production, which includes crop, fishery, forestry and livestock, can be increased through integrated use of water and land resources. The strategy should be to increase production per unit of land, water and time.

Water management approaches for different area should be different based on water availability and needs of participating farmers. In the past, most decisions were taken by government and itsimplementing wings. However, the situation is different now but needs further improvement for empowering water users to make their decision without direct or indirect interferences by government agencies. For simplification, water management approaches are subdivided and discussed below.

Water Management for Flood Protected Area

Northwest region covers the area under present Rajshahi division and greater Kushtia and Jessore districts which coincides with full of NW and part of SW of the Hydrological Regions (**Table 5**) suggested by the Water Resources Planning Organization (WARPO, 2000). Most part of this area has low rainfall but subject to less flood damages. However, this area which has net cultivable area (NCA) of about 2.94 Mha has dependable groundwater and

Table 5. Present and Projected Regional Distribution of Net Cultivated Area (NCA) and Irrigated Area in Million Hectare (Mha)

Region	Total Area (Mha)	1994 NCA (Mha)	2025 NCA (Mha)	Irrigated Area* (Mha)					
				2000		2025		Maximum Dev.	
				Area	%	Area	%	Area	%
NE	2.01	1.16	1.14	0.48	41	0.91	80	1.08	95
NC	1.60	1.06	0.99	0.55	52	0.89	90	0.98	99
NW	3.16	2.30	2.23	1.47	64	2.12	95	2.21	99
SW	2.43	1.28	1.24	0.59	46	0.99	80	1.19	96
SC	1.25	0.82	0.80	0.12	15	0.56	70	0.76	95
SE	1.01	0.68	0.65	0.32	48	0.58	90	0.62	96
RE	0.59	0.33	0.31	0.13	37	0.27	80	0.32	95
EH	1.93	0.34	0.33	0.11	33	0.23	75	0.29	95
TOTAL	13.98	7.97	7.69	3.77	47	6.55		7.45	

Total irrigated area as of 2001-2002 was 4.8 ha (BBS), but distribution by Region is not elaborated.
NE=Northeast, NC=North Central, NW=Northwest, SW=Southwest, SC=South Central, SE=Southeast, RE=Rivers and Estuaries, EH=Eastern Hills.
*** Irrigated area is estimated based on water availability during November to May period of the respective time.**

Source: Technical Paper No. 7: Land and Water Resources, Water Resources Planning Organization (WARPO), June 2000.

can be brought under double/triple cropping with conjunctive use and improved management of water resources. This is the most potential area for agricultural development and may be planned for growing three crops in a year.

Management and Governance. In the past, it was managed by agencies and government. Therefore, cropping intensity increase and extent of conjunctive use was decided by government departments. In the recent past, there has been change in management as irrigation sector as a whole is encouraging farmers' participation. At present, farmers can decide about number and type of crops they will like to cultivate in the irrigation systems. Market force influence farmers' decision as they are bearing full production cost.

Surface Water Management in Coastal Area

It is believed that water resources of the area become saline during the entire dry (Boro) season, therefore, no crops can be grown under this condition. Research data indicated that river water in the coastal area become saline to the extent of unsuitable for irrigation for most crops only during mid February to May. Water quality in Kazibacha River was monitored by research group and long term data colleted from Soil Resources Development Institute (SRDI) indicates that salinity level is within acceptable range (4 dS/m) during July to mid February (CEGIS, 2002). Therefore, crop cultivation in this area can be practiced without any major risk through management alternatives. Moreover, during Aman season, only local rice varieties were grown, which are generally low yielding. Efforts were made to replace local varieties with HYVs during Aman season and introduction of another rice crop during dry (Boro) season through water management.

HYV rice varieties developed by Bangladesh Rice Research Institute (BRRI) was grown under research management in Aman season in place of local transplanted Aman (T. Aman) during mid July to November and harvested 3.0 to 5.5 t/ha whereas, yield from local varieties used to be 1.5 t/ha. Dry season rice was cultivated in the same field with improved water management and average yield of over 3 t/ha was harvested during dry seasons of 2003 and 2004. River water was directly used in the research field from November to mid February during high tide. Water was stored in the adjacent canal and used for irrigation using low lift pumps for irrigating rice crop from later part of February to whenever it was required. Since river water becomes unsuitable for irrigation after mid February.

It has been established by the research group that river water can be stored in exiting canals and low lying area by managing exiting sluices and infrastructure and can be used for crop production ((Mondal et. al, 2004). This has opened up opportunities for water conservation in canals and existing infrastructures, which can be used for crop production during dry season. IRRI with support from Challenge Program on Water and Food (CPWF) and government and non-government organizations in Bangladesh is initiating a study on coastal water management for expanding dry season crop production and year round use of water and land resources for increasing agricultural production in the coastal area (CPWF, 2004).

Management and Governance. In the past, decision on investment and experimentation was managed by agencies and government within the government policy guidelines. Under research study, researchers discussed with farmers and experimented with new approach. Farmers observed research activities and outcome in the first year and replicated and expanded in subsequent years with support from research group. Water controlling structures were managed by BWDB earlier, now beneficiaries are encouraged to take charge. Farmers have control over water management infrastructure therefore they are planning for its better use and management. The present governance type is participatory, where farmers' opinions influence decision.

Prospect of Groundwater Use in Coastal Area

Prospect of using ground water has also been explored as entire coastal area groundwater may not be saline and unsuitable for irrigation. A study was conducted in three selected sites (namely Ratanpur, Gobindopur and Munshigonj) under Satkhira district of Bangladesh during 2002-2004 to explore opportunities for groundwater utilization. Water and soil samples were collected in each month from the selected locations for salinity analysis. In Ratanpur and Gobindopur areas river water and groundwater (mainly tubewell water from the existing hand tubewells) were found to be less saline (<4 dS/m) during wet season (July - November) and suitable for irrigation but the salinity increased beyond the critical limit (4 dS/m) during dry season (December – April). In Munshigonj area, both groundwater and river water are highly saline throughout the year and are not suitable for irrigation.

Observation wells were installed at different depths in Munshigonj area for searching a suitable layer of sweet water. Water samples were collected and tested for salinity level and a good water bearing aquifer was found at a depth from 170 ft (52 m) to 245 ft (75 m) from the land surface. It was observed that groundwater at this depth of aquifer remain less saline (<4 dS/m) during the whole year and suitable for irrigation. Farmers of the area were delighted to see suitable groundwater for irrigation and installed 11 shallow tubewells in the dry season of 2003. BRRIdhan 28 (HYV rice variety) was grown during Boro season (dry season) of 2004 and farmers harvested average yield (paddy) of 3.0 t/ha. Seven shallow tubewells were in operation during the dry season and irrigated about 30 hectares. Farmers are expecting better yield and more irrigation coverage in the coming seasons. This finding confirms that groundwater in entire coastal area is not unsuitable for irrigation. Therefore, productivity of the underutilized coastal rice lands can be increased substantially by judicial use of groundwater, which is the urgent need to improve livelihood of the resource poor coastal farmers of Bangladesh (Rashid et. al, 2004).

Management and Governance. In the past, it was managed by agencies and government. Government agencies did not take initiatives of conducting exploratory research. Site selection and installation of tubewells (DTW/STW) were done only by government agencies. After suspending regulation of tubewell spacing and site selection, farmers have authority to install tubewells at their cost. Research group confirmed availability of suitable water for irrigation in certain areas. Farmers liked this development opportunity and started using it for their benefit.
Therefore, management has been changed from public to private level decision making.

Ponds for Crop Production

Rain water and part of surface flow during later part of monsoon can be stored in low-lying area, canals and ponds for supplemental irrigation of rice crops. There are opportunities to use pond water for supplemental irrigation to stabilize yield of Aman crop and for dry season irrigation. Observations have also been made that with one ha of pond, about 10 hectare lands can be brought under supplemental irrigation for rice. The same pond can also be used for irrigating about 10 hectare of dry season non-rice crops. Excavation of ponds and re-excavation of existing canals will increase storage capacity for subsequent use of water for irrigating the second crop. New ponds and re-excavated canals can also be used for fish cultivation (personal communication with fisheries experts). Fish cultivation alone in the ponds and re-excavated canals will be cost effective.

Management and Governance. In the past, it was managed by land lords and then by government departments. So uses of ponds other than household purpose were not explored. Barind Multipurpose Development Authority (BMDA) took up the idea of using tanks for supplemental irrigation along with their household general uses. We are aware that tank irrigation is an old technology in Sri Lanka. Farmers are showing interest for replicating this approach especially in coastal area of Bangladesh. Future governance will be mostly individual farmers and their associations.

Use of River Water

In some coastal districts, even river water during entire year is suitable for irrigation. However, most people still depends on major irrigation systems operated by government agencies. Under this type of arrangement, potential development in the area is not achieved and poor farmers are affected most in such situations. Under research management, opportunities of organizing resource poor farmers were explored, where small manually operated pumps can be used. Small farmers will own, operate and irrigate their small holdings for cultivating crops of their choice and will be benefited. Mobile pump is a foot-operated low cost pump for pumping water from ponds, canals and rivers were introduced in Barisal area (a coastal district). In this area, farmers were mostly dependent on canal irrigation managed by government institutes (BWDB). Farmer did not grow dry season crop suspecting that canal water was saline during dry season. IDE, an NGO with support from IRRI project (poverty elimination through rice research assistance, PETRRA), popularized mobile pump for irrigating dry season rice and non-rice crops in that area during 2003 and 2004. On an average, 50 decimals of rice and 100 decimals of non-rice crop were irrigated by over 100 farmers using mobile pumps. Use of pumps enabled farmers to generate more income through irrigated crop production as well as increased their rice availability for family consumption (Badrul, 2004). Users are happy to be owner of mobile pump and call it "Pedaling the poor out of poverty".

<u>Management and Governance.</u> In the past, river water through large scale irrigation systems was managed by agencies and government. Irrigation was not a popular practice in that part of Bangladesh even in the recent past. Moreover, most people still think that entire water in costal districts is Saline especially during dry season. NGOs and research groups proved it incorrect and motivated using water resources of the area for dry season irrigation where salinity level is within permissible limit. In the past, water use for irrigation was public decision, now it is private and participatory management.

Shrimp and Rice Cultivation

Studies have indicated that with better social and technological management, production of shrimp and rice can be increased without creating detrimental effects on the production environment and people of the area. But per capita annual income also can be increased. Farmers of the area reported that they are practicing shrimp and rice cum sweet water fish including galda (sweet water shrimp) for over five years under farmer’s management and getting more than 5 t/ha rice and over 400 kg/ha shrimp from the same land. They used to grow only wet season rice with annual rice production level of less than 5 t/ha. This has been possible due to availability of HYV rice and shrimp cultivation technologies in the area and there is no sign of environmental hazards.

Opportunities of Non-rice Cultivation

It is strongly believed that when rice can be grown in the coastal area, non-rice cultivation can be planned easily as water requirement for non-rice crops are much lower than rice crop. Therefore, more areas can be cultivated with available water resources if non-rice crops are popularized in coastal area. Crop scientists should come forward with better alternatives so that more farmers can be benefited. It is believed that soil health will also improve if combination of crops is cultivated over the year rather than rice alone.

Flood Plains

Flood plain area in this paper is considered most part of the central flood plain and remaining area of the coastal belt where saline water inundation is rare. With reference to the Hydrological Regions, NE, NC and part of SW and SC falls under this category (WARPO, 2000). Annual floods affect this area and FCDI facilities have been created for saving lives and properties of the people. Multiple uses of the FCDI facilities will be an approach under improved water management and integrated agricultural production for this area.

Hill Tracts

Hill tracts cover about 1.94 Mha of which only about 0.34 Mha is net cultivated area (NCA), has unique water availability and land topographic conditions. This area comes under the EH (Eastern Hills) of Hydrological Regions. Hill slopes can be brought under fruits, vegetables and fodder cultivation. Plain lands can be used for suitable crop production and low lands and riverbeds can be used for fish cultivation through appropriate water conservation and fish production practices. However, all these innovative practices should be developed through beneficiary participation and provision of operation and maintenance and cost recovery. This approach can be expanded to other hilly areas of Chittagong, Sylhet, and Comilla districts.

Conjunctive Use of Water

Irrigation or water resources development of the country should be different for different agro-ecological regions of Bangladesh. The national development plan should be to maximize utilization of rainfall, surface and ground water through conjunctive use of these resources. Water management for increasing crop production is more important in Bangladesh than increasing irrigation efficiency. The development strategy will be to increase production per unit of land, water and time. Comprehensive studies should be undertaken at upazila level involving stakeholders, government and non-government organizations (NGOs) working with agriculture, soil and water based development programs for developing and implementing local level production plan. It is assumed that this is similar to one of the priority issues considered by FMIS approach in Nepal.

Integrated Water Resources Management

Bangladesh Water Development Board (BWDB) has constructed 628 flood control drainage and irrigation (FCDI) projects in Bangladesh by June 2002 (**Table 2**). These FCDI projects include infrastructures like embankment, water conservation structures, irrigation and drainage canals for providing FCDI facilities. These facilities are mostly used for increasing crop production through irrigation development and protecting crops from flood damage. However, these facilities can also be used for development of fisheries, livestock, and production of fruits, vegetables and timber through integrated use of the FCDI facilities. Embankment slopes can be brought under afforestation and fodder cultivation programs through stakeholder participation. Fodder cultivation will contribute to the development of livestock sector since availability of livestock feed is major constraint to the development of this sector. Effective maintenance of irrigation and drainage canals can be used for fish cultivation in addition to their primary uses.

Compartmentalization of Rivers

Rivers especially smaller rivers can be compartmentalized to series of seasonal ponds during November to May through appropriate water conservation structures like weirs and rubber dams. Community based fisheries management system can be introduced in the seasonal ponds following the Common Property Resource Management Procedure of the country. Fisheries experts confirmed that these seasonal ponds could be brought under profitable fish cultivation program through stakeholder participation and on an average, 0.5 to 1.0 ton fish can be harvested per hectare of water body. Moreover, water stored in the seasonal ponds/riverbeds will be a continuous source for groundwater recharge, which subsequently can be used for irrigation using deep and shallow tubewells without severe lowering of groundwater table. River water conservation will also contribute to afforestation program along the riverbanks, irrigation development using low lift pumps for the lands adjacent to the rivers and availability of drinking water and bathing place for cattle. FCDI facilities are contributing to increased crop production and multiple uses of these facilities and as suggested will contribute to increased production of fisheries, livestock and forestry and will subsequently contribute to poverty reduction. Success of this approach in any river may be replicated in other area of the country, which will contribute to its overall development.

Status of Governance. Exploratory ideas for opportunities of non-rice cultivation in the coastal area, multiple uses of flood plains, multiple use of water resources in hill tracts, consumptive use of water, integrated water resources management and compartmentalization of rivers are being pursued by the author. There has been beginning to address issues like plantation on embankment slopes and fish cultivation in government owned canals, low-lying areas and river leased out to individuals or cooperatives. Governance is still under public property rule and needs to be participatory and private focus.

Changes in Perspective

Bangladesh has created facilities for 4.8 Mha (**Table 6**) of irrigated and 5.38 Mha of FCDI area. Water potential permits irrigation development up to 6.55 Mha by 2025 and 7.45 Mha to the maximum. Therefore, about 6 Mha may easily be planned for year-round crop production through effective use of FCDI facilities. About 10 tons/ha can be harvested in the FCDI area per year adopting available technology. Therefore, the country can produce 60 million tons food grain (paddy + pulses) from the FCDI area which may be about 45 million tons of net grain production (rice + other grains). This production target can be achieved adopting available research and management technology and through integrated land and water management. However, it will require coordinated efforts for improved water management, post harvest technology, processing and improved storage for favorable returns to the farmers which can only be achieved through effective management of services provided by the government.

Table 6: Trends in Irrigated Area by Irrigation Technology in Thousand Hectares

Season	ST W	D TW	Manual	LLP	Trad	Major Canal	Ground Water	Surface Water	Total
1982-83	371	234	16	337	405	160	622	903	1525
1983-84	480	263	16	342	372	136	759	851	1610
1984-85	586	287	16	351	384	147	889	883	1772
1985-86	586	304	16	356	314	163	906	833	1740
1986-87	639	318	16	386	326	155	973	867	1840
1987-88	753	345	16	402	433	115	1114	950	2064
1988-89	941	380	16	482	391	170	1338	1043	2381
1989-90	1037	384	16	484	478	176	1437	1138	2576
1990-91	1078	365	18	513	498	316	1462	1184	2646
1991-92	1234	434	19	500	316	251	1686	987	2674
1992-93	1392	437	22	496	323	291	1851	978	2829
1993-94	1388	389	29	458	348	326	1806	961	2767
1994-95	1638	502	25	538	250	352	2165	942	3108
1995-96	2004	540	51	568	207	355	2592	1157	3749
1996-97	2159	475	38	570	186	333	2672	1090	3762
1997-98	2182	465	64	622	201	285	2711	1122	3833
1998-99	2522	507	101	628	232	358	3126	1219	4345
1999-00	2644	522	87	645	224	361	3253	1230	4482
00-01	2747	576	63	761	182	470	3391	1414	4804

Source: Adopted from Moniruzzaman, A.K.M., 2003.

LOOKING AHEAD IN FUTURE

- With management alternatives, part of the excess water during rainy season can be retained in the rivers, canals and low areas and can be effectively used for agricultural (crop and fish production) and non-agricultural purposes during the lean period, November to May. Through conjunctive use of ground and surface water, about 76% of the cultivable area can be irrigated. It can be achieved empowering farmers participatory management and decision making.
- Through irrigation management and effective operation of flood control and drainage projects, agricultural production of the country can be increased substantially and will remain sustainable.
- To create enabling conditions for the improvements, mistrust between public/government and private sector has to be removed.

- Agricultural development should be linked to the industrial development and export market for comprehensive and overall development of the country.
- Stakeholders' participation in management of available water resources should be ensured at all levels of project cycle that is planning, implementation, operation and management. Other constraints like, low productivity per unit of land and water, access to marketing and transportation, access to credit and frequent changes in government policy should be resolved for sustainable development of agriculture in Bangladesh.
- The land and water management strategy should be to increase production per unit of land, water and time. Strategy of irrigation management should aim in protection of the resources to allow their long-term use.

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LAO IRRIGATION SYSTEMS: GOVERNANCE MODE

PHALASACK PHEDDARA[1]

HISTORY

Lao PDR, a member of ASEAN, is a landlocked country surrounded by China, Vietnam, Cambodia, Thailand and Myanmar. Its population is 5,500,000 as per the census of 2002 and area is 236,000 km^2 . Buddhism is the main religion of this country and it follows socialism as political system. The maximum average temparture is 33°C and minimum average temperature is 15°C.

On the day of declaration of independence on 2 December, 1975, dry season irrigated area was only about 2,500 ha. Ten years later, dry season irrigated area reached to 26,000 ha. Still Lao PDR has food insufficiency especially rice. Rice is the staple food of Lao PDR. The party decision, following the new polticial strategy, insisted on the "acceptance of change in the new context mobilizing all resources step by step and sustainably moving to prosperity." It also shifted its emphasis on the need of food security. Since 1996, irrigation infrastructures were rapidly developed. In the year 2001, dry season irrigation coverage was 214,000 ha and wet season irrigation was 300,000 ha. This is a big challenge in the irrigation achievement of Lao PDR. These changes required more qualified staff, budget and facilities for operation and maintenance which forced massive increase in the government expenses. In response to these changes, the irrigation management transfer concepts were introduced.

PRESENT SITUATION

Policy

National Policy in Lao PDR is determined and set by Congress which meets annually. Sectoral policy is based on recommendations from relevant ministries which are formulated through a consensus building process within the Cabinet of Ministers and within other relevant ministries. Lao PDR

1 Director for Planning and Cooperation, Department of Irrigation, Lao PDR.

operates under one party system and the Peoples' Revolutionary Party is the key instrument in the formulation of policy. Government officials in line agencies are often very careful in dealing with "policy formulation" matters as this is seen as a party responsibility.

Planning in Lao PDR is based on five year plan. The policies for rural development under the present five year plan are:

- Food security and in particular the attainment of rice self-sufficiency.
- Enhancement of farmer income through crop diversification and agricultural commercialization.
- Reduction of environmental degradation, and in particular, the reduction of shifting cultivation.
- Integrated Rural Development and Human Resources Development.

Strategy

The Government of Lao (GOL) Agricultural Sectoral Strategy proposed in November, 1999 and endorsed by the Minister, Ministry of Agriculture and Forestry (MAF) during February, 2000 was based on sectoral policy developed in 1993 which included the following programs:

- food production;
- commodity production support;
- stabilisation/reduction of slash and burn cultivation;
- irrigation development;
- agriculture and forestry research; and
- human resources development.

The Irrigation Development Program is aimed at increasing rural incomes and stabilising rice availability by expanding irrigated areas for both wet season and dry season production and to improve the operation and maintenance of existing irrigation systems. Some of the water resource issues identified under this program are as follows:

- need for participation of farmers and communities for effective and sustainable use of all resources;
- need for efficient use of water for increased agricultural system performance;
- concern for watershed degradation; and

- insufficient funds to provide timely and adequate GOL support to the sector at all levels.

The Agricultural Sectoral Strategy makes provision for the devolution of responsibilities and activities to Provincial Agriculture and Forestry Service Offices (PAFSOs) and District Agriculture and Forestry Service Offices (DAFSOs). This process of devolution of responsibility is in line with Prime Ministerial Decree on decentralization. An innovative approach to agricultural extension has been adopted. This approach relies heavily on subject matter specialists at provincial level, and generalist extension staff at district level.

The strategy recognises the need for:
- a participatory approach to ensure the participation of farmers as well as district and provincial officials;
- training in technical matters related to irrigation;
- decentralization of responsibility for decision making to the provincial level with related administrative change; and
- high levels of capital investment.

From the six programs of MAF, the strategy has developed eight thematic approaches. These are:
- the planning approach;
- GOL/MAF planning and decentralisation;
- business regulatory environment;
- external trade;
- lowland transformations;
- sustainable upland development and environmental management;
- irrigation; and
- shifting cultivation.

The Irrigation Development Program relates to each of these thematic approaches.

The Agricultural Sector Strategy makes a clear distinction between the necessary approach for agriculture in the lowlands compared to the approach needed for agricultural production in the uplands. The need for different approaches is based on the clear differences in:
- access;
- communications;
- ability to mobilise credit;
- interactive markets;

- market information mechanisms;
- monetised economy;
- free access for local and foreign entrepreneurs; and
- agro-geographic conditions.

The thematic approach to irrigation set down in the strategy is based on the following policies:
- allocation and provision of water on a sustainable basis for agro-forestry systems in the uplands and for the existing and new agricultural areas in the lowlands;
- diversification of water resources for irrigation and management for sustainable use;
- improvement of water resource based productivity;
- improvement of the maintenance of irrigation systems and strengthening of O&M arrangements;
- maintenance of watersheds and mitigation of environmental degradation;
- alleviation of rural poverty; and
- acceleration of cash crop production for export and import substitution.

The strategies relating to the thematic approaches are as follows:
- continue to focus investment in the most economically viable irrigation systems and to consolidate and expand irrigation areas;
- continue to strengthen community participation and initiative in project planning, works and maintenance;
- encourage beneficiary financing in development and in O&M of irrigation systems;
- strengthen farmer driven extension focus on cash crops, marketing and improve market access; and
- target rural development on “focal sites” within watersheds/river basins.

Programs and priorities resulting from these strategies are:
- water resources use planning for sustainable irrigation development and management;
- improvement of irrigation technology through the use of various irrigation innovations;
- continued promotion of irrigation management transfer and of community managed irrigation programs which include active participation in planning construction and O&M; and
- consolidation and expansion of training programs for farming communities and farmers in irrigation system management in, O&M, watershed preservation, and improved and diversified farming systems.

The expected outputs identified by the strategy were:

- major consolidation and expansion of community managed small scale irrigation systems;
- accelerated increases in upland farming systems diversification, particularly in dry season irrigated agriculture;
- full irrigation management transfer to local communities; and
- sustainable irrigation systems where management and operational costs are borne by the irrigator farmers.

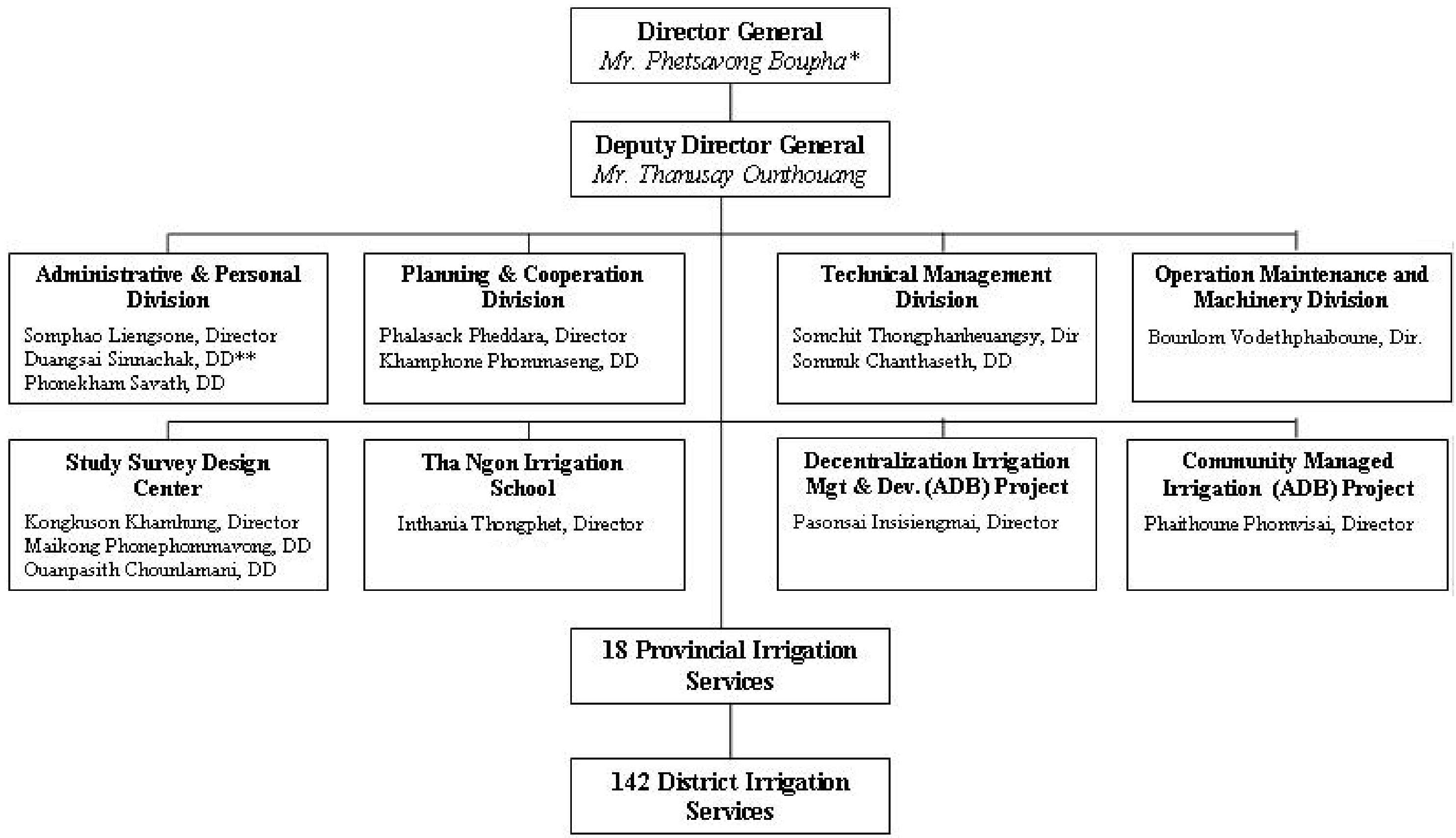
Fundamental to this National Strategy for Irrigation Development are five National Strategic Plans. These plans, derived from the list of programs outlined above, are:

- Water Resources Planning;
- Irrigation Technology;
- Irrigation Management Transfer;
- Community Managed Irrigation; and
- Training and Extension.

The strategy focuses on community management of irrigation, irrigation management transfer, and consolidation of past achievements. Construction of new irrigation systems will be deferred until these stated priorities are attended to.

Administration

Figure 1 below illustrates the administrative pattern of the Department of Irrigation, Vientiane, Lao PDR.



Director General
Mr. Phetsavong Boupha*
Deputy Director General
Mr. Thanusay Ounthouang
Administrative & Personal Division
Somphao Liengsone, Director
Duangsai Sinnachak, DD**
Phonekham Savath, DD
Planning & Cooperation Division
Phalasack Pheddara, Director
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Technical Management Division
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Sommuk Chanthaseth, DD
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Study Survey Design Center
Kongkuson Khamhung, Director
Maikong Phonephommavong, DD
Ouanpasith Chounlamani, DD
Tha Ngon Irrigation School
Inthania Thongphet, Director
Decentralization Irrigation Mgt & Dev. (ADB) Project
Pasonsai Insisiengmai, Director
Community Managed Irrigation (ADB) Project
Phaithoune Phomvisai, Director
18 Provincial Irrigation Services
142 District Irrigation Services

IRRIGATION MANAGEMENT TRANSFER

Building on the work of the Sustainable Irrigated Agricultural Project (SIRAP), which was funded by the Government of the Netherlands through the Mekong River Commission, a Draft Strategic Plan for National Irrigation Management Transfer (IMT) has been prepared. An ADB loan supported program of supporting IMT in six provinces of Lao PDR has commenced. This project is the Decentralized Irrigation Development Management Project (ADB 1788-LAO-SF). As IMT is a GOL priority it is likely that further externally supported work will proceed in this field. The IMT process generally relates to lowland, flood plain irrigation although there are some exceptions.

Objectives

- (Visible)
  - Farmers owned irrigation system
  - Sustainable irrigated agriculture development
  - Effectively and reasonable government support
  - Support government policy on decentralization
  - Support Village Development Fund (VDF)

- (Non-visible)
  - Decreased government staff
  - Decreased government expenses
  - Increased farm income
  - Market negotiation
  - Water sources prevention and quality improvement
  - Others

Strategic Goals

- Basically, to transfer all irrigation schemes to the community; and
- To own all irrigation system by farmers themselves

Implementation Strategy

- Step by step, from small to big based on priority
- Making a pilot promotion of success and expansion
- Small size automatic transfer
- Prioritizing on medium size

- Step by step transferring of joint management (of big size) to the community
- Developing new schemes, preparing for IMT from the early stage and soon after construction transfer to the community
- Focussing on Human Resources Management (HRD)

Agency

Central Level

- Prime Minister Office (PMO)
- Ministry of Agriculture and Forestry (MAF)
    - Department of Irrigation (DOI)
    - National Agriculture and Forestry Extension Service (NAFES)
- Ministry of Finance (MOF)

Provincial Level

- Provincial Governor Office (PGO)
- Provincial Planning Office (PPO)
- Provincial Finance Office (PFO)
- Provincial Agriculture and Forestry Service Office (PAFSO)
    - Provincial Irrigation Service (PIS)
    - Provincial Agriculture and Forestry Extension Service (PAFES)

District Level

- District Governor Office (DGO)
- District Planning Office (DPO)
- District Finance Office (DFO)
- District Agriculture and Forestry Service Office (DAFSO)

Field Level

- WUO
- Village Authority
- Benefits to Farmers

Water Users' Organization

There are two types of Water Users' Organization (WUO). They are recognised by law in Lao PDR. Both of them have multi-functional Water Users' Association (WUA) but the main role is to carry out effective operation and maintenance of the irrigation system and to strengthen the community capacity for management of irrigated agriculture.

- WUA to be registered with the Provincial Finance Service Office.
- Water Users' Group (WUG) registered at the District Governor Office.

WUO is usually established at the pre-construction stage in order to mobilize farmers for their contribution to the development of the irrigation scheme along, with assistance of the provincial and district extension workers. A standard structure was proposed as follows:

<u>Before Operation</u>: (by consultation)

- Chairman
- One or two Deputy Chairman(s)
- Three Committees for (1) Labor, (2) Quality and Quantity Control, (3) Finance and Procurement

<u>When Operation</u>: (by election)

- Chairman
- One or two Deputy Chairman(s)
- Three Committees for (1) Labor, (2) Water Management, and (3) Administration

Village Development Fund

Village Development Fund (VDF), originally proposed by Prime Ministerial Order No 26 (PMO 26) has evolved and is now being implemented on a somewhat random basis throughout the country. The general purpose of VDF is to provide a mechanism whereby irrigators who have benefited from GOL irrigation projects, repay the cost of the investment into a fund that will then be available for the rehabilitation and further development of irrigation schemes. The capital cost of the irrigation scheme is repaid by the beneficiaries on a *pro rata* basis (per irrigated hectare) over a period of 20 years with 5 percent of the capital cost being repaid each year. PMO 26 recommends the establishment of a village level committee for the management of the fund, but in reality, fund management has generally become the responsibility of existing committees, usually WUAs.

Payment of VDF may be made in cash or kind (produce). The managing committee should immediately convert the material collection to cash.

Irrigation Service Fee

Irrigation Service Fee (ISF) is a fee levied on irrigators, by the WUA or other village level committee for the use of irrigation water. The purpose of the ISF is for the payment of the management, O&M of the irrigation system. Levels of payment, again related to irrigated area, are determined by the WUA or management committee based on known costs. The fund is maintained at village level and managed by the WUA or the committee responsible for the management of the irrigation system.

Support

Sustainable irrigation depends on the capability of the operators to effectively operate and maintain the system. This capability will require appropriate training and extension support.

Community participation, whether it be for the community managed irrigation projects on the valley floors of the uplands, or for the processing of IMT on the lowland flood plains will require substantial transfer of technology and capacity enhancement to WUAs, other community organisations and individuals. This transfer of technology and capacity enhancement will require appropriate training and extension support.

Sustainable irrigation relies not only on sustainable infrastructure, but also on the sustainable incomes of the irrigator farmers. These sustainable incomes will be generated by:

- improvements in crop yields, varieties and overall quality of produce;
- assured reliable markets; and
- reliable and competitive supply of agricultural inputs including chemicals, spare parts and service.

These will be generated only by a reliable agricultural extension service. If GOL staff is to be enabled to provide such a service, appropriate training and extension support to enhance the capacity of provincial level Subject Matter Specialists, and district level Generalist (Farm Systems Extension Workers) will be required.

A successful and ongoing Training and Extension program underlies all the elements of sustainable agriculture.

PARTICIPATORY IRRIGATION MANAGEMENT IN VIETNAM

NGUYEN HONG KHANH[1]

INTRODUCTION

Vietnam is an agricultural country located in South-East Asia with population of 80 million of which approximately 80% are living in countryside. 70% are engaged in agriculture.

Before 1986, Vietnam had faced critical agriculture situation. Output of all economic-sectors was low. In the late 1980s, Vietnam introduced a series of institutional and economic reforms and changes in all sectors, especially the policies in agricultural sector. This change included the introduction of the responsibility system in cultivation, the allocation of land, allowing farmers a choice in input supplies. These reforms gave impetus in the agriculture economy and established the conditions for sustainable economic growth. Then, in the early 1990s, Vietnam embarked on its move from a centrally planned to a market economy. That is a milestone in the economic development history of Vietnam. From food deficient country , Vietnam has now become the food self-sufficient country and also one out of the fourth world's leading rice exporters. Annually, Vietnam has started exporting about 3-3.5 million tons of rice.

IRRIGATION DEVELOPMENT AND PARTICIPATORY IRRIGATION MANAGEMENT IN VIETNAM

Traditionally, the State and people of Vietnam have invested to develop many hydraulic systems for irrigation, drainage, flood control, aquaculture, electric generation, navigation and tourism, etc. They contribute significantly to ensure food security, water conservation, environmental protection and sustainable development of agriculture.

There are 130 state- owned Irrigation Management Companies (IMCs or Enterprises). They do not include independent management stations, management boards of separate hydraulic works and provincial centres for irrigation management, exploitation and protection .

[1] Senior Officer, Department of Water Resources, Vietnam.

There are more than 10.000 agricultural cooperatives serving irrigation and drainage activities in large and medium-scale systems, and about 2.000 water user organizations acting as "a bridge" to link between IMCs, local authorities and farmers in irrigation and enforcement of laws and policies on irrigation scheme management.

Currently, there have been many obstacles and issues in irrigation system management such as cumbersome and ineffective management organizations, especially the relationship between IMCs and water user organizations. Therefore, the irrigation systems do not operate with high output capacity. There are problems like degraded constructions. There is no fund to improve the deteriorated infrastructures and State budget is limited.

Water wasting situation often occurs in many irrigation systems. In some irrigation systems, farmers are dependent on the Government's subsidy for operation and maintenance (O&M) and have not paid sufficient water fees. Meanwhile, State budget for O&M is very limited and fails to meet requirements of repair and rehabilitation. This leads to the fact that irrigation schemes are being deteriorated and caused low effectiveness. That makes a bad circle (**Figure 1**).

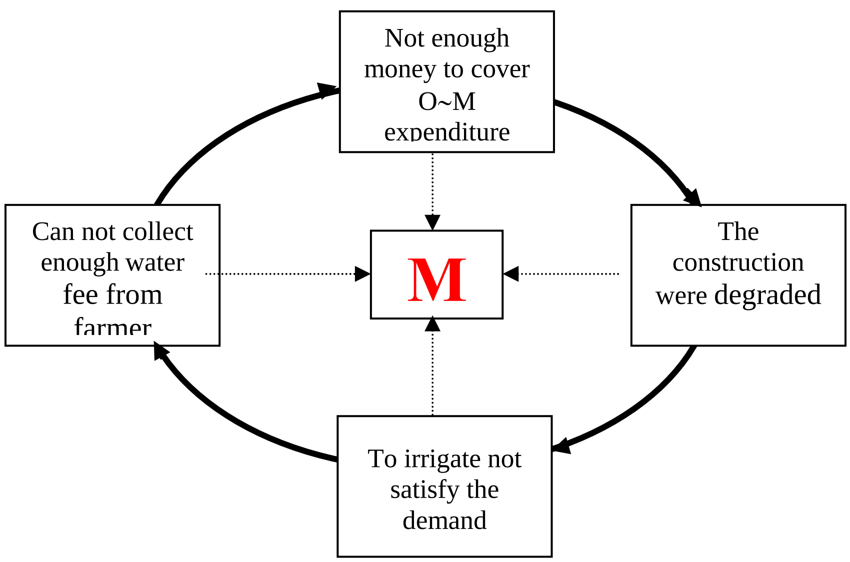

Figure 1: Deteriorating Irrigation Scheme

In Vietnam, the policy regarding the development of irrigation is "*investment sharing between the Government and the people*". In terms of management, the Government encourages farmers involvement in all aspects of irrigation, but they are only at secondary, tertiary and grass-root level.

In some cases, small-sized schemes within a village, a commune and inter-commune schemes especially in the mountainous, and remote areas have been neglected. There are no real managers to manage the small irrigation systems due to the lack of decentralization and division of responsibility, lack of appropriate policies and lack of funds for maintenance resulting in deteriorating the schemes and decreasing service quality.

In order to solve this problem, some localities have consolidated primary irrigation organizations by irrigation management transfer (IMT) to farmers by promoting the role of public participatory irrigation management (PIM).

In practice, in some provinces, farmer's cooperatives or associations manage most of irrigation schemes. The achievements indicate that for small-scale schemes, including communal and inter-commune canals under the large-sized and medium-sized irrigation systems, it would be more effective if IMT is practiced.

With experiences of some pilot ADB-funded projects, it is found that irrigation systems which are scattered in a wide area, and having bad effect of natural calamities as well as of human mismanagement, they require huge amount of money for the repair. The Government cannot manage the O&M for each individual paddy field, and each farm household cannot solve the irrigation issue individually. They have to rely on the community.

Therefore, it is clear that the community participation in the O&M is necessary and PIM is seen as the one of the most effective solutions for maximizing the capacity of irrigation systems in a sustainable manner.

THE EXISTING IRRIGATION MANAGEMENT MODELS

There are two types of irrigation management models in Vietnam:

State-owned Units

The first type is State-owned Units. They include inter-province irrigation management company, provincial irrigation management company, inter-district irrigation management company and district irrigation management enterprise (hereinafter Irrigation Management Company - IMC), and the independent stations and some irrigation management board belonging to district authorities. They operate on the common guidelines of Government.

Each State-owned models established are based on many conditions. It can be based on hydraulic boundary or on an administrative boundary. Almost State-owned companies are subsidized by Government, but the State budget is limited so the IMCs operate by income sources that they can get. The major incomes are water fee and a small State-subsidy.

The inter-provincial irrigation management companies manage the head-works and the main canals to serve irrigation and drainage for area of more than two provinces.

The provincial irrigation management company manages the works and the main canals within province, except those which have been transferred to collective or individual management. Provincial irrigation management companies own directly the irrigation management enterprises or stations.

The inter-district irrigation management company (enterprise) manages the works and the main canals to serve irrigation and drainage for area of more than two districts.

Collective or Individual Organization

The second type of irrigation management model is collective or individual organizations. Details are as under:

The Impact and Models of PIM in Vietnam

According to available data, there are now 90% of the total irrigation schemes watering 80% of irrigated areas under the systems managed by the State IMCs. The rest (above 9%) are managed by collective and individuals and they provide irrigation service to 20% of the total irrigated areas. This means that the scale of irrigation management by WUAs is large and of high efficiency.

There are many reviews and studies on the effectiveness of different forms of PIM with various scopes under different investment projects, different technical assistance projects implemented by different projects management organizations, different sectors and localities.

They are now typical models which are as follows:

- Type 1: One of the models is the inter-commune irrigation management model (2-3 communes each) which manages canals of large and medium-sized systems irrigating 300-500 hectares of land under the responsibility of Water Users Cooperative or Water Users Association. They manage schemes based on hydraulic basin, not in the administrative boundaries. They work quite effectively but after 10 years of development, they are still small in number. If this model is developed, it will result in redundancies in IMCs and affect the power interest of communes in the area (in administrative boundaries) and IMCs. The expansion of this model is still facing difficulties.

- Type 2: The other type of model is inter-commune irrigation management model (1-2 communes): managing canals and facilities irrigating less than 200 hectares of land under the responsibility of Management Units, or cooperatives. The operation of the Management Units is not relevant to the name. It provides services like irrigation teams in agricultural cooperatives. However, they are independent as they have their own bank account at the state treasury. Even if they are part of some agricultural and forestry cooperatives, they will have their own accounting.

- Type 3: Another model isn one-commune, inter-village or village model managing a canal, a part of a canal, a pumping station or small ponds and irrigating the area within one commune (and by administrative boundary) under large- and medium-sized irrigation systems or small one (like pumping stations, reservoirs). They are in most of the localities under different names. The most popular names are agricultural cooperatives (ACs), irrigation cooperatives (ICs), WUAs and cooperation teams, groups, units, teams.

- Type 4: Individuals can manage irrigation system but it is not popular. It takes responsibility only of small pump stations.

Figure 2 underneath shows the organization of irrigation management in Vietnam.

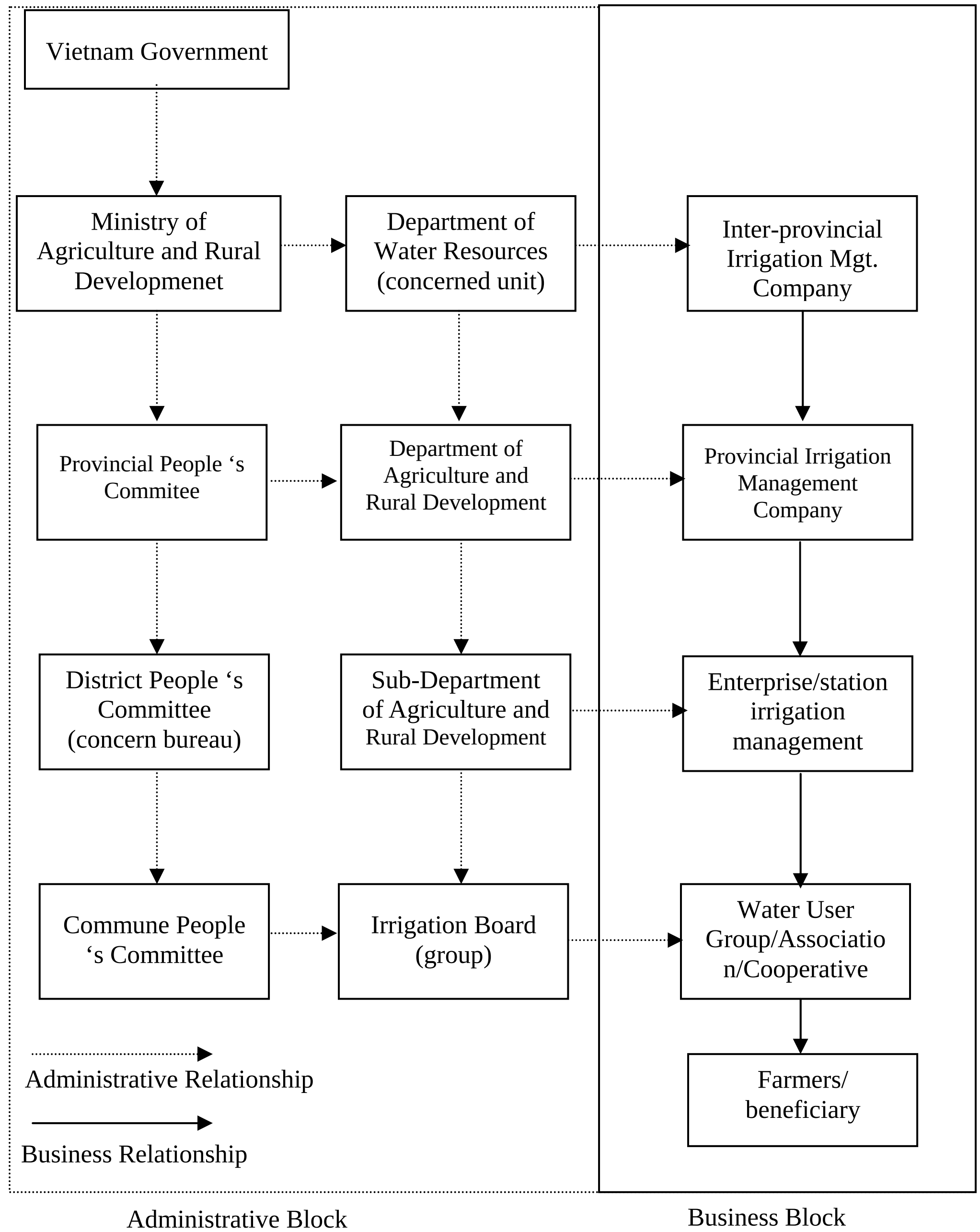

Figure2: Organization Charts of Irrigation Management in Vietnam.

SOME CONSTRAINTS IN PARTICIPATORY IRRIGATION MANAGEMENT

- In all Water Users' Organizations (WUOs) which have irrigation water supplied by pump, can barely afford the electricity expenditure from their budgets. A huge portion of the budget covers only the electricity cost.

- Some WUOs have difficulty in achieving O&M services because of not having enough equipment and machinery.

- The penalties of the late payment of water charges is not effective to users.

FMIS AND GOVERNANCE, CHALLENGES AND OPPORTUNITIES: EVIDENCES FROM INDIA AND NEPAL[1]

BALARAJU NIKKU AND PRANITA BHUSHAN UDAS[2]

INTRODUCTION

Recognition and importance of farmer managed irrigation systems (FMIS) in Nepal and India is a recent phenomenon though existence of them was rooted in long history. In both countries, FMISs are grown as an exemplary governance structures, responding to changing socio-economic and political conditions. Tank irrigation in South India is hundreds of years old technology and played a significant role in food security[3]. Number of tanks built in the British and a post-independence period is almost negligible compared to number of tanks constructed during previous centuries. Similarly, there are about 17,000 FMIS functioning in Nepal contributing about 70 percent of net irrigated area. There are exemplerary works on knowledge building and understanding dynamics of FMIS functioning in past decades. FMISs play an important role in managing water and agriculture resources for the benefit of rural communities, both as people's organisations at the grassroots and a very important organisational resource at local community level (Pradhan and Gautam, 2002).

India is described as a soft state, unwilling to enforce its own rules and regulations[4]. Nepal, a small mountainous landlocked country bordered with Indian states in all three directions except Northern Himalaya. Both countries in South Asia offer a unique opportunity to discuss and analyse water governance as they differ in socio-economic and political spheres. Being two neighbouring countries with historical cultural interdependence, the comparison further provides an opportunity to understand interrelationship between two countries in terms of governance. The Indian constitution often described as establishing a quasi-federal structure, includes detailed provision with regard to relationship between the states and a central government. Under the federal structure of India, water is largely, a state

1 Presented paper is benefited from a research project on Neeru Meeru program in Andhra Pradesh.

2 Ph.D., Fellow, Irrigation and Water Engineering Group, Wageningen University. The Netherlands; Ph.D. Fellow, Irrigation and Water Engineering Group, Wageningen University, The Netherlands.

3 Approximately 38,000 tanks in the state of Karnataka irrigate roughly 19 percent of the net irrigated area in the state according to 1986-87 Census. (for more discussion, see Vaidhyanathan, 1998)

4 It was back in the 1960s Gunner Myra, the Swedish economist, described India as a soft state.

matter with a limited defined role for central government. The Nepal case is different with a constitutional monarchy. Water is a national issue and water resources are central matter. With promulgation of Local Governance Act, the local authority has more power in decision making on local water management compare to earlier days.

CASE STUDIES

This section provides analysis of Tank WUAs in Andhra Pradesh (A.P) and Nala Tukucha FMIS from Central Nepal. In the case of A.P user associations were formed under irrigation sector reforms[5] initiated in 1997. In case of Nepal, an attempt was made to cover the FMIS under SISP project initiated in 1996. The reform programme and policies in both countries were funded and supported by external aid agencies.

Tank Irrigation in Andhra Pradesh

Andhra Pradesh is embedded with 72,840 tanks with a potential to irrigate 14 to 18 lakh hectares of land. At present, nearly 80 percent of tanks perform below their capacity. The gap reported to be about 40 percent between irrigation potential created and actual irrigated area under tanks. High degree of siltation was reported as an important problems affecting water storage capacity of tanks and in turn affecting their irrigation potential. The state receives on an average 8,631 tmc of rainfall water of which 81 percent either evaporates or runoff into the sea, thus leaving only 19 percent, which is 1,640 tmc for irrigation and other needs. Hence tank irrigation plays a crucial role in irrigated agriculture in the state[6]. Out of 4.84 million hectares of irrigated land, contribution of tanks and wells is estimated about 2.2million ha in the state.

There are institutional and social arrangements, which are responsible to deliver services to users of irrigation water in the past. Traditional institutions like *Neeradi*, *Neerukanti*, *Klava Pedda* were responsible for the water distribution and management under canal and tank irrigation until recent times, lost their presence and relevance when the State came up with formation of Water Users Associations. As new institutions crafted by the

5 See Mollinga (2001), Parthasarathy (2002) and Nikku (2003), for discussion on irrigation reforms in Andhra Pradesh.

6 Over the years, the state has been able to create an irrigation potential of 4.84 million hectares by constructing 15 major irrigation projects, 75 medium irrigation projects, and approximately 12,264 tanks in the state. Where as the tanks are in addition to the tanks vested under the control of the G*ramPanchayat* numbering 60,000, mainly used for drinking water, animals use, fisheries and small-scale wet irrigation. Source: Government of Andhra Pradesh, 1999. *Vision 2020.* Hyderabad.

State and empowered by a legislative act, these new WUAs started functioning at local level with an assured funding from the State in initial years. By bringing successfully a legislation, the State showed its commitment of transferring powers and duties of traditional irrigation department to these new institutions so that these associations shall function better and be responsible to safe guard canal resources. In this paper, we present analysis of two Tank WUAs from Warangal district[7] and one Tank WUA from Chittor district in Andhra Pradesh. Historically these districts are known for tank irrigation. Warangal district[8] ranks first in the state having the highest number of dug wells and percentage of area irrigated under these sources. During 1997-98, of the total 11,60,312 dug wells in the state, Warangal alone has accounted for 1,82,435 (15.5%). Canal and tank sources have only accounted for 0.5% and 14.6% respectively in the district. The rise in population is more than double during past decades and has posed tremendous pressure on land. As a result, tank beds were occupied and used for non-agricultural purposes leading to decline in tank irrigation. The first case study discusses the WUA management in implementation of NeeruMeeru program, bringing out the role of politics in distribution of silt. The second case study discuses role of WUA in lobbying for a lift irrigation project. The third case study is on conflicts over water sharing.

Case Study of Ganesh Tank

Desaipalle village, located 35 kms from town Warangal, used to be ruled by Desai Zamindar. After British regime, with formation of the Andhra Pradesh state, the Zamindari system was abolished. The name of the village still remained as the witness of the past Zamindari history. The villagers expressed different opinions about date of excavation of the tank. One hundred and sixty acres form an ayacut of the tank today, which according to

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[7] Warangal district situated in north part of Telangana region of Andhra Pradesh occupies 12,846 sq.km area with 1098 villages. A/C to 2001 census, population of the district was 32, 31,174 with a density of 251 per square km, of which 80.8 percent live in rural areas. It has 4 revenue divisions and 51 mandals. As per 1991 Census, there are 12.76 workers and the workforce comprises 47.7 % of the total population. Agricultural work force constitutes 74.5% of the total work force. The proportion of cultivators and agricultural laborers to the total work force is 32.4% and 42.1% respectively.

[8] Warangal is gifted with numerous irrigation tanks and existence of some of these tanks has been traced to centuries. The Kakatiya rulers of Warangal constructed several lakes in 13th century A.D. The Pakhal Lake, first in a chain of tanks, is situated 32 miles East of Warangal and was constructed across Manneru Vagu around 1213AD by a General called Yagala Ummidi under the Kakatiya king Gananpathi of Warangal. Today Pakal Lake irrigates about 18,000 acres. The Ramappa Lake was constructed adjoining two hillocks across Medivagu and Rallavagu by General Rudra in 13thcentury. It has water holding capacity of 5,401 m.c.ft. and irrigates about 8,000 acres. The Lankavaram lake, third in the chain of tanks built by the Kakatiya kings in the same period by closing up three narrow valleys amidst thick forests near Govindarapet mandal. It has a catchment area 103 sq. miles and irrigates about 10,000 acres.

old farmers had increased than the past. The irrigated aycut falls under two Panchayat villages namely Deasaipalli and Kesavapuram Panchayat under Duggondi mandal. Out of total irrigated ayacut, 100 acres belongs to Desaipalle Panchayat[9] and remaining 60 acres to farmers of Kesavapuram Village. According to APFMIS act 1997, a tank association was elected in June 1997. President of the association was selected from Kesavapuram village. When enquired about TC members that were elected, villagers could not identify the members. Transect walk to the tank ayacut showed that original place and shutter arrangements are modified with time. Farmers told that the tank had expanded in terms of ayacut from a *Kunta* to *Cheruvu*. None of them including the *Neeradi* could explain quantity of water discharge in terms of cusecs but they shared that about 100 days water will be released continuously from two sluices. Under the sluice belonging to Desaipalle, the length of the *panta caluva* (field channel) is about 2kms on which five sub-field channels exist, and that in Kesavapuram is 1.5km of canal length with 3 field channels.

<u>Tank Management.</u> Farmers' responses reveal that the tank was built in British regime. For sometime it was under management and control of Desai. After abolishment of the feudal system, management of the tank was brought under Revenue department. Now the tank is under management of Tank Water Users' Association (TWUA). To sustain the association and its activities, the government payback to the association a sum of Rs.90 out of every Rs.100 collected as a water cess per acre from farmers. The remaining money goes to local Panchayat. The state is also willing to handover collection of cess to the association and provides incentives, which show prompt payments. The APFMIS act of 1997 provides power to the associations to find sources to increase resources. For example an association can auction grass on tankbunds and fish from tank. This raised conflicts among new institutions and the one which are already existing. The newly elected WUA claims fishing rights as their, where as fishermen claim that their association was formed much before, and the tank is their main livelihood source.

[9] Desaipalle Panchayat comprises one main village and two hamlets namely Gudi Maheswaram with 150 households, Sambhaipalle with 150 households and Desaipalle with 300 households. The total voting population is 1300. Caste plays an important role in social setting. Gudi Maheswararam represents the *Munneru kapu* as dominant caste where as other castes like *Gowda*, *Arya* (Marathi), *Yadava* represent backward, schedule caste and tribe. Out of 600 households about 100 households are landless mostly from the backward and schedule caste, and their main occupation is agricultural labour.

Management of the tank witnessed changes and this includes water distribution system. Under present system, the tank ensures Khariff crop where paddy is grown. If there is availability of water, farmers sow paddy as Rabi crop. In present year, about 30 acres of paddy only was sown out of 160 acres as the Rabi crop. The *Neeradi* will be paid minimum 20 kilos of paddy per acre for the services. A payment to the Neeradi is linked with crop yield. The work of a *Neeradi* begins with monsoon rains in June when storage of water starts in the tank and ends by end of November when Khariff crop will be harvested. If there is water available in the tank, second crop which is also paddy will be harvested by end of march. In an interview, main *Neeradi* said that they perform a ritual if the tank receives good amount of water in beginning of the season. They will offer meat to local deity *Maisamma* and pray for a good crop. Neeradi felt that they are ignored after formation of TWUAs. They still report to village *patwari* and the Mandal Revenue Officer, in addition to tank WUA president if they come across any violations during water release and allocation.

During discussions with farmers, it was revealed that Tank WUA president belongs to Kesavapuram and is from Reddy community. He is a member of ruling Telugu Deasm Party and a close relative of local MLA. He is a government teacher and stays in place of his work. When enquired about works carried out during last four years by the tank association, the farmers answer is that they are ignorant. It was revealed that they never attended any meeting organized by the TWUA.

Farmers pay Rs 50 for a tractor load of silt to apply to their dry lands. On an average 30-40 loads of tractors silt worth of Rs.1,500- Rs.2,000 was applied in previous year and that reduced the cost of fertilizers. However the result was not visible in terms of production of the crop. Cropping pattern witnessed changes in last twenty years from growing maize, groundnut, green gram and red grams to cash crop like mirchi and cotton. The leguminous species were replaced. Farmers also tried oil species like sun flower and sesame but today they had to settle for cotton. The choice of the crop is no more with the producer but with the buyer. According to the farmers experience they had spent Rs.5,000 for the total cost to grow one acre of cotton ten years before and today the cost had multiplied four times i.e. Rs.20,000. The price they got per quintal of cotton approximately is Rs.2,200 and the production per acre was 15-20 quintals. Today price they get is Rs.1,600 and the production had come down to 6-7 quintals. Farmers claimed that the choice is limited to growing cotton. Wells were dug and electricity run bores are in use to meet the crop water requirements. The farmers had to pay whether they use electricity or not? There is a slab rate for electricity use. According to policy for a five-horse power motor installed farmer pays Rs.230 per month. The ground water depletion is increasing and hence farmers acknowledge that removal of silt from the tank and storing more water will increase recharge but they had expressed that they have not seen such results yet in their area. They also felt that since motors are located far from the tank it might not help them.

Water Sharing and Rules. There are two sluices and shutters fitted in the tank. Neeradi was appointed by the Revenue Department. He operates shutters of the sluices. He hails from Desaipalle. There are two other members from same village appointed by villagers as neeradi who are responsible for supply of water to fields under the tank CA belonging to Desaipalle. Similarly Kesavapuram farmers also appointed another Neeradi. After death of the Neeradi, his wife took over the job in assistance of her sons since last seven years. Sixty acres forms catchments of the tank according to the farmers. Main problem regarding management of the tank as explained by respondents are a) there are less rains and hence the tank was not filled, the ayacut development decreased; b) no removal of silt on annual basis; c) weeds and other plants infested the tank bed and bank; and d) no feeder channel or major irrigation canal that supply water to the tank. The formation of small tanks in upper reaches of the tank is some of the problems that the tank is presently facing.

Removal of Silt. Removal of silt from the tank was carried out under the government sponsored *Neeru- Meeru* programme. Total money spent on Ganesh tank according to department statistics was Rs. 167760, where as farmers do not have a clue on money spent. Surprisingly not only villagers but also local MPTC and the community leaders were also not aware as to how much money was spent on the tank restoration programme under the state sponsored Neeru Meeru programme. The farmers saw this as another government sponsored programme and did not participate actively. Hence, the farmers were at receiving end. Ganesh tank as a case reveals that the programme was target oriented and was implemented in a hurry.

According to the farmers, the removal of silt was carried out for six days. First two days, there was no work because there are differences of opinions on location of the silt removal in the tank bund. The tank belongs to two villages and the two existing sluices serve the ayacut of these two villages. The villagers wanted to remove the silt near to their sluice so that more water can be stored to accrue benefits. Finally, centre of the tank was the choice. When asked about results, the *neeradi* told that the present year would be the first year after the excavation. But he believes that because of the removal of the silt there will be additional water available and the farmers went for the second crop. He operates both the sluices and keeps them open for equal number of days, though the total ayuact under these sluices is different.

Farmers from Kesavapuram belong to dominant reddy caste and they are well connected to the political leaders. According to the Desaipalle farmers most of the farmers from Kesavapuram had access to their own tractors and hence used more silt than the Desaipalle farmers who are economically weak. The WUA president also comes from the same village and hence the farmers of the Desaipalle felt that their representation in the tank management was not sought. Hence they suggest that the tank can be divided by creating a bund across the tank and a separate association can be formed by electing representatives from their village, which will solve the problem of water allocation between two villages.

There are farmers who wanted to have the silt but could not hire tractors. Tractors came from neighbouring villages and the farmers made arrangements with the tractor owners directly. The hydrological excavator belongs to a contractor. Payment to excavator is made by the department on basis of quantum of work carried out. There is no visible role played by the Tank WUA. Assistant Engineer from minor irrigation department certified the work and accordingly payments were made to contractor. The whole program was completed in less than a week.

Case Study of Pedda Cheruvu (Tank)

Peddacheruvu is the biggest tank in Narlapuram Village. There are 18 irrigation tanks of different sizes falling under Parakala mandal. The tank users association was formed in 1997. Narlapuram with an area of 1386.85 hectares includes 667 households and a population of 3023. Literacy rate is stated as 30 percent. Agriculture is the main source of livelihood. Small and marginal farmers (who also happen to be agricultural labourers) together with landless agricultural labourers, form around 80 percent of total village population. Majority belongs to backwar caste (*boya*) and secheduled caste. Most of them are landless and live on both agriculture and non-agriculture activities. Total cultivated area in the village is more than 1000 hectares of which both wells and tanks irrigate around 700 hectares. Area not available for cultivation is 227 hectares while the cultivable waste constitutes 120 hectares. This village neither has forest nor pasture land. Paddy and cotton are major crops grown. Paddy is purely irrigated crop, whereas cotton is grown both in irrigated as well as a dry crop.

Tank History. Peddacheruvu is the main source of irrigation in addition to 17 smaller tanks (kuntas) available for the village. It has a command area of 320 acres while most of the Kuntas have ayacut between 3 to 40 acres. Most of the kuntas are largely silted up and on verge of becoming defunct. Peddacheruvu had a command of 320 acres out of which about 220 acres are now receiving water from a rivulets 'Pedavagu'. At present, tank exclusive command is deemed to have only 100 acres. The reduction in ayacut is due to decrease in storage capacity of the tank due to accumulation of silt for decades. One important reason is that a feeder channel, name Muhammad Shah Nala is disturbed. It used to feed Peddacheruvu as long as Nala (water path) was maintained by a local Muslim landlord five decades ago. At present, farmers around Nala started cultivating lands by diverting water to their field. Still the tank receives a good amount of water during rainy season from the catchment. According to farmers, the tank bed is of 200 acres and there is no large-scale weed grown in the bed. In summer, landless schedule caste people cultivate some part.

The tank has a sluice that feeds to all its command area. The field channels are often cleared and repaired by individual farmers. Majority of the farmers in the command area are marginal farmers with small and fragemented land holding. Paddy is the main crop grown in the command area. In past, most of the CA used to get irrigation for two seasons. At present it hardly irrigates 100 acres in kharif season and about 20 acres in summer season. Farmers think that water would be sufficient if it rains after paddy transplantation. For this tank should be filled 2-3 times during rainy season. From last 20 years, water from the tank is enough for single crop. For second crop, farmers share the water on rotational basis (locally called *taibandi* system). There are problems in water sharing which is solved among the users.

Tank Water Users Association.[10] Two tank associations are formed on Pedavaagu and Peda Cheruvu which receives water from Pedavagu, and irrigate about 220 acres of ayacut. Elections were held to Peddacheruvu WUA. After formation of association some rehabilitation such as widening and strengthening of bund took place. The association repaired sluice and distribution channels under state government funding. The association leaders claimed that there is need for more works to be carried out. Both WUA Presidents and farmers informed that silt is a big problem for them.

[10] For detailed discussion please refer Venkateswarulu, D and Balaraju Nikku et al (2003) *Desiltation of Tanks under Neeru-Meeru programme in Warangal District : Issues and Lessons*, Research study Commissioned by District Water Management Agency (DWMA), Warangal and Modern Architects for Rural India (MARI),Warangal, Andhra Pradesh.

There are instances of silt removal by individual rich farmers who have used tractors to carry the silt. There is no formal activity initiated by the association. No large-scale desiltation work was done for last several decades. The tank associations could not mobilise community support and farmers involvement in tank renovation and desiltation activities.

Leaders of the tank association together with village sarpanch approached local MLA, the Executive Engineer (Irrigation Department) and the District Collector for sanctioning funds under Neeru-Meeru programme. According to the leaders, the government officials asked them to arrange for a hydrological excavator first on their own. The expenditure incurred would be reimbursed after completion of the work by the government.

The Tank association after a month long search could hire a hydrological excavator by paying Rs.50,000/- as an advance. Money required is arranged from big farmers of the village. WUA initiative is note worthy and they carried out desiltation activity in 2001. Desiltation was done first in middle of the tank around four. As many as 20 tractors were engaged for transportation of the silt. Digging was done upto 3-4 feet deep. Tractor owners were paid an advance by one day for the next days work. There were nearly 9000 tractor trips taken place for the transportation of silt from the tanks to the fields. Farmers paid Rs.60/- for a trip of a tractor. Hydrological excavators were paid a rent of Rs.750/- per hour plus a *bhatta* of Rs.10/- per hour for hydrological excavator drivers. The total amount released by the government for this programme is Rs.2.60 lakhs. The WUA president in public admitted that not all the money was used for desiltation activity. Around Rs.2. lakhs were paid for hydrological excavator. The remaining money was used for other expenses.

<u>Proposal for Lift Irrigation Scheme.</u> The main source of water for Peddacheruvu is the Muhammad Shah Nala (stream). In recent years due to large scale cultivation in the catchment, inflow of water into Peddacheruvu has decreased. Farmers and WUA thought for alternative choices of getting water into the tank. A perennial stream, called `Pedavagu` (situated about half kilometer away from the tank), used as a water source for 220 acres of ayacut of Peddacheruvu was thought to be a right choice for bringing water to the tank. Lift Irrigation Scheme was considered to be a solution for this problem. Efforts were extensively made to construct an L.I.Scheme on the stream to pump water into the tank. Farmers approached District Rural Development Agency in this regard (DRDA). The DRDA authorities directed irrigation department to prepare a survey of the project.

In 2001, survey was taken place and a proposal was made to construct a lift. Irrigation authorities for the construction of the L.I.Scheme gave an estimation of Rs.18 lakhs. The DRDA agreed to share about Rs 7 lakhs. Kakateeya Grameena Bank came forward to give a loan of Rs 6 Lakhs. Farmers were asked to contribute the remaining Rs.5 lakhs for the Scheme. As the majority of ayacutdars are small and marginal farmers (mostly belonging to SC and BC communities) they could not pool money till today. Consequently the proposal is pending. Meanwhile, the WUA of Pedavagu and Peddacheruvu for the last four years got money for different works for tank maintenance and rehabilitation activities. Farmers opined that though WUA's have been receiving money for rehabilitation works for the last four years, no visible improvement is seen in the Peddacheruvu and Pedavagu. They spent around Rs.25 lakhs on restoration activities, which were largely considered to be futile and not helped to solve the main problem of the tank. Most of the farmers reported that if the same funds were used for construction of L.I Scheme the situation of tank would have improved significantly.

In this case, the presence of formal tank association has helped in negotiation with government authorities to sanction funds. At the same time farmers' contribution in terms of voluntary labour decreased. The dependency on external government funds increased. The users (farmers) perceived that the problems of the tank have to be solved by the elected leaders. The elected leaders took interest in the tank matters, as they want to continue in the office. There is a clear patron- client relationship that has emerged than the collective management of the tank in the past.

Case of Kambakam Tank (Chittor District)

This case of Kambakam Tank is an example of how conflicting interests influence functioning of a tank institution. As urban cities are growing and drinking water needs of these cities are increasing there are more pressures on existing water resources. These pressures often lead to conflicts as irrigation water often diverted to drinking water purposes.

Kambakam is a village in Varadapalem mandal in Chittor district. The village political landscape is dominated by Reddy families followed by Yadava and Muslims families. Four hamlets fall under Kambakam Revenue Panchayat. The tank of Kambakam is located between Telugu Ganga canal and Avanti leather factory. The tank supplies irrigation water to seven hundred acres belongs to Kumbakam and other hamlets in the Panchayat.

Discussion with formal water users' association president during 1997-2002 reveals that the tank is the only source of irrigation to these villages.

In 2000, average annual rainfall reduced and tank could not fill to its capacity. The standing wet crop was in need of at least one watering to protect crop from dying. At that time in Telugu Ganga Project canal water was flowing. Farmers made a request to irrigation department to fill the tank so that they can save standing crop. The department turned down farmers' request on the pretext that they cannot supply water to the tanks, since it is meant to supply to Chennai for drinking water. "Farmers from four villages brought pressure on me as a tank president. The department were very sensitive to supply water to Chennai instead of filling our stomachs. We decided to breach the canal to fill our tank. Within few hours in the evening the tank filled and we repaired the breach. The officers came next morning and made a police case on me. The case is still pending in the local court though my term as a WUA president is over" says the President. "The department should have thought about the local farmers needs while designing the project. Our fields are also fall under TGP command. But the government is not able to dig the branch canals and other majors in time." "*We do not object supplying water to Chennai in principle. But we feel bad when we do not receive water in time for our own fields due to governments delay and in addition put legal cases on us''* argues farmers of Kambakam Tank.

Case Study from Nepal[11]

Case of Nala Tukucha Irrigation System, Central Nepal

Tukucha Nala Irrigation system is located in Tukucha Nala Village Development Committee in Northwest of Kavre Palanchowk district in Nepal. In ancient time, Kathmandu valley was a lake and settlements were around it at the bank. Nala at that time was one of the many settlements around the lake. Therefore the dominant castes in village are still Newar community. The system is a small hill irrigation system with a command of 34 ha. The system receives water from perennial nonsnow fed Punyamata Khola which is a part of Sunkoshi river basin. The system has a free type of river diversion without a fixed structure of cement and concrete. The length of main canal is 2.05 km, of which 650 m is structured with cemented canal lining. These linings were built during the government supported rehabilitation program under the SISP in 1997-98. The present infrastructure demands regular checks at the diversions to verify whether the iron mesh

[11] The section is benefited from field work conducted as part of M.Sc. thesis of the author (Pranita B. Udas) in 2001 to 2002 and updated with additionlal fieldwork in 2003.

filled with rock are washed away by river water. The canal also required frequent cleaning in rainy season to remove sediment carried by monsoon rain from uphill. To prevent the canals from getting blocked, regular follow up is needed to guide monsoon drains with heavy sediments out of the canal. Therefore the system requires frequent maintenance which is possible with a collective action and an effective organization of the users.

Initiation of Tukucha Nala irrigation system. Majority of villagers started irrigating from the Punyamata river in 1982 at the head end on their own effort. In 1992, the river flooded and washed away the diversion and fertile land. Majority of the villagers affected were from downhill ie ward number three. The District Irrigation Office assisted the villagers with a small budget for rehabilitation. All farmers contributed voluntary labour and saved NRs. 10,000 of the budget allocated for labour wages. The year after the flood, there was a painful drought, which again hampered agriculture production. This drought made farmers realise the need of water for irrigation in order to limit risk associated with rainfall. The ward president of ward number three, and two other local leaders took initiative to divert water from the same headwork to ward number three. With the money saved from the River Control Program and their own effort, the local/WUA leaders bought Hume pipes (cement casting pipes) and guided water into their field. All users accepted the decision made by local leaders. The Hume pipes were installed, but the repair and cleaning of closed type Hume pipe was quite troublesome as the pipes got blocked from time to time. Once the pipe was cleaned, the cleaning used to cause leakages at the junction with another pipe.

Emergence of formal WUA. In view of solving their irrigation problems, the local farmer leaders made a request to the District Irrigation Office for system rehabilitation. This was done in year 1996.This request was approved in the same year. The process through which the request was approved is exemplary for the way in which irrigation issues are dealt with. The villagers made an application to district irrigation office for system rehabilitation referring to their irrigation system as Phanalphat irrigation system, which refers to the present irrigated area. The reason for applying with the name of Phanalphat was that the villagers wanted the project approval for only this area and not for the whole VDC. The present name of the WUA is Tukucha Nala, a name which refers to the whole VDC. At the time the request was made to DIO, other informal WUAs from the same river in upstream also made an application to DIO for rehabilitation. One of these systems was under pre-feasibility study. The first president of Tukucha Nala WUA was an active local leader (ward president) with important political connections. He contacted the parliament member of that time. This member belonged to the same political party as he did. The parliament member took his request seriously and managed to pressurise the Department of Irrigation for the project approval. Since then, the pre-feasibility study of one of the irrigation system upstream of the studied system in Punyamata river basin, had already been started, the department approved the request for system rehabilitation for the Tukucha Nala VDC without specifying the name of the system. The Phanalphat Irrigation system got approval for rehabilitation, at the expense of the system where the pre-feasibility study was already started and in the process the system got the name Tukucha Nala. This case shows how a political connection of local leader who is also a FMIS leader could mobilize external resources for the system improvement. The local leader claim his WUA got credit for collective action for saving NRs 10000 under river control program.

<u>Role of WUA leadership</u>. When the system was constructed in 80s, there was an active participation of the then Panchayat leader. It is quite evident in this system, the leadership has changed to young energetic ward president in 90s with introduction of multiparty system in the country. The Ward President belongs to communist party and is neither a landlord nor a person with high profile like the Panchayat leader earlier. But he is relatively educated among other villagers. The villagers express their positive attitude towards their leader for his dedication for the association. In the due course, he was elected as an Area representative. In the WUA assembly held in 2001, he expressed his inability to continue as WUA president due to his busy schedule to visit other part of the district as an Area Representative. Still, he expressed his willingness to represent the WUA in National Federation of Water users association and was interested to make an effort for the registration. The case suggests that how the WUA positions are linked with a higher level politics and the position in WUA were seen as a base for the higher level political offices.

<u>Contribution of Labour</u>. The WUA makes decision usually in the general body meetings. One such decision was discussed in the third general body meeting. The decision is about share of contribution for cleaning canal. Present practice to participate on cleaning on household basis is discussed as unequitable as every household irrespective of the land holding size contribute the same amount of labour. The users (especially low land holders) wanted to change this rule to make the labour contribution proportionate to land holding size. The large land holders did not agreed to change the rule with an argument that they do not have more family members to contribute physical labour. Some of them also explained that their sons are studying or working in town ie temporarily absent in the village. The discussion went on

but no concrete decision was made. At the end there was no change in the existing rule. The incident suggests the clear domination of large land owners in the decision making of the WUA functioning. It is also evident that the Newar community dominated the representation in the WUA committee as well in the discussions.

Quota System. The quota system was mentioned in the Irrigation policy of 1992 with an intention to increase women participation in WUA management. Twenty percent of women representation in the WUA managing body is needed according to the policy. The policy objective was partially successful as evident in the Nala Tukucha. The WUA membership is based on household basis than land right. The quota system opened some spaces for women to represent their voice. A widow user from lower caste can nominate her daughter in law when there was a nomination for women members for the WUA committee. The president nominated three Newari women members though the nominee refused to take the responsibility. The widow took this opportunity to nominate her daughter in law who has a formal education for the post. Other members agreed to her proposal. However mere physical presence of women members do not result a change in terms of WUA decision making. It is realised that women involvement in canal cleaning is more than their participation in meeting after rehabilitation. It is because the rehabilitation of FMIS reduced labour requirement for system maintenance. Those male who are working away from the village, used to come back during repair of diversion structure in past since it was heavy work. These days after rehabilitation the labour requirement is less and they believe only canal cleaning can be done by their female family members.

Accountability. The Nepal Government is involved in national irrigation sector since 1922 AD. The irrigation projects are heavily funded by donor agencies. There is enough indication that the donor agencies influence the project designs and objectives. For Example the ADB which funded SISP imposed moratorium from 1998 to 1999 indicating the poor institutional development of WUAs within the SISP area. These factors influence the functioning of FMIS as they depend on external resources. This will in turn affect accountability within the FMIS. The irrigation bureaucracy becomes accountable to their funding partners than to FMIS. In this case, the local leader seems accountable to users for brining resources through political connection in seeking vote. Nala Tukucha is not an isolated example but reflects the present status of FMIS functioning after state interventions.

CONCLUSION

Irrigation management is a complex dynamic process. There are many stakeholders with different interests and needs are involved. Many factors beyond local management did affect an organizational evolution. In Andhra Pradesh the traditional *Neeru Kanti* was replaced by formal arrangements after introduction of reform policies in the state. The Tukucha Nala FMIS adapted to new roles with changing socio-economic and political conditions. The FMIS showed that they are dynamic, responding to new needs of the users, reacting to the state policies and proactive to external influences. The issues of equity, right to control and manage, and sustainability of FMIS are continuing to be challenged within existing governance structures. Research on governance alternatives is more pertinent because of current thinking of irrigation management transfer policies, decentralisation of local governance and privatisation of water resources and discourse on property rights and justice.

What can we conclude from the case studies? The discourse/discussion on governance opened up a new intellectual space. The discussion of governance systems in FMIS enabled us to understand the role of different actors in coping with their collective problems. The rule making is an important characterstic of self governing sytems[12]. This is evident in the case studies. In case of TukuchaNala, user participation in operation and maintenance activities resulted in right over share of water where as the same rule is missing in case of tank associations. The association is depended on external funding especially from the government than raising their internal resources. The heavy dependence on external agencies would weaken the governance. The Quota system in the case of Nepal resulted in creating some space for women participation. This was absent in Andhra as no provisions were made for women representation in the Act. The participation in the WUA activities is based on the land ownership. Hence, women having a piece of land in their name only became members of the WUA.

There is ample scope for formation of social capital[13] in FMIS. However less explored in the tank associations. Managing silt operations have shown how the caste and party politics influenced the in equal distribution of the resorce.

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[12] Levine (1992) argues that FMIS were characterised by rules that prescribed the irrigation behaviour of water users. Equity formed the basis of these rules and rule making. The Perception of equity was based on circumstances and operational rules embodied in physical structure of the systems.

[13] Pradhan (2003) argues that the age-old farmer managed irrigation systems in several parts of Nepal fascinates institutional experts with richness of social capital in their governance structure. The direct involvement of users in resource identification, resource utilisation and resource regeneration has created physical capital as well as social capital.

The volunteer contribution of users in Nepal case under river control program shows the degree of social capital formation. What we can derive from this is that formation or presence of social capital structures is the key to achieve better governance in managing water resources. If a project is large in terms of physical structure and financial investments, more care and time should be spent on institutional development.

One of the important characteristic of FMIS is that they are less prone to conflicts as they operate on clear rules. The increased pressure to share irrigation water for other purposes as evident in the case of Kambakam tank suggest that there bound to be conflicts among different users as their needs are different. The FMIS needs to address this issue by making clear rules for sharing arrangements. The mechanisms of rewarding and punishment are not evident in all the case studies. In absence of these mechanisms the FMIS will not be able to control free riders.

The presence of accountability mechanisms is crucial in achieving good governance. In the case of Tank irrigation associations the leadership, caste, politics played a crucial role in managing the association activities. The accountability relationships are rather weak between the leadership and users. Accountability[14] cannot simply be created or designed. It has to be achieved through the process of negotiation and reformulation of arrangements between agencies and actors. The case studies suggest that underlying accountability are *social relations of power.* Hence to understand or to create accountability structures between many actors, we need to understand: who is controlling whom and how to balance the power equations. We conclude that the *relations of Power* influencing the institutional dynamics *are* an important factor that shape Governance.

We conclude from the case studies that three important processes needs to be present inorder to achieve good governance in water resources management. They are: first, access to information, second; participation in decision-making, and third: accountability in institutional matters. Implementation of these principles will require a thorough rethinking of the ways in which government interacts with the local users of water and society, at large. Political interests dominats the planning and policies of water sector. Hence getting the *political process right* is the key towards effective water governance. The discourse on governance needs to be focused on how to

[14] There are different levels of accountability (for example between users and community leaders, politicians, between bureaucracy and users and policy makers). There are different types of accountability, i.e. Operational, financial, socio economic and political accountability. We are not discussing this issue in detail in this paper because of need for further research.

achieve an enabling environment and institutional arrangements right. Effective policies that enforce water governance would be those that consider not only scientific or technical feasibility but recognise the social, cultural and political aspects of the decision making process. Understanding the link between politics and policy is crucial for implementation of any development programme that is aimed to achieve good governance.

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Socio-economic Dimension

EVOLVING IRRIGATION MANAGEMENT INSTITUTIONS IN SARDAR SAROVAR PROJECT, INDIA

JAYESH TALATI AND JANWILLEM LIEBRAND[1]

INTRODUCTION

Institutional reform with policy support has helped states in developing a range of institutional alternatives for joint irrigation management. The principal driving force for institutional reform is poor operation and maintenance and the inability of the government to mobilize funds, either directly or indirectly, for even deficient service provision (Johnson III et. al, 2002). Irrigation management transfer or turnover of irrigation systems to farmers' groups, also called participatory management, is an accepted way of improving performance (Sengupta, 1993) and has become a world-wide phenomenon.

Water user associations (WUAs) have emerged as one of the most preferred institutional choices of states to facilitate management of irrigation systems in a participatory and sustainable way. Irrigation agencies work with existing irrigation associations or build upon other existing institutions by integrating water related functions or create new WUAs (Cernea and Meinzen-Dick, 1994). Generally three types of farmers' associations, viz., farmer-initiated WUAs, non-governmental organization (NGO) facilitated WUAs, and government induced WUAs, are found under participatory irrigation management (PIM). Government-initiated WUAs are dominant associations in India (Brewer et. al, 1999). Andhra Pradesh and Maharashtra governments have made considerable progress in the implementation of PIM. Isolated cases of successful WUAs from Gujarat, Maharashtra, Kerala, and a few other states have been documented in several research studies (Pant, 1999; Ballabh et. al, 2001; Bose, 2003; Neetha, 2003).

After drawing lessons from national and international experiences, the government of Gujarat has introduced the PIM in the Sardar Sarovar Project (SSP)[2]. The Sardar Sarovar Narmada Nigam Limitd, (SSNNL) a government

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1 Consultant, International Water Management Institute IWMI-Tata Water Policy Programme, Gujarat, India; and M. Sc. Student, Wageningen University, The Netherlands.

2 The SSP has the most extensive network of irrigation canals in the world (Berger, 1994). On completion of the entire canal network, it will serve a total area of 1.8 million hectares in the State.

of Gujarat undertaking, was created and entrusted with the work of implementing the SSP, including construction of head works and canal systems and irrigation management. The government has also constituted a task force, which has developed final draft of the PIM act to provide legal and policy support to farmers' associations.

A study was undertaken in the first phase command area of the SSP falling in the four districts of Narmada, Bharuch, Panchmahal, and Baroda to understand the socioeconomic and institutional dynamics evolved in these areas with the introduction of canal water. This study describes the growth and development of WUAs in SSP, examines policy and other support provided by SSNNL, identifies communication and coordination gaps within irrigation agency and between agency and WUAs, analyzes performance of the first irrigation season and delineates factors responsible for functioning of WUAs. The study is expected to be useful to policy makers and the project authorities, who have enduring interest to implement irrigation projects in a sustainable manner.

REVIEW OF PIM/IRRIGATION MANAGEMENT TRANSFER PROGRAMME

Numerous studies have been conducted in the past decade on PIM and IMT (Shah et. al, 1994; Meizen-Dick et. al, 1994; Kumar, 1996; Vermillion, 1997; Ballabh et. al, 2001; Parthasarathy, 2001; Swain, 2002). These studies covered transfer of public tubewells as well as surface irrigation schemes. Some of them attempted at identifying the factors that were critical to achieving the intended objectives of IMT process/farmer participation, while others analyzed the impact of IMT or PIM using a wide range of performance indicators.

Parthasarthi (2000) has looked at the institutional and financial issues of pilot projects on PIM initiated in selected canal commands of Gujarat and observed that convincing farmers to participate in the formation of WUAs is one of the common problems across the pilot projects. Swain (2002) studied prospects and constraints of IMT in Orissa. She firmly believes that there is a need to convince farmers that the benefits of participation will exceed the cost of participation; otherwise, farmers will not evince interest in a programme introduced and implemented through a government agency. Meinzen-Dick et. al (1994) have identified factors/conditions for sustainable water user associations and have expressed that "Many type of WUA, the benefits to farmers must outweigh the costs of participation."

Derashri (1998) suggests that assured water supply in tank irrigated areas to acceptable degree of certainty is a powerful incentive for farmers to join WUA. According to Meinzen-Dick et. al (1994), users' control over water supply is a major incentive for farmers to participate in WUAs.

Ballabh et. al (2001) implemented an action research project in one of the villages of Gujarat where a farmers' cooperative was established. Management of four government tubewells was transferred to the cooperative. They experienced that often government organizations follow the blue print approach in promoting WUAs. Kishore and Mukherji (2003) analyze the performance of irrigation cooperatives after IMT in Gujarat and found that the Gujarat Water Resource Development Corporation has adopted a target-oriented marketing approach to promote WUAs. Hooja (1997; 2000) has suggested a 3-tier model for promoting WUAs. He recommends that numerical targets for creation of WUAs should not be fixed to cover an entire project in a short period of time. Vermillion and his colleagues (1999) assessed small scale IMT programmes in Indonesia and suggested that locally-respected farmers should be utilized as institutional organizers, not as a substitute but as a supplement to agency staff inputs in promoting WUAs.

Merry (1996) studied institutional design principles in a large scale irrigation system and establishes a hypothesis that "single irrigation systems managed by system-specific organizations that are financially and organizationally autonomous and accountable to their customers, generally perform better and are more sustainable over the long term." According to Meinzen-Dick et. al (1994), internal structures and external conditions determine effectiveness, viability and sustainability of WUAs. Parthasarthi (2000) has pointed out that wherever rehabilitation work precedes formation of WUAs, the performance of WUAs seems to be better.

Vermillion and Carlos (1998) studied impacts of IMT in Colombia and found that government expenditure on irrigation management was reduced because of IMT. Johnson III (1997) studied IMT in Mexico and concluded that a sharp rise in water fees collection supported water users and irrigation agency staff in operation and maintenance (O&M) of irrigation system in the post-IMT period. Pant (1999) assessed the impact of IMT in Maharashtra and found higher water use efficiency after the introduction of IMT. He also found that water charge collection considerably increased after IMT despite hike in water fees. He considered that as a good sign of generating fund for O&M expenditure. He concluded that a majority of WUAs are making profit even after withdrawal of management subsidy by the government. Jairath

(1999) critically examined the impact of PIM in Andhra Pradesh. According to her, there are two probable reasons for higher revenue collection in the post-PIM. First; WUAs were to get funds from state government for O&M in proportion to the revenue that was collected from within their command and hence the official entry of irrigated area, which was not reported prior to PIM, has increased. Second; increase in revenue collection could be owing to higher charges and not necessarily because of larger numbers of farmers complying with payment. In fact, transfer programmes have increased the irrigation cost of farmers (Vermillion, 1997).

BACKGROUND

The SSP, popularly known as the Narmada project, has been widely discussed, debated, and thoroughly appraised by experts in almost all disciplines of water sector. Construction of the project heated in the eastern part of Gujarat began in the 80s. It is the terminal dam on the downstream of the Narmada river. Canal command of the SSP is divided into three phases; Phase I – from head regulator to 144 km chainage (Ch.) of main canal, Phase II – Ch.144 to 264 km and Phase III - Ch. 264 to 357 km of the Narmada Main Canal, respectively.

It was a political decision to release water for irrigation for the first time in the Phase I (dark area, **Figure 1**) from rabi (winter) 2002-2003 onwards. SSNNL had an irrigation plan to cover a command of 91,688 hectare (ha),

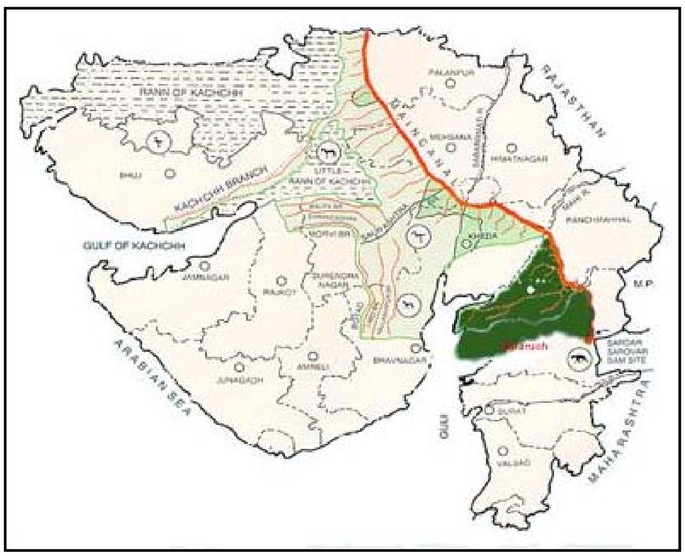

Figure 1: Map Showing SSP Command Phase-I

Source: SSNNL, Gujarat

out of 444,274 ha culturable command area (CCA), for the rabi season. The distribution system covers a major part of the command area between the Narmada and Dadhar rivers (85,621 ha, 32.52 %) spread over 670 beneficiary villages of 14 talukas of Narmada, Bharuch, Panchmahal, and Baroda districts, Gujarat.

The concept of PIM is gaining ground in Gujarat with government initiated efforts to promote WUAs in irrigation command, especially in SSP command. As per the policy decision of SSNNL, it is mandatory for farmers to form WUAs to get water from the Sardar Sarovar scheme. On the initiative of the Nigam, more than 800 WUAs have been registered under the cooperative act prior to the first irrigation season (SSNNL, 2002).

Since training programmes for the Nigam officials and farmer representatives have been organized to orient them about PIM, it was felt necessary to critically examine the process followed by the Nigam officials in promoting WUAs and to see how these WUAs evolved in a different socioeconomic milieu and how farmers managed the first irrigation season, given the fact that the canal network was incomplete.

METHODOLOGY

Primary information on demography, village level institutions, socioeconomic conditions and existing irrigation facilities, etc., was collected through check lists, structured questionnaire, focused group discussions, and by documenting day to day irrigation management practices of canal irrigators. Secondary information was collected from different government and non-government institutions through personal communication, official records and literature reviewed. Procedures followed in selection of branch canals, villages, WUAs, and water users are described below.

Selection of Branch Canals

The canal network consist a 532 km long main canal and 42 branch canals that cover a distribution network of 66,000 km. A layout of the canal system network is depicted in **Figure 2**. As the canal system with its distribution network was ready to deliver water in phase I command, it has been selected for the study. There are 15 main branch canals on the Narmada main canal in Phase-I command. Two from the head reach, two from the middle, and three from the tail reach of the main canal were purposively selected as these branches were likely to receive water. Branch canals with both complete and incomplete distribution system were selected to understand the institutional dynamics and irrigation management practices adopted by the irrigators in different canal conditions.

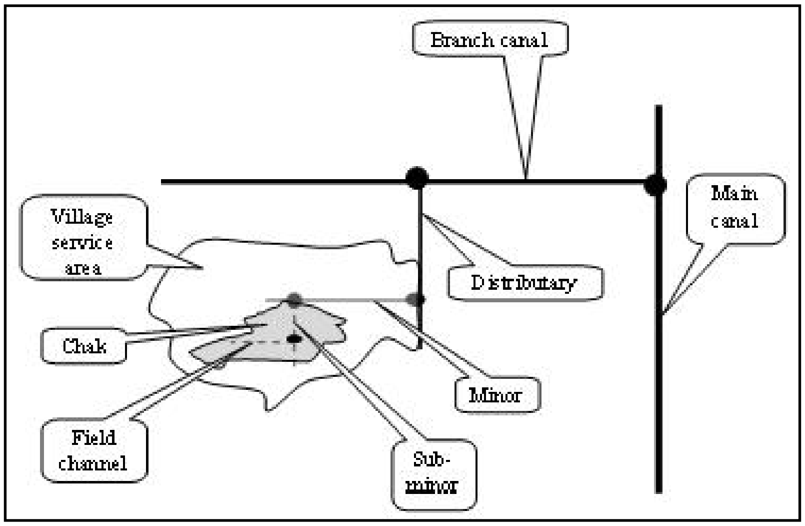

Figure 2: Canal System in SSP Command

Source: SSNNL, Gujarat

Selection of Villages

Since the focus of the study was to understand the institutional development process and to see how farmers manage the first irrigation season in a given situation, authors have selected only 12 villages. Four villages from each of the reaches (head, middle and tail) of selected branch canals were purposively selected. Total twelve villages across Phase I were selected to capture the geographical differences. These villages were supposed to get water in the first irrigation season.

Selection of WUAs

As per the SSNNL criteria, one WUA should represent one village service area (VSA) that comprises one or more villages. Each VSA represents one minor. Thus, one WUA represents one minor. There are 17 WUAs in 12 selected villages. Authors selected one WUA having larger area of village command and more number of village beneficiaries from each selected village to study the institutional aspects intensively. All selected WUAs were likely to receive the first irrigation water.

Selection of Water Users and Other Respondents

A total of 543 water users who used canal water, including non command farmers, across the study villages were selected to monitor and document their day to day irrigation management practices. 12 focused group discussions were held across the study villages to understand farmers' awareness and perception about the formation and functioning of WUAs. Besides a total of 16 farmers from 12 selected villages were contacted to know level of awareness at individual level.

In order to realize the study objectives, a rigorous analysis of socio-economic conditions, institutions and physical systems has been carried out. Figures and Tables using absolutes numbers, frequencies, and percentages have been used.

SOCIO-ECONOMIC PROFILE OF VILLAGES

Village population varies from 448 in Palsar village to 1949 in Goriyad village with mean population of 998 as per the 2001 population census. More than fifty per cent of villages belong to socio-economically backward caste communities comprising mainly Baxipanch, Scheduled Castes (SC) and Scheduled Tribes (ST), and majority of landowners in these villages belong to upper caste communities, mainly Patel and Rajput/Kshatriya. It is evident that the majority of villages is endowed with socio-economically backward caste population, while their agriculture economy is controlled by upper caste communities.

Different categories of land holders across the study villages are shown in **Figure 3**. More than 60 per cent land holders belong to marginal and small farmer categories. Physical work and jobs are primary sources of occupation in four villages and agriculture is the primary occupation in rest of the villages. All villages have a good number of livestock which serves as either a secondary or a supplementary source of livelihood.

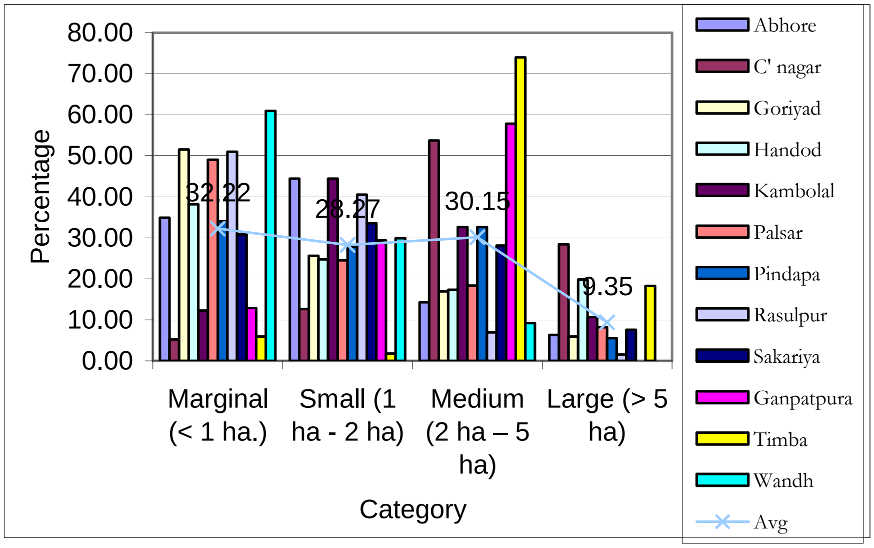

Figure 3: Category of Landowners

Source: Survey, 2002

Apart from WUAs, there are other village level institutions such as gram panchayats, the dairy cooperatives, and agricultural credit cooperative (ACC) societies in majority of the study villages[3].

IRRIGATION FACILITIES

Sources of Irrigation

There was no irrigated land in Pindapa, Sakariya and Ganpatpura villages; Abhore and Rasulpur had nearly 30 and 50 per cent irrigated land, respectively; Handod and Palsar had more than 70 per cent irrigated land and the rest of the villages had less than 14 per cent irrigated land prior to the first irrigation season (**Figure 4**). In physical terms, Handod and Rasulpur had dug well as well as tubewell irrigation facilities; Rasulpur had tank irrigation facility too. Palsar and Wandh had exclusively dug well irrigation and rest of the villages had exclusively tubewell irrigation facility. Information on groundwater table and its quality have been assessed on the basis of perceptions of local communities in the study villages. Groundwater table was ranging from 30 to 180 feet with mean water level of 90 feet. Groundwater quality was not suitable for agriculture in Chandranagar, Pindapa, Sakariya, Ganpatpura and Timba villages may be because of inland

3 Gram Panchayat is a local governing body and dairy cooperative is a vibrant economic institution at village level. ACC is providing agricultural inputs and credit for carrying out agricultural operations.

salinity problem. For example, Timba village has been declared as no source village because of inland salinity.

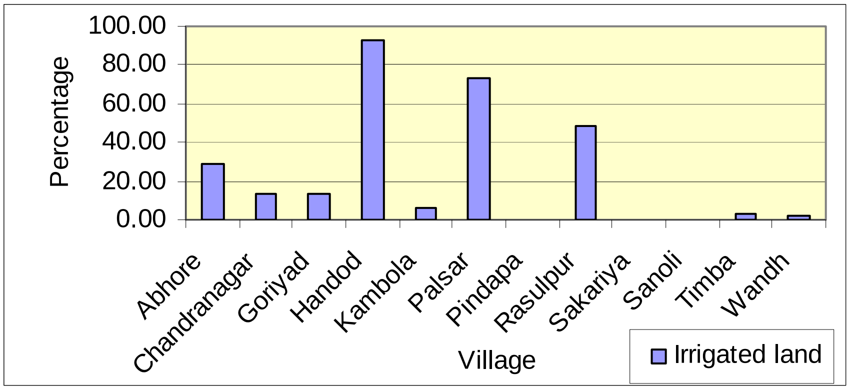

Figure 4. Percentage of Irrigated Land

Source: Survey, 2002

Canal Systems

Though more than 90 per cent of overall work of main and branch canals and around 73 per cent concrete work of distribution system have been completed in Phase I command[4] more than 70 per cent of minor canals were not ready to deliver water on the eve of the first irrigation season **(Table 1).**

Table 1: Construction Status of Water Delivery Network

Village	Construction status of minors (numbers)			
	Completed	Partly completed /Under construction	Yet to construct	Total
Abhor	-	2	1	3
Chandranagar	-	-	2	2
Goriyad	-	6	-	6
Handod	2	-	1	3
Kambola	-	-	2	2
Palsar	1	-	-	1
Pindapa	-	2	-	2
Rasulpur	-	-	2	2
Sakariya	-	1	-	1
Ganpatpura	2	1	-	3
Timba	2	2	-	4
Wandh	1	-	-	1
Total	8	14	8	30

Source: Survey, 2003

[4] http://www.sardarsarovardam.org/default.htm.

As per the Nigam policy, WUAs have to construct delivery system, especially sub-minors and field channels, below the head regulator of minor, for which SSNNL officials would provide technical inputs and monitoring assistance. However, no WUA has taken up construction work. There are two probable reasons: (a) the financial requirement of creating water delivery infrastructure is very high[5], which is beyond their financial capability (Shah, 2003); and, (b) the Nigam has to acquire farmers' private land within VSA. Though, the Nigam has principally approved the compensation package for land acquisition, it has yet to initiate the process of land acquisition. Some farmers thought of raising fund through bank loan; however, they were skeptical about the integrity, commitment, and dedication of farmer representatives as well as availability of regulatory and legal support from the Nigam.

Branch canals of Palsar, Sakariya, Ganpatpura and Wandh villages had almost complete distribution system. Rest of the villages had incomplete distribution system. Canal contractors did not completely construct distribution system at several places, partly because of critical land acquisition policy[6] of the Nigam and partly because of irregular payment. Evidently, the contract work system creates hurdles. For example, farmers of Goriyad village were willing to clean a distributary that was heavily silted; however, the Nigam officials did not allow them to clean the canal as contractors had left the work of canal construction incomplete.

WATER USERS' ASSOCIATIONS

Capacity Building

The Nigam had organized training for farmer representatives and its own staff personnel to orient them about PIM with the help of Water and Land Management Institute (WALMI), Anand (**Table 2**). Farmers' representatives were also made aware of the canal system network (**Figure 2**) and its operational system, distribution and delivery of canal water, irrigation management, irrigated agriculture, etc. Only a few beneficiary farmers have attended training (**Table 2**). The trainees could not properly perceive the concept of PIM and hence, could not disseminate it to their fellow farmers.

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5 According to Nigam engineers, estimated cost of constructing lined sub-minors with lined field channels is INR 12,000 per ha and that of creating lined sub-minor with earthen field channels is INR 5,000 to 7,000 per hectare.

6 As per the land acquisition policy of the Nigam, contractors can start construction work in areas where 75 per cent land of the total length of canal is acquired. As a result, contractors face the risk in constructing the canal in the rest 25 per cent land, where farmers are not ready to give up their land without receiving proper compensation.

Table 2: Training and Participant Category

Year	No. of trainings	Category of trainees (numbers)			
		SSNNL officers	Farmers	Lower level functionaries (Work Asstt., NGOs, Agronomists Etc.)	Total
1988-89	1	30	0	0	30
1989-90	2	0	0	0	0
1990-91	2	0	0	0	0
1991-92	0	0	0	0	0
1992-93	2	0	0	66	66
1993-94	4	32	0	51	83
1994-95	25	184	501	5	690
1995-96	28	265	384	3	652
1996-97	12	161	208	6	375
1997-98	16	108	272	0	380
1998-99	22	168	205	12	385
1999-2000	30	262	202	6	470
2000-2001	19	102	263	5	370
Total	163	1312	2035	154	3501

Source: WALMI, 2003

Once farmer representatives of particular WUA attended training, there was no follow-up training thereafter. There is a distinct time gap between training period and actual practice. For example, farmers' representatives of Baroda district attended training in 1996-97 at the time of trial irrigation, while they started irrigating their fields only from rabi 2002 using canal water.

Formation of WUAs

Discussions with different Nigam officials across the hierarchy revealed that the Nigam had invited non-governmental organizations (NGOs) to facilitate the process of WUA formation and registration. In response, approximately, 45 NGOs evinced their interest and forwarded proposals. After scrutinizing the proposals, the Nigam identified 10 prospective NGOs and initiated dialogues with them. However, according to the Nigam officials, financial requirements of these NGOs to socially mobilize irrigators were very high and hence, it could not entrust the work of facilitation to them.

The Nigam staff had to work hard in creating WUAs, as a large number of beneficiary farmers were not familiar with PIM policy (**Table 3**). The Nigam staff also had to take part in promoting WUAs and getting the WUAs registered under the prevailing cooperative act as part of their duties. For example, engineers of a branch held a total of 34 meetings with farmers between March 2002 and September 2002 to promote WUA[7]. Farmers' participation was very low in such meetings as they were skeptical about the functioning of the canal system. Though more than 80 per cent WUAs registered in the form of cooperatives as in September 2002 (**Table 4**), only 2 to 3 per cent farmers became shareholders by owning the membership of WUA. Surprisingly, authors came across a village, where WUA was created after following the proper procedure (**Box 1**).

Table 3: Awareness Level About WUA among Beneficiary Farmers

Area of awareness	Percentage of farmers		
	Do not know	Know	Partly know
Purpose of WUA formation	62.50	37.50	-
Meeting held at the time of WUA formation	50.00	50.00	-
Committee members	12.50	50.00	37.50
Selection procedure of committee members	62.50	37.50	-
General body meeting	75.00	25.00	-
Rules and regulations	100.00	-	-
Bylaws	81.25	18.75	-
Irrigation charges	-	100.00	-

Source: Survey, 2003

Table 4: Salient Features of WUAs

WUA Village	Name of minor canal in WUA village	Registration date of WUA	Total no. of villages in WUA	VSA of WUA (Ha)	VSA of selected village (Ha)	No. of beneficiary farmers in WUA	No. of beneficiary farmers in selected village
Abhor	Kanzat	1/4/2002	4	419.16	238.05	526	261
Chandranagar	Chandranagar	14/2/2002	3	544.00	96	255	NA
Goriyad	Goriyad	20/12/2001	2	220.40	219	344	339
Handod	Handod	12/2/1998	2	70.00	41	64	40
Kambola	Ghantiyad	11/7/2002	2	365.00	NA	392	NA
Palsar	Palsar	7/2/1998	4	158.30	112.67	108	45
Pindapa	Bhanpur	NA	3	646.52	148.81	849	245
Rasulpur	Rasulpur	Proposed	2	90.15	47.72	102	NA
Sakariya	Sakariya	30/9/2000	4	542.37	278.56	389	287
Ganpatpura	Alwa-G	11/7/2002	5	1209.03	227.50	997	217
Timba	Gunder	16/6/1996	8	744.13	224.79	710	190
Wandh	Wandh	16/9/1996	4	163.81	131.98	121	95

Source: SSNNL, 2003

[7] Based on Personal Communication with Different Officials of the Nigam. Vadodara; Gandhinagar.

Box 1: A Case of Sakariya Village WUA

The Nigam officials informed villagers to create WUA prior to the first irrigation season. The president of Sakariya village WUA himself took interest and personally motivated other farmers of the village command to form a WUA. Farmers held a village level meeting and forwarded a proposal to register a village level WUA. The registration of the WUA took 15 to 20 days. After the registration of WUA, a general body meeting was held and 9 committee members were selected unanimously. The committee has framed rules and regulations to manage irrigation. The president was also presiding over dairy cooperative of the village and majority of members of the WUA were also members of the dairy cooperative; hence it was unanimously decided to deduct the irrigation charges from the dairy payment after each round of canal irrigation. Resultantly, the irrigation cooperative recovered 100 percent irrigation charges from its irrigators. Presence of a village institution played catalytic role in this case.

Source: Survey, 2002

Few farmers knew all committee members. As far as canal irrigation charges are concerned, all farmers knew it well. However, there were several misconceptions and misunderstandings among them about the norms of fixing canal water price. Majority of farmers believed that canal water prices would be fixed on crop-area basis and at par with other irrigation projects that are under operation in other parts of Gujarat, which is not the case.[8] Farmers were also not clear about the mode of payment.

Focused group discussions with farmers across the study villages revealed that many WUAs did not have information about the designed command area and number of water users within the command owing to lack of supporting documents that were supposed to be handed over by the Nigam officials prior to the first irrigation season. Similarly, some WUAs even did not have the copy of bylaws. Farmers were not aware about the provision of fund allocation for repair and maintenance of water delivery network. It is very important to note that all farmers were aware of the canal irrigation schedule, which was declared by the Nigam office in local newspapers prior to the first irrigation season (2002).

Internal Dynamics of WUAs

WUAs of four villages are more than four years old, other six WUAs have been registered very recently and one WUA is proposed to be registered

8 The canal water price is INR 157 / ha /watering in SSP.

(**Table 4**). VSA of WUAs varies from 70 to 1209 ha and the number of water users ranges from 64 to 997. Each WUA covers more than one village under its VSA. Therefore, it was decided to collect information of WUAs only from the selected villages rather than entire VSA for study purposes. Accordingly, VSA of selected villages varies from 40 to 339 ha and the number of water users ranges from 40 to 339 (**Table 4**).

A management committee comprising 9 to 13 members has been created to look after various functions of WUA by the Nigam. Committee members were randomly selected by the Nigam officials in consultation with only a few command area farmers. There was a president and a secretary to manage a WUA. Many presidents and secretaries were either political workers or social and religious workers and they were also representatives of other village level institutions, inside or outside their villages. Majority of them were large landowners as well.

As per the modified bylaws of an irrigation cooperative society, there should be at least one female member and one SC/ST member in the management committee, either as a regular member or as a nominated member. Similarly, there should be a nominated member from each of the following departments/offices: irrigation department/agency, registrar of cooperatives, and state agriculture department. The state government has made efforts to involve female members and poor section of rural communities in the management committee through such constitutional and legal provisions. However, only three management committees have a female committee member (**Table 5**). It may be because of the fact that land ownership is predominantly on the name of the male family member. Management committees of ten WUAs were largely dominated by upper caste (Patels and Rajputs) communities and the rest two WUA were fully dominated by SC/ST and Baxipanch communities (**Table 5**). Only three WUAs enrolled beneficiary farmers as members besides committee members on the onset of the first irrigation season (**Table 5**).

Majority of farmers was not happy with the process of WUA formation and committee members' selection. However, they were satisfied with the selected committee members, mainly because nobody was interested to spare and devote time for common cause without any economic incentives. A large number of farmers were not interested to take part in any of the meetings organized by the Nigam officials at village level until release of canal water in the first irrigation season. After receiving canal water, farmers became enthusiastic about organizing a village level meting to elect committee members of their choice for the next year.

After completion of the first irrigation season, it was observed that since farmers were getting canal water without having membership of WUAs, they were neither interested nor seriously concerned about becoming members. However, WUA committees in three villages could convince their irrigators about the mandate of WUA and as a result membership of these villages has notably increased at the end of the first irrigation season (**Table 5**). This clearly indicates that farmers have little incentives to become members of WUA.

Table 5: Caste Composition and Gender Representation in WUA Committees

Village	Size of committee (numbers)	Female members in management committee	Major Caste	Members of WUA in Rabi 2002-2003	
				Onset of season	At the end of season
Abhor	13	-	Patel(7), Rajput(4)	13	13
Chandranagar	11	-	Patel(11)	11	22
Goriyad	12	-	Patel(10)	13	13
Handod	11	-	Patel(10)	11	11
Kambola	11	1	*Rajput (9)	15	15
Palsar	11	-	**SC/ST (11)	47	47
Pindapa	11	-	Rajput (8)	NA	NA
Rasulpur	11	-	Rajput (9)	11	11
Sakariya	9	1	Patel(7)	21	21
Ganpatpura	11	-	Patel(11)	11	27
Timba	11	1	Patel(10)	11	53
Wandh	11	-	***Baxi-Panch (10)	26	26
Figure in brackets indicates numbers. *Rajput includes Chauhan, Padhiyar, Bhaliya, Jadav, Solanki, Thakor and Gohil, whereas **SC/ST includes Bhill and Rathva, and ***Baxipanch includes Bariya.					

Source: Survey, 2003.

FUNCTIONING OF WUAS

WUAs undertook three major tasks: indent collation and water allocation, orderly distribution of water, and collection of water charges (**Table 6**). The

Table 6: WUA Activities

Major activities undertaken	No. of WUAs	
	Active	Partly Active
Organizing general body meeting	6	-
Conducting management committee meeting as and when needed	6	-
Framing rules and regulations	1	1
Indent collection	1	1
Water distribution	1	1
Collection of water charges	4	3

Source: Survey, 2003

most crucial function of operation and maintenance though envisaged in planning was not applicable. Apart from these functions, some WUAs have initiated several other functions such as framing rules and regulation, holding annual general body meetings, and holding meetings of management committee.

Indent Collection, Water Allocation and Distribution

All farmers of the SSP command who wish to obtain canal water are required to forward an application in prescribed form stating survey number-wise area and crops proposed to be irrigated to the Nigam office through their WUA (Frederiksen, 1985). Thereafter, the WUA has to issue an irrigation pass to its irrigators. The irrigation pass is an evidence of legal irrigation for member farmers. Among all, only the formally created WUA (**Box 1**) informed its irrigators to apply for canal water requirement for the first irrigation season. Unfortunately, farmers did not follow it because they did not have trust on the functioning of canal system. Ultimately, the WUA submitted a joint indent on behalf of command area farmers of the village to the Nigam before the first round of irrigation. In other cases, the Nigam staff directly issued irrigation passes to farmers of a village on behalf of WUA and also supplied indent forms to WUA of another village after completion of the first irrigation round with the intimation that the indent forms were to be submitted before the next round of irrigation. Other WUAs were not active as far as indent collection was concerned because they were not informed to do so. Thus, in absence of proper demand assessment, canal water was allocated to farmers as and when needed subject to availability of water in the main, branch and distributary canals. There were isolated cases of canal water distribution among farmers through mutual understanding within a village command. Farmers distributed canal water orderly, turn by turn, in Sakariya and Ganpatpura villages.

Collection of Water Charges

Collection of canal water charges is one of the main activities of resource generation and mobilization. It partly reflects the status of institutional development. The Nigam officials assessed the canal irrigation and handed over lists of irrigators to concerned WUAs for collection of water charges. WUAs of Sakariya, Ganpatpura, Timba and Wandh villages have independently collected water charges. WUAs and the Nigam staff jointly collected water charges in Chandranagar, Goriyad and Kambola villages, while the Nigam had to collect water charges in Handod, Palsar, Pindapa and Rasulpur villages. Neither the Nigam staff nor WUA attempted to collect water charges in Abhore where farmers were erroneously informed that the first irrigation would be provided free of cost.

The recovery is 100 per cent in villages where WUAs have independently collected water charges. The present status of recovery (**Figure 5**) shows that though recovery rate is appreciable, it is more important to know that how many WUAs have started collecting water charges rather than how much they have collected. Probable reasons behind inactiveness of WUAs in collecting water charges are: farmers did not have faith in their selected representatives; absence of economic incentives for collecting water charges at individual level; absence of legal support; and, misleading political propaganda.

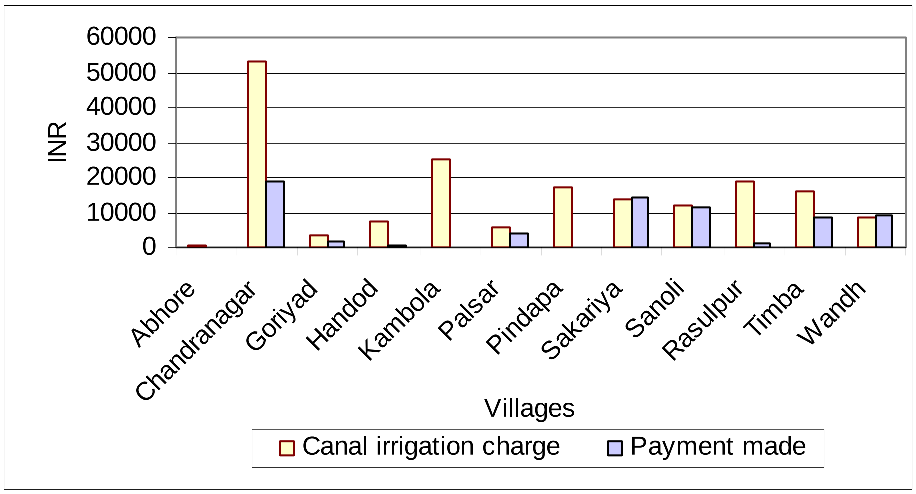

Figure 5: Recovery Status of the First Irrigation Season

Source: Survey, 2003

FACTORS RESPONSIBLE FOR SMOOTH FUNCTIONING OF WUAS

It is very difficult to explicitly delineate factors responsible for the functioning of WUAs. However, based on field observations, authors have identified some factors/conditions in which WUAs became active. Completion of canal network was the foremost motivational factor in organizing farmers. Homogenous group (caste composition), limited number of beneficiary farmers, existing sources of irrigation and its quality, presence of village level economic institutions like dairy cooperative, etc. were other factors that contributed in the formation and functioning of WUAs. Lack of trust among the farmers, lack of awareness about the project and its operational mechanism, poor communication between irrigation agency and farmers, incomplete water distribution system, location of farms, method of irrigation, and financial condition of farmers, were the factors impeding the functioning of WUAs.

IRRIGATION PERFORMANCE

Farmers of Sakariya village created earthen field channels within the village command by contributing money and labour equally. As a result, majority of farmers of the village command could irrigate their fields through gravity flow despite the fact that the construction of minor canal was partially completed. In Ganpatpura village: a few farmers, whose land is located near head end of a minor passing through the village, deployed their personal resources and completed the delivery system. Consequently, farmers of an adjoining village created a three km long temporary sub-minor like structure, off-taking from this minor, and irrigated their fields in the post-monsoon period. Similarly, a few political leaders, who contested the last state assembly election, deployed their personal resources and completed canal network in their respective constituencies. Therefore, considerable non-planned command area was brought under irrigation in the first irrigation season.

On the other hand, farmers in some areas had to suffer heavy economic loss owing to breakages and leakages in the canal system. For example, standing crops were washed out in 48 ha of land in Abhore village owing to canal breakage. Some branch canals and majority of distributaries were heavily silted with vegetation.

Since the canal system is designed for canal automation (computerized control of canal water flow) and farmers' participation for O&M has been envisaged from the beginning through transfer of irrigation management to WUAs, the Nigam did not recruit gatekeepers to operate the canal system. Besides, cross regulators were to be installed at many places in the canal system which made the task of irrigation operation more difficult for both engineers and farmers.

There was continuous canal water supply[9] in Chandranagar, Handod, Kambola and Timba villages as farmers of these villages were drawing canal water directly from the branch canals. Farmers in other villages received the

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9 The supply was only interrupted when there were breakages in the canal system.

canal water in 2 to 3 rounds in the first irrigation season. Those farmers whose lands are located on the canal banks could utilize the canal water for irrigation, mainly by lifting or siphoning. However, some farmers could also irrigate their fields through gravity flow.

Though there was no guarantee of equitable distribution of canal water in absence of complete canal network, performance of the first irrigation season was quite appreciable (**Table 7**). A total of 543 farmers, out of 1754 from 12 WUAs, could irrigate 725.46 ha of land with 1150 ha watering (irrigation intensity of 1.6) in the first irrigation season across the study villages. Out of 1150 ha watering, lift irrigation contributed to 727 ha watering. Water users incurred additional lifting cost over and above canal water irrigation cost, mainly because of incomplete water distribution and delivery systems. The lifting cost was more than twice the cost of canal water irrigation at aggregate level.

Table 7: Performance of the First Irrigation Season

Village	No. of irrigation round received	No. of actual water users	Net irrigated area Ha.	Hectare watering Ha.	Cost of Canal irrigation INR	Lifting cost INR	Total irrigation cost INR	Percentage of lifting cost
Abhore	1	4	2.40	2.40	377	1200	1577	76.10
Chandra-Nagar	Continuous	22	206.88	338.88	53204	126832	180036	70.45
Goriyad	3	20	14.64	20.76	3259	3920	7179	54.60
Handod	3	20	18.60	47.40	7442	3585	11027	32.51
Kambola-Ghantiyal	Continuous	114	112.50	159.30	25010	101755	126765	80.27
Palsar	Continuous	26	14.60	35.35	5550	3200	8750	36.57
Pindapa	2	111	90.96	107.76	16918	NA	16918	NA
Sakariya	3	38	36.32	87.53	13742	840	14582	5.76
Sanoli	2	27	68.64	75.12	11794	15640	27434	57.01
Rasulpur	2	79	70.68	119.04	18689	75900	94589	80.24
Timba	Continuous	45	59.04	102.24	16052	71635	87687	81.69
Wandh	3	37	30.20	54.60	8572	2330	10902	21.37
Total		543.00	725.46	1150.38	180610	406837	587446	

Source: Survey, 2003

The maximum area was irrigated under cotton (63.78 per cent), followed by tobacco (10.8 per cent), wheat (9.84 per cent), and arhar (6.08 per cent) across the study villages (**Table 8**). According to farmers' opinion, the productivity of cotton, tobacco, wheat, and arhar has considerably improved through canal irrigation. For example, a farmer of Ganpatpura village was claiming that some farmers of his village were able to get two to three times more yield, especially in cotton.

Table 8: Productivity of Major Crops During the First Irrigation Season

Crop	**Area ha**	**Production Kg**	**Productivity Kg/ha**
Cotton	386.10	437791	1134
Tobacco	65.40	144900	2216
Wheat	59.55	118793	1995
Arhar (*Tur*)	36.79	38155	1037
Cumin (*Jiru*)	19.68	6206	315
Maize	16.53	23540	1424
Gram	10.58	4570	432

Source: Survey, 2003

The water market was proliferated due to siphoning, lifting, and transporting canal water. Farmers were lifting and transporting canal water up to 1500 feet against gradient and up to 2500 feet towards natural gradient from the canal. Farmers of ten villages have purchased 40 diesel pump sets with 5 to 8 hp capacity and purchased 14,024 meter delivery pipes of different makes and materials such as rubber, plastic, high density poly ethylene (HDPE), fertilizer bag, etc., during the first irrigation season. *Bucknali* (delivery pipe) was widely used to siphon canal water. The pump water rate was ranging from INR[10] 30 to 73 with the average range of INR 50 to 60 per hour. Farmers in all study villages could foresee that the Nigam would not allow lifting or siphoning of canal water for irrigation once the canal network is completed.

CONFRONTING ISSUES

Conflicts among head, middle, and tail farmers were noted. For example, head end farmers were heading and interrupting the canal water flow, which made it difficult for tail end farmers to get adequate amount of water. Heading canal water flow was also causing waterlogging in the fields of other farmers who did not require water. Uncontrolled canal water flow during night time also created waterlogging. For example, green gram

[10] US $ 1 = Indian rupees (INR) 46, September 2003.

(*Mung)*, gram and cotton fields that are located 5 to 7 km from Tham village of Bharuch taluka were waterlogged owing to overflow of water from Avaj and Amleshwar canals during night (Gujarat Samachar, 2003).

Farmers were causing damage to the canal system by breaking the embankment of branch canal, distributaries, and minors for lifting and siphoning water for irrigation. Nature of such damage would invite premature investment for repair and maintenance.

There were conflicting interests among farmers of different classes and groups. For example, Patel farmers of Handod village, who hold an approximately 70 per cent area of a VSA, were not concerned about the construction of a proposed minor, sub-minors, and field channels as they had easy access to private irrigation sources within the VSA command. They could also irrigate their farms by siphoning canal water either from the distributary or branch canal passing through both sides of VSA command. Rest of the beneficiaries could not irrigate their fields owing to topographical constraint, unless and until the proposed minor canal is constructed. Farmers of a suppressed community of the village disclosed the fact that some powerful farmers had illegally installed a piece of cement pipe as an outlet beneath the embankment of the distributary or branch canal and were diverting water into their fields. Referring to this incidence, they expressed deep concern about equitable distribution of canal water within the command of that particular minor.

Precious canal water was not used efficiently and water use rights of different water users were not protected. For example, authors observed during one of their field visits that water from a branch canal was flowing into the fields before it reached an irrigation tank. Likewise, huge amount of canal water was lost on the way to irrigation tanks. In another incidence, the authors observed that farmers located on edges of the branch canal were unrestrictedly lifting canal water flowing towards an irrigation tank thereby depriving tank water users.

There were inter-governmental disputes over canal water use and its billing. For example, the Nigam office claimed that it has released 201.5 million cubic feet (MCFT) water to fill up irrigation tanks, but according to a panchayat minor irrigation circle office, irrigation tanks received only 129 MCFT water[11]

[11] Panchayat minor irrigation circle office, Vadodara, 2003.

All these examples clearly give a message that if the institutional capacity building process is not strengthened, it would lead to serious conflicts among different water users' groups and between the Nigam officials and water users.

SUPPORT FROM THE IRRIGATION AGENCY

Apart from declaring an irrigation schedule prior to the first irrigation season, the Nigam had distributed handouts, which contained information on canal irrigation norms, to farmers. The Nigam officials have provided their valuable inputs in assessing canal irrigation. They first approached canal irrigators to know the area of irrigation and then crosschecked that information with village land revenue records. Thereafter, they verified that information by consulting concerned WUA committee members. Even though, actual irrigated area differed from the assessed area in some cases. For example, authors have recorded 47.40, 87.53, and 119.04 ha watering (**Table 7**) against the Nigam’s record of 4, 30, and 15 ha watering (SSNNL, 2003) for Handod, Sakariya, and Rasulpur villages, respectively. However, the Nigam’s record of ha watering did not differ much from authors’ record in other study villages.

Besides organizing training, promoting WUAs, and assessing canal irrigation, the Nigam also provided monitoring and supervisory support, which is very crucial in developing good irrigation practices and curbing bad ones. Its officials strictly monitored the first irrigation season through conducting regular field visits of canal irrigated areas, especially, each and every spot of lift irrigation. Its field officials tried to set a few examples of strict actions against those farmers who were violating the irrigation norms. However, they did not succeed, mainly because of lack of legal, departmental, and political support. For example, they could not file police complaint against a culprit who caused major damage to the canal system because of lack of legal support. In another incident, they seized irrigation equipments of a farmer who was not paying his irrigation dues and was heading canal water flow. However, they failed to take any disciplinary action against him, thanks to political interference.

CONCLUSION

Government officials were engaged in implementation and execution of PIM without having a clear plan of action in the case of SSP. Unlike other irrigation projects, the government had envisaged farmer’s participation at the very outset of programme implementation. It appears that use of the Nigam staff as institutional organizers was rather ineffective may be because of triple work responsibility: canal construction, irrigation management, and WUA promotion. The Nigam did not have adequate manpower and financial resources to effectively implement PIM policy.

Some of the issues identified by authors in promoting WUAs are: (1) low level of awareness about the concept of PIM and its implementation strategy among beneficiary farmers; (2) departure between policy formulation and its implementation; (3) communication gap within the Nigam officials across the administrative hierarchy and between the Nigam and farmers. Factors such as homogenous group (caste composition), limited number of beneficiary farmers, quality of irrigation service, presence of village level economic institutions like dairy cooperative, etc., have positively contributed to the formation and functioning of some WUAs.

Irrigation performance of the first irrigation season is quite appreciable, despite the fact that the canal system was incomplete, mainly because of large scale lifting and siphoning of canal water. Farmers felt that the Nigam should authorize WUAs to undertake construction of minors. It would save supervision and monitoring charges and overhead expenses of the Nigam office and at the same time, a sense of belongingness would be created among farmers of WUAs. However, constructing sub-minors and field channels is beyond the financial capacity of farmers and hence it is unlikely that farmers would construct water delivery infrastructure in near future. Therefore, there is a need to provide credit facility in the form of medium term loan to farmers of SSP phase I command at the earliest to build water delivery infrastructure to exploit the full potential of irrigated agriculture.

Efforts should be made to let emerge pilot WUAs. The pilot experiences would enable the government to reorient its working pattern in favour of farmers. It is worthwhile to involve village level economic institutions like dairy cooperatives and taking help of NGOs as facilitators to promote and energize WUAs. If WUAs are to act as instruments of empowerment, farmers need to be informed about state water policies and changes made in these policies from time to time, and support available from the project implementing agency and other relevant government departments. Creating awareness about policies and programmes among beneficiary farmers through communicating the right kind of messages at the time of first irrigation season is necessary to avoid misconceptions and to make WUAs functional.

There should be enough motivation and economic incentives for farmers to organize themselves and mobilize technical, financial, and human resources.

Apart from a centralized training programme, village level training programme should be organized. The project implementing agency should constantly provide support to WUAs for institutional capacity building till they become self-reliant. However, completion of canal network should be the first priority besides the institutional capacity building of WUAs. Finally, it is concluded that institutional reform requires professional approach with policy and legal support to ensure improved productivity, equity and sustainability of water use in agriculture.

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SOCIAL CAPITAL AND ITS ROLE IN THE SUSTAINABILITY OF IRRIGATION MANAGEMENT: A CASE STUDY OF SORA-CHHATTIS MAUJA FARMER MANAGED IRRIGATION SYSTEMS FROM WESTERN TERAI, NEPAL[1]

LAYA PRASAD UPRETY[2]

SOCIAL CAPITAL: THEORETICAL UNDERPINNINGS AND TYPOLOGY

The term "social capital" has been due recognized in the contemporary social science literature of development. The increasing use of the term "social capital" in the regime of sustainable development has been the function of the failures of the past development models that accentuated "hardware" exclusively by ignoring the "software", the crucial variable. The development theorists and the practitioners have increasingly realized that a particular development intervention vis-à-vis the natural resources management can only be sustained if when the already existing " social capital" is duly utilized and new "social capital" is created according to the necessity. Of late, a galaxy of the scholars working in the field of common property resource management have made the endeavor to define the term " social capital" and develop its typology.

Uphoff and Wijayaratna (2000) write that, "the forms of capital presently recognized in economics that produce streams of goods and services are physical capital (made by people including financial assets), natural resources (coming from nature, not created by people), and human capital (people's capacity for productive activity that utilizes these other forms of capital). While these sources can be socially beneficial, they are used mostly

[1] This is abridged version of the paper presented in the Seminar. Interested individuals can approach Mr. Uprety for full paper at e-mail: layaup@mos.com.np.

[2] Reader in Anthropology, Central Department of Sociology/Anthropology, Tribhuvan University, Kirtipur, Kathmandu. The author is grateful to Mr. Keshab Neupane, the ex-chairman of the executive committee of *Chhattis Mauja* and the current chairman of the National Federation of the Water Users' Association of Nepal, Mr. Dadhi Ram Gautam, *Meth Muktiyar* of *Chhattis Mauja*, Mr. Sukdev Neupane, the chairman of the executive committee of *Sora Mauja* and Mr. Dev Bahadur Gurung, the *Meth Muktiyar* of *Sora Mauja* for their commendable assistance to create a congenial ambience for my fieldwork.

so as to benefit those persons who are utilizing them rather than others. Social capital, in contrast, although it benefits individuals, is expected to produce goods that are more collective than just individuals. Social capital can be understood as existing in either structural or cognitive forms. Both forms arise from the mental rather than the material realm, so both are ultimately cognitive. But structural forms[3] are indirectly rather than directly based on mental processes, whereas the latter forms are purely mental, and thus interior to the mind and not observable like structural forms. Both categories of social capital can have definite material consequences to understand the impacts of introducing farmer organizations in that irrigation system.

Under the category of structural social capital, they (2000) include, " roles, rules, procedures, and precedents as well as social networks that establish on-going patterns of social interactions. In particular, roles for decision-making, resource mobilization, communication, and conflict resolution are supportive of collective action. They make it easier for people to engage in mutually beneficial collective action (MBCA), by lowering transaction costs as well as accumulating social learning. Structural forms of social capital facilitate MBCA. Norms, values, attitudes and beliefs that predispose people to cooperate are, on the other hand, forms of cognitive social capital that are conducive for MBCA. They are individual in origin but usually reflect broader, shared symbols and meanings within culture, or subculture. The norms of trust and reciprocity have often been written about as cognitive forms of social capital, but one can see how values of truthfulness, attitudes of solidarity, and beliefs similarly create and maintain an environment in which MBCA becomes expected and thus more likely ".

Uphoff (2002) is of the opinion that the ways in which "software" (social subjectivity) can be constructed and maintained have been analyzed mostly in terms of what he characterizes as the "hardware" aspects of social relationships and interactions. He says that attention has been focused mostly on material incentives and what are considered to be "rational" calculations of the interest. Farmers have been regarded essentially as individual decision-makers who are seeking to maximize their respective well-being co-operatively but independently of one another. Explaining the rationale of the

3 Structural forms of social capital are relatively external and objectified. This category derives from various aspects of social relationships that can be explicitly described and modified. Mental activities supportive of MBCA, on the other hand—represent cognitive forms of social capital that are more internal and subjective. The two forms interact, of course, and are in practice connected. The distinction made here is intended to be analytical so that social capital can be understood more accurately" (Uphoff and Wijayaratna 2000).

softer aspect of software, he further writes that, "…this kind of rational actor analysis can capture a large part of social reality, and that it has advantages such as parsimony and predictability. I want to suggest that we need to learn how to incorporate some of the softer aspects of social relationships and interactions, dealing more with norms, values and ideas, into our planning for and support of participatory irrigation management. This can give more sustainability to such efforts, I will argue, as well as greater effectiveness, efficiency and equity".

Based on the above theoretical discussions, we can conclude that common property resources can sustainably be managed provided there is the relative strength of both the structural and cognitive social capitals among the beneficiary communities. If there is over-emphasis only on the structural social capital and the cognitive/normative social capital is ignored in the process of managing common property resources, the sustainability cannot be achieved in the long run.

LOCATION OF STUDY AREA AND METHODOLOGY

The study was conducted in the command areas of *Sora-Chhattis Mauja* indigenous irrigation systems located in the plains of Rupendehi district. They are the exemplary systems in the domain of managing water as a "commons". The *Sora* and *Chhattis Mauja* irrigation systems have the command areas of about 1,500 and 3,500 hectares of land, respectively. These were originally constructed by the *Terai* autochthonous Tharu people. Initially, the *Sora Mauja* irrigation system served a total of 16 *Maujas* (settlement areas which roughly corresponded to villages) and *Chhattis Mauja* irrigation system served a total 36 *Maujas*. But the command areas of both the systems later expanded-- a function of the population growth triggered by the Hill to Terai migration particularly after 1960. The migrants comprise *Brahmins,Chhettris*, traditional service caste people and indigenous ethnic groups *Mongoloid* origin. During the period of the fieldwork in 2003, the *Sora Mauja* was found to be expanded to 30 *Maujas* (a couple of years back, a total of 33 *Maujas* were covered by it) and *Chhattis Mauja* was expanded to 56 *Maujas* (like in *Sora Mauja*, a few years back, a total 62 *Maujas* were covered by it). The increase and decrease of the number of command *Maujas* depends on whether they make the regular collective contribution of labor and financial resources for the repair and maintenance of the irrigation systems. If the water users of a *Mauja* contribute labor/financial resources as required by the organizational norms, their right to use water remains intact and vice-versa. Though both these systems were originally developed in two different locations of Tianu River by the autochthonous Tharu people about 170 years ago. There is no unanimity on the exact time of their constructions. They have been sharing water from a single mega- canal since 1964. Since then, the mega-canal has been jointly managed up to the point of bifurcation (called Tara Prasad Bhond) from where water has been divided between the two systems proportionate to the size of their respective command areas.

Despite the heterogeneity in the social structure of the beneficiary farmers of the command areas, both irrigation systems have been effectively functioning for a relatively long period of fine. They have become the often-cited references of the participatory and sustainable irrigation systems in Nepal. Hence, I have selected these two systems to document the aspects of social capital with a view to generating the social learning's which are worth sharing for the wider academic discourse on developmentalism.

ASPECTS OF SOCIAL CAPITAL AND THEIR ROLES IN THE SUSTAINABILITY OF FARMER MANAGED IRRIGATION SYSTEMS

Given the fact that social capital is often dichotomized into structural and cognitive social capitals, the sections that follow have the analysis and interpretation of both aspects based on the empirical data.

Structural Social Capitals and their Roles

"Structural social capital" comprises two significant variables, namely, organizations of the water users and institutions governing their behavior.

Organizational Structures of Water Users: Nested Enterprises from Sora-Chhattis Mauja Irrigation Systems and their Roles for the Sustainability of Management

The organizations of the water users of both the irrigation systems have the nested enterprises. Both of them have three-layered of the enterprises, namely, system level committees, regional structures, and *Mauja* level committees. Put in other words, they have the federated organizational structures. In the case of *Chhattis Mauja* irrigation system, there is Mauja level, area/regional level and the system level executive committee. It is the same in the case of *Sora Mauja*. Given the fact that both systems have shared the water from the single mega-canal, they have also formed a *Sora- Chhattis* joint management committee comprising the representatives from both the systems. A succinct analysis has been provided hereunder.

Sora- Chhatis Joint Management Committee. The *Sora* and *Chhattis Mauja* started to share water from the intake to the same diversion of Tara Prasad Bhond since 1964. This was feasible only through the formation of a joint committee comprising the representatives from both the systems. Both the systems have the constitutional provisions to send the representatives to it so long as the committee has the justification of being in the operation. As per the understanding of the representatives of the two systems, *Chhattis Mauja* nominates six members and *Sora Mauja* nominates five members from their respective system level executive committees making a total of 11 members. Of the 11 members, one is elected or selected as the chairman, one vice-chairman, one secretary and one treasurer as the functionaries and other remain as the members. The committee has also *Meth Muktiyar* (chief staff) and one *Chaukidar* (watchman-cum-messenger).

The principal functions of the joint management committee comprise: (i) Mobilizing the resources from the external agencies; (ii) co-ordinating between *Sora* and *Chhattis Mauja activities;* (iii) ensuring the right of 40 % and 60 % of the water volume from the jointly-operated *Mul Tapaha* (main canal) to the command areas of *Sora* and *Chhattis* respectively, and (iv) mobilizing the cash and labor resources upkeeping and maintenance of the jointly-operated *Mul Tapaha* which is proportionate to the amount of water share for both the systems. The *Meth Muktiyar* basically plays the crucial role in supervising the canal, monitoring the emergency condition of the headwork particularly in the rainy season, motivating the *Kularas* ((laborer to be sent for the yearly repair and maintenance of the *Mul Kulo* – the main canal) from both the systems as per the estimate and mobilizing them for regular, periodic, seasonal and emergency maintenance, maintaining the records of the *Kularas;* supervising the desiltation work done through the use of the dozer made available by the government agencies, etc. The joint committee has the *Chaukidar* who basically assists the *Meth Muktiyar* for discharging his functions but also works as the messenger for the committee. The *Meth Muktiyar* and *Chaukidar* are paid NRs. 2500 and NRs. 2000 per month respectively. They are also provided the local transportation support. Regarding the communication from it to other executive committees of both the systems, the decisions are communicated through letters. The secretary writes letters and *Chaukidar* hands them to the committees of both the systems or *Meth Muktiyars*. They, in turn, send the decisions to *Mauja Muktiyars* who, turn, send the message to water users. Such messages are quickly communicated.

System Level Autonomous Organizational Nested Enterprises of Sora and Chhattis. In both the systems, the land (whether owned or tenanted) and regular contribution (cash or labor) for the repair and maintenance of the system are the main criteria for being the members of the irrigation systems. The users have to be permanently domiciled within the command. But of late, there has been the norm in both the systems that initial cash contribution creates the basis of the membership for the households of the *Mauja*. For instance, in *Sora Mauja* system, if a *Mauja* wants to join the system, it can do so by paying NRs. 5000 per *Kulara* (unit which requires to send one laborer for the repair and maintenance per 25 *Bighas* of land) for the membership of its users. The potential member households do collect this sum as per the size of the land to be irrigated. If the *Mauja, which left the system*, previously wants to join the system should also pay NRs. 5000 for the resumption of the membership of the potential water users. In reality, the non-payment of the *Khara* (fines of being absent to contribute the labor) results in the dismissal of its membership.

It is contextual to have a brief analysis how the organizational systems of the both irrigation systems function in the most institutionalized fashion. In the case of *Chhatis Mauja*, *Amsahba (*general meeting) is the most powerful/supreme decision-making body. It has the participation of all the water users of the command areas as per the standard rule of having four representatives of one *Kulara*. Generally, *Amshabha* is held once a year. But the main committee can call it any time to make decision on any complicated subject. Following are the jurisdiction of *Amshabha*. They are; formulation of the policies, regulations, study of the account audited, approval of annual income and expenditure, election of the chairperson, vice-chairperson and member secretary of the executive committee, making the final decisions on the issues raised in the meeting or *Sadharansabha* (general assembly*)*. Following aspects are also included; issues brought by the executive committee, contribution for the formation of committees/sub-committees/ issue-based commissions (whose decisions will be accepted as the final one and these are required to give the decision to the main committee or the concerned member or the person of the committee within 15 days of the holding of the *Amsabha*). All the expenses are to be approved by the A*msabha*. There is no *Amsahha* as the organizational arrangement in the *Sora Mauja* system.

The *Sadharanasabha* of *Sora Mauja* is constituted by the members selected /elected by the farmers of each member *Mauja* as per the standard rule of one representative per one *Kulara*. Unlike in *Chhattis Mauja*, it is the highest body in the organizational arrangement of *Sora Mauja*. Nonetheless, the *Sadharansabhas* of both the systems discuss and make recommendations and policies for the systematic management of the irrigation, promotion and preservation of the irrigation canals. They also discuss on the appropriation of the budget in the different headings and approve the annul budget, income and expenditure. Despite these similarities, there are also discrepancies in the functions.

Both organizational arrangements have the provisions of the existence of the executive committees at the system level. They basically discharge the day-to-day functions of the organizations on behalf of the water users. It is worthwhile to analyze the process of the formation of these committees.

In *Sora Mauja*, there is an executive committee of 11 members constituted for the irrigation management in a systematic way. While constituting the executive committee, the command area is divided into six areas to ensure the proper representation from the member *Mauja* on the basis of *Kulara*. The farmers of each *Mauja* region select/ elect one representative as the member of the executive committee bringing a total of six. The chairman and vice-chairman are directly elected by the *Sadharanasabha*. Interestingly, the member secretary of the committee is nominated either from among the elected members or from the general water users. The treasurer is nominated from among the elected members or from the water users. In addition to them, the chairman nominates one member from among the general water users. Generally, the tenure of the members of the committee is one year but the two-third majority of the *Sadharanasabha* can dissolve it and reorganize it any time as mandated constitutionally.

In the case of *Chhatis Mauja*, there are two types of members in the executive committee of the water users' organization. These comprise elected and nominated members. The chairman, vice- chairman, and member secretary are directly elected by the *Sadharanasabha* of the users. The nine regional members are either selected or elected by the users of the respective command areas of the *Maujas* of the regions. The majority of the 12-membered executive committee formed through the selection/election also nominates a few other members from among the water users. More specifically, 3 members are usually nominated including a woman. Generally, the nominated members have to be educated, respectable, intellectual, and capable of offering the special assistance to the committee whenever needed. The treasurer would be elected from among the 15 members of the committee (but from among the members excluding the three elected functionaries). Tenure of the members of the executive committee shall be for two years'.

Both the systems have the institutional provision of appointing the staff for discharging the irrigation-related activities with the direction of the executive committees. Both have the provision of the appointment of *Meth Mukthiyars* (chief system level staff-one in *Chhattis* and two in *Sora*) . Organizationally and institutionally speaking, they are the backbones of both the systems. They are the ones who play the instrumental role in making the system operational. The common functions/roles discharged by them include the following: (a) mobilizing the *Kularas* in the *Kulahai* (labor contribution for repair and maintenance) as per the direction of the committee; (b) giving *Nap*/*Nath* (measurement of the canal) for *Kulahai* and specifying the amount of work (c) presenting the details of the *Kulahai* to the committees; (d) maintaining the daily attendance record of the *Kulahai* for the*Mul Tapahas* and *Sheer Kulhai* (repair and maintenance of the headwork) and the record of the *Kularas* of *Mauja* for *Gailkhara* (fines for being absent to contribute labor*)* and present to the secretaries who maintain the records ; (e) making the on-site inspection of the *Mul Thapaha*s and *Badhs* (diversions) to ascertain the type of the construction and repairing and maintaining work and mobilizing the *Kularas* accordingly; (f) making the on-site inspection to determine whether or not the *Maujas* have received the water proportionate to the amount of *Kulahai* and ensuring the equitable distribution of the water; (g) discharging all the works assigned by committee in a disciplined way; (h) waiving the labor contribution to any person or *Mauja* during the time of the emergency or natural disaster on the reasonable grounds (such as sickness and social ceremonies) ; (i) deciding the rotational distribution of the water by considering the timing of the farming and distributing accordingly, (j) supervising the water distribution, (k) opening the office daily or asking to open the office daily, (l) submitting the attendance of the *Chaukidars* to the secretaries, etc.

In the case of both irrigation systems, there is also the provision of *Mauja Muktiyars* (village level staffs) who are selected by the users of the particular *Mauja* and are responsible for disseminating the information of the village level committee apropos of its activities, distributing water equitably, mobilizing the labor, resolving the conflicts, getting the decisions of the executive committees implemented, etc. Though not universal, there is also the *Gaun Chaukidar* (village level watchman*)* in the irrigation system who comply with the orders of the *Gaun Muktiyars, Chetradakshya* (regional chairman/representative) and executive committee. He plays the crucial role in the exchange and dissemination of the information.

The *Meth Muktiyar* of *Chhattis Mauja* receives NRs. 2500 per month and his two *Chaukidars*/assistants receive NRs. 2000 per month. Similarly, the two

Meth Muktiyars of *Sora Mauja* are paid NRs. 1,750 per month and the *Chaukidar* / office assistant is paid NRs. 1500 per month. They are also provided the financial support for their local transportation and exempted from the labor contribution to repair and maintain the irrigation systems.

The system level operational rules for the regulation of the behavior of the irrigators are outlined in the constitutions of both the systems. A brief synthesized analysis of the rules-in-use from the constitutions and the practices governing conflict resolution and social equity are:

Rules For Conflict Management. The water users have developed their own system of conflict management. Infractions are resolved through the informal and formal mechanisms. While discussing the institutional systems of resolving the conflict in the command areas of both the irrigation systems, the analyses have proceeded at three levels: (i) inter-systemic conflict,(ii) inter-*Mauja* conflict, and (ii) intra-*Mauja* conflict.

(i) Inter-systemic Conflict

As indicated in the preceding sections, *Sora* and *Chhattis Mauja* irrigation systems have been using the irrigation system from the same source of water and from the same mega-canal. Therefore, they have constituted a joint management committee. This committee helps resolve outstanding issues/problems cropped up in the relationships of the two systems. Both the systems have been managing the common resource very successfully for sustaining their livelihood by resolving the conflict through the consensus –a function of the mutual discussion, negotiation, trust, and solidarity.

(ii) Inter-*Mauja* Conflict

Conflicts between and among the *Maujas* are also the common sociological phenomena in this irrigation system. The conflicts between the head, middle and tail locations causes from the violation of the distributional norms (such as the infraction of the rotational norms or inequitable distribution) do occur frequently. Some of the conflicts are specific to the cropping seasons. For example, conflicts between the *Maujas* occur more frequently during the period of the paddy nursery seedbed preparation. Such cases are generally mediated by the system level executive committee when the complaints are lodged by the affected parties. The resolution of conflicts takes places in the form of the on-the- spot inspection, persuasion, and creation of the conducive environment for the compromise between and among the conflicting *Mauja* parties. The decisions are generally accepted by the conflicting parties. A water monitoring committee comprising of four members has been formed for the settlement of water cases in *Sora Mauja* irrigation system. This committee imposes fine if a *Mauja* steals the water in the turn of another *Mauja*. The amount is NRs. 500 for the one time water theft. All inter-*Mauja* conflicts are settled within the *Maujas.* They do not resort to the courts/police/administration for the conflict settlements.

(iii) Intra-*Mauja* Conflict

Intra-*Mauja* conflict is also frequent occurring sociological phenomenon. The principal sources of the conflict starts from the violation of water distributional turn between head, middle and tail locations, water theft, unjust distribution of water between head, middle and tail farmers. Water stealing within the *Mauja* is more frequent during the period of paddy nursery bed preparation and maize cultivation. Characterizing the scale of the water stealing during the period of the maize cultivation in March- April, one key informant of *Sora Mauja* remarked: " Water users here have a proclivity to steal water very frequently during the period of maize cultivation but they are ready to pay NRs.500 as fine because that payment of fine contributes to accrue NRs. 7000-8000 from the sale of the cobs of maize". When the conflict arises between and among the farmers of the head, middle and tail locations or between and among the farmers of a particular location, the issue is brought to the *Mauja Muktiyar* by the affected party/ies who then make the immediate on- the- spot inspection of the situation. During the period of the observation, the conflicting parties are allowed to present their arguments. The witnesses are also called for the verification of the conflicting complaints. Once the complaints of the conflicting parties and the opinions of the witnesses are heard, the *Muktiyar* tries to persuade the conflicting parties and resolve the issue through compromise. But if he fails to resolve the issue of the conflict, it is brought to the *Mauja* level mass meeting, which then finalizes the case through the elaborate discussion. The person/s responsible for the infraction of the irrigation norm has/have to accept the decisions of mass arbitration including the compromise / payment of the compensations to the affected party/ies. Generally, the intra-*Mauja* conflicts have not resorted to the police, court and administration. This shows that community verdict is the final one.

<u>Rules for Maintaining Social Equity Among the Disadvantaged Groups Within the Irrigation Systems</u>. The irrigation management is a mutually beneficial collective action, and there is the involvement of multi-stakeholders (farmers of different socio-economic statuses determined by wealth, caste and ethnicity, and education). These farmers belonging to the different socio-economic statuses referred to as the multi-stakeholders in this analysis have a democratic space to participate in the decision-making process and articulate their interests. In this academic research, smaller

holders (say those who have less than five *Katthas*[4]), traditional low castes and autochthonous Tharus are the disadvantaged groups. Most of these social groups have the direct participation in the meetings/ general assemblies of the *Mauja* (village) level committee. In these fora, every member of these social groupings is encouraged by the local leadership to articulate their opinions/ voices, share their irrigation- related problems, assess the performances of the leadership and policies, and their inconsistencies.

As analyzed in the preceding sections, both the systems have evolved the norm for the equitable distribution of the water, that is, every user is entitled to receive the water proportionate to the size of the landholding, which is again determined, by the amount of contribution (cash or labor or both) as per the necessity. This fair distribution of water as per the norm is equally applicable to all users regardless of the socio-economic statuses. This means the minority *Tharu* ethnic people and low caste people as well as the small holders have the right to the equitable distribution of water. There is no evidence of the discrimination in this regard.

Cognitive Social Capitals and Their Roles in Sustaining The Irrigation Management

This section presents the brief analysis on the cognitive social capitals, which comprise the social norms and values, ideas/ideals/principles, attitudes, trust, social solidarity, sense of mutual obligation and strategy of co-operation. Though structural social capitals such as organization, roles, rules, institutions, procedures, precedents are diametrically important and necessary for the sustainable irrigation management, the roles of the normative /cognitive social capitals is no less important. In other words, it is only through the synergistic effect of the structural and cognitive/normative social capitals that the management of the common property resource such as water for irrigation can be sustainable managed.

Social Norms and Values

Despite the heterogeneity of the water users in terms of caste/ethnicity and cultures, they have a social norm of co-operation handed down from one generation to the next. One is socially expected to contribute to the community works such as irrigation development, construction of the temples, public places if he/she wants to stay in the community with social respect/prestige. In the case of irrigation, a water user is expected to co-operate for the larger common interest, that is, repair and maintenance and

[4] Kattha=0.0339 hectares.

operation of the systems. If he/she does not comply, of course, fine will be imposed as per the operational rules. If he/she does not comply with the operational penalty rules, he/she is deprived of the irrigation facility and is also publicly ridiculed and at the worst case, is socially boycotted. Explicit is the recognition that the social norm of the community of water users requires everyone to work for the larger community interest/welfare and irrigation is one of these spheres.

The migrant water users belonging to *Brahmin* and *Chhettri* communities have the altruistic social value in their culture. For instance, they have a saying that *Sewa nai param dharma ho* (social service is the principal religion). Explicit is the social recognition that the social service helps to earn the *Punya* (merit). Traditionally, they do not calculate the material benefits from the social service. The indigenous *Tharus* have the sense of communitarism. This social value has also the implications on the water resource management. The water users not only think of their own benefits accrued from the irrigation but also think of other fellow- water users' needs and therefore, they largely comply with the operational norms of water distribution and do not generally use the water at the cost of others. The traditional social value helps maintain the balance between the self-interest and interest of others.

It was reported in the sample locations that when water user's own paddy seed is germinated and has still his/her turn of water use, he/she gives the turn to another farmer whose seed has not germinated and is in dire need of water. Generally, one has to irrigate the land in his/her own turn. Often water users also consider the problem of the fellow- water users of the neighborhood if their need is more urgent. Thus, the farmers have the altruistic social value, which has, in one way or another, helped maintain the irrigation system for ensuring social equity of the benefits.

Ideas/Ideals/ Principles

There is no other source of water for irrigation and the water users have to depend on these irrigation systems for the livelihood, they do not want politics to be played within the organization, which may potentially be disintegrative. In a democratic environment, users definitely have a panel of the candidates along the party lines/ideologies during the period of the election for the *Mauja* level and regional level committee structures and system level executive committee. For instance, for the last 14 years, the system level executive committee of *Chhattis Mauja* irrigation system had a total of 58 functionaries/members being close to Communist Party of Nepal

(United Marxist and Leninist) followed by 29 being close to Nepali Congress. A few were also selected from Rastriya Prajatantrik Party and the United Front (**Table 1**).

Table 1: Distribution of the Functionaries/Members of the Executive Committee of *Chhattis Mauja* Who Contested Election Along the Political Party Lines After the Resurgence of Multiparty System in 1990 by Years

<table>
<tr><th rowspan="2">S. N.</th><th rowspan="2">Year</th><th colspan="4">Members from</th><th>Remarks</th></tr>
<tr><th>NC</th><th>CPN-UML</th><th>UF</th><th>RRP/N</th><td rowspan="9">NC=Nepali Congress,
CPN-UML= Communist Party of Nepal-United Marxist and Leninist,
UF= United Front,
RPP=Rastriya Prajatantrik Party
N= Neutral</td></tr>
<tr><td>1</td><td>1991/92</td><td>3</td><td>9</td><td>1</td><td>0</td></tr>
<tr><td>2</td><td>1993/94</td><td>2</td><td>9</td><td>1</td><td>1</td></tr>
<tr><td>3</td><td>1995/96</td><td>2</td><td>9</td><td>1</td><td>2</td></tr>
<tr><td>4</td><td>1997/98</td><td>4</td><td>10</td><td>1</td><td>0</td></tr>
<tr><td>5</td><td>1999/2000</td><td>4</td><td>9</td><td>1</td><td>1</td></tr>
<tr><td>6</td><td>2001/2002</td><td>4</td><td>9</td><td>1</td><td>1</td></tr>
<tr><td>7</td><td>2003-2004</td><td>10</td><td>3</td><td>0</td><td>2</td></tr>
<tr><th colspan="2">Total</th><td>29</td><td>58</td><td>6</td><td>7</td></tr>
</table>

***Source*:** Field Survey, February/March, 2003

Once the election is over, the elected leadership whole-heartedly works for the effective functioning of the irrigation system and thereby ensures the equitable distribution of irrigation benefits among the water users. If the elected leadership is partial in its role performance and diametrically fails to ensure the benefits among the water users, it would be rejected in the next election. There is a traditional culture to make the organization apolitical (in the sense of party politics that may work to create the social rift among the water users which can work as the impediment for the promotion of the community interest such as the collective contribution for the irrigation management) but the organization has the political agendum, that is, empowerment of the community of water users by involving them in the decision-making process for the management of the irrigation system to ensure the equitable benefits of the community.

The users have a uniform understanding that politicization leads to the spoil of the irrigation system and have a strong conviction that water has no color/creed. They have evolved a system that all the water users of the command areas should get united to manage the irrigation systems irrespective of the affiliation with a political party or adherence to a particular political ideology.

Social Solidarity

Given the fact that the effort of an individual or a group of individuals cannot acquire the water from the river, the larger social collectivity has to make a united effort for this. The water users have a" we-feeling" in each *Mauja* and in each system which has helped manage the irrigation systems in their respective command areas. The water users have a proclivity that they have a role to repair and maintain the system in their respective areas to ensure the equitable benefits between and among themselves.

Attitude

"Attitude" is a crucial cognitive social capital for the development of any society. If all the community people have very negative "attitude" with respect to the developmental effort, it does not bear any fruit. The positive attitude of the people creates the social energy, which can potentially be harnessed for the development of any sector of the community. The water users of the irrigation systems have a very co-operative and participatory attitude in the community vis-a-vis the management of the irrigation system. They have the clear understanding that these systems can function only if we have a positive and participatory attitude to contribute to repair and maintain and operate the systems for the larger benefits of the community.

Friendship

Friendship is a strong cognitive/normative social capital that has the potential to contribute to the better functioning of the irrigation systems. There is inter-systemic, inter-*Mauja* and intra-M*auja* friendship between and among the water users. Water users/ leaders of the organizations have friendship based on mutual interest/reciprocity, trust and empathy. This bond of personal friendship has also contributed to maintain the community-property system. For instance, if a water user does not comply with the irrigation norm, his request or put pressure on him/her to comply with. The leaders also get positive suggestions/advices from their friends to lead the organizations in an impartial and effective way.

Leadership Factor

Generally, the people in the leadership positions are relatively experienced and socially reputed. Often, the chairmen of the joint management committees and executive committees of both the irrigation systems have also the experience of the local governments/co-operative movements and hence, command the respect from the fellow-irrigators. Barring a few exceptions in the past, the leaders' articulations/decisions always make the users to comply with the irrigation rules/regulations. The leadership supported by the committed staff has hitherto inspired the community of the irrigators that the internal resource mobilization is the only factor that can keep the system functioning. It is always the reputation of the leaders (which has commanded the respect from the community of water users to comply with the rules) that has helped receive the resources from the external (material, technical and financial) for the improvement of the irrigation system. The leaders have to be accountable to the community of the water users so that they are motivated to work. The personality of the leadership should be the motivating factor for the mobilization of the resources. Generally, the leaders have given the impression that they do not practice the nepotism/favoritism while treating the irrigators. They can function only as per the mandate of the general meeting/general assembly. They justify the actions for the larger interest of the community and failing to do so would penalize them in the next election. The neutral and impartial leaders have earned the trust from the fellow irrigators.

Trust

Of all the cognitive/normative social capitals, "trust" is supremely important because it contributes to building and cementing the relationships between the leadership positions and the community and vice versa. Lack of "trust" in the community does not trigger any sustained development. In the case of both irrigation systems, there is generally higher degree of trust in the leadership of all the layers of the organizations—a function of the transparent behavior in the process of the decision-making and the financial dealings.

Sense of Mutual Co-operation and Social Energy

The people are socialized in such a way that they have a sense of co-operation which helps develop the social energy. There is a culture of mutual labor exchange called *Parma* among the hill migrants and *Saklahara* among the indigenous *Tharus*. The hill migrants have also the saying *Jiudaka Janti Mardaka Malami* (meaning relatives/friends/acquaintances join during the marriage procession when one is alive and join the death procession when one passes away). Such mutual co-operation enhances one's social dignity. This traditional cultural system has helped harness the social energy, which is the collective effort of the community of the water users. It is also the function of the unwavering commitment of the water users to keep the system functional with the mobilization of internal resources. The self-serving behavior is discouraged by the community and will have no prestige in the community. In fact, the social energy is the function of the communitarian feelings in the traditional cultures. Most of the social activities/ceremonies are collectively performed and so are the irrigation-related activities.

CONCLUSIONS

The empirical evidences have shown that the community property resources can only be sustainably managed provided the structural and cognitive/normative social capitals have been developed/nurtured and utilized. In both the irrigation systems, the sustained management is the synergistic effect of the roles of the structural and cognitive/normative social capitals. Generally, there has been over-emphasis on the structural social capitals (such as organizations, roles, rules/institutions/procedures /precedents, etc.) in the existing literature of the development. Conversely, the normative/cognitive social capitals (such as norms and values, ideas, leadership factor, friendship, sense of mutual co-operation, social energy, etc.) are willy-nilly ignored. The professional culture of ignoring the paramount importance of these vital social capitals cannot furnish the holistic analysis of the social dimension of the sustainability of the common property resources management. Uphoff states, "Promoting participatory development will be more successful effectively with a more contemporary understanding of the nature of social as well as material realities… Post-Newtonian social science understands reality as embracing both objective and subjective factors in less linear and less deterministic way… Values and personalities find the legitimacy in post-Newtonian considerations which is denied in any scheme modeled after classical physics where objective and subjective factors are considered entirely separate" (Uphoff, 1996). I also concur with his scientistic position that ignoring the analysis of the cognitive/normative social capitals in the regime of development would disqualify us to claim to be the real social scientists because we do embrace only the objective social realities. Hence, we need to embrace both structural and cognitive social capitals in the analysis of the sustainability of common property resource management.

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PERFORMANCE OF IRRIGATION SYSTEMS MANAGED BY INDIGENOUS AND MIGRANT COMMUNITIES IN THE EAST RAPTI RIVER BASIN OF NEPAL

DEVI PRASAD GHIMIRE[1]

INTRODUCTION

Nepal is an agrarian country where about 80 percent of her population is still engaged in agriculture who produce only about 40 percent of the GDP. The country, a moderate exporter of food grains, particularly rice, until 1970s, has become an importer of it in recent years. There is a very limited scope for increasing production through expansion of area because of the geographical and topographical situation. This means that there is a warranted need for increasing agricultural production and productivity through the intensification and commercialization of agriculture in order to meet additional requirements of food and fiber for the continuously increasing population and transform the agrarian economy into the commercial one. This requires development and utilization of abundantly available water resources in agriculture and other sectors more efficiently.

The irrigation systems for study are from the eastern Chitwan located in the East Rapti River Basin (ERRB). They are either small or medium in size. Few of these systems are still operated and managed by the indigenous Tharus, despite the increasing domination of migrants. The O&M of most of these systems were transferred to the respective WUAs immediately after the completion of East Rapti Irrigation Project (ERIP) launched during 1995-96.

METHODOLOGY

Selection of Study Area and Irrigation Systems

The East Rapti River Basin (ERRB) was purposively selected for this study considering the researcher's limitations. Multistage sampling method was used. Initially, a consultative meeting of some key persons and local leaders was organized to select the appropriate irrigation systems. As a result, the

[1] Associate Professor of Agricultural Economics and Coordinator of Water Management Study Program, Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal.

eastern part of Chitwan district located in the ERRB was selected as the study area where the irrigation systems managed by both indigenous and migrant communities are still available. Four irrigation systems namely Tarauli, Baireni, Chipleti, and Mahadevtar, two each managed under the leadership of indigenous and migrant communities, respectively were selected purposely (**Figure 1**).

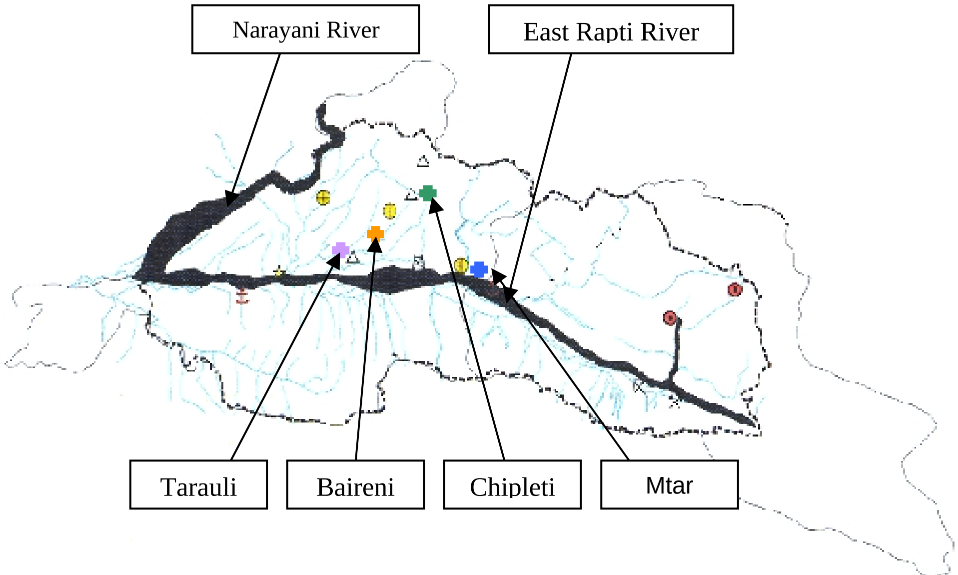

Figure 1: Map of East Rapti River Basin with the Locations of the Irrigation Systems Studied

Source: Ghimire et. al, 2000

Sample Selection

A complete list of all the farm households of each of the selected irrigation systems was prepared by location. A sample of about 20 percent of the total households was selected proportionately and randomly, besides the inclusion of all the concerned WUAs. Hence, the sample size of all the systems was 156 consisting of 25, 58, 45, and 28 households from Taraulu, Baireni, Chipleti, and Mahadevtar irrigation systems, respectively.

Data Collection

The primary data from the selected households were collected from interviews with the household members. Similarly, primary data were gathered from the WUA executive regarding the WUA organization. The secondary data were obtained from the records and publications.

Analyses of Data

In addition to qualitative description, descriptive statistics such as percentage for presenting the differences in the mean values of the variables considered and the Binary Logistic Model were used in determining the factors affecting water availability. Similarly, Simple Regression Model was used for identifying the factors affecting labor and financial contribution. The t-test and z-test were used for testing the significance of the difference while comparing the results between the two communities.

RESULTS AND DISCUSSION

History and Command Areas

All the selected systems are among the oldest ones in the district. Tarauli, Baireni, Chipleti, and Mtar are believed to be constructed long before 1954. The command areas and number of households in all the systems increased tremendously over time as a result of inflow of migrants and family separation. The initial command areas increased from 33, 95, 10, and 45 hectares to 75, 95, 160, and 140 hectares in 2002, respectively. The increase in command areas in all systems but Baireni was due to both improvement of systems and conversion of forest land into the cultivation. Similarly, the initial number of houses increased from 12, 14, 54, and 13 to 116, 300, 222, and 139, respectively in 2002. These figures indicate the intensity of population pressure in the study area.

Sources of Water in The Irrigation Systems

All the systems selected for this study are the gravity flow systems. Dungre Khola (river) of Tarauli, Pampa Khola each of Baireni and Chipleti, and Lother river of Mtar are the sources of water, respectively. Dungre has been relatively richer source of water after the ERIP rehabilitation of upstream systems getting water from the ERR because the drained water coming from them sinks into it. The earlier scarcity of water in Lother has disappeared as a result of better catchment area management by the Parewaswori Community Forest Group. These results suggest the need of establishing coordinating mechanisms between upstream and down stream irrigation systems and other stakeholders for capitalizing the means and ways of benefiting each other.

However, the water scarcity in Pampa has been increasing particularly during the spring season and is of serious concern of the farmer.

Structural Changes of the Systems

Many structural changes were made in all the systems by mobilizing the internal as well as external resources over time. Changes in locations and structures of the intakes were the most common phenomenon until they were made either semi-permanent (**Figure 2**) or permanent, particularly by the ERIP. Similarly, the water users and external agencies particularly the ERIP made many attempts to bring all irrigation systems to the present condition. Although the ERIP made semi-permanent and permanent canal structures in the most fragile portions of canals by lining both the sides and making water regulating gates (**Figure 3**), some portions of Tarauli, a portion of Baireni near Khurkhure Bazaar, and 10 spots of Chipleti were seriously damaged by the devastating flood of 2002 which require external supports for repairing permanently in order avail the continuous flow of water.

Figure 2: Intake Structure of Baireni Canal Constructed by Using Stone filled Gabbion Boxes

Figure 3: Typical Water-regulating Gate Constructed with Both Sides Lined Structure of Baireni Canal

SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Socio-demographic Characteristics

About 83 percent of the total respondents were male. Interestingly, the percent of male respondents in all the systems was higher than the overall percentage except in Baireni. In general, 46 percent of the respondents were from the so-called superior castes (Brahman and Chhetri).

Despite the prevalence of various castes with their own traditions, more than 90 percent of the respondents were married. Majority of the respondents (56%) were not affiliated to any organization. The highest number of respondents (69%) in Chipleti managed purely by the migrants were affiliated to political parties. The affiliation of respondents to political parties was higher, i.e. 51% in the systems managed by the migrants than managed by the Irrigation Committee (IC), i.e. 14%. Affiliation to other organizations and participation in training was very poor in all systems irrespective of communities.

About 40 percent of all the respondents were still illiterate with the highest (52%) in Tarauli and 41 percent in Baireni both managed by the IC. The percent of respondents with primary level of education was significantly higher in the systems managed by the migrants than those managed by the indigenous Tharus. Percentage of literacy was also significantly lower in the systems managed by Tharus than managed by the migrants.

The overall average family size of all the system was 6.15 persons/family which was significantly higher in the systems managed by the IC than those managed by the migrants. This means that the indigenous people are still far behind socially than the migrants.

Economic Characteristics

The overall average size of landholding of all the respondents during the early 1990s was 0.69 ha which reduced to 0.65 ha in 2002. The average land size of the respondents in the systems managed by the IC in 2002 was significantly smaller than those managed by the migrants. It means that the land fragmentation in the indigenous communities is more than in the migrant communities which could be due to the migrants' action of converting forest and marginal lands into the agricultural ones.

The indigenous Tharus had higher percentage of both permanent and temporary houses while the migrants had relatively higher percentage of semi-permanent houses. It indicates as greater difference in the living condition among indigenous people and the tendency of migrants to maintain a minimum stander of living.

The overall average income family from all sources was NRs. 74,000 with highest in Baireni located near the emerging town and lowest in Mahadevtar where the number of absentee landlords is greater in number. Agriculture was the main occupation of all the water users. However, the overall average income from agriculture (crops and livestock) was only NRs. 32,000 while it was highest (NRs. 107,000) from foreign employment. Percentage of self-sufficient households was highest (68%) in Tarauli where the land is more productive and lowest (43%) Mtar. These results indicate that the level of income depends more on the soil fertility and the opportunity of off-farm jobs rather than the area and communal variation.

FORMATION OF ORGANIZATION AND LEADERSHIP DEVELOPMENT

The Coordination Committee of WUAs

All the irrigation systems are working independently with their own WUAs. A 21-member Coordination Committee of Water Users' Associations (CCWUAs) representing all irrigation systems of the eastern Chitwan is formed to coordinate among all the concerned stakeholders as and when needed particularly for the rehabilitation of irrigation systems. The CCWUAs currently has an office, a full time office secretary and a peon who are paid nominal salary. CCWUAs has an excavator which is used in repair and maintenance of all systems on a priority basis.

The Leadership Development in WUAs

One-man leadership in succession existed in both the systems managed under the leaderships of the IC and also in Mtar managed by a Pathak family. The Tharu community leaders (called Praganas or Chutaria in local dialect) mostly from the Jamindar (Landlord) families made all the decisions regarding O&M of their systems before the influence of the migrants. Although full participation of the water users in the O&M was reported in the traditionally managed Tharu systems, lack of consensus in decision-making and non-transparent financial transactions were reported as the major problems during the one man leadership system. However, an informal WUA was formed from amongst retired army men from the very beginning in Chipleti.

The collective decision making process of O&M of all the systems started only in early 1980s through the informal WUAs as a result of opposition by the users against the one-man leadership. Many conflicts particularly in Tarauli and Baireni are resolved under the leadership of IC. The formal WUAs were formed only at the time of ERIP rehabilitation in the early 1990s. This was required for availing the rehabilitation supports. This means that the organizational and leadership development are the gradual processes which are slower in the indigenous communities than in the migrant ones. Further more, people tend to organizer quickly for getting external supports irrespective of communities, particularly in the systems with relatively scarce in water availability.

Users' Knowledge on WUA Activities

In general, 24 percent of the respondents knew the date of their systems construction. On an average, the knowledge on the date of system construction among the IC water users was significantly lower (14%) in the irrigation systems managed by the IC than managed by the migrants (35%). Similarly, an overall 26 percent of the respondents knew the date of their formal WUA formation which was also lower (19%) in the systems managed by the IC than managed by the migrants (33%). The respondents reported that an overall average of 83 percent of the respondents knew their positions as general members of WUAs which was again relatively lower (80%) in the former than later (87%). Both in Tarauli and Mtar system, the users are unfamiliarabout this position in the system. Both of these systems are abundant in water availability. It means that the indigenous people are still far behind in knowledge on O&M activities than migrants and the water users of systems with abundant water availability do not care much the organizational activities of their systems.

Users' Participation in WUA Activities

Although the higher number (72%) of the respondents in the irrigation systems managed by the IC were consulted for rehabilitation and lower (67%) in the migrant managed systems. Consultation for planning and design was significantly lower (23%) in the former than the later (33%). It implies that the external supporters still consult indigenous people more for physical and monetary contribution whereas they consult migrants more for the mental works such as planning and designing. The participation of users in election/selection in all the systems was almost the same ranging from 57 to 62 percent with overall average of 61 percent.

An overall average of 23 percent of the respondents were always present in all O&M activities which was almost the same in the systems managed by both the communities. The percent of respondents who were absent once or twice was also almost the same in both systems but the continuous absence for the third time (continuous absence for three times deprives users from the water right according both social norms and WUA constitutions) was negligible in all the systems irrespective of the communities. It implies that all the water users want to hold water right intact once got at any cost irrespective of the communities.

Perception of Decision-making and Faith on Leadership

The percentage of respondents who perceived that the decisions were made collectively was almost the same in both communities. However, the percent of them who perceived that the decisions were individually made was higher (35%) in the systems managed by the migrants than managed by the IC (28%). In general, only 21 percent of respondents expressed WUA leaders as highly faithful which was significantly higher (30%) in the IC managed systems than the migrant managed ones (16%). It means that individualistic approach of decision-making is more among migrants and faith in leadership is more among the indigenous people.

WATER SHARING AND CONFLICT RESOLUTION

Water Availability and its Allocation Systems

Strict rules of water allocation were not followed in systems with abundant water availability. However, it was allocated 24 hourly to each branch from head to tail even during the monsoon season in Chipleti where water scarcity was more serious. The rotational systems were also followed for the spring rice in Tarauli and Mtar during the periods of water scarcity in order to minimize conflict. Spring rice was not grown in Chipleti and it was increasingly irrigated by pumping the ground water in Baireni. It means formulation of rules and allocation systems of water depend more on water supply condition rather than communities.

Water Allocation and Users' Influence

In general, 51 percent of the respondents preferred the existing head to tail water allocation (WA) system while 40 percent of them mostly from the tail ends wanted a new system of WA**.** The percent of respondents preferring the existing system of WA was higher (58%) in the systems managed by the IC than managed by the migrants (49%). This implies that indigenous people are relatively reluctant to a change than the migrants and water users getting less water from the existing systems want to introduce a new system as far as possible. This indicates that the migrants are more hesitant to contribute labor and react against the traditional system of sending a person from each household irrespective of sizes than the indigenous people. Forty-four percent of the respondents influenced water allocation in the systems managed by the IC while it was only 27 percent in those managed by the migrants.

Conflics and Their Resolution Mechanisms

In general, only four percent of the respondents faced conflicts related to all issues (water allocation, canal route, labor contribution, non-registered land, and water right). The labor contribution was the most common issue of conflict which was more serious in the systems managed by the migrants (46 %) than managed by the IC (33%). There are some serious water related conflicts. The conflicts related to the water right between systems, particularly in Tarauli and Chipleti were so serious that they were not resolved until the external interventions of the Chief district officer and the court were made.

Although there was no significant difference in the percentage of respondents' involvement in the conflict resolution between communities, non-involvement was higher (47%) in the systems managed by the migrants than those managed by the IC (41%). These results imply that the indigenous people are more cohesive and interactive among themselves than the migrants. In general, 31 percent of the respondents perceived that the conflicts were resolved by means of combination of both negotiation and intervention followed by negotiation alone, and avoidance, respectively. The use of combination of negotiation and intervention was significantly higher (34%) in the systems managed by the IC than managed by the migrants (24%). This implies for a greater need of a negotiator or a middleman for the resolution of conflicts for the indigenous people than the migrants.

FACTORS AFFECTING WATER AVAILABILITY AND CONTRIBUTIONS

Perceived Factors/Problems Determining Water Availability

In general, the highest of 29 percent of the respondents reported flooding/silt deposition as factors that limited water availability. This was more serious (29%) in the IC managed systems than those managed by the migrants (19%). This seems realistic since most of the command areas of IC systems are located in the downstream of the ERRB where the floodwater is accumulated. Although the perceived problem of cooperation/participation was almost the same in both communities, the problem of WUA leadership/conflict was more serious (29%) in the systems managed by the IC than managed by the migrants (13%). This could be because of the prevalence of mixed communities in IC managed systems. In general, 32 percent of the respondents reported faulty initial designs as the most serious problem limiting water availability which was higher (35%) in the systems managed by the migrants than managed by the IC (30%).

Empirically Estimated Factors Affecting Water Availably

Table 1 presents the logistic model estimates of index function for water availability in the irrigation systems managed by the indigenous and migrant communities. The results showed that among the variables included

Table 1: Logistic Model Estimates of Index Function for Water Availability in the Irrigation Systems Managed by the Indigenous and Migrant Communities.

Variables	Systems Managed by IC		Systems Managed by Migrants		OVERALL	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	12.086	0.008***	20.754	0.800	8.572	0.00***
Area	0.3221	0.701	2.235	0.071*	0.399	0.405
Education	-0.9540	0.073*	-0.699	0.328	-0.580	0.086*
Location of farms	1.1356	0.154	2.423	0.087*	1.638	0.006***
Intake location	0.5226	0.484	-0.874	0.370	0.261	0.553
Intake condition	1.288	0.088*	0.712	0.527	0.240	0.610
Technology used	0.317	0.706	11.445	0.780	1.229	0.079*
Financial contribution	-0.011	0.392	0.024	0.375	-0.004	0.685
Labor contribution	0.052	0.0478**	0.021	0.571	-0.025	0.151
Faith in WUA	1.214	0.094*	0.064	0.917	0.553	0.203
Cooperation among user	0.269	0.773	0.186	0.952	0.405	0.572
System performance	0.777	0.380	0.870	0.499	0.036	0.948
Tarauli					1.297	0.138
Baireni					0.136	0.863
Mtar					0.271	0.800
Number of observations	**70**		**64**		**134**	
Model Summary						
-2 Log likelihood	54.58**		40.021***		120.51**	
Nagelkerke R Square	0.388		0.502		0.305	

*** , **, and * indicate the significance at 1, 5, and 10 percent probability levels respectively.

education, location of farm, and the technology used were the factors significantly affecting water availability. In general, location of farm and technology were directly related to water availability which imply that the irrigation water is easily available to all farms of the command areas if the irrigation systems are well designed. However, education was inversely related to water availability. In particular, labor contribution was significantly contributory in the systems managed by the IC while area availability (size of farm) and their location in the systems managed by the migrants. This implies that the indigenous people believe that more the labor contribution higher will be the water availability whereas the migrants perceived that more water is available on larger and nicely located farms.

Factors Determining the Labor Contribution

Table 2 presents the linear regression estimates of index function for labor contribution to O&M in the irrigation systems managed by the indigenous and migrant communities. In general, area, availability of off-farm opportunities, location of farm, technology used, and faith in WUA leadership were the factors that determined the level of labor contribution. The location of farm was significantly contributory to labor contribution in the systems managed by both communities whereas area availability and faith in leadership were also contributory in the systems managed by the migrants.

Table 2: Linear Regression Estimates of Index Function for Labor Contribution to O&M in the Irrigation Systems Managed by the Indigenous and Migrant Communities.

Variables	Systems Managed by IC		Managed by Migrants		Overall	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	6.990	0.000***	4.616	0.029**	6.890	0.000***
Water availability	0.072	0.828	0.114	0.764	0.050	0.840
Area	0.457	0.511	1.201	0.00***	0.915	0.00***
Education	-0.188	0.175	0.265	0.125	-0.012	0.911
Family size	0.049	0.360	0.018	0.778	0.028	0.489
Available opportunities	-0.507	0.111	-0.500	0.074*	-0.364	0.082*
Location of farms	0.517	0.048**	1.075	0.00***	0.743	0.000***
Intake location	0.138	0.601	0.295	0.138	0.222	0.118
Intake condition	0.186	0.458	0.036	0.903	0.266	0.118
Technology used	0.418	0.112	0.297	0.325	0.388	0.045**
Financial contribution	0.001	0.778	0.001	0.468	0.000	0.792
Faith in WUA	0.202	0.466	0.621	0.00***	0.491	0.004***
Cooperation	0.076	0.819	0.105	0.854	0.154	0.568
System performance	0.060	0.847	0.782	0.032**	0.271	0.228
F-value	2.522	0.009***	9.836	0.00***	7.034	0.000***
R square	0.373		0.805		0.478	

***, **, and * indicate the significance at 1,5, and 10 percent probability levels respectively.

These results imply that well designing of irrigation systems covering all the farms of the command areas of irrigation systems is the pre-condition for labor contribution in both communities. However, the migrants require additional conditions such as the size of land and faithfulness of leadership for making more labor contribution.

Monetary Contribution

Table 3 presents linear regression estimates of index function for financial contribution in the irrigation systems managed by the indigenous and migrant communities. In general, area, family income, and family size significantly affected the financial contribution. In particular, the cooperation among the users in the IC managed systems and education in those managed by the migrants significantly contributed to the financial contribution. These results imply that the cooperation and cohesiveness among water users contributes more to monetary contribution among the indigenous people and education inspires for more financial contribution among the migrants.

Table 3: Linear Regression Estimates of Index Function for Financial Contribution in the Irrigation Systems Managed by the Indigenous ind Migrant Communities.

Variables	Systems managed by the IC		Systems Managed by the Migrants		Overall	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	118.699	0.108	140.531	0.444	-4.431	0.955
Family income	0.000	0.029**	0.001	0.031**	0.000	0.022**
Water availability	15.173	0.445	28.373	0.448	4.378	0.822
Area	308.677	0.000***	127.724	0.000***	232.865	0.000***
Education	5.889	0.487	35.586	0.022**	13.536	0.113
Family size	1.267	0.709	4.003	0.542	5.778	0.093*
Availability of opportunities	22.165	0.228	38.621	0.163	9.337	0.578
Intake location	1.383	0.925	13.455	0.487	7.319	0.510
System performance	6.086	0.753	3.385	0.930	22.692	0.228
Intake condition	6.154	0.681	4.961	0.865	9.576	0.486
Technology used	3.242	0.833	3.096	0.944	10.499	0.528
Cooperation among users	48.199	0.015**	39.041	0.480	16.906	0.445
F-value	42.365	0.000***	8.473	0.000***	29.999	0.000***
R square	0.888		0.744		0.762	

*** , **, and * indicate the significance at one, five, and 10 percent probability levels, respectively.

PERFORMANCE OF IRRIGATION SYSTEMS

The performance of irrigation systems was measured in terms of money and labor contribution and the changes in agricultural performance. Agricultural performance included the temporal change in command area, cropping intensity, rice yields, cost of rice cultivation and their returns to fixed farm resources (RFFR).

Monetary and Labor Contribution

On the average, the annual cost incurred in the O&M of the systems was NRs. 172/ha which was higher (NRs. 180.90/ha) in the systems managed by the IC than managed by the migrants (NRs. 164.01/ha). Although not significant, the payment of the bighati was higher (79.05%) in the systems managed by the IC than the migrants (76,24%).

Similarly, the annual labor requirement was also slightly higher (6.37 mandays) in the systems managed by the IC than those managed by the migrants (6.19). In general, about 81 percent of the total requirement was already contributed with slightly higher (82.58%) in the IC systems than the migrant ones (81.05%). It means that the indigenous Tharus are ahead in both money and labor contribution.

Agricultural Performance

In general, the command area increased slightly from 94.26 ha in early 1990s to 100.93 ha in 2002 with maximum in Chipleti where the settlement of migrants is recent. However, the irrigated area in Baireni decreased significantly where the conversion of agricultural land into the settlement is rapid.

Although the overall area allocated to monsoon rice decreased from 93 percent in early 1990s to 89 percent in 2002, the total physical area allotted to this crop increased as a result of the command area expansion by converting forest land into cultivation particularly in the systems managed by the migrants. However, the area allocated to spring rice was significantly increased in terms of both percentage and the total area during the same period. Similarly, the overall cropping intensity was increased significantly from 237 percent in the early 1990s to 251 percent in 2002 which was significantly higher (254%) in the systems managed by the IC than managed by the migrants (216%).

The overall mean yields of monsoon rice increased significantly from 3.30 t/ha in the 1990s to 3.80 t/ha in 2002. Similar situation was observed in the case of the mean yield of the spring rice. As expected, the mean yield of both rice on farms located at the head ends of all the systems were significantly higher than those located at the tail ends. These results showed that the agricultural performance in the systems managed by the IC was higher than managed by the migrants which could be due to the difference in quality of land rather than the management.

Economic Performance of the Systems

Manures, chemical fertilizers, tractor hours, human labor, insecticides, irrigation, and interest on the total variable costs(TVC) of cultivating both monsoon and spring rice were included as the cost items. The overall average TVC of cultivating monsoon rice was NRs. 18644/ha with maximum in Tarauli and minimum in Chipleti. About 67 percent of the TVC was incurred for labor followed by about 10 and nine percent for tractor and chemical fertilizers, respectively. The values of the grain and straw were included in the total value product (TVP). Thus, the TVP was of this rice was NRs. 38454. Consequently, the average return to fixed farm resources RFFR was NRs. 19810/ha. The RFFR was in the systems managed by IC than managed by the migrants perhaps due to quality of land rather than management.

Similarly, the overall average TVC of cultivating the spring rice was relatively higher (NRs. 20150/ha) than that of monsoon rice but the TVP of this rice was significantly lower (NRs. 32942/ha) than that of monsoon rice. Consequently, the average RFFR of spring rice was only NRs. 12792/ha with maximum in Tarauli. The lower RFFR of this rice, however, was due to lower price of both the main and by product than that of the monsoon rice. The costs as well as returns of both rice were higher in the farms located at the upstream than those located in the downstream of all the irrigation systems. This means that the economic performance of the upstream irrigation system is higher than in the downstream which could be more availability of irrigation water.

CONCLUSIONS

Chitwan valley was the residential place of aboriginal Tharus community from the time immemorial. Most of the irrigation systems then developed were operated and managed by themselves with full participation of not only the adult males within systems but also the adjoining villages under the command of Pragana, the community leader in local dialect.

However, the inflow of migrants began along with the malaria eradication campaign launched by the Rapti Valley Development Project in 1953. Most of the migrants coming from almost all parts of the country started settling in the study area by converting forestland into farmland.

Rehabilitation/modification of the existing and construction of many additional irrigation systems were done along with the inflow of migrants by mobilizing both the internal as well as external resources. Among the external supporters ERIP is the one which rehabilitated almost all irrigation systems of the eastern Chitwan during 1995-96 and again handed the O&M to the registered WUAs. The influence of migrants on O&M of the systems increased over time which brought changes in the management and performance of irrigation system. Most prominent impact of these changes is the displacement of IC leadership by the migrants.

In general, the systems managed by the IC were suffered more from flooding and silt deposition as most of them are located in the downstream of the ERRB whereas systems managed by the migrants suffered more from erosion and land slides because both of them are located just at the bottom of most fragile range of shiwalic mountains.

The water users of irrigation systems managed by the IC still have lower level of awareness and knowledge on historical events of irrigation systems and organization formation is due to the low level of education and lack of interaction with the outsiders.

The ERIP consulted IC people more for cash, labor and material contributions and less for planning and designing of rehabilitating the irrigation systems than the migrants because the planners and designers are still continuing closer relation with migrants who are socially and politically powerful than the IC and suppressed people.

Water users of irrigation systems with relatively abundant water availability do not bother about their positions and the organizational activities of WUAs because they get water as and when needed without any botheration and do not yet feel the need of strong organizations.

Although the spirit of collective participation in O&M among indigenous Tharus has been decreasing over time as a result of migrants influence, water users of both communities do not hesitate to contribute labor and money as long as they perceive benefits from the contribution.

In addition to users' continuous efforts, external supports in repair and maintenance of damages that are beyond their capacity are needed for the sustainable O&M of irrigation systems irrespective of communities.

The initial faulty planning and designs of most of the irrigation systems irrespective of the communities are the reason why there was need for frequent changes in intake locations and canal routes in order to irrigate all the command areas as far as possible.

The water users in the irrigation systems managed by the IC are more influential than the migrants in water allocation because of their dense settlements where the intense interactions among themselves is possible.

Although the issue of labor contribution is a common problem, it is more serious in the systems managed by the migrants because the migrants hesitate to contribute labor unless they perceive direct benefits from their contribution.

Similarly, the resolution of conflicts through both negotiation and intervention is popular in both communities but conflict resolution through negotiation is more popular in the IC managed systems than the migrants because of mix community of the former.

In general, the factors such as education, farm location, and technology affect water availability. The first is inversely related while the later two directly meaning thereby the educated people perceive less water availability than the uneducated ones and the farmers who feel that their farms are easily irrigated and the technology is compatible to local conditions perceive that water is abundantly available.

In particular, the indigenous Tharus perceive that water is abundantly available if the intake condition is good, more labor is contributed, and high faith in the leadership is there. However, migrants perceive that more water is available on large and nicely located farms where the canal water can easily be applied.

Similarly, area, availability of off-farm jobs, farm location, technology, and faith in leadership are the determinants for labor contribution in general. In particular, the IC feels that only the farm location determines labor contribution whereas tend to contribute more labor if the farm size is large, faith in leadership is high, and system performance is better.

As expected, the income and area determine the level of money contribution irrespective of communities. However, level of education in migrant community and cooperation in the IC are contributory to monetary contribution, respectively. It means the educated migrants have more sense of paying the levied bighati than the uneducated ones. According to the people of IC, the payment of bighati depends on the faith and cooperation among users.

Relatively, the higher requirement of labor and money for O&M in the systems managed by the IC than managed by the migrants is because of downstream location of the IC systems where there is more danger of silt deposition brought by the floods and also the residual effect of their tradition of full participation in the communal works.

The better performance of the agriculture and economic returns from irrigation systems in 2002 than during 1880s is the result of both improvement of the systems during ERIP making more water available, pressure is also felt for additional production of agricultural commodities for the sustenance of living of ever increasing population. The higher costs and returns to fixed farm resources of rice in the systems manage by the IC is attributed to quality of land rather than the management. Higher figures of these variables on the farms located at the upstream of irrigation systems is, however, due to the availability of more water irrespective of communities.

Finally, the communities differ in socio-economic characteristics such as family size, education, farm size, income and so on because of difference in culture, traditions, ability, and resource endowment. However, labor and financial contribution depend on the perception of benefits from the contributions.

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A COMPARATIVE STUDY OF MULTIPURPOSE AND SINGLE PURPOSE WATER USERS' GROUPS IN CHITWAN DISTRICT OF NEPAL

KOMAL KUMARI MAGARATI[1]

INTRODUCTION

An irrigation system lies within an agricultural system, which in turn can be considered as a part of an agricultural economic system. Process, output and impact measures can be accounted for each of the irrigation system. Performance of an irrigated agricultural system can be measured in terms of agricultural production with crop production as the main output and water, land and finances as the major inputs (Molden et. al, 1998). Most of the Water Users' Associations (WUA) is single purpose organization involved in irrigation and water management and some are multipurpose carrying out other activities as well. Diversification of activities of WUA is an emerging issue in the present context of the country with most of the Water Users' Group (WUG) and Associations concentrated only in irrigation and water management. A few examples of multifunction WUAs can be found in Philippines, People's Republic of China, Taiwan, Vietnam and Nigeria (Pradhan and Gautam, 2002). Agriculture Cooperative in Vietnam carries out multiple functions like irrigation management, negotiation with River Basin authority for allocation of water to the irrigation system, supply of agricultural inputs to the farmers, rice mill operation and dealership of fertilizer distribution.

OBJECTIVES

The specific objectives of this paper are:

- To identify the organizational structure of local irrigation institutions with respect to reach of the irrigation systems (head, mid and tail reach);
- To assess the benefits achieved by the beneficiaries as compared to their resources contribution through institutions;
- To identify strengths and weaknesses of local irrigation institutions;
- with respect to acquisition of support services and resource mobilization; and

[1] Planning Officer, Department of Agriculture, Nepal and Graduate of AIT, Bangkok, Thailand.

- To assess the effect of local irrigation institutions on agricultural performance.

OBSERVATION OF THE STUDY OF KHAGERI AND PANCHAKANYA IRRIGATION SYSTEM IN CHITWAN DISTRICT

Socio-economic Characteristics

The socio-economic characteristics included in this study were household size, ethnicity, education status, occupation, income, and landholding of the surveyed households of the selected two irrigation systems. The study reveals that the average household size of the surveyed households in totality was 6.82 ranging from a minimum of 2 people to a maximum of 24 people in a household. This size is greater than that of the country and Chitwan district average**.** Between the systems, the size is greater in Panchakanya Irrigation System (PIS) but the difference is non-significant. The composition of female and male population was found to be about equal, 50.2 percent of males and 49.8 percent of females. The comparison between the two systems individually showed that the number of females is higher in PIS while the number of males is higher in KIS but the difference in their average was found to be non-significant.

The communities of these two systems are heterogeneous in ethnicity. The ethnic groups inhabiting in these areas are Brahmin, Chetri, Tharu, Gurung, Newar, Tamang, Damai and Darai. Among these ethnic groups, the greatest composition is of Brahmin and Chetri who are the migrants from the other districts. This is due to the reason that during 1960s, people were encouraged to migrate to Chitwan Valley by the implementation of resettlement program under Rapti Multipurpose Development Project. This project encouraged the influx of the hill migrants to this district. The actual inhabitants are Tharus but their number is decreasing as the hill migrants are dominating these areas. The study showed that there is not much difference in the composition of the ethnic groups in both irrigation systems.

The education status of these areas was found to be optimal with about 73 percent of literate people, higher than the literacy rate of the country. Comparison of the two systems showed that the literacy percentage was higher in Khageri but the difference in the average number of literate people in a household was not significant. The high percentage of literate people in these areas may be due to the reason that these areas have a very good facility of schools and other educational institutions. In addition to this, being a plain area, each and every corner of the area is accessible with good transportation facility and a good network of roads stretching all across the district that connects them to the urban center.

The primary occupation of the majority of the households of these two systems was found to be agriculture as it is the means of livelihood for them .A very small percentage of them are engaged in business and service for the primary occupation. They have also adopted business, dairy, labor, livestock farming, poultry, service, shop, giving tractor on hire and also agriculture as the secondary occupation. These activities keep them engaged during their leisure hours as well as help earn income for them to support their family.

Agriculture is the main economic activity in this district and also in the command areas of these two irrigation systems. Agricultural production is the main source of income for the households of both selected irrigation systems. These areas, which are bestowed with a very fertile soil and good source of water, are able to give a good agricultural production. Agricultural development has become the focal point in the district that has given importance to the development of market structure and marketing to enhance commercial agricultural production. The farmers are also inclined towards commercialization of the agricultural activities that can earn them good income as they can get market and a good price for their agricultural produce.

Land is the most important asset of the farmers as it is their source of livelihood. The average landholding size of the farmers of the two irrigation systems in totality was found to be 0.74 ha but it was greater for Khageri Irrigation System. The difference in the average landholding size of the two irrigation systems was found to be significant. Further, the categorization of landholding size into small, medium and large according to the size of the land owned, most of the households possessed medium landholding size (0.5-2.0 ha) followed by small landholding size (<0.5 ha) and a very small percentage of large landholding size (>2.0 ha). Comparison of these two systems showed higher percentage of households with medium landholding size in KIS whereas the percentage of households with small landholding size was higher in PIS.

Local Irrigation Institutions

The two selected irrigation systems: KIS and PIS have their local irrigation institutions in the form of multi – tiered WUA. PIS , started by Tharus, about 200 years ago was later taken up by the government in 1974 and its command area was also expanded from 100 ha to 600 ha. Although the management of the system was under the control of the government, the farmer formed informal WUA and undertook canal cleaning and other operation and maintenance activities in voluntarily. This tells us that the farmers of this area were always enthusiastic to participate in the operation and maintenance of the irrigation systems and their participation was spontaneous. This condition helped later in handing over irrigation system to the WUA in the year 1994 according to the Irrigation Management Transfer Irrigation Policy of 1992.

Khageri Irrigation System, started by the government in 1960, was completed in 1967 to irrigate about 4000 ha. In 1960s, migration of the people to this district started by clearing the forests and eradicating malaria. It resulted in increased population demanding more food production. This situation lead to the development of KIS and it remained under the control of the government till 1992. In1992, the system was put under the joint management of the government and WUA. The responsibility of management of the irrigation system was divided, allocating the main canal to the government and the branch canals to the WUA and branch canal committees.

In PIS, the first election of WUAwas held in 1994. The election selected 45 General members; one person per area of 10 ha, 13 Main Committee (MC) members comprising 9 representatives from seven branch canals and 10 outlets and four executives: the Chairman, Vice-chairman, Secretary and Treasurer. Panchakanya WUA formulated the rules and regulations.The concept of ‘Share System Administration’ was also started. One could get one share per katha (0.033ha). It also started to collect the Irrigation Service Fee (ISF) of NRs. 60 per ha. The second election was held in May 1996, and the third one in October 1998. The present WUA consists of 89 GA members, 15 MC members comprising four executives and one-woman representative; 2 from 10 outlets and 8 from 8 branch canals.

In Khageri Irrigation System, the first election was held in 1992 and GA members were selected followed by the selection of three executives on MC only in the following year. The command area of this system is comparatively larger than that of PIS, so each GA member came from 50 ha of land. The GA has 85 representatives, 73 members from each of 50 ha of land and 12 representatives from 8 branch canals and 3 from 3 minor canals. The second, third and fourth elections were held in 1995, 1997 and 1999 correspondingly electing the members by consensus.

Comparison of the organizational structure of WUAs of KIS and PIS showed that both are three-tiered with the MC at the system level, branch committee at the branch level and outlet committee at the outlet level. Panchakanya WUA has four executives, namely, Chairman, Vice-chairman, Treasurer and Secretary where as Khageri WUA has only three executive members excluding treasures and giving its responsibility to the secretary. The branch committee of this system has seven members consisting of Chairman, Vice-chairman, secretary and four general members while there are only five members excluding vice-chairman in the branch committee of Panchakanya WUA. The greatest difference is that the branch committee of KIS has its own General Assembly that elects the GA representative for the system and also for the branch committee members. The branch committee of six-east of the Khageri WUA was found to be multifunctional in its activity. Besides the water management activities of the branch canal, it is also involved in running a co-operative under which it is running a consumer goods shop. It has been selling the goods to the farmers at a relatively cheaper price since the year 2001. The profit from this shop is added to the resource of this Branch Committee.

Agricultural Performance

Increasing agricultural production and productivity is the ultimate objective of irrigation development. Among the various necessary inputs for agricultural production, water is an inevitable input. The supply and provision of irrigation water becomes a major focus in water scarce areas. Even in the areas with perennial source of water, supply of water varies according to seasons. The means of measuring performance taken for this study were total cropped area in a year and also by seasons, cropping intensity, yield and productivity of major crops and income from agricultural production.

The total cropped area of KIS is higher than that of PIS and the difference in their means is significant. It may be because of the reason that the average landholding size and also the command area are greater for Khageri Irrigation System. In the summer season, the whole command area of both systems was found to be cultivated PIS and in KIS, approximately equal total cropped area was found in both seasons. But in PIS, greater area was covered in the winter season (96%) than in the spring season (91%). The average cropped area in the head, middle and tail reach of both irrigation systems was found to be significantly different though it was not found to be true for the comparison between individual groups separately within the irrigation system and between the two systems. In summer season, the average cropped area in the two systems was found to be significantly different. This may be because of the difference in their average landholding size and the water supply is also adequate in both systems in this season. There was no significant difference in average cropped area in the winter season but there was difference in the spring season.

The cropping intensity was found to be higher in PIS than in KIS and their difference was also significant. The comparison between the head, mid and tail reach of both systems showed significant difference among themselves. Different types of crops are grown in the command area of these two irrigation systems in the three cropping seasons: summer, winter and spring. Summer rice was the major crop grown in the summer season and all the command area was covered by this crop. In the winter season, the major crop grown in KIS was wheat and in PIS, it was lentil. It may be because of the reason that water is scarce during this period and these crops do not require much water for their growth and development. But in the spring season, in the areas of the head reach of the irrigation systems, spring rice was grown where the water supply was adequate for this crop but its coverage percentage was very small. The major crop that was grown in this season was maize, which is also a type of crop, which can be grown in water stress areas. In both systems, the farmers grew similar types of crops in the three cropping seasons.

The households of these two irrigation systems basically use their agricultural production for home consumption. Those whose production exceeds the requirement for home consumption sell their production to earn cash income. The people of both systems earn income from the selling of the major crops, namely, rice, wheat, mustard, maize, lentil, pea and potato though the last two crops were not sold in PIS. In both systems, the maximum income was earned from the selling of rice and mustard as the production of rice was higher than the other crops and it could get a good price as well. Mustard, on the other hand, is a high value crop, that has a good market and high price. The difference in the average income from agricultural production of both systems was found to be non-significant.

The households of these two irrigation systems have access to ten markets, which are all permanent markets. The households of KIS have access to seven markets, namely, Pakaudi, Gitanagar, Health post, Shardanagar bazaar, Madhyapuri, Sundarbasti and Parbatipur. The people of PIS can get access to the three markets of Gitanagar, Bhanuchowk and Tandi Bazaar. Among them, the two markets: Tandi bazaar and Gitanagar are secondary markets while the other remaining eight markets are small – scale primary markets at the village level. All these markets are linked to the main urban market at Narayangargh by a good network of roads and transportation facility. The distance to the market is short i.e. within the range of 1-15 minutes to the majority of farmers.

The marketing channel is also an important factor for good marketing of agricultural production. The four types of marketing channels found in Chitwan district are producer-wholesaler, producer – retailer, producer – consumer and producer-itinerant traders. Among them, the most prevalent one in these two systems was ‘producer – wholesaler – consumer linkage’ followed by ‘producer – retailer linkage’. This showed that the agricultural produce does not reach directly to the consumers. There are middlemen who collect these agricultural produce from the farmers and earn more profit than the farmers. The reason for this may be that there is no a co-operative run by the farmers, which can collect their produce and take it to the market collectively. About 74% of the total sampled households sell their agricultural produce in PIS. More farmers of Khageri sell their agricultural produce.

Agricultural support services are necessary for the resource poor farmers in Chitwan district. District Agriculture Development Office (DADO) provides subsidies and extension services. Agriculture Development Bank (ADB) provides credit for agricultural activities. District Irrigation Office (currently Irrigation Development Division) gives training and workshops. Agriculture Input Corporation (AIC) distributes chemical fertilizers in this district. There are also NGOs, INGOs and projects such as LIBIRD, FORWARD, HARP that provide various kinds of agricultural support services to the farmers. In addition to this, Institute of Agriculture and Animal Science (IAAS) and a research station, National Agriculture Research Council (NARC) in the vicinity of the command area of KIS play a vital role in disseminating the new knowledge and recently developed technologies to the farmers.

The study revealed that only 47 percent of the total sampled households used the available agricultural support services with the maximum usage of support service in the form of agriculture inputs: seeds and chemical fertilizers. Among the three ways of acquisition of these support services, the most prevalent way was approaching the service provider by the individual farmer himself (60%), then distribution by the service provider itself (34%) and the least common one was through the local irrigation institution (6%). This showed that the farmers did not take the full advantage of the facility of provision of agricultural support services. There is a wide gap between the support service provider and the beneficiaries. The reasons for minimum use of these support services can be that the farmers may be ignorant of the provision of these support services or the service providers are not functioning well or the local irrigation institution is not very active and dynamic. Another reason may be that there is lack of good co-ordination between the local irrigation institution and the service providers. This is the weakness of the WUA contributing to the very minimum use of the available support services by the farmers.

Institutional Efficiency

Both selected irrigation systems have three-tiered WUAs. These WUAs have defined their operational rules for water distribution and allocation appropriate to their location. All the canals of the irrigation system, the main canal and the branch canals get continuous water supply in the monsoon season when the water is abundant. The water is supplied by rotation when its discharge becomes low in the winter and spring seasons. A workforce called the '*Karyadal*' made up of two – three members from the water users is made responsible for supervision of the canal operation and maintenance, measuring the water discharge at the intake and making recommendation to the MC based upon which the MC decides the water distribution and rotation schedule.

Resource generation and mobilization is a very essential activity of the WUA. The irrigation system, after handed over to the WUA, becomes the responsibility of the respective WUA. The government does not support the WUA financially in the completely transferred irrigation system like in PIS whereas it provides a minimum financial support to the jointly managed irrigation systems in Khageri. This necessitates the water users to generate resource and mobilize it for the operation and maintenance of the irrigation system. Generally, the resources generate by the farmers are in the form of membership fee, share fee, irrigation service fee, labor and cash contribution, cash in lieu of labor and the time they spend for meetings.

The membership fee for the water users to become the member of respective WUA for both irrigation systems is NRs. 10 per person and it needs to be renewed every year. The share fee is defined as NRs. 90 per ha for PIS. In case of Khageri, the general assembly of WUA in January approved the concept of 'Share system administration' according to which one could get one share for 1 katha or 0.033 ha of land but it was found to be not implemented though it still exists. The ISF for these two systems was different. It was NRs. 150 per ha of rice and NRs. 75 for other crops in Panchakaya while it is NRs. 60 per ha per crop in KIS. In PIS, a separate canal maintenance fee at the rate of NRs. 300 per ha was also collected to add the resource for canal operation and maintenance. Before WUA was formed, the water users used to contribute their labor. After its formation, ISF was collected and laborers were hired for canal cleaning purpose. The emphasis was given to hiring the local laborers, which provided the employment opportunity to the local needy people on one hand, and the money remained within the system on the other hand.

In both systems, the general assembly meeting is required to be held twice a year, one in the winter and another in monsoon season. The meeting of the MC needs to be called every month in a year but it can be held whenever needed. The meeting of the branch committee should be called at least once in a year but it can be held as required. The general assembly formulates the rules and regulations for the operation and maintenance of the system, prepares the annual programs of WUA, approves the annual budget of MC and also modifies the constitution. The MC is responsible for executing the decisions, programs and plans approved by the general assembly and have these issues discussed in their meetings. The branch committee is responsible for taking decision of operation and maintenance of the branch canals, resource mobilization, execution of repair works, protection of irrigation facilities and conflict management.

The households of these two systems were found to attend the meetings of general assembly, MC and branch committee. They were found to spend a minimum of 10 minutes to a maximum of 3 hours with 52.6% of households spent 2 hours for the meeting in KISi. In PIS, the households spent minimum of 15 minutes to a maximum of 5 hours for the meeting with the greatest percent of the households i.e. 31.4% spending 2 hours.

The study revealed that in totality, 76% of the total sampled households gave the opinion that the rules and regulations are followed well. The positive response for the KIS was higher as compared to PIS as 77.1% of the households of Khageri and 75% of PIS perceived the rules being followed. This is a good indicator of the efficiency of the WUA in applying the formulated rules and regulations but there still remains the room for making all the households (100%) to follow them.

The above-mentioned resources that are generated by the WUA internally are generally utilized for the operation and maintenance of the irrigation system benefiting the farmers. This is in the form of increase in water supply, cropping intensity and income as the result of increase in agricultural production. Regarding the opinion of the farmers about the benefits they achieved from resource generation and mobilization, the highest percentage of them said they were benefited in the form of increased income followed by the increase in the water supply and cropping intensity. The increase in income from agriculture is due to the increase in agricultural production and the factors like increase in water supply, cropped area and cropping intensity contribute in increasing the production.

Conflicts occur in the irrigation system, basically for the equal distribution of water. The farmers at the tail reach usually do not get sufficient water, especially during the dry seasons and so they raise the issue of unequal water distribution that consequently gives rise to conflicts. In totality, about 65% of the households gave their opinion that the conflicts do occur during water distribution and in both systems, 63% agreed with the occurrence of conflicts.

Satisfaction is a good indicator of effectiveness of any kind of work, service and functioning of an organization or institution. The study showed that about 79 percent of the total households surveyed were satisfied with the functioning of the respective WUA of these two systems. The satisfied percentage of household in KIS was higher than in PIS. In PIS; the head reach had the highest percentage of satisfied households while in Khageri; it was the middle reach. The level of satisfaction of greatest percentage of households was just medium, neither high nor low. When the reason for dissatisfaction was analyzed, the most prominent one was the insufficiency in water availability to the water users.

CONCLUSION

Both systems have three-tiered WUA with MC at the system level, Branch Committee at the branch level and Outlet Committee at the outlets. They differ in the general assembly members, branch committee members and the composition of the executive members. Panchakanya WUA has higher number of general assembly members while Khageri has higher branch committee members. In addition, the branch committee of Khageri WUA has its own separate general assembly, which is not practiced in Panchakanya. Panchakanya WUA consists of four executives comprising chairman, vice-chairman, secretary and treasurer where as Khageri WUA has only three excluding the post of 'treasurer'. The branch committee of branch six – east in Khageri is a multipurpose one that is involved not only in the management of the branch canals but it has also been running a shop since 2001 making the consumers goods available to the farmers at a cheaper price.

The cropped area in the winter and spring seasons along with the cropping intensity are higher in PIS. But the type of crops grown in the three cropping seasons in both systems is not really different. Rice is grown in the summer season that shows water sufficiency in this season in both systems. Growing of dry season crops like wheat, lentil and maize in the winter and spring seasons shows that there is water deficiency in these two seasons in both systems. The productivity of summer rice is also higher in PIS. This shows that PIS WUA has better agricultural performance than the Khageri WUA.

The households of these two systems have a good access to markets, whether primary or secondary market. The most prominent and common marketing channels are the 'producer – wholesaler – consumer linkage' and 'producer – retailer linkage' in these areas. This shows that the middlemen play an active role in the transaction of agricultural goods and benefiting more profit than the farmers. Concerning the agricultural support services, there are different government agencies like DADO, DIO, ADB, AIC, research station like NARC, NGOs like LIBIRD, FORWARD, HARP projects and IAAS, an agricultural institute have been providing the different kinds of support services to the farmers but not even fifty percentage of the farmers have used them. This shows that there is a wide gap between the support service provider and the beneficiaries. The most used support service is agricultural inputs such as improved seeds and chemical fertilizer that recognizes the essentiality of these inputs. Majority of the farmers acquired these support services on their own i.e. approaching the service provider themselves. The inactiveness of the WUAs in acquisition of these available agriculture support services can be deduced from this situation.

The WUAs of both systems have formulated the operational rules appropriate to their condition and need. Concerning the following of these rules, about three fourth of the population of these two areas agreed that these rules were followed well though more people of Khageri had this opinion. The farmers of both systems are enthusiastic and concerned about the proper management of these irrigation systems as they attend the meetings held by the WUA and its branch committees.

The resources in the form of membership fee, share fee, irrigation service fee, labor contribution are generated in both systems. They have received benefits from the mobilization of these resources for the operation and maintenance of these irrigation systems. Majority of the farmers are benefited by increase in their income as a result of increase in water supply that ultimately increases the agricultural production and productivity. More farmers of PIS were of the opinion that they have received proportional benefits from their resource contribution. The reach of the irrigation system did not have any effect on the institutional efficiency of its WUA.

The occurrence of conflicts is apparent and common in both systems. In spite of these conflicts, which are common in everyday life, the farmers of both systems are satisfied with the functioning of their respective WUAs and their level of satisfaction is medium i.e. neither too high nor too low. But the farmers of PIS are more satisfied with their WUA than that of Khageri. Small number of the farmers is dissatisfied and the main reason for their dissatisfaction is the insufficiency of water availability in the canals of the irrigation system. Panchakanya WUA was found to be more efficient institutionally than Khageri WUA.

The local irrigation institution in the form of WUA in the two irrigation systems: KIS and PISs are actively working for the benefit of the farmers. Comparatively, Panchakanya WUA has performed better in terms of agricultural performance and institutional efficiency. Khageri WUA has a multipurpose WUGs at the branch level i.e. branch committee six-east, which is involved in supplying the daily goods only but it has no direct involvement in transaction of any agricultural inputs or the marketing of any agricultural produce. Though it is serving the farmers by making these goods available at a cheaper price, it lacks in providing any of the agriculture related services and this must be the particular reason for not finding any effect of the diversification of this branch committee on the agricultural performance of the irrigation system.

Farmer centered governance in both irrigation systems; KIS and PISs is appreciative in managing the irrigation systems in terms of drafting rules and regulations for operation and maintenance of the canals, water management activities like water allocation and distribution, management of conflicts related to water right, water distribution and water rotation schedules. In both irrigation systems, local irrigation institutions: WUGs and WUAs are vital and are of major importance for effective irrigation governance and management. These two irrigation systems have performed well in terms of agricultural performance and institutional efficiency as a result of good governance but still the challenge lies to enhance the capability of the WUG and WUA to utilize and exploit the availability of various agriculture related support services and to diversify their activities for which they need external support. Various government agencies, NGOs and INGOs and private sector can play a crucial role in promoting and strengthening these local irrigation institutions but their role should be limited to facilitation only, not be involved in the governing and directing role.

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A DECADE LATER, CONTINUITY AND CHANGE IN ILO-ASSISTED IRRIGATION SYSTEMS: POSSIBLE IMPLICATIONS FOR POLICY AND GOVERNANCE

TORSTEN RØDEL BERG[1]

INTRODUCTION

Most studies on the management of common pool resources, while often based on implicit understanding of the role of surrounding social, economic, political and physical contexts have, nevertheless, explained the workings of, for example, irrigation institutions at rather internal levels (Dayton-Johnson, 2001; Moench, 2002), and have tended to analyse communities as stable entities in which people are seen to have incentives to manage resources that they are assumed to depend on for survival (Moench, 2002; Sadeque, 1999).

However, globalisation and economic integration are strongly associated with local, regional and global markets. In the case of rural Nepal, it would appear that the webs of globalisation lead to livelihoods diversification and demographic transition through migration. This happens at a rather rapid pace that has been accelerated by the present insurgency. In this context, it seems relevant to ask the following questions: To what extent are irrigation institutions affected by these events? Is agriculture no longer central to people's livelihoods? What are the current challenges to policy and governance?

CONCEPTUAL ISSUES

The above questions suggest a need for examination of irrigation institutions in terms that go beyond their institutional capacities to include their wider socio-economic circumstances as well as the livelihood strategies played out within institutional, social, economic and political contexts. The conceptual framework that informs this investigation is based on the common property school's[2] insights into institutional and social processes at internal levels, in combination with more structural historical approaches that focus on the total

1 Torsten Rødel Berg, Ph.D. Research Fellow, Research Center on Development and International Relations, Aalborg University, Aalborg, Denmark; and Central Department of Geography, Tribhuvan University, Nepal.

2 Moench (2002) traces the roots of this research, which was conducted in reaction to Hardin (1968), to the Board of Science and Technology Conference on common property management in 1986. A great deal of its insight is the result of research carried out by the so-called 'Indiana School', and involves many cases from Nepal (see, for example, Ostrom et. al, 1993 and Tang, 1994).

system of relationships in rural societies as key factors that shape livelihoods and related to both approaches the concept of livelihoods systems.

(Neo-) classical rural development theory defines the process involved in economic diversification as a proportional decline in the agricultural sector, in its contribution to national output and employment, and the rise of the manufacturing sector (Kuznets, 1966). Specialisation is an important mechanism in the process, as is the concomitant expansion of markets as the principal institution to integrate and facilitate the activities of the producers, the savers and the investors. The central role assigned to the market may be further illustrated by the emphasis on essential 'linkages' (backward, forward and consumption) as in the pervasive 'regional growth linkages' school (Start, 2001). As highlighted by Ellis and Biggs (2001), models of rural growth linkages continue to be at odds with thinking on 'political economy of agrarian change', owing to the former's neglect of inequality, class and power as well as social differentiation and the forces of development under capitalism that influence these issues. While also providing an understanding of macro-level structural transformation processes, these perspectives enable understanding of the structural contradictions and the forces that create obstacles along the otherwise smooth path envisaged by neo-classical rural development theory.

However, these dominant strands in rural development theory largely ignore the role of non-market institutions such as those associated with common pool and property resources. One notable exception in the neo-classical tradition is Hardin's article on the 'Tragedy of the Commons' with its arguments that environmental degradation is inherently related to common ownership (Hardin, 1968). Reactions to Hardin have formed a theoretical context that continues to inform policy and research, and which paved the way for the local resource management institution to occupy a significant place in development policies in general, and irrigation policies in particular.

The institutions associated with common pool resources such as irrigation are seen as collective institutions that have evolved around people's contractual or economic interests. Following from this, people's willingness to invest in collective management of the resource depends on choices made by individuals in the context of wider economic, policy and governance circumstances, particularly the opportunities and constraints offered by these circumstances.

THE NATURAL RESOURCE MANAGEMENT INSTITUTION IN THE RURAL DEVELOPMENT FRAMEWORK OF NEPAL

Resurrection of the Local Resource Management Institution in Nepal

The paradigm shift that has been briefly described above found—if somewhat belatedly compared to other Asian countries —fertile ground in the newly democratic Nepal of the 1990s, particularly with respect to the notion of the local resource management institution. While local irrigation management in Nepal, in the period from the early 1950s to the early 1990s, had become increasingly 'governmentalised', this form of institution was neither new to Nepal nor to the region where, historically, resources have long been community-managed in one form or another, albeit with social and economic ramifications that differ significantly from, for example, Southeast Asia.[3]

Gradually, the local resource management institution came to occupy a significant role in the development strategies and policy frameworks of Nepal. The process was helped along by a series of influential studies that rediscovered the historical role of indigenous irrigation, and which sought to define factors of success, organisational form, functions and logics (ILO 1995: KC and Pradhan, 1993; Ostrom et. al, 1992; Pradhan, 1989, Pradhan, 2003; Pradhan and Yoder, 1990; Rana, 1993; Yoder, 1994). The local natural resource management institution rose to prominence during a period when Nepal (like most of the rest of the region) adopted structural adjustment policies and associated policies of economic liberalisation. Thus, it may be argued that the local natural resource management institution with its theoretical emphasis on incentives and choice was particularly attuned to the liberal environment promoted by international donors[4] (Ellis and Biggs, 2001).

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[3] Bray (1991), along with Schendel (1991), notes that water control in South Asia has until quite recently been scattered and decentralised, thus not contributing to patterns of change or 'laws of motion' to the extent that, according to Geertz (1963) ('agricultural involution') and Wittfogel (1957) ('hydraulic society'), took place in parts of East/Southeast Asia.

[4] While as Ellis and Biggs suggest "advocates of grassroots approaches may like to think that that they have nothing in common with World Bank market liberalisers, nevertheless, the spaces in which grassroots action flourished from the mid-1980s onwards were created in some measure by the backing off by big government from heavy-handed involvement in the rural economy. A growing disenchantment with the performance of state rural development agencies was an important shared agenda across a number of divergent rural development actors" (2001).

The Rural Development Framework and Changing Realities

In addition to the themes already dealt with, the current rural development framework (to 2015) has been prescribed by the Agricultural Perspective Plan of 1995 (NPC/APROSC 1995), which is based on a strategy that relies on agriculture as the engine for both economic growth and poverty alleviation, very much along the lines of the 'growth linkages model' mentioned in Section 2.[5] With more than 85 % of the population, according to the 2001 census, living in rural areas, agriculture certainly remains important, but not as important as it used to be, as rural dwellers diversify their livelihoods through off- and non-farm income generation. The low growth in agricultural GDP (2.6 % a year on average over the past 20 years) and a 40 % agricultural contribution to GDP in the mid-1990s (Seddon et. al, 1998) compared to 65 % in the mid-1970s (World Bank, 1991) is evidence of this.

As suggested by these figures, the plan's reference to the centrality of agriculture in Nepal's development is increasingly problematic. Furthermore, in contrast to the intentions of the Agricultural Perspective Plan, Nepal has so far failed to experience the transformation that in other countries has led to the transition from agricultural to industrial economies; instead resource transfers into non-agricultural sectors increasingly appear to come about as a result of non-farm income and remittances from migrants. However, both the Agricultural Perspective Plan and the World Bank continue to see migration and remittances "as an unfortunate and marginal by-product of a stagnant rural economy, to be eliminated progressively by programmes for economic development within Nepal and within the agricultural sector" (Seddon et. al, 1998).

Irrigation development is one of the pillars of the plan, and water users' groups are seen as a key mechanism for the organisation and management of irrigation systems. But how feasible is it to assume that communities are stable entities with incentives to manage resources?

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5 The plan emphasises the dynamics of the private sector and market forces, and sees obstacles to growth as chiefly technological, with policy foci including access roads, fertiliser, irrigation, and research (Cameron, 1998).

EXTENT OF LIVELIHOODS DIVERSIFICATION AND REPORTED EFFECTS ON IRRIGATION

Recent research [6] seriously challenges the perception of rural Nepalese communities as stable. Rather it finds that migration in search of economic opportunities is widespread and remittances are increasingly important to local communities (Seddon et. al, 1998), and that new technology [7] and advances with respect to the upheaval of human capital in general (Blaikie *et al.* 2002) directly affect local livelihoods. Blaikie et. al (2002) have compared data on non-farm incomes from the mid-1970s with data from the mid-1990s and found that among the poorest households only 35 % had non-agricultural income in the mid-1970s compared to 53 % in the mid-1990s. For middle-income households, the figures are 32 % and 38 % respectively, and for the highest-income households the figures are 51% and 73% respectively. According to 2001 (census) data, aggregate employment figures suggest that one-third of the economically active population is solely involved in non-agricultural activities (ICIMOD, 2003). Compared with World Bank data from the 1980s suggesting that 14 % of the population worked in non-agricultural activities (World Bank, 1991), the trend towards an increasing proportion of the labour force engaged outside agriculture seems quite clear.

Migration has historically been a common livelihood alternative in the hills and mountains. Farmers seeking to escape the poverty of far western Nepal have for decades been both permanently and seasonally employed in India in vast numbers. Likewise, Gurkha soldiers from the western and eastern hills have traditionally been employed in the British and Indian armies. In addition, women and girls from a variety of places, but with a concentration in the central hills, have for sometime worked in the commercial sex industry in India (Seddon et. al, 1998). Recently, women have begun to migrate more formally, chiefly to the Middle East. From an official figure of 400,000

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[6] Reference is made to the body of socio-economic research carried out by the Overseas Development Group at the University of East Anglia in the mid 1970s and again in the mid 1990s in the hills of western Nepal. The first round of research provided an influential foundation for further analysis of the political economy of agrarian change in the region. The second round sought to understand how livelihoods had changed over 20 years by comparing socio-economic circumstances and the processes of earning livelihoods.

[7] There are strong indications that the widespread use of pumps for groundwater irrigation by individual farmers seriously affects water management at the institutional level in many parts of India (Shah, 1998). In the context of Nepal, the use of pumps is mainly confined to the plains and is not as widespread as in neighbouring India, even if the phenomenon is reportedly on the rise (Gyawali and Dixit, 1999). In the hills of Nepal, it is not unlikely that an increase in the spread of micro-hydropower devices, by privatising water use, may to some extent have effects similar to pumps. For figures in this respect see Danida/ESAP 2002.

people working abroad in 1980, the estimate for the late 1990s has rise to as high as 1.4 million or more than one in twenty of the population. The importance of migration for the economy should not be underestimated; a conservative estimate in the mid-1990s puts the value of remittances at NRs 35 billion, which is close to the 1997 official figure of NRs 38.3 billion for all foreign exchange earnings combined, while the most liberal estimate puts the figure at NRs 69 billion or almost double the official foreign exchange earnings (Seddon et. al, 1998). By the early 2000s, annual remittances are reported to have reached around NRs 100 billion as reported in Kathmandu Post 20 April 2004.

On top of foreign migration comes the highly visible, but not easy to quantify, rural–urban migration, which is also part of an historical trend. However, it has recently been accelerating as a consequence of displacement resulting from the insurgency and counter-insurgency[8] that in many rural areas has led to economic crisis, displacement and exodus on a large scale (Lal, 2001). While incomes from remittances may be ploughed back into rural communities in the short run, both local and foreign migration should probably be understood in the context of a trend towards structural and, subsequently, demographic change that is not restricted to Nepal, and which according to one estimate may see urban populations surpass rural populations in a number of developing countries within a couple of decades (Pinstrup et. al, 1999). Some of the reported consequences of this trend for common property institutions in irrigation are reviewed below. Actual effects of livelihoods diversification have not been documented in detail. However, scattered information provides pointers towards the key directions of effects.

- Inability on the part of communities to manage water owing to reduced repair and maintenance activities, as a result of labour shortages (Gyawali and Dixit, 1999; Pradhan, 2003).[9]
- Disintegration of the 'moral economy' of villages as a result of demographic restructuring (Blaikie et. al, 2002).

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8 See, for example, Nepali Times, Vol. 161, 5–11 September 2003, 'Kathmandu's Malignant Urban Turmoil'.

9 "Another challenge is presented by the economy. Political uncertainty, Maoist violence and global events have compounded the problem of an already stagnant agriculture base. Able-bodied youths from rural areas have migrated to urban centres and other countries in search of employment. Because the maintenance of FMIS [farmer-managed irrigation systems] is a labour intensive task, without the muscle power of young men, the tasks of repair and maintenance have been neglected in many systems" (Pradhan, 2003).

- Failing institutional memory, when decision-making and management decisions with respect to collective property are (generally) the domain of men (who are increasingly absent) (Meinzen-Dick and Bruns, 1997).

Additionally, increased feminisation of rural life (Blaikie et. al, 2002) and subsequent increased livelihoods vulnerability (Cameron, 1998), as women's right to property are more loosely defined than that of men (Meinzen-Dick et. al, 1997), have been noted.

LIVELIHOODS, DIVERSIFICATION AND GOVERNANCE IN IRRIGATION SYSTEMS IN THE UPPER GANDAKI BASIN

Introduction

As suggested in the previous section, scattered information from a number of sources supports the assumption that rapid socio-economic change may impact on the ability of communities to operate, maintain and manage irrigation systems in general. As part of the present research, these issues, along with broader governance issues, are under investigation in the mountain district of Mustang, and the hill districts of Myagdi, Baglung and Parbat in the Western Development Region of Nepal. Within an overall policy framework that aimed, among others things, to halt emigration from the hills and mountains of Nepal, raise agricultural production, and create employment, these four districts were home to the Dhaulagiri Irrigation Development Project of the International Labour Organisation and His Majesty's Government of Nepal's Department of Irrigation from 1989 to 1997. By the end of the project, 67 irrigation schemes had been assisted, mainly as rehabilitation projects, and 6000 households or some 34,000 persons were affected directly by new or improved irrigation facilities.

Methodological Approach

The irrigations systems assisted under the Dhaulagiri Irrigation Development Project were selected for this study because of the availability of historical data that enables comparison between socio-economic and institutional circumstances over time. As part of the Dhaulagiri Irrigation Development Project's monitoring and evaluation efforts socio-economic baseline and key-effects studies were conducted in 15 irrigation systems in all four districts on an annual basis in the period from 1992 to 1997.[10] This research project has been divided into a first phase (conducted in the first half of 2004) that

[10] The author was in charge of their design, implementation and modalities in the period 1992–95.

entails a re-study of the baseline and key-effects studies of the 1990s (DIDP, 1992-995), and a second phase (to be conducted in the second half of 2004) that aims to construct livelihood trajectories and link processes to the broader institutional context.

This paper reports on the findings of phase one only, and the findings are preliminary in the sense that final conclusions depend on integrated analysis of data from both phases. At this stage, the analysis simply seeks to assess the extent of livelihood diversification compared to a decade ago, and the implications of possible changes with respect to irrigation governance and management. It must be kept in mind that the socio-economic diversity of Nepal renders any area study untypical, even if the sampled irrigation systems and their settings are not necessarily unusual. The re-study has followed largely similar methodologies and thematic areas as the socio-economic studies that were conducted during 1992–95[11] in 15 irrigated communities. Thus, the 2004 'snapshot' contains basic data related to population, landholding size, and parameters of livelihood diversification such as income and source of income, employment, migration, and expenditure on food as well as data on yields, cropping patterns and cropping intensities. Institutional aspects include investigations into parameters of cooperation and performance such as organisational structure, operation and management practices, including labour inputs and the basis for labour contribution, as well as water supply, distribution and allocation. Other methodological features of the survey include the following.

Sample Design

As in the 1990s, 20 % of the heads of households (male or female, as decided by the household) in the individual schemes were interviewed; however, with a minimum of 10 and a maximum of 30 households in each sub-project.[12] As this is not a strict cohort study, original household samples were not re-selected. New samples were taken based on official lists of landholdings. As with the surveys of the 1990s, only households with land in the command area of the irrigations schemes were sampled. Also in line with previous methodologies, the samples were stratified according to the size of landholdings in the command area (large, medium and small), and represent

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11 This consists of four annual surveys, all of which involved the author. It was decided not to include surveys from 1996 and 1997, because their quality and validity could not been confirmed.

12 This was deemed necessary owing to resource constraints at the time. The smallest community has only 11 households, while the largest has some 245 households with land in the command area. In the small community, 10 households were interviewed, while in the largest community 30 (or 13 %) were interviewed.

separate locations of farms corresponding with the main branch canals, i.e., head, middle and tail.

Data Collection Techniques

As in the 1990s, a semi-structured questionnaire covering similar themes was used, but abbreviated to fit the current scope. Assistants were trained to be observant, iterative, prodding and explorative throughout.

Key Informants Checklist

Unlike earlier surveys, a specific checklist was used for interviews with key informants (typically irrigation or village leaders) to obtain general information.

Survey Organization

A consulting company associated with the Department of Geography of Prithivi Narayan Campus in Pokhara conducted the 1992–95 surveys. As part of the exercise, the consultants (trained in an 'exact' sciences tradition) received additional training on participatory methods associated with informal surveys, participatory techniques and a reversal of roles. In view of the knowledge possessed by this group, and with a view to ensuring a homogenous approach, the original plan involved the participation of key members of the group in the re-study**.** Unfortunately, the security situation in the first half of 2004 deteriorated[13] to the extent that only one area Mustang District was deemed a safe place to work for local academics. Subsequently, it was decided to utilise the knowledge of a local NGO with some institutional knowledge of the Dhaulagiri Irrigation Development Project[14] and, most importantly, an extensive network of skilled fieldworkers and a 'working relationship' with both the armed forces and the Maoists for data collection in Parbat, Myagdi and Baglung Districts. Two senior staff members from the NGO received theoretical and practical training, and conducted the hill part of the survey under the supervision[15] of the researcher.

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13 The decisive factor was the Maoist attack on Beni, the headquarters of Myagdi District, in April 2004.

14 The NGO (the Dhaulagiri Community Resource Development Centre) conducted social mobilisation activities for Dhaulagiri Irrigation Development Project schemes in Baglung and Myagdi Districts from 1992 to 1997.

15 The researcher sat in on interviews and conducted key informants interviews in three of the six remaining villages. Apart from this, supervision and feedback was carried out from the NGO office in Baglung.

Coverage and Duration

The deteriorating security situation meant that only nine out of the original 15 communities could be visited.[16] While the original survey covered some 1350 households, the present survey covers some 975 households (or some 5500 individuals). The surveys were conducted over a period of 40 days during April and May 2004.

The Setting

The irrigation systems that have been studied are all located along the watershed of the upper Kali Gandaki River in north-central Nepal, with focus on a 75-km transect from Parbat District in the south, through Baglung and Myagdi Districts, northwards to Mustang District. Between Myagdi and Mustang, the Annapurna and Dhaulagiri Massifs bisect the area and, whereas the southern parts are subtropical with monsoon rains, the northern part is located in the rain-shadow of the Himalayas with resulting arid conditions. Particularly in Mustang District, human habitation is defined by the Kali Gandaki River and its tributaries along which all arable land is located, where mainly barley, naked barley and buckwheat as well as apples are grown under oasis-like conditions (Messerschmidt, 1995). In the southern districts, rice paddy, wheat and to some extent maize constitute the main irrigated crops in the studied communities, but the cropping scenario is diverse and includes upland crops such as millet as well as a great deal of vegetable and fruit production.

While pockets of poverty certainly exist in Mustang, the district continues to rate above average on most socio-economic accounts and belongs to the 'most developed' category according to a composite development index for all 75 districts of Nepal (ICIMOD, 2003). Parbat, Myagdi and Baglung present more varied socio-economic conditions, with a tendency for (irrigated) communities at low altitudes, close to the main trading arteries[17] to be relatively better off than communities in the hinterlands. While lower down the scale than Mustang, these three districts also feature among the one-third of districts in the 'most developed' category referred to above. The communities covered in Mustang are located in the Thak Khola and Bara Gau areas of southern Mustang. Basic data associated with these communities are presented in **Table 1.**

[16] This was decided in consultation with the local NGO, which—to illustrate the security problem following the Maoist attack on Beni and subsequent air attacks by the army on villagers—had in its latest monthly staff meeting decided that "no village meetings were to be held in the open".

[17] A motorable road now links Myagdi, Parbat and Baglung with Pokhara.

Table 1: Basic Data for Mustang Systems, 2004

Community	Total households* (sample)	Average landholding size** (ha)	Command area size (ha)	Population
Thini	190 (30)	0.33	93	1254
Tiri	14 (10)	0.75	11	79
Khinga	34 (10)	0.59	45	218
**** In village; ** of sampled households.***				

***Source**:* Field Survey, 2004

In the hill districts (**Table 2**), the communities include Amalachaur and Arjewa in Baglung, Kurgha, Pakuwa and Lampata in Parbat, and Pipalbot in Myagdi.

Table 2: Basic Data for Hill Systems, 2004

Community	Total households* (sample)	Average landholding size** (ha)	Command area size (ha)	Population
Amalachaur	119 (30)	0.24	35	625
Arjewa	127 (22)	0.16	20	800
Kurgha	234 (30)	0.29	80	1170
Pakuwa	122 (30)	0.36	55	732
Lampata	60 (10)	0.44	30	360
Pipalbot	75 (15)	0.44	31	n/a
**** In village; ** of sampled households.***				

***Source**:* Field Survey, 2004

In the following presentation, distinction is made between the 'mountains' (Mustang District) and the 'hills' (Parbat, Myagdi and Baglung Districts), as the differences between these ecological zones call for some interesting comparisons.

Economic Contexts of Livelihoods and Livelihoods Diversification

Key informants and heads of households in all communities were asked the broad question of whether life had become 'better' or 'worse' over the past 10 years. First, we will focus on the responses from Mustang District. In

Khinga and Thini, the informants claimed that life had improved, but in Tiri people found that life had become worse over the past 10 years. These statements reflect the dominant strategies and conditions associated with earning livelihoods in the respective communities.

- Agriculture continues to dominate as a main source of income in Khinga; ‘business’ ranks second, with tourism in third. Remittances are important for only a couple of families. More stable supplies of irrigation water since rehabilitation of the irrigation project was put forward as the reason for life having become ‘better’.
- ‘Business’ ranks as the major source of income in Thini, with the sale of agricultural products in second, and official jobs in third. Remittances play a minor role, and are mainly associated with government jobs outside the district. Here the reasons for stating that life had become ‘better’ were two-fold: with sufficient irrigation water compared to before being one reason, and increasing involvement in off-farm activities being the other.
- ‘Business’ is the major source of income in Tiri, and farming comes second. Foreign remittances come in third place and are important for one-third of families. However, physical conditions for farming have deteriorated and ‘business’ is facing increasing competition.

In Thini, trade and ‘business’ chiefly denote the buying and the selling in southern Mustang of livestock (jho[18] and horses) purchased further north as well as tourism (hotels and shops). The sale of agricultural cash crops (cereals, vegetables and apples) and livestock products remains, however, important. In this context, it should be noted that Thini’s close proximity (45 minutes) to the district headquarters, tourist centre and transport hub (airport) of Jomsom Bazaar creates a great deal of demand not only for agricultural products but also for services and other activities associated with dynamic central places. While traditionally a major trading centre along a north–south trading route, the importance of Jomsom Bazaar has increased significantly since it became a district headquarters in 1975, with army and government personnel representing considerable demand for local produce (Vinding, 1984).

In Khinga, areas under cash crops, particularly apples, have reportedly increased over the past decade under conditions that are quite favourable owing to a sheltered microclimate. In Tiri, on the other hand, conditions for agriculture are relatively harsh, and irrigation water supplies are critical at times. In Khinga, relatively benevolent cropping conditions have apparently

[18] A crossbreed between yak and common cattle.

helped offset the crisis associated with traditional trading patterns, which, as in Tiri, involves husbands and sons from most households going to Guwahati in Assam to trade for 3–4 months every winter where they sell sweaters and purchase items on the return journey. Furthermore, people in Khinga and Tiri are involved in the buying and selling of livestock, as well as Chinese goods, some of which are also taken to India. Particularly in Tiri, concerns were voiced about increased competition in the Himalayan trade pattern where the traditional winter trade in India faces new competition from people in southern districts who also now go to India to sell garments. Additionally, the north–south trade in Chinese goods is not as lucrative as it used to be, as Chinese goods are increasingly abundant in Nepal and India through other channels.

Hence, the economic conditions in these three communities should be understood in both a local and more global context. The relatively dynamic economy of Mustang District, exemplified by increasing flows of goods, services and tourists affect Thini (as a central place) positively, chiefly owing to its proximity to the district headquarters. Here, the majority of families continue to pursue traditional, but increasingly diversified, economic livelihood strategies with agriculture remaining an important source of livelihoods. In Tiri and Khinga, however, the dynamics of the local economy appear to have had less of a positive effect on agriculture. Not only as a result of the distance of these communities from the district headquarters but also because, in a wider context, the traditional demand for 'indigenous Himalayan products',[19] for which these people have branded themselves, is facing greater competition. In Khinga, this appears to have been compensated for, to some extent, by agricultural intensification (**Table 8**) and diversification, while in Tiri further intensification is constrained by limited irrigation water. However, average annual household incomes at over US$ 2000 remain relatively high (some three times higher than those in the hills), and appear to have increased considerably over the past nine years.

Turning to the hill districts, respondents here consider life to have become 'better' in all the studied communities. Improved agriculture is given as the principal reason, with access to foreign employment as the secondary reason. Agriculture has diversified substantially over the years to include cash crops such as coffee, bananas and vegetables that thanks to improved infrastructure are sold in the town of Pokhara[20] and beyond. Agricultural diversification accompanies high levels of economic diversification into off-farm activities

[19] The woollens sold in Assam are not actually produced in Mustang.

[20] About 3–6 hours of transport time from most communities.

that chiefly takes place outside the districts. Whereas commercial enterprise is a major source of income in Mustang, it is external, chiefly foreign, employment that constitutes the main source of income in these hill communities. Average annual household incomes in the hill districts at some US$ 800 are lower than those in Mustang, but have increased substantially, even after inflation.[21]

In most cases, farmers are reluctant to disclose cash incomes, and such data should be considered indicators of magnitude only.[22] In the context of this paper it is, however, the proportion of income earned from off-farm activities that is of major interest, as an indicator of levels of livelihoods diversification. Agricultural income is defined as sale of grains, vegetables, fruits, livestock, etc., whereas sources of non-agricultural income are defined as hotel/tourism, remittances, government service/army, shop-keeping, labour, trade, portering or transportation (mule trains). Comparing data from 1995 with data from 2004 suggests that non-agricultural income still constitutes the vast bulk of income in all communities. In the case of Thini, this is probably even more so, as the proportion of households with less than 25 % of income deriving from agriculture has increased from 47 % to 63 %. In all other communities, however, it appears that, relatively speaking, agricultural incomes are marginally more important in 2004 than they were in 1995. Moreover, the number of households that depends heavily on agriculture appears to have increased. Considering the increases in income levels, this appears to reflect what has already been suggested about agricultural diversification and an overall expansion of economic activity.

Patterns and Extent of Migration

It has already been suggested that, compared to trade and agriculture, remittances play a relatively minor role in sustaining livelihoods in the villages studied in Mustang, and that the contrary is the case in the hills. Yet income earned in India has traditionally been, and continues to be, very important to most households in Tiri and Khinga. This requires clarification with respect to definitions used in the present and historical studies. Temporary migration is categorised as migration of up to six months duration, while migration in excess of six months is categorised as permanent. Temporary migration has traditionally been important in earning

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21 Annual inflation during the 10–13 year period ran at about 5–6 % (Nepal Rastra Bank).

22 In this and previous surveys, information on incomes has been arrived at indirectly by first requesting information about expenditure (which people tend to be a lot less reluctant to talk about), and then enquiring about how the expenditure is met.

livelihoods in the Himalayas,[23] as dealt with in the previous section. However, because of the traditional nature of this pattern of temporary migration, it is not directly relevant to the thesis of this paper.

What does matter in a perspective of economic diversification and change is the more permanent migration, which as mentioned in the earlier section 4 has increased tremendously in many parts of Nepal. Here we must distinguish between the migration of households and the migration of individuals. With respect to the former, the past 10 years have seen no household migration changes in Khinga. However, six households have emigrated from Thini (apparently to Pokhara and Kathmandu). In line with traditional practice, they have not actually sold their property; rather, their houses and agricultural land has been leased out, in this case to immigrants, mainly from areas north of Jomsom, and the population has remained stable. Tiri, on the other hand, has seen a reduction of households, and now has 14 households compared to 16 households 10 years ago. Five households have emigrated south, out of the district, while three have immigrated from Dolpo and upper Mustang. While, as Vinding (1984) observes, the rate of emigration from Thak Khola has probably slowed since the 1970s, a north–south migratory dynamic[24] remains evident.

The pattern of migration is somewhat different in the hill communities; a total of 38 households or some 5 % have emigrated over the past decade. While agricultural land is leased out, immigrant households, unlike in Mustang, do not replace the vacating households. Turning to individual migration of the more permanent kind, historical household-level data exist only for Thini, where the proportion of households with migrated members has increased from 53 % in 1994 to 60 % in 2004. In all communities, however, all respondents claim that migration, particularly to foreign countries, has increased substantially, a factor that, as previously mentioned, is assigned as a reason for improved livelihoods. It is interesting to note (**Table 3**) that virtually all migrants in the hill communities are reported to be husbands and sons,[25] while in Mustang sons and daughters tend to migrate.

[23] However, prior to the 1970s, emigration was high for various reasons, including the collapse of the traditional salt trade, thus explaining the presence of Thakalis in Kathmandu, Pokhara and along the trading routes southwards from Thak Khola, most of whom are engaged in hotel and restaurant business. Vinding (1984) suggests that this emigration, rather than resulting from distress only, was also to a large extent opportunity-driven.

[24] Messerschmidt (1995) also mentions this dynamic in connection with the village of Marpha close to Thini.

[25] In most cases, a ‘pull-factor’ is evident; most migrant-affected families have more than one migrant (1.5 on average).

Table 3: Households Affected by Individual, Permanent Migration for All Systems*

	Proportion of households with migrants	Main migrants	Destinations (percentage)		
			Nepal	India	Other countries
Amalachaur	50	Husbands, sons	8	79	13
Arjewa	50	“	20	63	17
Kurgha	32	“	57	36	7
Pakuwa	37	“	50	29	21
Lampata	40	“	57	36	7
Pipalbot	33	“	17	17	66
Thini	60	Sons, daughters	56	11	34
Tiri	60	“	10	50	40
Khinga	10	“	0	0	100
***Excludes students/children.**					

***Source**:* Field Survey, 2004

The figures provided here corroborate reports that individual migration, in particular, but also household migration from both mountain and hill districts is relatively high, and that it has increased over the past decade. The question remains, however, to what extent this affects irrigation management, governance and agricultural production.

Organisational and Institutional Aspects

As is often the case in Nepal, the institutional and organisational arrangements surrounding irrigation management vary between the communities studied. Even among the Mustang systems, major differences occur between the relatively large, ethnically mixed village of Thini, on the one hand, and the small, Bhotia[26]-dominated villages of Tiri and Khinga, on the other. For example, in all three villages the irrigation system, along with other common property resources, is governed through village councils[27] whose responsibility it is to enforce regulations, manage funds, summon meetings, and impose fines. The exact mechanisms for enforcement and resolution of conflicts are somewhat opaque,[28] but observers generally agree

[26] Tibetan speakers who in the context of Mustang come from the north of Thak Khola (the Thakali homeland).

[27] Known as *gempa* in Tiri and Khinga (see Parajuli and Sharma, 2000 for details).

[28] Intra-community conflict as a subject is usually avoided in discussions with outsiders, and no accounts have been found.

that village councils with consensual leadership and high accountability, along with strong cooperation from villagers in common property management, are critical factors for survival, particularly in upper Mustang (Messerschmidt, 1995; Parajuli and Sharma, 2000).

Traditional village organisation is largely unrecognised by government organisations and conversely, particularly in Tiri and Khinga, only lip service is paid to government administrative systems. In Thini, where concerns and scope for influence and power extend beyond the village, there is considerable overlap between traditional and official leadership. For irrigation and other natural resource management purposes, however, it appears that leaders in Thini remain strongly accountable to their core constituents. Thini, owing to its large size, has at least two councils, reportedly with eight members each, headed by a *mukhya* (village chief) and assisted by one head *katuwal* (caretaker) and three deputy *katuwals*. The *mukhya* and *katuwal* are selected for a period of two years on the basis of merit. The head *katuwal* appear to receive NRs 15,000 per annum as remuneration. In Tiri and Khinga, the *mukhya* concept does not seem to apply; rather councils, with members representing each household, appear characterised by joint leadership. The councils are renewed every year (Parajuli and Sharma, 2000). Tiri and Khinga each have one *katuwal*, a duty that rotates between households every year. These *katuwal* do not seem to receive a salary but are possibly compensated in kind.

In all three villages, the *katuwals* are responsible for routine maintenance of canals and other structures, the organisation of routine and emergency works, and the collection of fees and fines, etc. The resilience of traditional systems of governance can be illustrated by the fact that in Mustang nothing remains of by-laws introduced by the ILO and the government at the time of the irrigation system rehabilitation. The by-laws (that completely ignored the existence of traditional governance structures), among others functions, devised organisational structures for irrigation committees with a *adhyasi* (chairman), treasurer, etc. They enabled official registration of users' groups with local authorities and sought to secure democratic decision-making.
However, upon departure of the project's social mobilisers, they were quickly forgotten.

Mustang's village councils are unique; however, obviously traditional systems of governance and management also existed in the hill systems (Pradhan, 1989; Yoder, 1994) prior to the ILO's organisational re-crafting. However, unlike in Mustang, local politicians in the hill communities, long exposed to government administrative systems, were quick to realise the advantages of formal committees. In many cases, political influence helped bring the rehabilitation project to the community in the first place,[29] and its arrival reinforced such influence. In four of the six hill systems, the 'crafted' irrigation committees continue to exist, while in Lampata and Pakuwa they have been defunct for the past couple of years because of, in the words of key informants, the migration of members and the reduced importance of agriculture relative to other sources of income. It should be noted, however, that while all of the committees and users' groups for the hill systems were renewed every year for the first 6–9 years, all such renewal has ceased since the start of the 2000s, as political life became increasingly problematic and local authorities increasingly unresponsive to local institutions.

Maintenance of the Irrigation Systems

As previously mentioned, in Mustang, *katuwal* are responsible for monitoring of the water supply and for carrying out minor maintenance. For major, regular maintenance work, such as cleaning of the canal, each household is compelled to send an adult representative, irrespective of landholding size or other factors. Such work is usually carried out twice a year. In the case of emergencies, the *katuwal* informs the *mukhya* or the council, who in turn mobilises labour from each household and maintain records. Participation is compulsory, and abstention leads to fines of NRs 100–200 per day. Abstention is not considered a problem in any of the villages, and in none of the communities did the key informants find that the ability to mobilise people for collective action had diminished over the past 10 years. One of the *mukhya* in Thini, in fact, expressed the opinion that limited migration in Thini was a determining factor for a well-functioning maintenance system.[30] All interviewed households expressed satisfaction with the way in which the irrigation system is maintained, despite the fact that considerable labour inputs are required (four days in Thini, eight days in Tiri, and 10 days in Khinga). The number of labour days has decreased over time since less maintenance has been required, following canal rehabilitation.

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[29] Obviously projects were subject to screening and, whenever technical and social feasibility was deemed negative, even influential communities were not able to obtain assistance. The project was, however, not subject to any area-based master planning.

[30] Messerschmidt (1995) with reference to the nearby village of Marpha assigns considerable importance to this variable by suggesting that "..the realisation of economic opportunities … attracted the more entrepreneurial Thakali farmers away from Marpha. As they left, home farms were placed under tenancy with Bhotia immigrants, non-Thakalis, and the old system of irrigation was replaced by a lottery. The Bhotia farmers and a few remaining Thakali farmers began looking after water distribution on their own" .

In the hill systems, maintenance routines are less structured than in Mustang and range from the case of Kurgha where one family has voluntarily assumed responsibility for monitoring the canal, to the case of Arjewa, Lampata, Pakuwa and Pipalbot with no permanent caretakers, and to the case of Amalachaur where a permanent caretaker is employed. Labour contribution for regular (generally twice a year) maintenance in all hill systems is in principle based on landholding size, but is generally referred to as 'voluntary', and abstention is not uncommon. For emergency and structural damage, assistance is often sought from local authorities for the financing of labour, but if the community is not successful in obtaining such assistance, it will carry out work by itself. If funds are needed, these are also generally collected on the basis of landholding size. Provisions for fines exist but, except for Pipalbot, these are not actually levied. With a few exceptions, the tendency over the past decade is for labour inputs to decline over the years, from an average of 11 days in 1993 to four days in 2004. It appears that the reason for the decline goes beyond that of reduced maintenance requirements. This is certainly so in Lampata and Pakuwa where the present state of the physical structures warrants considerable maintenance, and where the villagers themselves point to problems with respect to undertaking collective action.

Water Allocation and Distribution

In the three Mustang irrigation systems, water is allocated to individual farmers based on water shares and differs according to crops, with cereal crops receiving the highest priority. While small variations exist among the systems, the following summarises the general workings of the system. Small farmers with up to five *ropani*[31] receive one share per 28-day cycle, whereas larger farmers with up to 15 *ropani* receive three shares per 28-day cycle. A share corresponds to a specific date, decided upon by means of a lottery, within the cycle, on which individual or groups of households are allowed to irrigate their fields. On the given date, it is the farmers' responsibility to distribute water to their fields, and to ensure that gates are closed upon completion. It is the responsibility of the *mukhya* and/or village councils to monitor the system, keep records, and impose sanctions, if required.

In the hills, the irrigation committees are nominally in charge of allocation and distribution, which in all systems are on a rotational basis, but the system for allocating turns is somewhat unclear. It should be noted, however, that even for systems where caretakers are not employed on a regular basis, they

31 1 *ropani* = 0.052 ha.

are appointed for monitoring distribution at the onset of the monsoon when planting of rice paddy takes place. As an indicator of acceptability and irrigation system performance, farmers were asked about irrigation water sufficiency (**Table 4**). In at least three locations Tiri, Khinga and Lampata the reason for perceived water insufficiency is of a physical nature.[32] For other systems, the increased dissatisfaction is rooted either in ambitions with respect to higher production (this is the case in Thini) or simply worse delivery, for reasons of institutional failure.

Table 4: Percentage of Farmers Expressing Water Sufficiency for all Systems

	1993	**1994**	**2004**
Amalachaur	61	71	13
Arjewa	41	45	n/a
Kurgha	32	83	42
Pakuwa	46	59	40
Lampata	n/a	63	10
Pipalbot	76	65	60
Thini	81	100	90
Tiri	100	60	30
Khinga	100	57	60

Source*:* Field Survey, 2004

Farmers were also asked if they found that they received ‘fair’ shares of water or not (**Table 5**).

Table 5: Percentage of Farmers Receiving Fair Shares of Water all Systems (all locations – head, middle, tail)

	1993	**1994**	**2004**
Amalachaur	88	90	7
Arjewa	86	68	0
Kurgha	57	90	42
Pakuwa	n/a	n/a	40
Lampata	n/a	60	0
Pipalbot	57	57	53
Thini	100	100	90
Tiri	100	100	80
Khinga	100	100	90

Source*:* Field Survey, 2004

32 Reportedly, snowfall last winter at the source of Tiri’s irrigation water supply (a high-altitude lake) was lower than normal. The irrigation system in Khinga passes through an ecologically fragile and landslide-prone area; over the years, seepage and leakage have increased as a result of landslides and a sinking alignment. This is also the case in Lampata.

The vast majority of farmers in Mustang continue to find that shares are distributed fairly. Those who find shares unfair tend to be located at the tail-end of the command areas. This suggests that water shortages contribute to the creation of inequities in the form of so-called ‘tail-end problems’ even in seemingly well-governed irrigation systems. In the hill districts, the proportion of farmers who find that they receive fair shares has decreased drastically. At this stage, it has not been possible to ascertain if tail-end problems have increased, but overall this state of affairs adds to an impression of institutional problems leading to reduced equality with respect to water distribution.

Agricultural Productivity

Similar to water sufficiency, agricultural production is an important indicator of the performance of irrigation systems. Current and historical agricultural output for the command areas of the Mustang communities is presented in **Table 6**. In Thini and Tiri, yields have remained relatively stable over the years, with record high yields of buckwheat and naked barley in 2004. While Khinga has seen a drop in the yield of naked barley, the data suggest stagnating, but not necessarily declining, yields.

Table 6: Yields of Main Crops for Mustang (t ha^{-1})

Scheme	Crops	Base	1992	1993	1994	1995	2004	Mean
Thini	Naked barley	n/a	3.1	4.1	4.7	3.6	3.4	3.8
	Buckwheat	n/a	2.0	1.6	2.1	2.0	2.5	2.0
Tiri	Naked barley	3.3	n/a	4.1	3.8	4.2	4.9	4.1
	Buckwheat	2.4	n/a	1.5	1.8	1.5	1.4	1.7
Khinga	Naked barley	1.8	1.5	2.5	3.4	3.4	2.7	2.6
	Buckwheat	1.5	0.9	1.3	1.5	1.6	1.7	1.4

***Source**:* DIDP, 1992-1995; and Field Survey, 2004

In the hill communities, on the other hand, the data suggest falling productivity (**Table 7**). Excepting rice paddy in Kurgha and Pakuwa, yields have decreased significantly to levels that are well below the average over the years and, in many cases, even below levels prior to rehabilitation of the irrigation schemes.

Table 7: Yields of Main Crops for Hill Systems (t ha^{-1})

Scheme		Base*	1992	1993	1994	1995	2004	Mean
Amalachaur	Paddy	2.5	3.0	3.6	3.6	3.5	3.3	3.6
	Wheat	1.7	1.8	2.4	2.3	2.7	1.2	2.0
	Maize	1.7	2.0	2.8	2.6	2.7	1.9	2.3
Arjewa	Paddy	n/a	4.4	3.8	3.9	4.4	3.3	4.0
	Wheat	n/a	1.7	2.2	2.4	2.6	1.3	2.0
	Maize	n/a	2.4	2.9	2.3	3.0	2.1	2.5
Kurgha	Paddy	n/a	3.0	3.4	3.8	3.7	3.7	3.5
	Wheat	n/a	2.0	2.8	2.9	2.7	1.3	2.3
	Maize	n/a	2.2	2.5	3.0	3.0	2.1	2.6
Pakuwa	Paddy	1.8	2.4	2.9	3.1	3.1	3.9	2.9
	Wheat	1.5	1.5	2.5	2.3	2.5	1.0	1.9
	Maize	1.1	1.5	2.5	2.6	2.9	2.1	2.1
Lampata	Paddy	2.0	n/a	2.7	2.8	3.8	3.3	2.9
	Wheat	1.5	n/a	1.2	2.2	2.5	0.9	1.7
	Maize	1.5	n/a	1.5	2.3	2.9	1.5	1.9
Pipalbot	Paddy	3.0	2.9	2.8	3.4	2.9	2.6	2.9
	Wheat	2.1	1.8	2.0	2.7	2.3	1.0	1.8
	Maize	2.1	1.6	1.4	2.7	2.3	1.1	1.9
	Early paddy**	3.0	2.8	2.8	3.0	3.0	n/a	2.9
*** Yield prior to rehabilitation; ** so-called 'early' (spring) rice paddy.**								

Source: DIDP, 1992-1995; and Field Survey, 2004

A second measure of agricultural productivity is that of cropping intensity,[33] which in the case of the Mustang systems (**Table 8**) appears to have stagnated in Thini, decreased by 21% in Tiri, and increased by 10 % in Khinga. These reported cropping intensities are close to the national average of 180 % (Sharma, 1999), but considerably higher than an estimate of 140 % for Mustang made in 1984 (Vinding, 1984).

Table 8: Average Cropping Intensities for Mustang

Scheme	1992	1993	1994	1995	2004	Mean
Thini	164	185	184	183	180	180
Tiri	n/a	191	183	192	166	183
Khinga	138	163	156	156	171	157

***Source**:* DIDP, 1992-1995; and Field Survey, 2004

33 A cropping intensity of 100 % indicates the planting of relevant crops in one season on all relevant land. If half the land is cultivated for two seasons, the intensity is a similar 100 %. With three crops and three seasons, a maximum cropping intensity of 300 % may be achieved.

As with output, cropping intensities in the hill systems (**Table 9**) have dropped since their peak in the mid-1990s, when systems such as Kurgha and Arjewa reported virtually full cropping in all three seasons. All systems, however, report cropping intensities that are close to the average for the last 10 years.

Table 9: Average Cropping Intensities for Hill systems

Scheme	1992	1993	1994	1995	2004	Mean
Amalachaur	176	227	251	262	246	232
Arjewa	224	250	233	296	275	255
Kurgha	228	241	282	287	266	260
Pakuwa	185	197	215	227	206	206
Lampata	n/a	198	215	251	237	225
Pipalbot	211	206	259	n/a	209	221

***Source**:* DIDP, 1992-1995; and Field Survey, 2004

Implications for Policy and the Wider Governance Context

The irrigation and natural resources governance systems studied in Mustang function largely independently from government (and donor) administrative systems. Replicating institutional successes is notoriously difficult for a number of reasons, but promoters of farmer managed irrigation systems could do well to study and learn from the Mustang systems before 'imposing' governance frameworks in both new systems and those that 'convert' to more autonomous forms of governance. While not necessarily democratic in a modern sense, the Mustang systems appear efficient, and as such they conform to the aims of a central principle of decentralisation, viz. the management of resources at the lowest appropriate level.

In the hill systems, falling productivity and dissatisfaction with operation and maintenance practices bear evidence of eroding irrigation governance abilities. Farmers appear to find themselves in a 'squeeze' or vicious circle where they unable to sustain and intensify otherwise viable agricultural production as a result of migration. This state of affairs contrasts with policy intentions that provide a central place to irrigated agriculture, and is all the more challenging considering that the relative importance of farming activities, as a source of livelihoods, remains high.

The common pool resources management policies that are part and parcel of Nepal's rural development framework are also components of decentralised resource management perspectives but, for these to be actively supported, local institutional landscapes would need to be strengthened through active devolution. While the current insurgency certainly has exacerbated the problem and added political complexity, responses to the situation could include resumption of the disrupted process of improving governance, decentralisation and devolution of political power to local levels. It is quite significant that the majority of hill systems appear to have adhered to the democratic provisions of the by-laws introduced at the time of rehabilitation, and continued to embrace their scope for local representation for quite some time. It is equally significant that renewal of registration stopped in response to the disruption of the decentralisation process in 2002.

Irrigation management institutions appear to stand a reasonable chance of gaining ‘voice’ and becoming counterparts to more formal institutional settings in accountable local institutional landscapes with elected local bodies carrying the required portfolios. This is not to suggest that decentralisation is a panacea local power structures, etc. obviously matter a great deal. Even if, however, we view the ‘local’ and the ‘district’ as units that constitute arenas in which regulatory, coordination and planning issues are both negotiated and contested, it is difficult to envisage mechanisms other than local ones for mitigating localised and context-specific water resources governance problems.

Strengthening the decentralisation process may, in particular, be seen to hold some potential for mitigating negative consequences of rapid socio-economic change for the more vulnerable rural groups, who depend on access to common pool resources for their livelihoods. Increasingly those who depend on these resources are women, faced with risks of exclusion. It is difficult to picture alternatives to empowered local institutional landscapes involving the strengthening of local users' groups made up of those vulnerable groups who require ‘voice’ and representation.

CONCLUSION

The data suggest that livelihoods have diversified and even improved quite considerably in most of the systems studied. The majority of farmers believe that they have improved. It confirms that global and regional economic dynamics, along with the current insurgency, manifest themselves in widespread emigration from rural areas in Nepal. An increasing proportion of the population works outside agriculture, and access to both labour and commodity markets have led to considerable increases in incomes over the past decade. Non-agricultural incomes, as in the early 1990s, continue to constitute the bulk of incomes, but in most communities agricultural incomes are still extremely important and appear, thanks to increasingly diverse cropping portfolios, to be increasing along with non-farm incomes.

The effects of livelihoods diversification on irrigation system governance vary considerably between the communities and ecological regions studied, and depend on a combination of local and global economic dynamics, livelihoods strategies, and institutional characteristics. The resilience of the Mustang governance systems demonstrates that diverse livelihoods portfolios and market orientation do not necessarily erode irrigation governance institutions. Patterns of migration adapted to the requirements of livelihoods activities play important roles in this context. In Mustang, permanent household migration is offset by a north–south migration dynamic where new arrivals take up the places of the leavers, and a tendency for male heads of households to stay behind under conditions where returns from agriculture remain satisfactory. This appears to translate into a willingness and ability to continue to invest in collective action, with farmers generally continuing to express satisfaction with the operation and maintenance of the irrigation systems.

Hill irrigation governance systems have traditionally been more loosely structured than their counterpart institutions in the mountains. Operation and maintenance in some systems appear increasingly informal, and based on voluntarism and *ad hoc* mobilisation. The fact that many more farmers now, compared to a decade ago, are unhappy with water sufficiency and find that they receive unfair shares of water is a serious indication of some degree of institutional erosion. Farmers claim that returns from agriculture have increased. At the same time, there appears to be a decline in the performance of the irrigation systems largely due to excessive male migration and signs of an inability to invest in collective action. This ‘productivity squeeze’ poses a challenge to a rural development strategy that emphasises growth linkages.

Programmes that aim to reinvest remittances into agriculture may not necessarily solve the problem of reduced productivity, given that the rural-to-urban migration trend is a global phenomenon. However, considering that (hill) agriculture remains important to vast numbers of livelihoods, some of which may become increasingly vulnerable as a result of migration (and thus increasingly depend on common pool resources), enhancing the relative role of natural resource management institutions in the local institutional landscape may be one option. This would involve the promotion of community-based water resources management institutions as counterparts to more formal set-ups in local institutional landscapes that constitute the arena in which regulatory, coordination and planning issues are negotiated and possibly contested. This would, however, also require the resumption of a decentralisation process that goes beyond territorial decentralisation and the appearance of going through the motions.

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GOVERNANCE PERSPECTIVES ON WATER MANAGEMENT PRACTICES: A CASE STUDY OF BHAKTAPUR CITY, NEPAL

GANESH KHANIYA[1]

INTRODUCTION

The rice production of Bhaktapur district used to be enough to feed the entire population of Kathmandu valley in the past. There, it was called *Bhatgaun* (literal meaning of *Bhat* is rice and that of *gaun* is village). Later, it was called *Bhadgaun*. Some inscriptions show that it was called *Bhadra Gram* (village of gentle people). In the inscription of King Mandev I of Devpatan in 477, this city was known as *Khwopring*. Later, it was called only *Khwopa.* In the inscription of Shivdev and Anshuverma in 537, the name *Makhopring* was mentioned (Prakash, 2000). Some evidences show that people in this city had profound religious devotion due to countless temples and shrines so it was called *Bhaktaharuko Pur* (abode of devotees), and thus Bhaktapur.

Geographically, this city is situated between 85.21^{o} to 85.32^{o} E longitude and 27.37^{o} to 27.44^{o} N latitude. This conch shaped historical city, spreading over an area of 119 square kilometers and lying at 13 km. east of Kathmandu, is situated at 1331 meters from the mean sea level.

In spite of continual invasions by intruders and natural calamities, the historic city still boasts of its superb art and subtle culture so vividly depicted on the remaining palaces, temples, monasteries, *Biharas*, and other monuments truly making it the 'city of culture' ('Bhaktapur' brochure, Bhaktapur municipality).

History shows that King Ananda Dev Malla founded this Bhaktapur city during 13th century (Prakash, Ibid) and had ruled over it for two decades. Jayasthiti Malla made many rules and regulations to the inhabitants of Bhaktapur. They were inscribed in religious scriptures. This city was the capital of the Kathmandu valley for almost 315 years till the reign of king Yaksha Malla. He divided the then *Nepal Mandal* (entire valley of today) into four principalities for his four sons. Being a capital city, it had excelled in art, culture and other infrastructures in comparison to other cities. King Yaksha Malla during 15th century heavily fortified this city. *Asta Matrika*

[1] Program Officer, FMIS Promotion Trust, Nepal.

(eight revered Goddesses that are believed to have spiritual power to keep Bhaktapur city safe) were installed for the divine protection of this city. *Masan Ghats* (cremation and burial sites of dead bodies) had also been constructed. This city was surrounded by tall walls at inner banks of the rivers of Bhaktapur in such a way that the rivers were kept outside these walls.

STUDY BACKGROUND

The purpose of this study is to look at the management of water for drinking, domestic use and for agriculture. Obviously, water is intrinsic component of human life right from the birth to even after death. It has multiple values such as religious/spiritual, social, economic, aesthetic, medicinal and others. With growing competition and conflict over the multiple use of water, its management has been a crucial issue today**.** The infrastructure development alone can not be sufficient for water management. Values, customs and rituals have equally important role. Culture plays vital role which guides different value systems of our life and thus is indispensable part in management of scarce water. Sprinkling water brought from holy rivers for purification and expiation are still rife in our culture. Different rituals such as Shradhda and Tarpan (religious offering to the deceased) are performed in nearby rivers and other water sources. Dipping in sacred rivers during certain planetary configurations have the potential of washing away past sins and accumulating religious merit. Long and arduous pilgrimages are undertaken just to take a dip in sacred rivers at those configurations (Sharma, 1994).

The world's best-known human civilizations are based on water civilizations since they have been evolved at the bank of river, sea and other water sources. Thus, water management should be studied with the cultural perspective. Cultural practices, beliefs, customs, do's and don'ts and cosmic relationships are important factors to understand the philosophy and practices of water management resource in a given community (Sen et. al, 1997).

In Nepal, various traditional sources of water such as *Dhunge Dharas* (stone spouts), ponds and wells are found in use for drinking water preceded by irrigation and other secondary purposes. The state took leading role in the construction of the water system while community played a key role in the management of such systems.

Bhaktapur city is rich in water heritage. There are dozens of stone spouts in Bhaktapur built during Lichchhavi era (known as *Pranali* at that time). There are still 83 stone spouts (Bhaktapur municipality, 1994) and 34 ponds

(Bhaktapur municipality, 1993) and 277 dug-wells (Heritage Branch, Bhaktapur municipality) within this city. There are still few *Raj Kulos* (state-sponsored irrigation systems) in this district as mentioned in the inventory report prepared by FMIS Promotion Trust. Bidol irrigation system, Sudar, Taleju Bhawani Jane Kulo, Bageswori and Katunje Raj Kulo, Katunje are few examples.

Bhaktapur Development Project (BDP) initiated in 1972 with the financial assistance of Germany changed the scenario of Bhaktapur by implementing drinking water and sanitation system. BDP also assisted in conservation, repair and maintenance of the stone spouts and ponds in Bhaktapur. They draw major flaws today in the sewerage disposal polluting the Hanumante Khola[2].

OBJECTIVES

The objectives of this study are:

- To assess the different socio-cultural and economic values of water relating to *Dhunge Dharas*, ponds and traditional canals.
- To understand the management practices of water through culture.
- To assess the implications of socio-cultural and economic values with respect to Integrated Water Resources Management (IWRM).

GENERAL INFORMATION ON CASE STUDIED DHUNGE DHARAS AND PONDS

The different aspects of *Dhunge Dharas* and ponds that include their use in past and present, management pattern, cultural importance and future prospect are enumerated in the following **Table 1**.

[2] Personal communication with Rajendra Pradhanaga, infrastructure planner, GTZ-urban development through local efforts.

Table 1: Synopsis of Case Studied Dhunge Dharas and Ponds

Name	Water Use		Management Pattern		Cultural Importance	Future Prospect
	Past	Present	Past	Present		
Bhimdyo Hiti	• Drinking • Religious Worship • Bathing	• Religious Worship • Bathing	• Local Guthi	• Municipality	• Being one of the eastward facing Dhara, people pay tribute to it on the day of Janai Purnima. • Being nearer to the Dattatraya Temple, it is also used for bathing and ablusions purpose during Shivaratri.	• Regular fund needs to be instituted by local initiative • It can still be a potent water source
Ga Hiti	• Drinking • Taking bath • Medicinal use (Curing goiter)	• Bathing • Drinking (Lesser extent)	• Local Community • 20 years ago, BDP rehabilitated it and made the drainage system working.	• Municipality	• No special cultural adherence	• Since its drainage system is disrupted, its permanent management can help smooth water supply to the locality.
Aring Hiti	• Drinking • Medicinal use • Religious worship	• Presently lying neglected and in no use	• Mahakali Area Conservation Committee.	• Mahakali Area Conservation Committee.	• No	• If rehabilitated properly, it might serve the water needs of the locality.
Pulan Hiti	• Bathing • Drinking (Water that can help digest the food) • Passersby needs	• Sparsely used for drinking.	• Local Guthi	• Municipality	• No	• Water source diminished considerably due to housing construction around and its prospect is bleak.

Sundhara	• Royal use for bathing • Worship in Taleju Temple	• Worship in Taleju Temple	• Royal Guthi (with ten ropani land allocated to it)	• Municipality	• The water from this Dhara is still being used to worship in Taleju Temple so its cultural importance is very high.	• It is one of the attractions of tourist's visiting Bhaktapur.
Naag Pokhari	• Cloth washing • Fire fighting • Fish farming	• Fire fighting • Fish farming use • Washing of dyed thread	• Local Guthi	• Municipality	• Since Naag (Serpent) is erected in the middle of the pond, people pay tribute to the Naag; in case drought persists.	• It offers itself as a potential recreational spot if infrastructures are built around it.
Kamal Binayak	• Fire fighting • Irrigation	• Fire fighting	• Local Community (Manandhar group)	• Municipality	• At the day of Ghatasthapana, people bring water from it to keep Jamara. • In case of death of small child of Manandhar family, they take holy bath on 3rd day to get purified. • People of Bhaktapur take bath in this pond at the eighth day of Durga Puja and offer worship to Manhalaxmi Pith.	• Can be developed as a recreational spot. • Boating can be started.
Tekhacho Pukhu	• Washing face in the morning • Irrigating the nearby farming land	• Washing face in the morning • Sprinkling water to the deities around • Recreation (sitting around in the evening)	• Local Community	• Municipality	• No	• Not observed significant.
Siddha Pokhari	• Religious bathing • Fire fighting	• Religious bathing • Recreational • Fish farming	• Local Guthi	• Municipality	• During Dashain and Indra Jatra.	• It can be a good income source if necessary provision like entry fee are introduced.
Hiti and Dhara stands for stone spout whereas Pukhu and Pokhari stands for pond in Newari and Nepali language respectively						

DIFFERENT ASPECTS OF DHUNGE DHARAS AND PONDS

Evolution of Dhunge Dhara

The development of *Dhunge Dhara* in Bhakatapur city can be traced as back as 800 to 1000 years. Unfortunately, there is no recorded history about earthquake, arson and other disaster that devastated the man made structures. So, the history recorded that the evolution of *Dhunge Dharas* and ponds dates back to Lichchhavi period in Bhaktapur district. Following are some *Hitis* of that period still in existence:

- Tulutulu *Hiti* of Suryamadhi *Tole* (Behind Dattatreya temple)
- Ga *Hiti* at Golmadhi *Tole* (In front of Ram Jhupdi-cottage)
- Dhauwa *Hiti* (Backside of Indrayani Pith)
- Baku *Hiti* (South of Hanumanghat)
- Bhindhyo *Hiti* near Dattatreya temple (Munakarmi, 1993)

Malla period was the booming period as regards the spread of these spouts. The mouth of *Hiti* facing towards south is still visible near Bal Mandir in the precinct of Durbar Square. This was built by Yaksha Malla in the memory of a deceased woman named Laxmi (the relationship of him with her hasn't been traced). Temples resembling *Char Dhams* (signifying four pious pilgrim spots namely Badri, Kedar, Rameshwor and Jagannath where Hindus wish to pay homage during their life) were constructed in the periphery of today's Durbar Square. A *Dhara* (spout) had been built by Yaksha Malla and it was used by the devotees and was popularly known as *Char Dham Dhara*.

Around 1973, this area was encroached and housing construction took place where Bal Mandir School was later established. Only visible part of the spout today is its *Hiti Manga* (mouth of *Hiti*). This *Hiti* is seen in the north-facing wall of Jagannath Mandir.

During Malla period, adequate provision of drainage was introduced around the *Dhara* to ensure the disposal of waste water and to avoid water logging around the surroundings. The *Dharas* built during Lichchhavi period, though successfully running, were not enough to fulfil the water demand of Bhaktapur city. Realizing the impending water scarcity, king Jitamitra prepared a big plan. The legend has it that he was once in a dream instructed by a deity to solve the water crisis of the city by managing water from Mahadevkhola at the foothill of Nagarkot. Later, he discussed it with his coteries and accomplices and other royal dignitaries. Accordingly, water from the Mahadevkhola was collected in a reservoir (today's Mahadev

Pokhari is the reservoir) and it was brought to the city through the earthen canal. The water was then supplied to many *Dharas* in Bhaktapur. Prominent among them is the Sundhara which still serves water for the worship of Goddess Taleju inside the Thanthu royal palace. These *Dharas* were allocated to the specific areas based on the households and population. 24 *Toles* (local area representing a community) existing at that time were systematically supplied with *Dharas* in an appropriate proportion. *Dharas* at Taumadi *Tole* and Nasamana *Tole* were also built during the reign of king Jeetamitra. The basic planning at that time was that each *Chowk* (central place where two or more alleys meet) had one *Dhunge Dhara* for drinking water, a temple for religious worship and a *Pati* for temporary shelter. In each of the ninety nine *Chowks* in this city, there was at least one *Dhara*. Some are still functional whereas many others are only now remnants. There are still 3 to 4 spouts around Durbar square.

Later, Bhupatindra Malla, following the footstep of his father Jeetamitra, also managed old *Dharas* and built new ones and supplied water to every *Tole* thus solving the problem of drinking water considerably. Besides drinking water, the water was used to irrigate the farmers' land and cultivate paddy. Water mills were as well running where people could grind their grains. During that time, there was provision of water purification as well as source protection and conservation.

During the premiership of Bhimsen Thapa, some new *Dharas* were built and some old *Dharas* were renovated. During Rana regime, Kathmandu became the administrative center and they didn't pay due attention in conserving and preserving these water heritages. Some Rana brigadiers took initiative in this regard and partially succeeded in their maintenance. *Guthis*[1] were responsible for the maintenance of these historical water systems.

Before 1933, there was smooth flow of water in the stone spouts of this city and enough supply of water was available to the people. Passers-by were also equally benefited. The devastative earthquake of 1933 proved bane to this city's ancient water heritages which turned many into only ruins. The political upheaval of 1950 weakened the *Guthi* system which used to manage land and other historical and cultural heritages. The land owned by *Guthi* was mismanaged and no resources were left for the maintenance of these

[1] *Guthi* is the institution for the conservation and preservation of public heritages like *Hiti*, pond, temple etc. as well as for carrying out different religious and social events. The adequate acres of fertile land were allocated for *Guthis* and the income generated through them would go to the maintenance works and social functions. Community members would also voluntarily contribute cash and kind in the *Guthis*.

heritages. *Guthi Sansthan*[2] at present has turned blind eyes towards these spouts. In some places, community *Guthi* is found where local Newars contribute voluntarily for the continuation of their religious functions and maintenance of temples, *Patis,* spouts and ponds.

The source of many *Dharas* was the *Raj Kulo*. It used to feed water into the Dharas at Khauma *Tole*, Nasamana *Tole*, Bhairavsthan and many others besides the Sundhara (inside the royal palace). After disruption of *Raj Kulo*, there was no supply of water through Sundhara and the devotees were compelled to bring holy water from Mahadev *Pokhari* at Nagarkot to worship Goddess Taleju. After the installation of modern piped system of water supply, the water was fed into the Sundhara. This water is considered equally holy as that was brought through *Raj Kulo* and being used for worshipping these days[3].

Evolution of Pond

There is very scanty account about the development of ponds. Most of the ponds in this city were man-made. In many ponds, the history of construction couldn't be traced. Many ponds in this city were believed to have been constructed during Malla period. During that era, many ponds had been constructed adjacent to the *Dhunge Dharas*.

Sources of Dhunge Dhara

The water sources of *Dhunge Dharas* are mainly of two types; a) they used water from *Raj Kulo* b) they utilized the underground source. Most of the *Dharas* in this city were fed by the water brought from the Mahadev Khola, Nagarkot through the *Raj Kulo*. It was reported that water from different sources around Mahadev Khola was impounded into Mahadev *Pokhari* and was fed into 15 km. long canal constructed by the local Newars and finally brought into different *Dharas* of this city. *Dharas* at Khauma *Tole*, at Nasamana *Tole*, Bhairavnath *Tole* and others were using the water brought through this *Raj Kulo* besides the Sundhara at royal palace. This water supply had resolved considerably the water crisis of this city. Later, *Raj Kulo* got damaged and there is no longer water supply through it. In those days, water brought through this canal was also used for the irrigation of nearby

2 *Guthi Sansthan* is the administrative agency for managing the *Guthis*.

3 The researcher expresses deep indebtedness to Mr. Lita Bhakta Munakarmi, the historian and cultural expert of Bhaktapur for sharing valuable information regarding the evolution of *Dhunge Dharas*.

farmlands. They were also used for running water mills and in fish farming too. Thus, this *Raj Kulo* was the lifeline of the Bhaktapur people in the past.

Other *Dharas* tap the independent sources of water. They are utilizing the underground natural sources. They lie deep down the road level and access to them is made easy through steeped stone stairs at different levels. Hence, one would find the difference of level of water spouts depending on the source of water supply to these *Dharas.*

Sources of Pond

Most of the ponds under this study were found with no independent sources of their own. Since many of the ponds were at the vicinity of *Dharas*, these *Dharas* were the prominent and perennial sources for them[4]. However, Siddha *Pokhari* (**Figure 1**) is believed to have its separate source. Locals believed that the source of this pond is at Dhalchibasi, Surya Binayak in the dense forest and water had been brought from there with *Tantrik Shakti*(a belief in super natural power). On the other hand, the rainwater is another source of water for these ponds.

Figure 1: Panoramic View of Siddha Pokhari

Motives behind the Construction of Dhunge Dharas and Ponds

In the past, many social activities were undertaken under royal patronage, community effort and commoners' initiative. Besides constructing *Dharas* and ponds, contributing in making temples, *Pati, Pauwa*, digging wells and undertaking other philanthropic activities were carried out in a self-motivated manner by the people in the society.

People had the belief that by making *Dharas*, ponds, *Pati*, *Sattal* and temples, they would earn the merit after death. Merit earning was, thus, another

[4] With the disruption of age-old water distribution system through *Raj Kulo*, most of the *Dharas* today are fed through modern water supply.

driving force which encouraged high-profile royal dignitaries and the commoners alike to contribute in worth remembering deeds. Yaksha Malla, Jeetamitra Malla, Bhupatindra Malla and other Malla kings were pioneer contributors in many infrastructures such as *Dhara*, pond, *Pati*, temples etc. Bhaju Kasha, a brave royal adviser made Bhaju *Pokhari* for earning merit as well as exhibiting his courage. On the commoners' front, a widow made Pulan *Dhara* in 1586 with the earning she made by weaving cotton thread. Gosain *Hiti* and Dhawbadhel *Hiti* were constructed through community effort. The stone inscriptions were also installed mentioning explicitly the do's and don'ts regarding their upkeep and maintenance.

The contribution for the construction of *Dhara*, *Pati*, *Pauwa*, temples and other infrastructures for the benefit of the common people was woven in the fabric of socio-cultural life of the people in Bhaktapur.

Functions of Dhunge Dharas

Dhunge Dharas have multi-functions. They are:

Drinking Water

Before the introduction of piped water system in 1896, *Dharas* were the important source of drinking water supply in this city. Their importance has decreased now. They, now, supplement water only in the lean period before the start of monsoon.

Public Bathing

Many *Dharas* built during Lichchhavi and Malla periods had wide space with proper drainage system. Though special *Ghats* (spacious accommodation for bathing and washing) were not provisioned, local people could take bath in these *Dharas*. Many devotees could take bathing before performing worship in nearby temples. Being water directly fed into the conduit through spring source, water is cool in summer and warm in the winter.

Laundry Purpose

In the past, there were separately assigned *Dharas* for the laundry purpose. The *Dhobis* (washer-men) as well as local people could use these sources. They were built at the outskirts of the city. In Bhaktapur, however, such *Dharas* were not observed during the study. In Kathmandu, there are some places named after *Dhobi Dharas*. Since no specific *Dhara* was assigned for laundry purpose in Bhaktapur, cloth washing can be done in any of these *Dharas*.

Religious Functions

In the vicinity of every *Dhara*, at least a temple for the religious offering and a *Pati* for having rest by the devotees as well as the passers-by were made. Therefore, besides having bath and making ablutions before entering the temples, the water of these *Dharas* was used for cleaning the idols and religious shrines every morning. This function is still in practice in many shrines. The water from Sundhara inside the Durbar Square is still offered to the Goddess Taleju at Thanthu royal palace. Many *Dharas* in this city have special significance during the religious occasions. In the day of Janai Purnima, *nine Purwabhimukh Dharas* (East-facing spouts) are visited by the devotees of Bhaktapur city.

Medicinal Use

Since the natural source has been fed 7into the water conduit (unlike the use of conveyance pipes today), water through these *Dharas* possesses medicinal virtues. The water of Pulan *Hiti* is believed to have digestive quality. People believe that drinking water from it make them relieved after having heavy feast. On the other hand, Ga *Hiti* at Golmadi (**Figure 2**) has the virtue of healing goiter. Similarly, small children as far as outside of Bhaktapur were brought in the Aring *Hiti* to wash their faces to get rid of *Runche* (a symptom of disease in small child in which the child keeps on wailing and crying). Some others have the virtue of curing skin diseases too.

Figure 2: Ga Hiti and Its Interior Surroundings

Irrigation Use

Many *Hitis* in the past were extensively used for irrigation purpose since large number of people in the then Bhaktapur Town Panchayat (now the municipality) used to rely on agri-farming for their livelihood. The wastewater from the *Hitis* was used to irrigate the low-lying nearby farmland wisely adopting the gravity flow technique. The wide use of wastewater from the *Hitis* during the past period for this purpose can be understood from the following: "Irrigation is either through terrace irrigation, or by constructing subsidiary canals. The main wastewater drainage serves as the channel for the water flow. The water-taps, the sewerage and the drainage were identified as the sources of irrigation" (HMG/Nepal, 1983). Still wastewater from the *Hitis* as well as ponds are being used for irrigation, for example the wastewater of Pulan *Hiti* and Kamal Binayak pond. However, large farming land have been replaced by building all round thanks to the rapid pace of urbanization and such irrigation is limited mainly to the vegetables and small areas of paddy field.

Confluence of Religious Tolerance

Artistically carved images of many revered deities can be seen in and around many *Hitis*, mainly of Hindu and Buddhist faiths. So, these serve as the sites of religious harmony and co-existence.

Auspicious and Inauspicious Hitis

*Hiti*s facing in a particular direction still bear special significance to the people in this city. Notably, *Purwabhimukh Hitis* (water conduits with their spouts facing east) have major values. In such *Hiti*, we turn our mouth towards west while drinking water since the mouth of them is facing towards east. These are considered religiously auspicious. There is the unique tradition of taking bath from nine such *Hitis* in the day of Janai Purnima only in Bhaktapur. Thus, such *Hitis* have great religious followers during Janai Purnima. It is believed that such bath will refrain the people from the natural calamity as well as from other physical ailments such as dysentery, diarrhea, typhoid etc. Besides, food will be easily digested and prove nutritional to them.

Similarly, Gaijatra, the greatest carnival of Newars falls on the next the day of Janai Purnima. It is believed that such bath along with the prayer, worship and religious offering to the nine deities of power lying in the vicinity of these *Hitis* will liberate the hovering spirits of their deceased kith and kin ensuring their entry into the heaven.

During the day of Janai Purnima, the devotees initiate taking bath from the *Hiti* located on the right side of Surya Binayak Ganesh and worship Surya Binayak. At the end, they take bath from Bhimdyo *Hiti* near Tajpal (**Figure 3**) and complete their worship. Though there are numerous *Purwabhimukh Hitis*, following nine are visited by the people of Bhaktapur still today on Janai Purnima:

Figure 3: A Glimpse of Bhindhyo Hiti

- Surya Binayak *Dhunge Dhara;*
- Tin Dhara (Swadhara *Hiti*), near Mission hospital;
- Down the Surya Binayak (near Bhimsen Mandir);
- *Dhunge Dhara* at Sukuldhoka Vidyapith;
- Rayathor *Dhunge Dhara* at Nasamana Bazar;
- Dhauwadhel *Dhunge Dhara* at Puwahal, Taumadhi *Tole* (personal *Hiti*);
- Bulubulu *Hiti* at Tipukachhen *Tole;*
- *Dhunge Dhara* at Tripursundari Pith at Tulachhen *Tole;* and
- *Dhunge Dhara* behind Bhimsen temple at Tachpal *Tole*, also known as Bhindhyo *Hiti* (Munakarmi, 2001).

These nine *Hitis* were believed to have been built during Lichchhavi period and only had been renovated in Malla period. Most of the above mentioned *Hiti* don't have any water flow. Only few are running, some have only murky water flowing. Regretful though, devotees in the auspicious day of Janai Purnima bring water from the home and pour the water through the *Hiti* Manga and take symbolic bath.

On the other hand, the *Uttarabhimukh Hiti* (water conduits with their spouts facing north) are not considered auspicious. We should turn our face to the south while drinking water through them. Since *Shraddha/Tarpan* is carried out turning our face towards south, things consumed in this way is considered to be inauspicious and believed to cause harm and ailment. So, very few *Uttarabhimukh Hiti* have been constructed in Bhaktapur. Contrary to this belief, many *Hiti*s outside Bhaktapur especially in Kathmandu and Lalitpur are *Uttarabhimukh*. Furthermore, it is believed that

Dakshinabhimukh Hiti (south-facing *Hitis*) are very ominous and even dreaming them can prove fatal to their life.

Similarly, some *Dharas* were strictly forbidden to use for drinking water in the past. Two *Hiti*s near Indrayani were among them. Legend has it that Kasai (occupational caste of Newar involved in slaughtering) used to take bath in the nearby pond after slaughtering the he-buffaloes and other animals. The pond was the source of these *Hiti*s as well. Thereby, blood tainted water used to flow from the spout of the *Hitis.* That's why, this water was forbidden for drinking. According to the legend, whoever would catch sight of the blood flowing from this *Dhara* s/he would die instantly. The spouts of them have he-buffaloes as a reminder of demon. However, people resorted to drinking water from them due to growing water scarcity these days.

Significance of Bhagirath underneath the Hiti

Underneath almost all *Dharas*, image of Bhagirath can be seen supporting the conduit either in standing or squatting position. It has an intriguing legend. During *Vaidic Yug* (era of Veda), there was drought all around and people were dying of starvation. It was the reign of King Bhagirath and he engaged himself in *Tapasya* (meditative prayer) and invoked Ganga, Goddess of water for supplying water. Ganga agreed to cooperate him. However, she asked, "If I descend onto the earth, there will be huge water flow. Who will shoulder its massive pressure?" He again sat for *Tapasya* and evoked Mahadev. Later, Mahadev consented to carry the burden of shouldering the water pressure following the request of Bhagirath. However, Ganga expressed doubt saying, "Could the head of Mahadev shoulder the pressure of water?" At her ridiculous remark, Mahadev tidied up his disheveled hair and shouldered the entire mass of water flowing. Thus, Bhagirath could succeed to make feuding Ganga and Mahadev reconcile for the welfare of the suffering people. Consequently, the persisting drought was over. This almost impossible task could be possible with the enduring effort of Bhagirath. This endeavor has been developed as a cliché as *Bhagirath Prayatna* (literally, stubborn endeavor). In recognition of *Bhagirath Prayatna*, his conch-blowing statues had been installed underneath the most of the *Hitis*.

Design of Water Conduit

Dhunge Dhara in this city were mainly found in rectangular and square shape. Some of them are at the ground level and others are in deep down the surface of the road. Most of them are made of stone. However, Sundhara within Bhaktapur palace is of gold gilted ones. The spout of it and the image of *Naag* (the serpent, a revered water deity considered as the protector of water structures) erected adjacent to it are both of gold plated (**Figure 4**). The theft and weathering effect have rendered these elegant artistic structures less attractive today. Most of the spouts of *Hiti* have *Makara* (crocodile), an aquatic animal through the mouth of which water flows. It is a carrier or vehicle of Ganga, goddess of water. The back and sides of the *Hiti* are replete with the artistic carving of many aquatic animals such as *Naag*, frog and others. The mouths of *Hitis* also have the heads of goat, fish, cow, elephant and others. These signify the symbolic meaning of cohabitation and coexistence of human being with the animals- the essence of ecosystem. The cut-throat competition in art and craft among the kings of the valley during Malla period prompted the development of the exquisitely innovative design of *Dhara*, temple and other structures with elegant carving in and around them, making them legendary masterpieces.

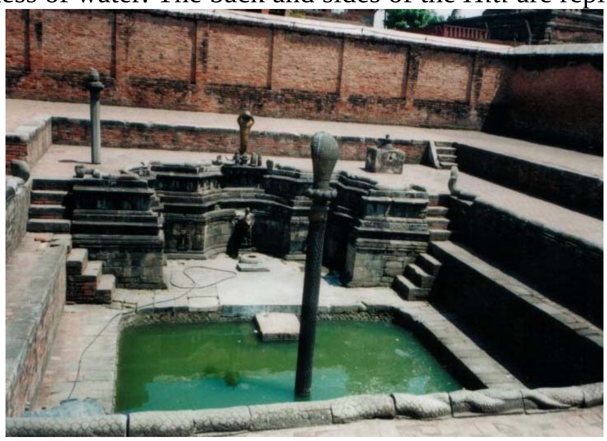

Figure- 4: Naag Pokhari Adjacent to Sundhara

Functions of Ponds

Since the Lichchhavi period, systematic development of Dharas started to fulfil the drinking water needs of this city. During Malla period, *Dhunge Dharas* were installed at every corner of the city to facilitate people's drinking water need. So, hardly a single pond was found to be used for the purpose of drinking water in Bhaktapur city. However, water from the ponds was widely used for washing clothes by the local people. Water from Tekhacho *Pukhu* and Naag *Pokhari* were used for washing clothes in the past. With the frequent water supply due to modern piped system and the growing pond water pollution, people don't use the water of the ponds for washing these days. However, water from Tekhacho *Pukhu* is still being used for washing the face by the local people, who come to worship the deities in the morning. In the past, ponds were basically used for fire fighting in the city. All of the ponds studied under this research are still being used for this purpose. Besides, these were the main source of irrigation water to the low lying nearby farm areas where gravity flow of water could be made digging small canals and ditches. Though not in large scale, fish farming was carried out in the past in many ponds in the city. Still today, this activity is being carried in Naag *Pokhari*. It has thus maintained the economic values by generating regular income for the maintenance of canal periphery. The open spaces all around the pond are the good recreational sites for the evening strollers (**Figure 5**). On the other hand, pond water is widely used by the locals for domestic use such as toilet cleaning etc.

Figure-5: The Image of Naag at the Center of Naag

Irrigation Linkage of Dhunge Dharas and Ponds

Many of the *Hitis* and ponds in Bhakatapur city, in the past, were using the water brought from the Mahadev pond, Nagarkot through the *Raj Kulo* as their perennial source. Around the periphery of most of the *Hitis*, there are ponds necessarily visible. These ponds used to be in existence mainly from the wastewater of these *Hitis*. The used water of many *Hitis* after bathing and washing were used for irrigating in the low lying nearby farmlands. The wastewater of Pulan *Hiti* is still being drained to irrigate the vegetable farms. So is the case of many ponds. One can still see that small channels have been dug to divert pond water into the farm from Kamal Binayak pond. In the medieval period, there were large chunk of land which were completely used for agri-farming within the Bhaktapur city. Thus, the water of the *Hitis* and ponds were massively used for irrigation. This fact can be supported by the survey report of East Consult, 1983 which explicitly mentions Tekhacho and Pasikhel are the name of canals. It can be recalled here that Tekhacho is a pond and Palikhel area lies adjacent to Ga *Hiti* today. This report further mentions: Irrigaton is either through terrace irrigation, or by constructing subsidiary canals. The main waste water drainage dserves as the channel for the water flow. The water-taps, the sewarage and the drainage were identified as the sources of irrigation. All households have irrigation facilities, rather have access to irrigation. they can apply the water in their fields as necessary and by rotation (HMG/Nepal, Ibid). Thus, the indigenous practice of *Jyapu* (local inhabitants) of Bhaktapur had effectively utilized the sewerage waste to irrigate their farmlands besides the wastewater irrigation.

With the growing urbanization today, there are very few areas left within the city for farming. On the other hand, *Raj Kulo* no longer functions today. BDP introduced arrays of programs to generate awareness as regards the health and hygiene of the people. Consequently, irrigation connection of these sources seems to have gone into oblivion today.

MANAGEMENT DYNAMISAM OF DHUNGE DHARAS AND PONDS

Water resources management in Bhakatapur city mainly dictated by ancient practices evolved from the very past were found quite unique but systematic as well as indigenous but sustaining. During Lichchhavi and Malla periods, water allocation, distribution, conflict resolution, penalty imposition and other related activities were strictly maintained through rigorous rules and regulations envisioned in the inscriptions and as well as by instituting *Guthis*. The ancient water management practices, changes over the period of time and current management modes have been presented to gauge the management dynamism of *Dhunge Dharas* and ponds.

Ancient Modes in Water Management

Maintenance through Sithi Nakha

Sithi Nakha is the last festive occasion of the year among Newars. It falls on sixth day of the bright half of the month of Jeth (in the month of May). This festival is set to have been observed to mark the birth day of Kumar, the Hindu deity of war and one of the sons of lord Shiva. It is one of the main festivals to be observed by native inhabitants of the Kathmandu valley. The special feature of this festival is the cleaning of wells and springs from which people, before the supply of filtered drinking water through galvanized pipes and tapes, used to drink water (Ranjit, 2004). This very day resembles the day at which the level of water in well, pond and *Hiti* goes to the lowest level in a year. Local people en masse clean and maintain these water sources as a religious process. It is believed that in this very day, the *Naag* deities inhabiting in these sources come out of the water retaining bodies, their habitat, thus paving the way for unhindered maintenance of these water sources.

This festival reminds us the inseparable connection between human life and nature. In the bygone days, this day was considered auspicious for initiating the important construction works. In the initiative of the state, the construction of temple, *Pati/Pauwa*, fort and others were carried out. Likewise, the state had divised rules and regulation regarding the cleaning and maintenance of stone spouts, wells, ponds and local *Toles.* Since *Sithi Nakha* falls before the monsoon it is the quite opportune moment for the maintenance and upkeep of human heritages. This is still in practice (Bibash, 2004).

Lime or *Abhrakh*, a herbal medicine is added into the water sources after cleaning them and the water from these sources are not used for drinking purposes for four consecutive days. In the past, the surroundings of water sources were blocked with fences in order to prevent their uses for few days.

In these days, modern water supply system is providing water at every house and ancient water heritages have been rendered useless and entirely neglected. so, the public importance of Sitrhi Nakha in the maintenance and clearing of the water sources has dwindled drastically and the festivity is confined within the private jubilation and in-house feasting. Hence, the community aspect of Sithi Nakha has been overshadowed by the household-level celebration.

Management through Guthi

Earlier, there were different *Guthis* for different activities. The people in a *Tole* used to constitute such *Guthi*. Mainly, there were two types of *Guthi*. One is Raj *Guthi* and another is Duniya *Guthi*. Raj *Guthi* was established from the state support. Earlier Kings, Queens and their relatives could make Hiti, pond, temples and other public assets and could institute *Guthi* for their maintenance. Such *Guthi* were Rajya *guthi*. Duniya *Guthi* is established by the peoples' initiative. Activity-wise, Jatra *Guthi* (for arranging seasonal religious fares), Dharmashala *Guthi* (for maintaining public rest houses), Si *Guthi* (for conducting death rites and rituals), Hiti *Guthi* (for the maintenance of pouts) etc. were important Guthis. After the construction of Hiti for the public purpose, a public fund for the maintenance of Hiti was established. The income of the crops in the fertile land allocated to such *Guthi* would be the resources of Hiti *Guthi*. The people responsible for running such *Guthi* could perform annual Puja in the day of erection of the Hiti.

After the construction of the temple, *Hiti*, pond, Pauwa or others either from the state or from the individual effort- a tradition of keeping Shilapatra (stone inscription) was prevalent during Lichchhavi and Malla periods. It continued during Shah and Rana regimes too. These inscriptions are still intact and can be read easily. They are mostly in Newari Ranjana script (and some of then are even in Sanskript script). In these inscriptions, strict rules and regulations had been envisioned for the maintenance of the ancient glories. Sources of resource generation and criteria of punishment for misdeeds have also been mentioned.

Strict rules and regulations were devised by King Jeetamitra about the use of water for drinking purpose and irrigating in the farming areas and even for running water mills, though the religious worship in the Taleju temple would get the foremost and primary water rights. The full text of it reads as follows (Wright, 1990): "The overseers of the water-course do not give water fairly to the people, therefore the following arrangement is being made. At the time of planting rice the people are to make a watercourse, and every one going to work at this, after doing a day's work, must come and get a certain royal token (to entitle him to a share of the water). He who cannot produce this token shall be fined 3 *dams*[5], but not more that that amount. The overseers are not to levy any duties for allowing water to be taken from the channel. The rank of people is not to be taken into account in distributing the water, but every one is to get a supply in turn. If the overseers do not allow water to be taken in turn, the head-officer shall be fined six mohars. By obedience to the above rules Iswari will be pleased; by disobedience she will be displeased. Sri Sri Ugra Malla, Sri Sri Bhupatindra Malla, and Chautara Dukhibhagirama have assisted in making this arrangement. The 15th of Jeth Sudi, Nepal Sambat 803 (A.D. 1683)".

Super Natural Belief

Most of the *Dhunge Dharas* or even many ponds in Bhaktapur built during Lichchhavi era are associated with *Tantrik Shakti*. As per the local belief, people used to excavate a bit in the earlier day in the course of constructing *Hitis* and ponds and wells. They were surprised to find full excavation and erection of *Dharas* or ponds on the next morning. Such belief is associated with the Bhimdyo *Hiti* near Dattatreya temple. During the excavation works undertaken by the experts of Bhaktapur Development Project some 30 years ago in order to explore the source of this *Dhara*, they went ahead towards

5 1 paisa= 4 dams.

Dhatttreya temple starting from its periphery. In between the Dhattatreya temple and Bhimsen temple lying near the *Hiti*, an inscription was found lying where it was explicitly forbidden to dig further. If disobeyed, no water would flow from the *Hiti*. Later, German experts too abandoned excavating. Instances are many where such disobeying has resulted the drying out of water.

Current Modes in Water Management

Community Efforts

The political change of 1950 weakened the *Guthi* system which used to manage land and other historical and cultural heritages. Large acres of land under *Guthi Sansthan* have been encroached these days by the influential elite. *Guthi* Sansthan is passive towards such unscrupulous activities. It is virtually facing chronic crunch of resources for the maintenance of ancient heritages and at present has turned blind eyes towards these spouts, ponds and other water structures. So, *Hitis* along with other historical monuments are quite vulnerable with the acute lack of maintenance fund that used to be earmarked earlier through *Guthi*. Somewhere, private community *Guthi* is found where local Newars contribute voluntarily for the continuation of their religious functions and maintenance of heritages. Many of the *Hitis* and ponds are in need of funds for appropriate maintenance.

Semi-government Institution (Municipality)

There is a heritage branch under the Bhaktapur municipality which is keeping the updated information of all the ancient cultural glories of the city. It has kept the inventory of stone spouts, ponds, dug-wells, temples, *Pati/Pauwa* and other such heritages. Through the publication of monthly magazine "Bhaktapur" by this municipality, these cultural heritages have been highlighted and their real status are brought into the public gaze. Besides, the respective wards of the municipality are responsible to carry out the maintenance and repair of all these heritages. The meeting minutes incorporating the agenda, decisions made and others are published in different issues of the aforesaid magazine. There is a clear-cut system of allocating budget and making these cultural infrastructures intact with the best effort of municipality fund. However, with the constant changing of central government and its subsequent impact in the reshuffle of the local level representatives, the pace of such maintenance is on retardation.

Many of the ancient water heritages have been vanished. Some have been damaged and only their remnants are visible. Others are in vulnerable condition. The concerned bodies such as Department of Archeology, *Guthi Sansthan*, need to give due attention for conservation and maintenance.

CONCLUSIONS

As defined by eminent evolutionist Edward Burnett Tylor, "Culture is that complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities acquired by man as a member of society". Thus, culture is the guiding notion of human being in the interaction and assimilation with the society. This study comprises the detailed case documentation of five stone spouts and four ponds within Bhaktapur city to understand the traditional modes of water management in this city. These age-old practices have substantial impact in the community management of water resources. Everyone used to abide by the belief, custom, norms, values and mores and they were instrumental in conserving and preserving the ancient infrastructures and water heritages. People at large had high degree of religious and cultural significance to the stone spouts and ponds in addition to the temples.

The study findings show that these water sources used to cater the multiple needs of the people such as drinking, bathing, washing, fish farming, livestock purpose and irrigating the low-lying farmlands, especially for paddy and winter vegetables. Moreover, water from many stone spouts were primarily used for the worship of the Gods and Goddesses. Some of them were constructed on behalf of state whereas others were by the individuals and community alike. The driving forces for their construction were to earn merit and religious piety. As revealed by the study, local Newars only in Bhaktapur take bath from nine stone spouts facing towards east in the day of Janai Purnima. It is believed that such bath will refrain the people from the natural calamity as well as from other physical diseases.

The maintenance and cleaning of these water heritages were carried out through enthusiastic participation of all the people living in a particular community in the day of *Sithi Nakha*, a local festival. On the other hand, belief in supernatural power was immense among the people in the past and many of them still believe that with the only grace of mystic or supernatural power, some water heritages are functional today. In many stone spouts and ponds, *Guthis* were instituted and adequate fertile lands were allocated to them. The income of these lands used to go for their maintenance. Explicit rules and regulations had been envisioned by installing the stone inscription around them, the non-compliance of which would stringently be dealt with. Thus, the indigenous water management practices prevalent during those days were quite effective.

As documented in this study, *Raj Kulo* constructed during the reign of King Jitamitra Nagarkot was used to feed water into Sundhara which was used to carryout worship of Goddess Taleju in Thanthu royal palace. Many other stone spouts in this city also used to utilize the water source of *Raj Kulo*. Besides the local farmers used to irrigate their paddy farm by this water. Even water mills were in operation during yonder years with the same source. Thus, *Raj Kulo* was the lifeline of agrarian people in Bhaktapur. The underlying notion of the Integrated Water Resources Management (IWRM) was thus quite effectively realized even during the medieval period.

As per the study findings, many sources of stone spouts dried following the disruption of *Raj Kulo*. As a result, many of the ponds which relied on the source of stone spouts also turned non-functional. Only those spouts having their own independent sources are running today. With the installation of modern piped system during the reign of Rana premier Bir Shamsher in1896, water was available at every corner of the city. Consequently, the earlier sources have been left redundant. The Department of Archaeology and *Guthi Santhan* were the responsible institutions for the upkeep and maintenance of them. Unlike the past days, there is neither any *Guthi* nor any regular resources nor any maintenance fund of these water glories today. Their effectiveness is par below in this regard. Municipality is taking charge of maintenance of them now-a-days.

Though some of the stone spouts have satisfactory water yield, hardly few of them have potable water for human use at present. The water quality of them has drastically degraded. If treated well with viable means, these sources can supplement the modern water supply, thus contributing for the reduction of the water stress of the city. Likewise, water retained by the pond can be used for secondary purposes such as fish farming and irrigation. These are the reasons why their intactness is of immense significance even today. On one hand, these living heritages are cultural pilgrimages for the natives because of their religious values and on the other, they are the famous tourist-destinations because of their exquisite artistic design. One of the four IWRM Principles (the Dublin principles) states that "Water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels". To keep this spirit alive, the onus of conserving and preserving these heritages-emblem of religious and cultural assets-lies equally on the government, municipality, local clubs and NGOs as well as the local youths.

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Equity Dimension

FARMER'S INCENTIVES TO PARTICIPATE IN IRRIGATION ACTIVITIES: FINDINGS OF CASE STUDIES IN KATHMANDU VALLEY

FUMIO OSANAMI AND NEERAJ N. JOSHI[1]

INTRODUCTION

Irrigation water is the local public good that is provided by farmer's collective work in Nepal. This paper analyzes the farmer's incentives to participate in irrigation activities by comparing two irrigation systems in Kathmandu Valley. For this purpose, two typical irrigation systems; one Khokana Irrigation system of Lalitpur district with well organized Water Users' Group (WUG) and another Shali Nadi Irrigation system of Sankhu in Kathmandu district with not so well organized WUG, were selected.

The survey conducted focused on the management practices based on randomly selected farmers' fields by zone based units on GIS.[2] The study covered the formation of WUG, its management system, water distribution pattern, User's participation and the analyses of the differences of agricultural productivity.

THE FARMER'S GROUPS IN IRRIGATION SYSTEM

Khokana irrigation system (**Figure 1**) is located in southwestern part of Lalitpur district of Kathmandu Valley. This irrigation system supplies water for 250 ha of the agricultural land of Khokana village benefiting about 1,000 households (**Table 1**).

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[1] Professor, Graduate School of Agriculture, Hokkaido University, Japan; and Sociologist, Nepal Forest Resources and Institutions Research Program, Nepal.

[2] The shape and location of the irrigation canals, beneficiary irrigated area and respondent's farmland plot location were mapped by GIS overlaying the ordinary map scaled 1:10000.

Table 1: Comparison of Two Irrigation Systems

Characteristics	Name of Irrigation on Systems	
	Khokana	**Shali Nadi****
Establishment	>200 years	>200 years
Type	Natural gravity	Natural gravity
Length of main canal (km)	4.7	2.7
Command Area (ha.)	250	74
No. of farm households associated	1000	230
VDCs covered by irrigation System	Khokana, Thecho, Chhampi, Sainbu, Bungmati	Bajrayogini, Pukhulachhi, Suntol
****Area and number of farm households in Shali Nadi is estimated based on the field study excluding Pukhulachhi.**		

Source: Farm Survey, 2001.

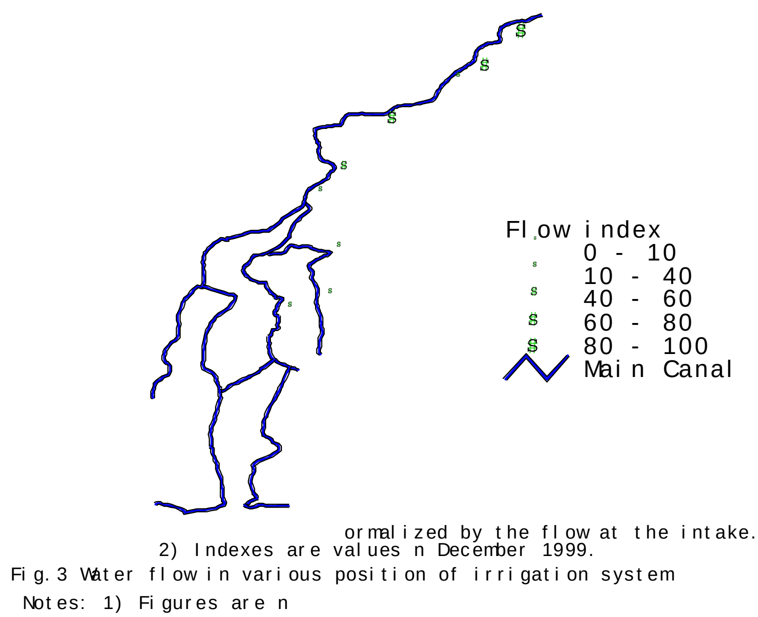

Figure 1: Khokana Irrigation System Layout

The beneficiary households were spread over not only in Khokana Village Development Committee (VDC) but also in Thecho, Bungamati and Sainbu

VDCs. Out of the total beneficiary households, 150 are from Chhampi, Thecho, and Bungamati VDCs and 70 from Sainbu VDC, while 780 households are from Khokana VDC alone. The beneficiaries have been formally registered a WUG at the Chief District Officer's Office (CDO) at Lalitpur District in 1996. Although, WUG has existed there for more than 200 years as an informal organization. The system has recently been rehabilitated with the technical and financial assistance through the Second Irrigation Support Program (SISP) funded jointly by Asian Development Bank (ADB) and His Majesty's Government of Nepal (HMG).

The WUG has been maintaining and operating the irrigation system by following the traditional practices by employing canal operators locally known as *Dhalpas* on a contract basis. The *Dhalpas*, who are presently associated with a local religious-cultural group known as *Thalachhen Dapa Khala*, is responsible not only for cleaning the canal but also to look after the smooth distribution of water for irrigation purpose. Among many social-religious groups in Khokana, Thalachhen Dapa Khala is a group of young people organized to play musical instruments during those festive days in Khokana. (*Dapa* is a kind of musical drum played by the local people.) The WUG has been taking care of the social and institutional system of the irrigation canal, while the religious- cultural group operates the entire physical system. About 80 persons were contracted for the repair and maintenance of the canal.

The availability of formal water users' group in Khokana Irrigation System means that there are rules to abide by the users. The beneficiaries are required to pay the charge for using irrigation water in terms of kind or fixed amount of rice and wheat per household per year. The charge paid by the beneficiaries is collected and use to hire *Dhalpa/s* who take care of the canal and conduct minor repair by himself/or a group of members of the *Dapa Khala*.

The study observed a change in the cropping pattern, i.e., paddy-vegetable, which is more profitable, from its traditional pattern of paddy-wheat, after the rehabilitation. This is an indication of the fact that the canal rehabilitation has increased the performance of the canal in terms of both adequacy and timely supply of water as demanded by the farmers for farming activities.

Figure 2: Shali Nadi Irrigation System Layout

Shali Nadi Irrigation System (**Figure 2**) of Sankhu village located in northeast of Kathmandu Valley is another irrigation system selected for the study. This system has a command area of about 74 ha[3] benefiting about 230 households.[4] As in the case of Khokana, the beneficiaries of Shali Nadi Irrigation System extend to three VDCs; Bajrajogini, Pukhulachhi and Suntol VDCs (**Table 1**). The farm survey of 1997 shows that out of 40 farmers surveyed, 35 percent of farmers have their agricultural land located in the head end while the rest 65 percent in the tail end. The irrigation system was a traditional system established more than 200 years ago (**Table 1**) and operating informally without the formal status of WUG (**Table 2**).

Table 2: Performance of Irrigation Maintenance Work

	Khokana	**Shali Nadi**
Organization	Water Users' Group	No
Membership fee	Compulsory	No
Maintenance work		
Performance	Well organized	Not well organized
Farmer's participation	Contracted group	Some farmer's group
Recent rehabilitation conducted	2000	1995
	HMGN (Second Sector Irrigation Support Project)	INGO(Plan International)

Farmers of this area have recently started taking multiple crops, including cash crop such as potato which is gradually changing from subsistence

3 The area is the estimated actual area that we mapped and estimated by GIS method.The area does not include the irrigated area in Pukrach and potential irrigated area . The command area of the scheme is about 150 ha.

4 The number of H/Hs is estimated in the field study conducted in 2000.

farming to commercial farming. Irrigation has been very critical in bringing this change. The farmers of the head-end with obvious advantage, practicing multiple crops, were found to be rather inactive in canal maintenance. On the other hand, farmers from the tail end depend on the traditional cropping pattern of rice-wheat due to scarcity of water in winter. The role of farmers at the downstream of the irrigation system with most of their plots far from canal was found to be very critical in maintaining canal. At preset downstream-farmers have strong economic motivation and take an initiative to raise the fund to improve the main irrigation canal, which is located in upstream area.

In the absence of WUG, an informal group organized by a progressive farmer during the rehabilitation works was found to be effective in maintaining the canal. This finding deviates with the findings of previous studies and basic understanding that formal institutions like WUG is necessary to organize canal maintenance.

CONVEYANCE COST AND CONGESTION COST IN IRRIGATION SYSTEM

To analyze the formation process of WUG , the two categories of cost like conveyance and congestion cost of irrigation water use should be identified.

The conveyance cost is very important to understand the small-scale natural gravity irrigation systems in Nepal. Most of small irrigation systems use temporary intakes and canals, which have very simple structure using natural rocks and stones according to the physiognomy. The traditional systems provide stable amount of irrigation water and they are maintained at lower cost than that of recently constructed. The farmers by themselves are making the intakes in indigenous way or maintaining their water courses, usually collectively in community. The informal WUG is formed easily in such system. They usually do not have a strict water use rule.

In case of Khokona, the conveyance cost is expensive because the length of main canal from intake to the irrigated area is very long and located in very steep slopes. Most farmers who irrigate in downstream area, recognize easily the high conveyance cost of irrigation water. Thus the establishment of WUG, which has some rules, is very effective for all users to avoid the free rider.

The Nakhu River is the source of the Khokana irrigation canal, located at the height of 1,420 meter above sea level. The Nakhu River is a tributary of the

Bagmati River, flowing through the narrow valley in between two hills from Tika Bhairab. The intake of the canal is located at the left bank of this river and extends about 4.7 km towards the north and northwest. The agricultural field receiving water from this irrigation system is located in between the two rivers, Nakhu and Bagmati. There are three other canals from the same river besides the one managed by this WUG of Khokana Village. Two canals were managed separately by people from Chhampi and Bungamati Village Development Committees (VDCs) while a smaller canal is privately managed by a farmer to operate a water mill, located at Bungamati VDC. The intake of the canal is located at point B^2 (**Figure 1**). The overall length of the canal is 1.3 km. This means that payment for the conveyance cost is necessary for all farmers to use irrigation water.

Table 3a : Change in Landuse Pattern and Cropping Intensity in Khokana

Zone		Before rehabilitation				
No.	Area (ha)	Rainy Season	Dry season			Cropping intensity
	Number of respondents	Paddy	Wheat	Mustard	Others	
1 Up	63.9	63.9	43.7	8.2	5.0	189
	28	100	68	13	8	
2 Down	74.6	74.6	61.9	0.6	6.9	193
	27	100	83	1	9	
3	44.4	44.4	26.1	2.3	14.1	196
	17	100	59	5	32	
4	49.2	45.2	6.8	41.1	5.4	200
	17	92	14	84	11	
5	40.6	39.3	13.3	20.9	1.3	184
	17	97	33	52	3	
Total	272.7	267.4	151.7	73.1	32.7	192
	106	98	56	27	12	

Source: Farm Survey, 2001.

The rehabilitation of the canal shows the changes in cropping pattern and increase in cropping intensity. In Khokana, a change is seen in growing other crops than the traditional rice-wheat to other crops including potatoes and vegetables. During the survey, the area was classified into 5 zones of which zone 1 is classified as upstream and zones 2 to 5 are downstream. The change in cropping pattern is seen mainly towards the upper parts from zone 1 to 3. However, the cropping intensity is a little less than 200 percent, which is a traditional level in Kathmandu valley. The change in the cropping pattern is remarkable due to the effect of canal rehabilitation in the case of upstream that farmers are growing other crops than wheat while it is only the expansion of traditional cropping pattern towards the downstream, **Table 3a** and **Table 3b**.

Table 3b: Change in Landuse Pattern and Cropping Intensity in Khokana

Zone	**After rehabilitation**					
No.	**Rainy Season**	**Dry season**			**Cropping intensity**	**Change of Cropping intensity**
	Paddy	**Wheat**	**Mustard**	**Others**		
1 Up	63.9	20.9	10.0	24.7	187	98.8
	100	*33*	*16*	*39*		
2 Down	74.6	54.9	0.4	17.7	198	102.5
	100	*74*	*1*	*24*		
3	44.4	8.1	2.3	32.2	196	100.0
	100	*18*	*5*	*73*		
4	48.8	12.4	34.6	1.7	200	99.9
	99	25	70	3		
5	40.6	18.8	18.8	2.0	198	107.3
	100	*46*	*46*	*5*		
Total	272.3	155.0	66.1	78.2	195	101.4
	100	42	24	29		

Source: Farm Survey, 2001.

Rehabilitation of the canal was important for the farmers due to the benefit they obtain. **Table 4** tries to answer the questions whether the accessibility of water has changed after the rehabilitation. It is understandable that the quantity and timing of water availability has improved. The change was seen from the result that 18 households out of 61 replied “sufficient” about the quantity while secured water availability was insufficient before the canal rehabilitation. Similarly, 11 households out of 26 have changed to sufficient from insufficient for wheat cultivation in dry season.

Table 4: Change in Accessibility of Irrigation Water after Canal Rehabilitation, Khokana

	Before	After	No. of respondents (households)			
			Rainy Season (Paddy)		Dry Season (Wheat)	
Volume of water	Adequate	NA	0	0.0	11	15.7
		Adequate	39	38.2	21	30.0
		Not adequate	2	2.0	0	0.0
		NA	0	0.0	12	17.1
	Not adequate	Adequate	18	17.6	11	15.7
		Not adequate	43	42.2	15	21.4
			102	100.0	70	100.0
Water supply	Timely	NA	0	0.0	11	19.0
		Timely	20	19.6	9	15.5
		Not timely	26	25.5	6	10.3
			102	100.0	58	100.0

Source: Farm Survey, 2001

Table 5 shows the result of the extent of benefits that the farmers received with the rehabilitation of canal as compared to the expenses they pay for the water use. 36% of the farmers replied that they received benefits from the payment for the water and only 4.7% of the farmers replied as to not receive any benefits. It can be considered that most of the farmers are satisfied with the canal rehabilitation.

Table 5: Extent of Benefit Received after Canal Rehabilitation, Khokana

	Much more	Same as before	Less than before	NA	Total	Remarks
Response No.	38	62	5	1	106	Farmers are asked the extent of benefit they received compared to what they pay as water fee.
	35.8%	58.5%	4.7%	0.9%	100%	

Source: Farm Survey, 2001

Again regarding the change in productivity after canal rehabilitation, **Table 6** shows the change in yield of rice, wheat and rapeseed. Although it could be seen that there is an increase in production in zones 1 and 2, however, according to the t test, the yield difference is not statistically significant. Therefore, it is not accepted that the canal rehabilitation affected the increase in production of rice and wheat, although it has initiated the cultivation of vegetable in the upper zone and is resulted in labor saving concerning the maintenance of the canal.

Table 6: Changes in Yield after Canal Rehabilitation, Khokana

	Zone 1,2	Zone 3,4,5	Remarks
Rice n	52	46	• Unit: Muri/Ropani • Differences are derived from the yield before and after canal rehabilitation • n is the sample number • According to the t test none of the yield differences are significant • One Muri Paddy, Wheat and Rapeseed are 50, 56 and 54 kg respectively.
Difference	0.134	-0.248	
Wheat n	31	15	
Difference	0.167	-0.032	
Mustard n	2	20	
Difference	-	-0.192	

Source: Farm Survey, 2001.

The other important cost is congestion cost; for instance in case of free highway, more drivers use the highway, more congestion cost [5] they have to pay, such as the traffic jam and the traffic accident. In developed economy, farmers face more competitive use of water among the beneficiaries under the scarcity of irrigation water. They might have the water dispute; usually they do not pay the cost by cash but pay by loss time for negotiating and reduction of production.

In absence of the formal WUG in Shali Nadi Irrigation System, farmers benefit from the rehabilitation of the canal. The benefit to the farmers is considered more in comparison to that of Khokana irrigation system. Since there are no fixed rule of timing of water supply for irrigation as in Khokana, farmers specially in the upstream area can irrigate their field anytime and so many of them have changed their cropping pattern. They have gone for commercial farming growing potato (summer potato and winter potato) due to the availability of water all the year from the canal.

[5] The congestion cost is one of the major characteristics of public good by Uzawa(1955). Pure public good is defined as good that has the characteristics of non-consumptive use and non-excludability of users. Uzawa(1971) criticized the concept of pure public good and proposed the new concept, Social Capital Provided Collectively, which include the characteristic of congestion; for instance in case of free high way, more drivers use the highway, more congestion cost they have to pay, such as the traffic jam and the traffic accident. The Social Capital Provided Collectively is defined as the necessary capital for people’s life and health, which should be provided without any congestion .

The cropping pattern has changed considerably in the Shali Nadi area that large area has been cultivated with three crops than the traditional paddy and wheat. As seen from **Table 7**, the traditional cropping pattern of paddy-wheat has been changed to paddy and vegetable specially potato which is grown two crops after paddy. The paddy-summer potato-winter potato is seen towards most of the upstream and midstream area while the downstream area has remained to paddy-wheat due to less access to water.

Table 7: Cropping Pattern of Farmland Located around the Canal, Sankhu (%)

Cropping Pattern	Upstream	Mid Stream	Downstream
Paddy-wheat	7.4	6.9	78.2
Paddy-summer po-winter po	72.3	56.4	0.0
Paddy-summer potato	12.3	0.8	0.0
Paddy-winter potato	6.2	19.9	8.5
Summer potato	0.0	9.2	0.7
Others	1.8	7.1	12.7
Sub-total	100.0	100.0	100.0

Source: Farm Survey, 2001.

The rehabilitation of the canal has exceeded the cropping intensity of 200 in Shali Nadi area. Cropping intensity in zone 2 has reached up to 289 while it is 284 in zone 1. Zone 4 at the downstream also exceeded 200 but still lower than the upstream. This shows that farmers from the upstream area have access to water not only in rainy season but also throughout the year. This does not mean that the farmers in the downstream area are not receiving water from the canal that they have some secured water for wheat cultivation if not diversify to potato crop.

Table 8: Cropping Pattern by Zone in Sankhu, 2000

Zone	Cropping Pattern					Cropping Intensity
	R-W	R-SP-WP	R/SP/WP/W	Others	Total	
1	0	46	2	3	51	284
	0.0	90.2	3.9	5.9	100.0	
2	1	38	4	2	45	289
	2.2	84.4	8.9	4.4	100.0	
3	24	24	8	3	59	243
	40.7	40.7	13.6	5.1	100.0	
4	35	1	1	1	38	203
	92.1	2.6	2.6	2.6	100.0	
Total	60	109	15	9	193	256
	31.1	56.5	7.8	4.7	100.0	

Source: Farm Survey, 2001

The survey of Shali Nadi irrigation system has shown that the involvement of farmers from downstream become important for making easy accessibility of water towards downstream. Of course there are some free riders from the upstream area taking the benefit from the canal rehabilitation but they will be benefited anyway being near the canal intake.

The intake from Shali Nadi river and the distance from the intake to the upstream irrigated area is very short, about 300 meters. The main canal to the upstream irrigated area was destroyed in monsoon season every year before they change the canal structure itself several years ago by Bajiriyogini VDC budget. The main canal conveyance cost is recognized by not all beneficiaries but upstream farmers.

Although farmers do not have to pay the members fee for the canal management, farmers have to pay the cost in different form for irrigating their area. As shown in **Table 9**, farmers not only have to spend time in bringing water to their field they also have to spend time in negotiating with

Table 9: Time Allocation for Irrigation Activity on Farm Level in Sankhu 2000

	Zone	**No. of sample**	**Average Hours**	**Average hours per Ropani**
Waiting time	1	51	6.9	3.3
	2	45	17.0	8.0
	3	59	20.9	10.9
	4	38	37.4	17.5
Negotiating time	1	51	5.1	2.0
	2	45	7.9	5.6
	3	59	8.8	4.0
	4	38	4.0	2.0
Watching water	1	51	4.3	1.8
	2	45	7.7	3.3
	3	59	12.2	6.0
	4	38	12.5	7.1
Negotiating time	1	51	5.1	2.0
	2	45	7.9	5.6
	3	59	8.8	4.0
	4	38	4.0	2.0

Source: Farm Survey, November 2003

the farmers from the upstream. The most benefited farmers from around zone 2 and 3 also have to spend considerable time for waiting and negotiating time. Conflict becomes a common thing during winter and that mainly occurs at the night, as farmers want to take turn to irrigate in the night since farmers from the downstream do not have chance in the daytime.

It is remarkable that the farmers from zone 4 have to wait long hours for water to come and require long time watching whether water do not terminate for the required time period.

The rehabilitation of canal although regarded as important, the participation of downstream becomes critical. Answering the question on the priority to solve the irrigation water allocation, rehabilitation of canal was considered the most important from among the four questions, increasing water in the canal, rehabilitation of canal, distribution method and making concrete rules. Farmers were asked to rank the questions from 1 to 4 numbers according to their priority as shown in **Table 10**. Although maintenance of the canal is important, response on cost bearing from **Table 11** give the indication that farmers would want to contribute in kind and not in cash. Almost all the respondents (more than 80%) answered to contribute labor during rehabilitation works but they (more than 90%) are not ready to pay to hire labor for the works.

Table 10: Farmers' Priority for Solution of Irrigation Water Allocation between Farmers' Group, Sankhu

Zone	Increasing water	Rehabilitation of canal	Distribution method	Making Rules	Total	Remarks
1	5	39	5	2	51	• Figures based on the responses regarding important thing in order from 1 to 5 • Figures are the number of respondents and figures in italics are the share percentage in each zones
	9.8	*76.5*	*9.8*	*3.9*	*100.0*	
2	7	32	4	2	45	
	15.6	*71.1*	*8.9*	*4.4*	*100.0*	
3	8	49	1	1	59	
	13.6	*83.1*	*1.7*	*1.7*	*100.0*	
4	5	32	0	1	38	
	13.2	*84.2*	*0.0*	*2.6*	*100.0*	
Total	25	152	10	6	19.	
	13.0	78.8	5.2	3.1	100.0	

Source: Farm Survey, 2003

Table 11: Willingness to Pay for the Maintenance of Irrigation Canal, Sankhu (Number of respondents)

Zone	No	Yes	Total	Remarks
1) Contribution in terms of labor				Figures in italics indicate the percentage
1	6	45	51	
	11.8	*88.2*	*100.0*	
2	6	39	45	
	13.3	*86.7*	*100.0*	
3	7	52	59	
	11.9	*88.1*	*100.0*	
4	10	28	38	
	26.3	*73.7*	*100.0*	
Total	29	164	193	
	15.0	*85.0*	*100.0*	
Zone	**No**	**Yes**	**Total**	
2) Contribution in terms of cash for hired labor				
1	48	3	51	
	94.1	*5.9*	*100.0*	
2	43	2	45	
	95.6	*4.4*	*100.0*	
3	57	2	59	
	96.6	*3.4*	*100.0*	
4	37	1	38	
	97.4	*2.6*	*100.0*	
Total	185	8	193	
	95.9	*4.1*	*100.0*	

Source: Farm Survey, 2000

FARMER'S INCENTIVES AND THE ROLES OF FARMERS' GROUPS

This paper shows the importance of conveyance cost and congestion cost for irrigation canal maintenance activity. In absence of WUG, an informal group organized by a progressive farmer during the rehabilitation works was found to be effective in maintaining the canal as shown in Shali Nadi irrigation system. This finding deviates with the findings of previous studies and basic understanding that formal institutions like WUG is necessary to organize canal maintenance.

In case of Khokana, the conveyance cost is high and all farmers recognize the importance of collective work for maintenance of main irrigation canal. They organize WUG formally and pay membership fee, which enables to hire the labor for main canal maintenance. Contrarily it is difficult to make consensus among farmers in Sankhu. Upstream farmers are reluctant to cooperate with downstream farmers who want to increase their availability of irrigation water in dry season. Congestion cost has become very important and downstream farmer pay more cost at present. Considering that the traditional water use rule was formed under the traditional cropping rotation system, rice-wheat, the water use in dry season should be re-allocated to achieve more equity use between upstream farmers and downstream farmers.

At present, downstream-farmers have strong economic motivation and take an initiative to raise the fund to improve the main irrigation canal, which is located in upstream area; upstream farmers become free rider but in longer term they have to pay to achieve the optimal of resource allocation.

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A STUDY, UNDER GAP-MOM PROJECT, ON SCHEDULING WATER DELİVERY AMONG THE FARMERS IN A TERTIARY CANALETTE SYSTEM OPERATING BY A WATER USERS' ASSOCIATION IN HARRAN PLAIN, TURKEY

HUSEYIN GUNDOGDU, RUPERT W. ELLIS AND FIKRET EYUPOGLU[1]

INTRODUCTION

Agricultural sector is a very great off importance role in Turkish economy from the period of foundation of Turkish Republic. Increase in employment, improvement in export and rapid growth in economy are directly related with the development of agricultural sector. Improvement of agricultural sector supports the development in other sectors as well. The agricultural improvement is mainly depending on irrigation. Because Turkey has Mediterranean climate condition, which is, cold rainy winters and dry summers. The precipitation is unevenly distributed and ranging from less than 250 mm in the central Anatolia to over 2 500 mm in the Black Sea Coast.

As a crossroads of civilization, Anatolian Peninsula is a land with fascinating open museums of innumerous water structures built over the last 400 years. There are some structures from Hittites (BC 2000), Urartians, Romans, Byzantines, Seljuks and Ottomans. Remnants of water structures for domestic water supply scattered around Turkey stand as impressive engineering masterpiece of their era. Çumra Project was the first modern irrigation and drainage project, which was designed and constructed before The Republic of Turkey by the Ottoman Empire between 1908 and 1914. After the foundation of Turkish Republic in 1923, the development of water resources in the country was in a high priority. Until the establishment of The State Hydraulic Works (DSI)-which is the major government agency for water resources development in 1954, several small-scaled projects were designed and constructed. After the establishment of DSI irrigation development was rapidly progressed (Ozlu et al, 2002).

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[1] Agricultural Engineer, DSI 2, Bolge Mudurlugu-Bornova-Izmir, Turkey; Civil Engineer, HALCROW Rural Management Ltd. England; and Agriculture Engineer, GDRS Soil and Fertilizer Research Institute-Ankara-Turkey.

There are two state agencies responsible for development of water resources in Turkey, namely The State Hydraulic Works (DSI) and The General Directorate of Rural Services (GDRS). The GDRS is working on generally small-scaled irrigation projects and DSI is the main executive state organization for overall water resources planning, implementation and operation.

There is 4.87 mha area under irrigation. 2.71 mha is developed by DSI, 1.16 mha is developed by GDRS and the remaining 1.00 mha area by the farmers themselves up to 2002 (Erdogan et. al, 2003). Irrigation in Turkey was managed by the state until recent years. Some small-scaled irrigation schemes were transferred in early 60s. It has been said that these slow-paced transfers were considered the pioneering works for the PIM concept to be adopted in Turkey. Farmers had been encouraged by DSI as forming Water Users Groups (WUGs) in those years. These activities were considered a transitory process for a larger scale transfer. Around 2000 ha areas were transferred until 1993. The transfer program was accelerated deliberately in the regions where WUGs existed. Transfer program has been rapid after 1993 and now around 1.7 million ha areas have been transferred to the water user organizations (Ozlu et. al, 2002).

The transferred irrigation systems have reached 1.7 mha as to June 2003. Most of them have been transferred to the WUAs. **Table 1** shows the distribution of the transferred area to the different organizations (Ince et. al, 2003).

Table 1: The Distribution of the Transferred Irrigations as to The Organizations

Organizations	Number	Ratio (%)	Area (ha)	Ratio (%)
Village Authority	214	30.3	34 238	2.0
Municipality	134	19.0	56 588	3.3
WUA	299	42.3	1 551 262	91.0
Cooperative	56	7.9	61 349	3.6
Other	4	0.6	1 032	0.1
Total	707	100	1 704 469	100

DSI in general and GAP RDA in local are supporting the WUAs on strengthening the organizational and technical abilities by organizing training and implementing projects (such as GAP-MOM Project).

SOUTHEASTERN ANATOLIA PROJECT (GAP)

GAP project area, where the irrigation water delivery programming was done, lies in Southeast part of Turkey. The project area consists of eight provinces, corresponding to approximately 10 percent of Turkey's total population and surface area. The project area includes watersheds of the lower Euphrates and Tigris Rivers and upper Mesopotamian plains. The total surface area is 7 300 000 ha, of which 42.2 % is cultivated (36 % rain-fed farmland), 33.3% pastures, 20.5% forest and bush (Unver, 1999). The Southeastern Anatolia Region of Turkey has been historically a low-productive plateau lying at the foot of the Taurus Mountains. The region is rich in water, land and human resources. In terms of water, both the Euphrates and Tigris rivers represent more than 28% of the surface waters of the country. The region has more than 20% of all economically irrigable land at the national level. According to the 1997 census, the ratio of working age population living in the area is above 48%. However, irrespective of all these strengths, the GAP region has lagged far behind the rest of the country in terms of development indicators such as per capita income, life expectancies, infant mortality rates, literacy rates, manufacturing activities and health and infrastructures. Average Household Income in this region is far below other regions. For example, In Diyarbakir, one of the province, in the region The average household income is 3 657 $ at the exchange rate of the year 2000 (national figure is 5 503 $) (Unver and Gupta, 2002).

However, It was the vast development potential of both the Euphrates and Tigris rivers which in the 1960s contributed to the idea of harnessing their water for irrigation and hydropower generation. Towards the end of 1970s, the DSI planned a series of land and water resources development projects on these two rivers under the name of Southeastern Anatolia Project. According to the present plan, by the year 2010, the GAP Project is expected to generate annually 27 billion kilowatt hours of hydroelectric energy, and irrigate 1.7 million ha of land, accounting for nearly one-fifth of the irrigable land of Turkey. This would be accomplished through the construction of 22 dams, 19 hydropower plants and extensive irrigation and drainage networks (Picture 1). The project is expected to almost double the existing area of artificial lakes to 228 136 ha in the country. The irrigated land would increase from 2.9% to 22.8% of the total area of the region. In 1989, it was decided that GAP would not only be a land and water resources development project but also a large-scale, multi-sectoral regional development activity. The project would focus not only on the economic growth based on infrastructure development, but also on the regional development taking into consideration industry, transportation, urban and rural infrastructure, environmental protection and social sectors like employment generation, health, education, capacity building, gender equity, etc. The main objective of the GAP project would be to strengthen social, economic, institutional and technical aspects of human development in an economically disadvantaged region by significantly increasing the living standards of its people (Unver and Gupta, 2002).

The investment and growth in irrigated area in the region is still continuing. Now the irrigated area has reached 215 000 ha as of middle of 2001. This growth increases the financial burden on the national budget. It was thought if it fails to perform the expectations, the seriously weakness on the economy at the region will be taken place. Also this fails will threat the sustainability of the rapid development. It was considered that the existing and proposed irrigation developments must be sustainable, the present levels of cost recovery must be increased and must be in line with world-wide trends and encouragement must be given to the greater devolution of management responsibility to the water users. The Government of Turkey through the GAP regional Development Administration (GAP-RDA), major agency for coordinating all development activities in the region, has commissioned the GAP Management, Operation and Maintenance Study (GAP-MOM) in order to identify the most appropriate management model for large-scale irrigation systems being brought into operation in the region (Kibaroglu, 2002).

GAP MAINTENANCE, OPERATION AND MANAGEMENT PROJECT (GAP-MOM)

GAP-MOM project has been initiated in 1993 by the GAP-RDA. During the preparation and implementation of the project, the related organizations, General Directorate of State Hydraulic Works (DSI), General Directorate of Rural Services (GDRS), Ministry of Agriculture, General Directorate of Agricultural Reform (GDARef), The Union of Turkish Chambers of Agriculture, have been in co-operation. The project has been executed by the joint venture formed up one Turkish company, DOLSAR and one foreign company, HALCROW.

The project up to now is considered as a unique project in Turkey in terms of its approaches, preparation, design and implementation. Especially its participatory approach, which is bottom up approach, is important:

The comments and opinions of the person who use such facilities are not referred to in general practice during the stages of planning, design, operation and maintenance of the irrigation facilities in Turkey. Upon completion of the soil and water surveys, public establishments prepare planning reports and projects, then generally engage construction firms for construction, but do not deem it necessary to have active participation in the formation of the irrigation districts and also when the operation and maintenance stage has been adopted and implementation started. GAP-MOM project has been aiming for realization of the most efficient use of soil and water resources in irrigated farming conditions in the region. That could be achieved if users have the power to control the resources. Physical structures are complex and require extensive engineering services. All steps must be taken in order to operate such complex structures in accordance with technical, economic and social criteria as well as ensure continuous development. The GAP-MOM project will endeavor to expand on-farm implementation methods compatible with irrigated farming as well as to ensure efficient participation of the farmers in the operation, maintenance and management of irrigation facilities. Farmers shall be persuaded to take leading part in the planning and development of agricultural practices. It will not be possible for each user to take individual responsibility of the operation and maintenance services. But it is deemed necessary to make the farmers using water feel that they are well represented, their rights and benefits are protected and that they have a say, through the decisions to be issued by the management. The institutional body which is operating the irrigation facility should meet the requirements of the users and enable optimum use of the resources (Kibaroglu, 2002).

The project began in 1993 and the formulation of the model was undertaken in 1993-1994. The project was suspended in 1994 and re-start in 1997. The project study implemented in 1997 and 2000. Now it continues with the GAP-RDA and DSI under bilateral protocol.

The overall objectives of the project is to form an institutional and organizational framework within the proposed model and then the management model is required to satisfy the major study objectives like maximizing the net benefits as measured in terms of the value of total agricultural production versus costs of management, operation and maintenance of irrigation schemes, ensuring the financial and physical sustainability with respect to political, environmental, financial, social and physical factors.

The main aim at the proposed model is to establish a body which is formed by the users in a democratic way having financial and organizational autonomy, self-governance, and having minimum supports, involvements and costs by the government and to be able to operate and maintain the structures in a sustainable manner. The model, which is illustrated in **Figure 1**, comprises, at the regional level, following three primary elements:

- A Bulk Water Supplier (DSI): Bulk water supplier will be focusing on the integrated water resources planning and management of major hydraulic works.
- An Irrigation System Operating Body (The Irrigation Authority): The authority is to be self-financing commercial authority and to operate and maintain primary and secondary delivery systems and to purchase bulk water from DSI for onward selling to the water user groups.
- Fully Participatory Water User Groups: The groups are to be responsible for managing water services at the tertiary levels.

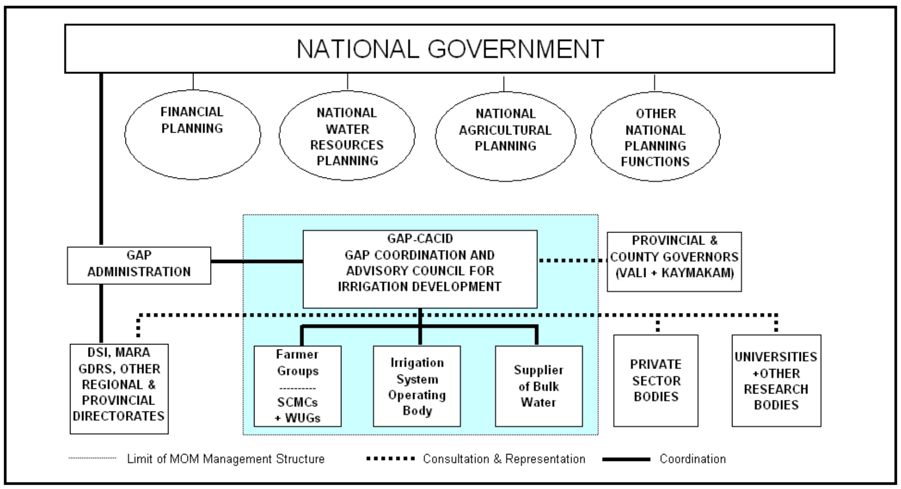


Figure 1: The Illustration of Proposed Model

The main functions to be undertaken at national level are those essentially related to economic and financial planning, policy development, resource use planning and inter agency co-ordination for activities that have nationwide effects. Within the water resources sector key functions to be undertaken at national government level include: Total water resources assessment and integrated resource planning; establishment of water management policies relating to water rights of surface waters and groundwater, water quality and pollution control; development of effective water laws and other legislation to create the appropriate enabling environment for operating agencies. At the regional and provincial level, the farmer groups represent the production unit and ultimate customer for the water; their primary function is to utilize the water efficiently in order to maximize agricultural production and to bring wealth to themselves and the region. The most important skills for this group are agricultural know-how, commercial acumen and general managerial ability. The Irrigation System Operator is responsible for conveying the water from the bulk supply point to the delivery points where it is taken over by the farmer Group; the essential requirement is that the water is delivered at the time and in the quantity that is mutually agreed with the end-user. The Supplier of Bulk water is similar to that of the Irrigation System Operating Body. It is responsible for supplying water, at one or more defined points, in accordance with an agreed policy. The significant distinction is that it operates at the national level rather than the regional, river basin or scheme level of the Irrigation System Operating Body. As well as meeting the agreed demands of perhaps several Irrigation System Operating Bodies, the Bulk Supplier must plan integrated water resources development at the national and international scale to meet national policy goals and to satisfy both national fiscal constraints and environmental protection requirements (Anonymous, 1994).

During 1997-2000, in the implementation phase, there have been many activities done. The two pilot areas have been chosen. One of them is in Harran Plain where some WUAs have already existing, and the other one is Kayacik Irrigation project area where no water and WUAs are available for the time being. Firat Water User Association has been chosen for the studies as first pilot area. The activities done here summarized as follows:

- Training in irrigation and irrigated agriculture for WUA staff and other organizations which involves irrigation
- Project awareness campaign in the villages
- Establishment and operation drip, gated pipe and modified furrow irrigation demonstration areas
- Evaluation WUA water charge mechanism and levels
- Evaluation the legislative and institutional framework
- Analysis the transfer process employed by DSI for handing over completed works to WUA
- Evaluation Firat WUA management capacity and practices
- Collation current manuals and guidelines pertaining specifically to the management of WUA under current legislation
- Assessment possible improvements to the management methods required in WUA
- Preparation land holding maps and customer database for Firat WUA
- Survey crop planting patterns in Firat WUA

- Preparation, in conjunction with DSI and Firat WUA, crop water requirements and an operational plan
- Check capacity constraints and prepared operation schematics for all secondary and tertiary systems of WUA by collation design information
- Survey and preparation stage discharge measurement points in the canalets (raised parabolic canals)
- Trainings WUA staff and water distributors in use of calibrated canalet measurement methods, use of schematics and crop water requirement calculations for water budgeting and control gate setting
- Investigation the existing tertiary level water distribution patterns and methods
- Preparation, with farmers in tertiary hydraulic units, revised water allocation schedules based on equitable distribution of flow
- Monitoring flow data at tertiary, secondary and main canal level and preparation water distribution performance reports
- Evaluation the methods and procedures of Firat WUA for maintenance identification and execution
- Development the recommendations for improvements to the maintenance procedures for WUA
- Preparation an example WUA operation and maintenance manual using the infrastructure of Firat WUA as a base

In the second pilot area, the progress was limited. So second pilot area is not going to be presented here. In the paper, emphasis will be given on tertiary water allocation activities done under GAP-MOM project in Firat WUA area in Harran Plain.

URFA-HARRAN IRRIGATION SYSTEM

The Urfa-Harran Irrigation System area is situated within the Harran Plain in Sanliurfa Province and falls under the jurisdiction of DSI Regional Directorate XV. Responsibility for operation and maintenance of the system falls under DSI Sanliurfa Plain Operation & maintenance Section Directorate (SOS). The main source of water for the Urfa-Harran system is Atatürk Dam on the Euphrates River, with tunnel outlet from the reservoir conveying a maximum design flow of 328 m^3/s into the northern edge of Harran Plain. At the first complex of control structures, a design flow of 204 m^3/s can be diverted into the main conveyance canal serving the Mardin-Ceylanpinar area and the remaining 124 m^3/s is to be used for power generation at the Sanliurfa Hydroelectric Station. Tha latter flow is again divided at the Harran regulator complex, with a design peak capacity of 84 m^3/s for the Harran main canal and 40 m^3/s for the Urfa main canal. The Urfa-Harran system commands a gross irrigation area of some 145 000 ha, with the Harran main canal serving some 100 000 ha and Urfa canal some 45 000 ha. Based on a total 124 m3/s available for the 145 000 ha, the maximum design irrigation duty is about 0.85 l/s/ha (or approximately 1.0 l/s/ha based on net irrigation areas) (Anonymous, 2000). All the main supply canals have concrete lined trapezoidal sections, with capacities generally designed to meet this level of irrigation duty.

Urfa Main Canal

Cross-regulators have been constructed along the trapezoidal concrete lined canals. These structures comprise undershot sluice gates and overflow weirs, which provide upstream control for operational purposes. The sluice gates are invariably intended for manual operation. The sluice and weir complexes are designed to produce sufficient head to divert water into the Constant Head Orifice offtakes which feed the secondary canal systems. The Urfa main canal system supplies six WUAs. A schematic map for Urfa main canal system showing the main supply points into the irrigation systems is shown in **Figure 2**. The 53 km Urfa main canal itself divides, supplying the UY4 main supply canal with a gross command area of some 20 000 ha with its 19 m^3/s peak canal capacity. The canalettes are manufactured as standard pre-cast reinforced concrete sections, 5 m long. Ten different sections are used

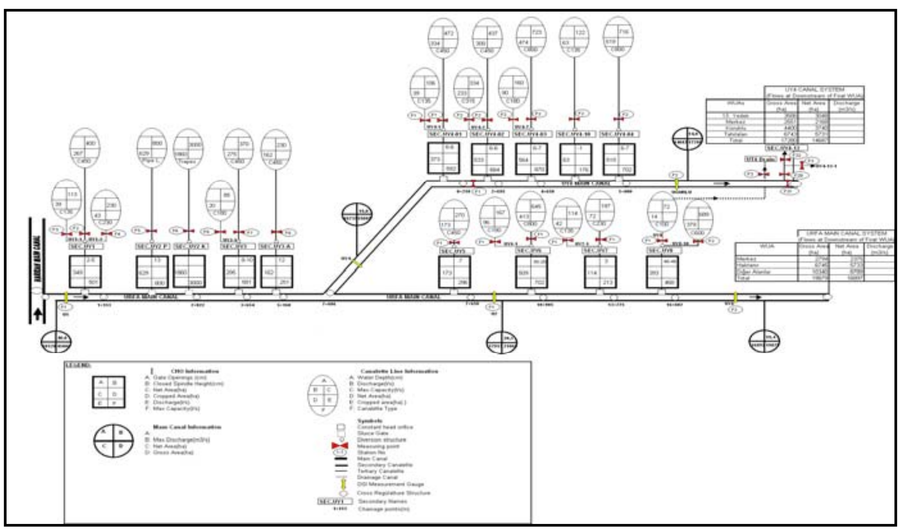


Figure 2: The Schematic of Urfa Main Canal System

varying in capacity from canalette type 70 of 80 l/s to type 1000 of 1980 l/s. Design freeboards vary from 4 to 8 cm accordingly. The two largest sizes are semi-circular in shape, the remaining sections are elliptical. Maximum canal design velocities are 1.2 m/s with bed slopes varying 0.0004 to 0.001. The pre-cast pedestals of varying lengths, depending on the topography, are anchored into the ground. Structures in the typical WUA canalette systems include division structures, checks, offtakes, siphons, drops, bends, bridges and tail-end escapes. Gated offtakes at division structures along the secondary canalette system enable supply to the tertiary canalette systems, which typically irrigate plots of land totaling 30 to 40 ha. Farmers generally use 75 mm, 100 mm or 150 mm siphons to divert water from the canalettes to their fields, in some cases employing gated pipe technology or layflat flexible pipe to convey water from the siphons to the head of the field furrows.

OPERATIONAL POLICY

The water in Harran Plain was available in 1995. On the other hand, Few WUAs have been establishing in the plain after 1995 under DSI's accelerated Transfer Programme. Fourteen WUAs have already been established in Urfa-Harran system. Six of them are on the Urfa Canal System and the others on the Harran Canal System. The efficiency of operation of irrigation systems is influenced to a large degree by the original design criteria of the system, the standards of construction and performance of the operators. The objectives of system operator:

- To deliver water, as required by farmers to satisfy the needs of irrigated crops, in the most efficient manner given the limitations imposed by the irrigation systems
- To achieve an equitable distribution of water
- To eliminate avoidable losses of water

If these operational objectives can be largely achieved, then this will go a long way towards achieving the principal objectives of the long-term sustainability and financial viability of the WUA irrigation schemes (Anonymous, 1999). There are a number of basic principles for efficient operation of the Urfa-Harran irrigation systems:

- Close co-operation of a range of people including representatives of DSI (the bulk water supplier), The WUA (the irrigation system operating bodies) and the Irrigator Group (farmers).

- Operational policy and responsibilities should be clearly defined and understood by all parties.
- Canal operations should be conducted in a planned, timely and well-managed manner.
- Uniform flow rates, planned to meet actual crop water demands, should be maintained at all levels in the systems wherever possible, with sharp fluctuations in flow avoided.
- Farmers should commence and complete their irrigation at the arranged times.
- At times of peak demand, a rationing system must be implemented to ensure that all farmers receive a reasonable share of the available supply of water

Following all these principles requires an understanding of the overall management process, careful planning of the various operations and a high degree of communication between the parties. The procedure by which this can be achieved is through preparation and implementation of an Annual Operational Plan. The policies and processes involved, the records to be kept and the communication lines required to achieve the overall objectives of an efficient system (Anonymous, 1999). DSI operational policy for the Urfa-Harran irrigation system is proposed to be set out in a future DSI O&M Manual for the system. Some of the key points that have particular impact on WUA operational policy and responsibilities include:

- WUAs to prepare and implement their operational plans based on 24 hour per day irrigation and to impose sanctions on farmers not following their plans.
- Ensuring that farmers do not interfere with DSI controlled gates and accept the principle of equitable distribution of water amongst all farmers.
- Representatives from WUAs to attend regular meetings with DSI staff to discuss, review and implement measures to address issues arising out of water distribution matters.
- To sign and implement a protocol agreement concerning the division of water usage between WUAs.
- Possible implementation of a system whereby WUAs should pay a water charge to DSI (or the main canal operator) based on volumetric measurement of flow delivered to the WUA irrigation systems.

These DSI policies have led to protocol agreements being signed by the Regional Director of DSI XV and the respective WUA Chairmen. The protocol now forms the basis of current DSI policy for operation of the respective parts of the system and the main points of important part of the future proposed Level of Service Agreement may be summarized as follows:

- Water usage must take into account environmental considerations that necessitate maintaining a certain minimum level of storage at the Ataturk dam reservoir.
- An overall annual water allocation plan is to be prepared by DSI on a weekly basis for planning delivery of the water between WUAs.
- During the peak season, appropriate division of the Urfa-Harran water between the WUAs is to be determined based on their respective command areas (in 1999 for the Urfa canal this was Firat:21%, Yedek 13:9.7%, Merkez:14.5%, koruklu:13.9%, Tahilalan:18.5% and Haktanır WUA:22.5%).
- A WUA will never receive more than its annual allocated share, although under particular circumstances DSI may amend monthly allocations.
- A WUA will be unable to obtain an increase in supply on the basis of not using all its share of water in the previous year.
- A WUA does not obtain a water right entitling it to any particular level of flow based on the previous years flow.
- DSI has the right to prepare an updated plan for flow allocation to WUAs for a particular change in circumstances, such as for unusual meteorological conditions, changes in cropping pattern or revised reservoir operating conditions.

A clear understanding is required amongst all concerned persons with respect to the meaning of equitable distribution within the Urfa-Harran system. This is of particular importance in the present transitional phase towards full development of the system as farmers are now facing the reality of significantly reduced water supplies and the necessity of modifying their previously adopted cropping patterns.

In short term, until such time as the Mardin-Ceylanpinar system becomes operational, the following general interpretation of the equitable distribution principle is understood. The peak season may be defined as the period when irrigation demand exceeds available supplies, which is typically occurs from late June to early September.

For DSI Operations

- During the early and late season period of main supply canal operations, when water availability and canal capacities are not a constraint, DSI will supply water at each WUA offtake based on calculated water demands for the actual cropping patterns in the WUA secondary systems.

- As constraints develop, primarily during the peak season period, so DSI will allocate and distribute the available water in accordance with the protocol Agreement; This has as its main principle equal allocation of water between WUAs based on the relative size of their irrigation areas. However, where possible, water will still be allocated to meet the cropping pattern demands of the various secondary systems.

For WUA Operations

- When water availability in the main canals is not a constraint, the WUA will allocate and distribute water from the secondary system to the hydraulic units (normally tertiary canal systems) in accordance with the cropped area water demands. This implies that there will not be equitable flow (measured in volumetric terms of l/sec/ha) to each hydraulic unit.
- As water constraints start to develop in Urfa Canal, so WUA will divide and distribute its total allocated share between its secondary systems, wherever possible, meeting the crop water demands. Capacity constraints within the secondary systems may result in some parts of the WUA being supplied with more or less than their equitable share based on comparison of area and cropping pattern.
- During the peak irrigation season, a WUA will divide its allocated share of water between its secondary systems in direct proportion to their relative areas. At the full stage of command area development for the Urfa-Harran system, This will results in a maximum equitable secondary canal head allocation of about 0.85 l/s/ha based on gross irrigation areas (equivalent to about 1 l/s/ha based on net irrigation area) to all secondary systems.
- During the irrigation peak season, the water will be allocated to each hydraulic unit (normally a tertiary) on the basis of an equal share of total water supplied at the head of the secondary system in proportion to the total irrigation landholding area (i.e. irrespective of the cropped area) within the hydraulic unit. Accordingly, based on his gross landholding size, each farmer effectively has his own water entitlement for the peak season of approximately 0.80 l/s/ha (this reduction from 0.85 l/s/ha allows for some secondary and tertiary system operational losses).

For Irrigation Group Hydraulic Unit Operations

- During normal periods of operation, distribution policy within the Irrigation Group Hydraulic Unit (typically a tertiary) will follow a time and area based schedule of rotation (number of siphons being used for a given number of hours), with farmers being supplied wherever possible with sufficient water to meet their crop demands.

- During the peak season, a fixed rotation schedule (typically based on a ten day period using siphon hours) will be followed based on an equitable allocation of approximately 0.80 l/s/ha to each farmer based on his landholding size, and irrespective of cropped area. It would be the responsibility of the group of farmers within the hydraulic unit to plan their cropping pattern to maximize use of their peak season allocated water entitlement.
- If an individual farmer chooses not to crop his land during the peak season, he may sell his water entitlement to another farmer in the hydraulic unit. In such case the rotation schedule to be planned and implemented by the Irrigation Group would take this into account.
- Rotation schedules within the hydraulic units are to be developed by the farmers themselves, assisted by the WUA Water distributors.

A CASE STUDY OF TERTIARY WATER ALLOCATION ACTIVITIES

In conjunction with the efforts to improve the main and secondary canal system operation, GAP-MOM undertook a number of activities targeted at the tertiary level in Firat WUA area. These Tertiary Water Management Trials (TWMT) were carried out with the following objectives:

- To assist in the development of appropriate methods suitable for farmers to plan and implement the distribution of water at the tertiary level.
- To assess the feasibility of developing irrigator groups to manage their own water at tertiary level.
- To assess the feasibility of developing the mechanism for introduction of a water charging policy based on allocation of flows at the tertiary level.
- To obtain detailed information from farmers about actual water requirements and existing scheduling practices.

The Firat WUA irrigation system command a gross irrigable area of 7 841 ha and a net irrigable area of 6 536 ha. According to the field survey done 1999, the cropping pattern in Fırat WUA area is as in **Table 2**.

This cropping pattern does not match the proposed cropping pattern in master plan for the Harran Plain. Cotton is proposed as 25% in master plan and on which DSI irrigation designs were based (Anonymous, 1998).

The three pilot secondary systems have been chosen for trial. These were UY1, UY4-03 and UY5 secondary systems. The aim was to select areas which were representative of various problems and situations in Firat WUA such as tail-end areas, water short areas, distribution problems between villages and different cropping patterns. It was not possible to implement a water distribution plan for UY4-03 and UY5 due to lack of interests from

Table 2: Cropping Pattern in Firat WUA in 1999

Secondary Canal Sub-system	Net Irrigation Area (ha)	Cropped Areas							
		Wheat		Cotton		Vegetables		Maize II	
		ha	%	ha	%	ha	%	ha	%
UY 1	349	196	56.1	167	47.8	17	4.9	4	1.1
UY 2 Pump	629	252	40.1	451	71.7	3	0.0	0	0
UY 2	1860	308	16.5	1736	93.3	29	1.6	9	0.1
UY 3	295	83	28.1	156	52.9	16	5.4	0	0
UY 3A	162	6	3.7	97	59.9	21	13.0	2	1.2
UY 4 – 01	373	63	16.9	317	85.0	14	3.7	0	0
UY 4 – 02	533	84	15.7	440	82.5	14	2.6	0	0
UY 4 – 03	564	85	15.0	473	83.9	1	0.1	0	0
UY 4 – 04	519	112	21.6	427	82.3	6	1.1	0	0
UY 4 – 10	63	0	0	62	98.0	1	2.0	0	0
UY 5	173	51	29.5	133	76.9	2	1.1	0	0
UY 6	509	10	2.0	464	91.1	8	1.6	0	0
UY 7	114	0	0	114	100	0	0	0	0
UY 8/9/10	393	0	0	390	99.2	2	0.1	0	0
Total	**6536**	**1249**	**19.1**	**5427**	**83.0**	**134**	**2.1**	**15**	**0.01**

downstream farmers and reluctance of upstream farmers and water distributor, problems of insufficient canal capacity and thus overtopping, and the muhtar and powerful farmers so on. Highly successful implementation was in UY1 secondary system.

There had been many meetings arranged with the groups of farmers and WUA distributors to discuss, agree and implement water schedules in accordance with the 1999 operational plan for allocation of water in Firat WUA. During the meetings small informal farmer groups have been developed at the tertiary level to explore the such groups taking over operation and maintenance responsibilities at this level in the system. Their field size, crop patterns, existing method of irrigation, irrigation timing and intervals, actual water requirements of the cropped fields, physical constraints in their canalette lines and concerning all parameters had been analyzed before the distribution plan was implemented.

The existing procedures for using a hand written farmer request order form is considered to be impractical to implement within the Urfa-Harran System. Instead, an approach has been developed for allocating and implementing fixed rotation schedules amongst farmers, based on use of standard sized siphons by a farmer for a specified of hours. Due to the extent of water constraints, the most appropriate and fairest way of distributing the available supplies is directly in proportion to a farmer landholding size.

Groups of farmers within a given hydraulic unit or tertiary agree to a fixed rotational schedule, which is presently planned on a ten day cycle to fit in with cotton irrigation practices. Over a given period, the total equitable water allocation to a particular hydraulic unit is calculated. The total number of siphons that can be operated is then determined based on an average discharge of 15 l/s being abstracted by one 100 mm siphon. A plan is discussed and agreed with all the farmers to schedule for each day of the ten-day cycle, the use of the available siphons to match in accordance with their landholding sizes. **Figure 3** shows an abstraction the water from canalette by a siphon.

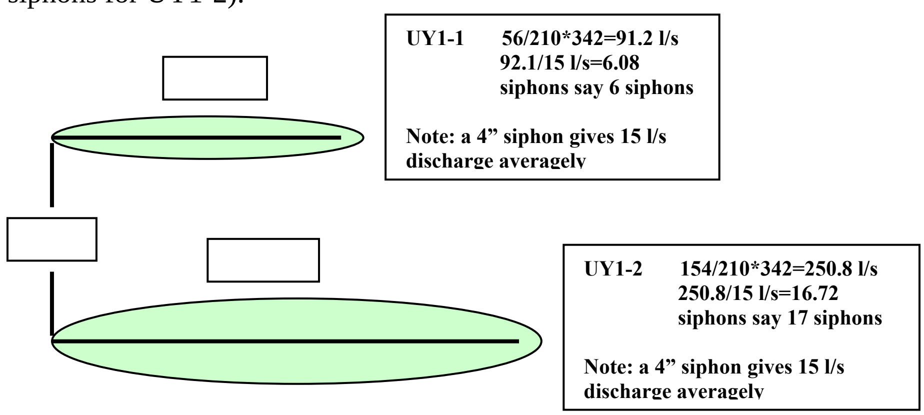
Figure 3: Typical Canalette and Siphon Used for Abstraction Water to the Field

Due to the comparatively high level of water demands for all peak season irrigated crops in relation to available supplies, the rotation schedule makes no specific allowance for the increased amounts of irrigation water required for some of the crops. Instead, it is considered that a farmer should adjust his future cropping patterns in line with his expected water delivery rights- typically he may decide to only plant half his land to cotton. This will encourage a shift towards an increased level of winter cropping which will reduce the present excessive irrigation requirements in the peak season.

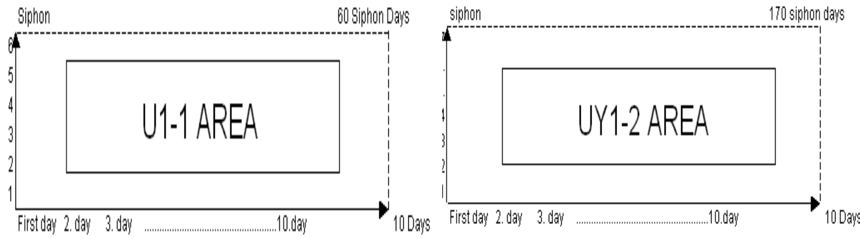
Under the lights of information given above an example of calculation of ten-day rotation plan is figured out as below:

Ten-day Rotation Scheduling Calculation Method

Q=380 l/s is fixed for the peak period at UY1 Constant Head Orifice. The conveyance efficiency assumed is 0.90 that's way Q= 380*0.90=342 l/s. UY1 Secondary system has 210 ha cropped area and 56 ha of that is at UY1-1 and the remaining 154 ha is at UY1-2 tertiary system. Then, the number of the siphons to be used at each area is calculated (6 siphons for UY1 and 17 siphons for UY1-2).



Due to the ten-day rotation period, total number of siphon for UY1-1 = 6*10 days = 60 siphon days. UY1-2 area has the right of 170 siphon days. Then you make a chart like jigsaw playground and you install each field siphon rights and other information such as irrigation start and finish hours. For example; The farmer Yusuf Gunes has 13 ha area cropped at UY1-1 so his siphon rights in 10 days = 13/56ha*60 =13.9 (if the farmer has 1 siphon he needs 13.9 days which is exceeding 10 days. So we should advise him to use 2 siphons which makes 6.95 days or more siphons to reduce reasonable irrigation days).



UY1 system has been divided in to three parts to establish reasonable groups of farmers to enable easy monitoring and evaluation. The main problem identified was the insufficient water for the downstream part of the system due to excessive water use in upstream. Upstream farmers never showed any interest in the discussions at the meetings. In spite of this, downstream farmers and GAP-MOM staff prepared and accepted a rotation plan for their area of the system and implemented a one month period from 19 July to 18 August in 1999.

CONCLUSION

A significant increase was found in the efficiency of water use in the lower part (where rotation schedule was implemented), 89% efficiency as against 78% for the areas without implementation of rotation schedule was observed. Farmers expressed their happiness on planned water schedules due to enabling to plan other works, rather than to spend time for waiting water in their canals. Farmers expressed as well their intention to establish a similar rotation for the next year. The water distributor found it much easier to control the water and experienced fewer disputes with or between irrigators. Such type of simple and easily understandable water delivery programs for each hydraulic unit enabled WUA to win confidence and positive effects on farmers. Presumably, due to the reliable water delivery, WUA will be able to increase the rate of irrigation charge collection from the farmers.

A scenario could be drawn with those 11% water saving for Harran Plain. Water used in 1999 in Harran Plain was averagely 11 990 m^3/ha. If 11% water saving can be achieved, the water to be used will be 10 671 m^3/ha and water saving will be 1 319 m^3/ha. When we extend the figure for whole Harran Plain which is roughly 145 000 ha, the total water saving will be 191 255 000 m^3. The water saved could create additional 17 922 ha area. It means, 17 922 000 $/year will be an input to the economy (net revenue is 1000-1500 $/ha in Harran Plain). The same scenario could be extending for the energy production in the area.

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WATER SHARING BETWEEN THE JHANKRE MINI- HYDROPOWER PLANT AND IRRIGATION[1]

AJOY KARKI[2]

BACKGROUND

In the early 1990's, Butwal Power Company Ltd. (BPC), the first private sector hydropower company of Nepal promoted the 60 MW Khimti Hydropower Project under Built, Own, Operate and Transfer (BOOT) agreement with His Majesty's Government of Nepal (HMGN). After the initiation of the infrastructure works of the project, a separate company named Himal Power Limited (HPL) was established to implement the Khimti Project. HPL is currently owned by a consortium of multinational companies (mainly Norwegian) and BPC (15% shareholding).

During the construction phase of the Khimti Project, BPC decided to investigate the feasibility of building a mini-hydropower plant in the vicinity of the project area to meet some of the construction power needs. The benefit from building such a mini-hydro plant was envisioned to be as follows:

- As the main source for construction power for the Khimti project was diesel generators (i.e., there were no transmission lines then), any electricity generated from a mini-hydropower plant would reduce the use of diesel. Thus, within the estimated four years of construction period of the Khimti Project, the cost of diesel saved by the mini-hydropower plant was expected to exceed the construction costs of the mini-hydropower plant.
- Replacing diesel with hydroelectricity would also contribute towards minimizing adverse environmental impacts in the Khimti Project area.
- Such a mini-hydropower plant could be used for extensive rural electrification as part of the Khimti Project's assistance to the rural communities once the Khimti Hydropower Plant would be commissioned.

[1] Mr. Madan Prasad Upadhyaya , Project manager of Jhanker Rural Electrification and Development (JREDP), HLP is duly acknowledged for verifying the data presented in this paper.

[2] Water Resources Engineer.

An appropriate site for such a mini-hydropower plant was identified about two km upstream of the headworks (intake area) of the Khimti Project. Jhankre Khola, the source river for this mini hydropower plant is a perennial stream and a tributary of the Khimti river (i.e., the source river of the Khimti Plant). This plant utilizes a head (drop of water) of 180 m and a design flow of 450 l/s to generate 500 kW of electrical power using three Pelton Turbines.

Full power generation (i.e., 500 kW) from the Jhankre mini-hydro plant is only feasible for four months a year due to limitation of water and irrigation demand from the river. During the dry season the flow availability drops to 90 l/s: adequate to operate only one nozzle of one of the turbines (each turbine has 2 nozzles). The reason for sizing the mini-hydropower plant at 500 kW was because as it was competing with the use of diesel it was still financially viable to over size the installed capacity**.**

IRRIGATION USE

The only appropriate site in the Jhankre River for the intake of the proposed mini-hydro plant was already being used by the beneficiary farmers as an irrigation off-take. Moreover, the command area of some 13 hectares (ha) was located along the waterways of the proposed mini-hydro scheme and thus it was not possible to irrigate the area from the tail water of the proposed mini-hydro plant. It became evident that if the mini-hydropower plant were to be built, the intake would have to be located at the existing irrigation off take.

During the initial discussions, an attempt was made by the technical staff of BPC and the Jhankre water users to quantify the flow requirements for irrigation. Flow measurements at the irrigation off-take indicated the maximum conveyance capacity of the system to be 70 l/s. The beneficiary farmers mentioned that full flow (i.e., 70 l/s) was required for paddy and half for wheat and rice seedling. Thus, the irrigation demand was quantified by consensus to be as follows:

- For wheat crops a maximum of 70 l/s flow is required for a total of 20 days during mid November to mid December and mid January to mid April
- For rice seedlings, a maximum of 35 l/s flow is required for a total of 10 days during mid April to mid June.
- For paddy (rice crops) a maximum of 70 l/s is required continuously from mid June to mid October.

The above irrigation requirements indicate that the Jhankre water users do not require year round irrigation. Furthermore, even during the dry season the entire river water is not required for irrigation. A plot (hydrograph) of the 75% average monthly flow availability, irrigation demand and power demand is presented in **Figure 1**. Only 75% of the river flow is assumed to be available for power generation and irrigation. The remaining 25% is allocated to account for environmental release and for seepage past the intake.

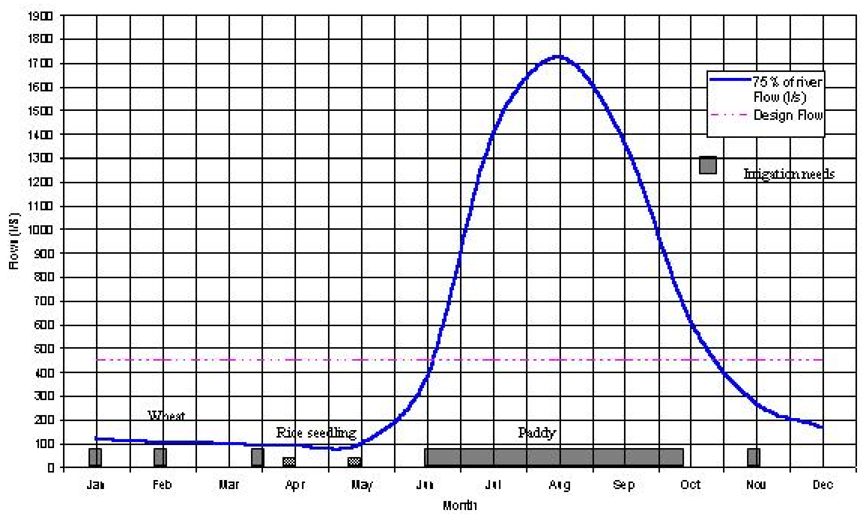

Figure 1 : Water Availability and Demand in the Jhankre River

WATER SHARING AGREEMENT

As can been seen from **Figure 1**, there existed a possibility for multiple use of water, vis. a vis. irrigation and power generation. An initial discussion regarding sharing of the Jhanre water resources was held at the Jhankre village between the water users (i.e., beneficiary farmers) and BPC staff. Based on a series of site discussions, a draft agreement was prepared and the water users elected two representative members to sign the agreement in the BPC head office in Kathmandu. The main clauses of the agreement were as follows:

- The beneficiary farmers would allow BPC to build a diversion structure for the mini hydropower scheme at the existing irrigation off take and to install a penstock pipe along part of the irrigation canal alignment.

- BPC would make provision for temporary irrigation supply during the construction period of the Jhankre mini-hydro plant.
- BPC would provide at its own cost the cement required for the improvement of 50 m length of the irrigation canal in the lower reaches of the command area.
- Water for irrigation would be provided for wheat crops, rice seedlings and paddy in the quantity and time period in accordance with the irrigation demand discussed above (a, b and c). Priority would be given to power generation at all times except during the irrigation period defined earlier. Provision for water distribution would be arranged by BPC to supply irrigation water from the mini-hydro intake system in accordance with the irrigation demand.
- Upon completion of the main Khimti Hydropower Project, BPC would commence a rural electrification program, which will make electricity available to the nearby communities according to the norms and policies adopted in other similar programs in the country.

The Jhankre River water sharing agreement between BPC and the beneficiary farmers was signed in 11 March 2003 in Kathmandu. This agreement has two main features as follows:

Optimizing Use of Water Resources

The existing irrigation usages (both flow rates and period) have been guaranteed in the "Agreement". Water is allocated for power generation only after the irrigation needs are met. Thus, the agreement attempts to optimize the water resources of the Jhankre River**.**

Equitable Sharing of Water Resources

The agreement also addresses the issue of equity in sharing of the water resources. The Jhankre water users had a well functioning irrigation system even before the mini-hydropower plant was built. Since the mini-hydro project would use only balance of flow available after irrigation, its establishment would not have any water scarcity impact for the beneficiary farmers. On the other hand, its establishment alone would not have any direct benefit for the farmers either, except for some employment opportunities during the construction period. Thus, to address the issue of equity BPC (now HPL) agreed to initiate a rural electrification program and a corresponding clause was also inserted in the agreement. For having agreed to allow BPC to build a power plant to meet part of the Khimti Project's construction power requirements, the nearby communities were assured of access to electricity.

IMPLEMENTATION OF THE JHANKRE MINI-HYDRO PLANT

In accordance with the agreement, the intake of the mini-hydro system was designed to incorporate the irrigation flow requirements. From the intake, High Density Poly Ethylene (HDPE) pipes were run parallel with the penstock pipe (i.e., pressure pipe which conveys water to the turbines). Four valves were provided along the HDPE irrigation pipe alignment at locations fixed by the beneficiaries so that water could be provided efficiently at different reach of the command area as required.

During the construction of the mini-hydropower plant, employment priority was given to the local community. The mini-hydro project bought sand, gravels and boulders required for concrete and masonry work at fixed rate form the community. This provided additional income generation opportunity for the community members, and especially for women. A public relations officer with agricultural background was also employed by the project to liaise with the community during the construction period.

Four of the local laborers were trained to be operators of the Jhankre mini-hydropower plant. At present these four local community members along with three other staff from the project area are employed as the operators of the Jhankre mini-hydro power plant.

The Jhankre mini-hydropower plant was commissioned in 1996 and provided power for the construction works at the intake area of the Khimti Hydropower Project for about four years.

CURRENT STATUS

The 60 MW Khimti Hydropower Project was commissioned in 2000. However, HPL electrified some 70 households in the Jhankre community in 1998, two years ahead of schedule. A Jhankre Rural Electrification and Development Project (JREDP) was established by HPL to oversee extension of rural electrification from the Jhnakre mini-hydro plant. In 2001, JREDP entered into its second phase with a five year plan to electrify an additional 4,000 households along with supporting various community development activities. The total project cost is estimated at US$ 2.65 million of which 80% has been contributed by the Norwegian Agency for Development

Cooperation (NORAD) and the rest by HPL. The overall responsibility for the management and execution of JREDP II lies with HPL. The project area covers 10 VDCs in Dolakha and Ramechhap districts**.**

To date over 2900 households within the project area have been electrified and another 1100 households are expected to be connected to the Jhankre electricity grid by the end JREDP II. Altogether, the beneficiary households will be around 5000. The powerhouse of the Jhankre plant was damaged a year ago as a result of the on going “conflict” in the country. At present electricity is being supplied to the households via the Khimti hydropower plant. HPL is currently involved in rehabilitating the Jhankre mini hydropower plant as well as upgrading it from 500 kW to 635 kW.

HPL plans to hand over the Jhankre Mini hydro plant to the users through the formation of Khimti Rural Electric Cooperative (KREC). It has already completed all preparatory works for the formation of KREC and has registered the cooperative in 21 April 2004. After the formal registration of KREC, membership has been opened and an election for the representative of the board members is scheduled during October 2004. According to the Cooperative Act all users of the Jhankre Mini Hydro plant will be shareholders (members) of KREC. As the capacity of KREC builds up, HPL plans to gradually limit its role in the management of the Jhankre mini hydropower plant. Eventually all the assets and liabilities of the project will be handed over to KREC.

The formation of KREC further emphasizes the issue of equity. As envisioned, the Jhankre mini-hydropower plant successfully provided construction power for the Khimti Project. After the commissioning of the Khimti project, given its location and socio-economic conditions, the only possible use of the Jhankre mini hydro plant is for rural electrification. As the eventual owner of the mini-hydro plant, it will be KREC’s responsibility to plan for the extension of electricity distribution lines, set the electricity tariff and manage the power plant.

To date, no water use conflict between irrigation and power generation has been reported. The beneficiary farmers mention that they have adequate irrigation flows to meet their needs. During the irrigation season, they inform the plant operators a few days ahead regarding their water needs. The plant operators then reduced the power generation and release the required flows. Communication regarding irrigation requirements has been made easy since two of the operators are from the local community. Furthermore, as the Jhankre irrigation users will also become the owner of the mini hydro plant, conflict between irrigation and power generation is not expected to be an issue in the future. Even during irrigation season, water can be used for irrigation during off peak period such as in the afternoon and nighttime (i.e., when demand for electricity is minimal) and for power generation at other times based on priorities set by KREC.

Furthermore, in order to minimize seepage along the earthen stretches of the irrigation canal, a consensus has been reached between JREDP and the local community to cement line such lengths. The intake is to be upgraded as well so that seepage through the diversion weir could be minimized. The refurbishment of the intake and the canal will make more water available for power generation and irrigation.

LESSONS LEARNT IN SHARING OF WATER RESOURCES

The Jhankre mini-hydro scheme demonstrates how a private sector company and a small Farmer Managed Irrigation Systems (FMIS) can share water resources for mutual benefit. Most hill irrigation systems have proven off-takes and waterways that have survived for centuries. Water is diverted from nearby perennial streams to irrigate small parcel of land which is mostly terraced. Such irrigation off-takes, the waterways and the terraced farm land are ideal for hydropower generation due to regular supply of flow from the perennial streams and the "head' or fall of water provided by the terraced topography. As demonstrated by the Jhankre Mini-hydro scheme such multiple use of water can result in win-win situation for both the beneficiary farmers and the developer of hydropower. The following lessons have been learnt from the Jhankre case study:

- In the rural communities, irrigation and small scale hydropower generation can complement each other as irrigation is not usually required year round.
- Equitable sharing of resources and "Good Governance" are pre-requisite for multiple use of water amongst different user groups.
- Development of small scale (mini-hydro) hydropower systems using hill irrigation off-takes can benefit the beneficiary farmers as they could become potential shareholders for having agreed to share their exclusive water rights with "hydropower developers"
- With an efficient management system in place, the beneficiary farmer can have access to electricity along with irrigation.
- Revenue from sales of electricity can provide additional funds to maintain the irrigation system, thus contributing towards its sustainability.

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Eco-technology Dimension

KUHL IRRIGATION: A COMMUNITY MANAGEMENT SYSTEM IN COLD DESERT OF THE LAHAUL VALLEY, NORTH WESTERN HIMALAYA, INDIA

SUBHASH C.R. VISHVAKARMA[1]

INTRODUCTION

Like other parts of the Himalayan region (Ramakrishnan, 1992; Pandey and Singh, 1984), agriculture is the prime economic activity of the hill people of north western Himalayan zone (Kuniyal et al, 2004a; Singh et al, 1997). Irrigated agriculture is one of the positive indicators to maintain food security in hilly environment. In the cold desert of north western Himalaya, under very scanty and rare rainfall conditions, snow accumulation is the only source of water for irrigation, drinking and other domestic uses. In the past, under extremely xeric, cold and harsh climatic conditions of cold desert of the Lahaul valley, local farmers developed earthen off-take irrigation system which is locally called *kuhl*. This channelizing snowmelt has become the only source of irrigation for ensured crop irrigation and other domestic use. Most of the *kuhls* are constructed by local people by contributing money and human labour which are managed by the villagers themselves. In 1870 Harcourt found extensive irrigation channels in crop fields. He also noticed that water from every available stream was diverted through people made earthen channels to the fields. About 99.5% of the total 2240 ha agricultural land in the cold desert of the Lahaul valley is under the community irrigation system called *kuhl* (Anonymous, 1995). Himachal Pradesh in India is most intensively irrigated state in Indian Himalayan region (Coward, 1990). The Lahaul valley in cold desert of north western Himalaya remains cut off for sometimes (November- June) in a year from other parts of the state due to heavy snow on Rohtang pass (3978 m), the only entry point to the valley.

The present study examines the kuhl system, land use under irrigation, yield pattern under canal irrigation, system of sharing of water among right holders. Attempt is also made to identify problems encoubntered by the farmers in the management of the canals in cold desert environment of the Lahaul valley. The main objectives of the present paper are: (i) to understand the kuhl system, (ii) to

[1] Scientist-in -charge, G.B. Pant Institute of Himalayan Environment and Development, Himachal Pradesh, India.

study the land use pattern under kuhl irrigation, and (iii) to study the system of water sharing among the kuhl users.

MATERIAL AND METHODS

Measurements of main *kuhl* and its branches were done separately. Later length of main *kuhl* and branches were added to find the total length the *kuhl*. Slopes for 100 m length of *kuhl* were measured using abney level. Command area of an individual *kuhl* was estimated under agriculture, forestry, cultivated grasslands and kitchen garden by administering questionnaire. Family heads were asked for the land holding, cropping pattern, and number of cultivated trees on their land. For final estimate of the command area of the individual *kuhl*, summation of all the irrigated land use types such as agriculture, forestry, cultivated grassland and kitchen garden was done. Canal command ratio was calculated after dividing length of *kuhl* by command area of the *kuhl*s. Number of trees under forestry and agroforestry were counted species -wise at village level. Per unit area production of cash crops like potato, pea and hops were measured through crop cutting method. Information of *kuhl* management and water sharing (water allocation to users) were collected after extensive interviews with *mukhiyas* (a nominated head for management of *kuhl* and water sharing) of all the *kuhls* from all the study villages. Crop irrigation is done from 6.00 a.m. to 6.00 p.m. The entire discharge of a *kuhl* from 6.00 a.m. to 6.00 p.m. was considered as one water as per local water sharing terminology.

STUDY AREA AND CLIMATE

Geographical Set-up

The cold desert of Lahaul & Spiti districts extends within 31°44’34” N to 32°59’57” N latitude and 76°46’29” E to 78°41’34” E longitude. The Great Himalayan range in the north and Pir Panjal range of the Lesser Himalaya in the south demarcate the boundaries of the Lahaul valley. The geographical area of the Lahaul & Spiti district is 13,835 km^2 with a total population of 33,224 persons. On average, 2 persons per km^2 inhabit in the Lahaul valley (Census of India, 2001). The Lahaul valley begins from Khoksar in the southeast and ends beyond Kuthar village in the north-west direction. On the north, it is demarcated by Ladakh district of Jammu and Kashmir; while on western and southern side by Chamba and Kullu districts of Himachal Pradesh, respectively. The Lahaul valley is divided into three sub-valleys: Chandra, Bhaga and Chandra-Bhaga sub-valleys after the name of river system. In the Chandra valley, River Chandra flows from east to west direction and meets River Bhaga at Tandi. River beyond Tandi is called Chandra Bhaga. The four study villages- Khoksar (3200 m) in

Chandra sub-valley, Jahlma (3000 m), Hinsa (2700 m) and Kuthar (2600 m) in Chandra-Bhaga sub-valley were selected for study which represent the entire Lahaul valley (**Figure 1**).

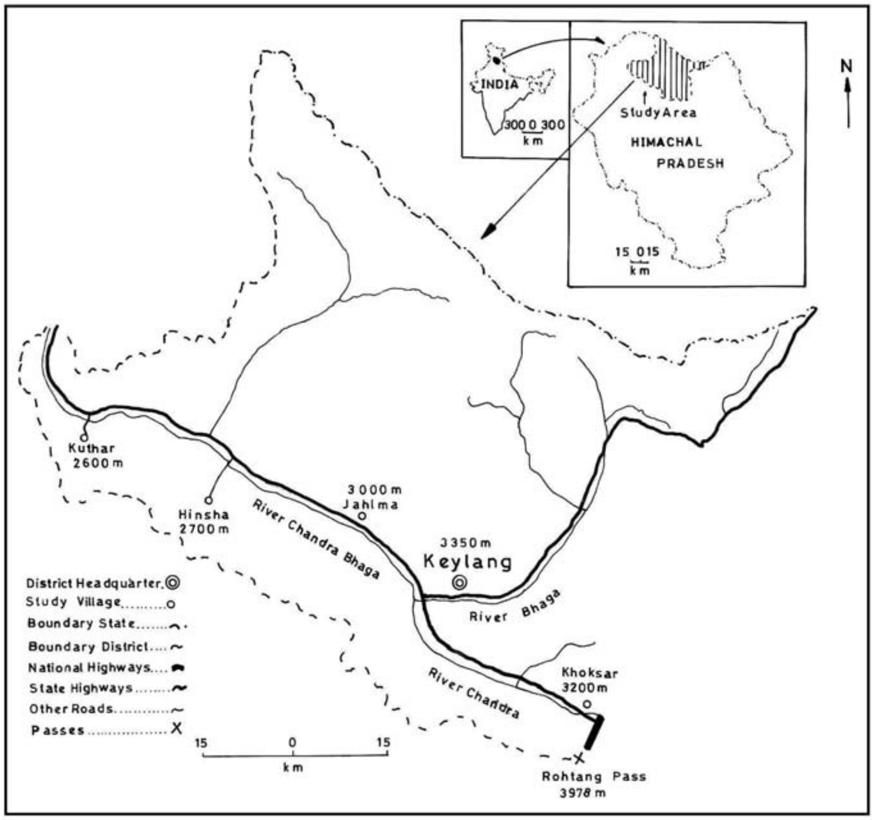

Figure 1: Locations of Study Sites in the Lahaul Valley in Cold Desert of North Western Himalaya

Climate

Climatically, the valley comes under cold arid zone with a very low rainfall and high snowfall, severe and prolonged winters. The region remains cut-off by high mountain ranges after heavy snowfall. The valley receives an average of 25 mm rainfall between June and July and 3000 mm snowfall from November to May. The Lahaul valley remains land-locked from winter to early summer (November to June) due to heavy snow deposit at Rohtang pass (3978 m), the only entry point to the valley. The valley has extremely harsh climatic conditions. During summer mercury rises upto 27 ^{o}C and dips upto 40 ^{0}C during winters at Khoksar (**Figure 2**).

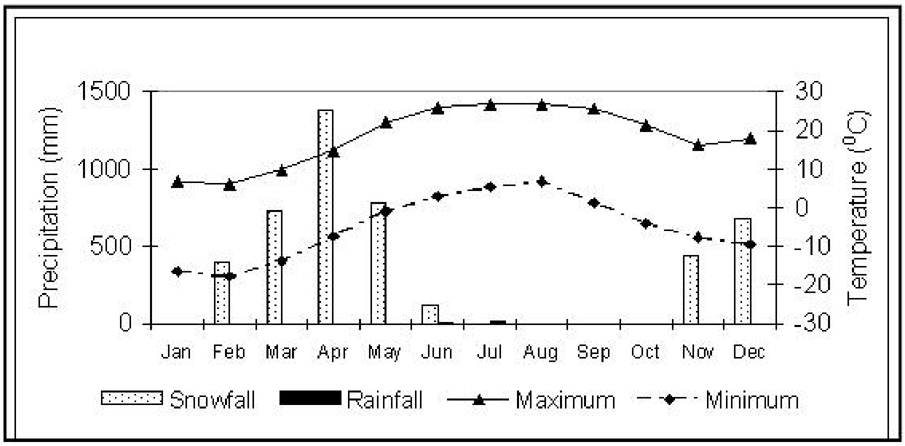

Figure 2: Temperature and Precipitation in Lahaul Valley

Vegetation

There are two types of vegetation zones: (i) temperate zone (2200 m to 3300 m) and (ii) alpine zone (above 3300 m) (Aswal and Mehrotra, 1994). Under temperate zone, maximum tree. Species of different uses like timber, fuel wood and fodder are found. Due to relatively very harsh climatic conditions of Chandra sub-valley, between Khoksar to Tandi, it has relatively poorer vegetation cover than the Chandra Bhaga sub-valley. In Chandra sub-valley, south facing slopes are, more or less, treeless up to Tandi. On lower reaches the north facing slopes, *chiat* (*Pinus wallichiana*) are found in a scanty form and on higher reaches, *bhiy* (*Betula utilis*) are found in a scattered patches (Singh et. al, 1997). North facing slopes have relatively richer bio-diversity and vegetation density as compared to the south facing slopes. *Shur* (*Juniperus macropoda*) is an important tree crop found on southern slopes at present; whereas in past *chiat* was also found in some patches of *shur* forests (Harcourt, 1970). Due to excessive harvesting of these species, they disappeared in course of time from the forests. North facing slopes are covered with patches of tree species like, *diyar* or *kley* (*Cedrus deodara*), *rei* (*Abies pindrow*), *tosh* (*Picea smithiana*) and *chiat* (*Pinus wallichiana*). The area receives high amount of snowfall where glaciers are common. Forest is found in alternate longitudinal patches with glaciers. *Chharma* (*Hippophae rhamnoides* sp. *turkestanica*) is also widely found in the valley particularly in landslide prone zones and close to water sources of Chandra-Bhaga and Bhaga sub-valleys.

Under alpine zone, chief stunted trees of *bhiy*, *chiat* and *Rhododendron campanulatum* are found in a scattered form up to 3600 m which is the highest vegetation limit of the Lahaul valley. Several bushy species like *bithal* (*Juniperus communis*, *J. indica*), *shur*, and *bhiy* are found on rocks, ridges and stony slopes. Several *belly* (*Salix* sp.) species like *S. flegilaris*, *S. lindleyana* and *S. pycnostachya* are found either in pure patches or mixed with *bhiy* as shrubs. Two species of Salix (*S. alba* and *S. fragilis*) are cultivated in agroforestry and village settlements to meet fodder and fuel wood requirement.

People and Villages

The inhabitants of the area are of Indo-Aryan origin and have, more or less, mongoloid features. Largely, they are the followers of Buddhism and Hinduism. People are humorous, soft spoken, simple and unsophisticated. Women are sturdy and self reliant largely performing the agricultural activities with inherited domestic operations. The people are largely attached with the joint family system. The Lahaulis language is a mixture of Tibetans, Hindi, Urdu and Persian (Harcourt, 1870).

From isolated hamlets to conglomerated settlements are the characteristic features of the villages. The houses are made up of stone, timber and earth, with flat roofs. Lower storey is used as cattle shed and first floor for the family if it is two Storey house.

About the System

Agriculture activities start in April, immediately after melting of snow from the fields. In each winter the heavy snow, damages the terraced fields and also causes leaching of soil nutrients. It is observed each year that, this natural process of turning the fertile soil into exhausted ones in the glacial and moraine environment, demands high quantity of organic manure to restore the soil's fertility for satisfactory yields. But the animal population, the main source of organic manure, is very small in this region. The fodder production in the valley it is not enough to support large herds. Even a pair of bullocks for draught power is not owned by single family; they are usually shared by two households. The high demand for manure is therefore met by using night soil that is recycled as traditional farmyard manure (FYM).

Under extremely dry soil conditions, no crop is possible without irrigation. As a result, the villagers on community basis have developed a local irrigation system-- *kuhl* (irrigation channels). The *kuhl* carries the water along the gravitational flow from the high snow bound peaks to the terraced fields downward. This indigenous community based irrigation system is in practice since time immemorial which ensures a regular supply of water for irrigation throughout the valley. As the water is considered to be a common resource and irrigation has been developed with community effort, no money for irrigation is paid. *Kuhls* remain operational from April to end of the October. In November, *kuhls* are closed at it's origin point. During winter, they are used as path for routine movement of villagers.

RESULTS AND DISCUSSION

Kuhl System

In Khoksar village four *kuhls* (Janksha, Pomokuhl, Ghanka and Chantha) have been constructed. In Jahlma there are two *kuhls* (Groni and Kalpader). In Hinsa and Kuthar, each village has one kuhl each (**Table 1**). In Khoksar, Pompkuhl is the main *kuhl* and all these 16 households have the equal water right. However,

Table 1: Average Number of Dependent Families, Canal Command Ratio and Land Area under *Kuhl* Irrigation in the Cold Desert of the Lahaul Valley, North Western Himalaya

Attributes	Villages			
	Khoksar* **(3200 m) n = 4**	**Jahlma (3000 m) n = 2**	**Hinsa (2700 m) n = 1**	**Kuthar (2600 m) n = 1**
Number of dependent families	10.8	27.5	52.0	17.0
Number of branches of kuhl	3.8	9.0	4.0	3.0
Status	Earthen	Earthen	Earthen	Earthen
Length of kuhl (km)				
• Main *Kuhl*	0.33	0.37	0.26	0.15
• Branches	0.55	1.47	1.80	0.65
• Total	0.88	1.84	2.06	0.80
Slope of kuhl per 100 m distance	5° - 6°	5°	5°	5°
Area under per kuhl irrigation (ha)	2.72	28.13	32.53	10.31
Canal command ratio (km/ha)	0.32	0.07	0.06	0.08

*** The village has one government *kuhl*, which is exclusively used by the Department of Forests for irrigating of 0.24 ha forestry land; hence not included in the table.**

other *kuhls* were constructed later for irrigating cash crops like pea and potato as well as, willow plantations on newly acquired lands. On an average, each *kuhl* of the Khoksar has command area of about 2.72 ha of land (agriculture, forestry, grassland and kitchen garden) with very high canal command ratio of 0.32 km per ha, the highest in the valley. In Jahlma village, two *kuhls* irrigated an average area of 28.13 ha of command area where average canal command ratio was 0.07 km per ha. The highest command area was in Hinsa village. In Kuthar, command area was 10.31 ha of land. In Jahlma, Hinsa and Kuthar villages, there is not much difference in the canal command ratio. However, in Khoksar village, canal command ratio was very high. Studies on hill irrigation systems often make comment about the length of the conveyance canals. The length of conveyance canal per irrigated area, or per irrigator, is a better indicator of operation and maintenance facing new challenges in irrigation development in cold desert environment. Canal ratio as high as one kilometre per irrigated hectare has been noted by Ambler (1989) in Sumatra, but the ratio is usually much shorter in most canals.

Under extreme xeric conditions and in the absence of rainfall in the Lahaul valley, availability of soil moisture is a necessity during crop months. Innovative farmers learnt to rearrange the water resources from snow melts to gravitational off-take water channels upto agriculture fields. As a result, water channel (*kuhl*) system came into the existence in the land locked Lahaul valley. *Kuhls* have been constructed by the local people with the contribution of the users since time immemorial. The contribution was in terms of cash and as well as labours. The valley has very sloppy mountains, moraine conditions, scree and stony outcrops. Sometimes *kuhls* pass through narrow and steep gorge of about 90° slopes after cutting the rocks and in some place erecting the stone walls as in case of Garoni *kuhl* along Jahlmanal stream near Jahlma. At origin point of the *kuhl* after 10 metre distance, *kuhl*'s wall facing toward stream side is kept opened as a scope door upto a length of 30 cm to pass entire *kuhl*'s water back to the stream again when *kuhl* does not remains in use. During operation of *kuhl*, this door is closed with a gunny bag filled with sand. The older *kuhls* do not have history or record about construction year and construction cost. The senior citizens of the valley say that, Balti people (people of Baltistan) were hired. The Baltis had skill of stone cutting and digging kuhls through gorges. Tiwari and Gupta (2003) found that *Baltis* were hired by the *Dards* rulers of Leh for construction of canal system for irrigation. *Dard* rulers occupied the Leh region even before *Namgyal* dynasty which was established around a thousand year back (Ghani, 1999) *Baltis* were experts in designing and making the canal and tunnel systems for irrigation. Sometimes *kuhl* passes through a stone wall and use of hume-pipes in case of scree. Falling pebbles cover humpipes and later pipe comes under pebbles and water flows from the pipe like in a small tunnel.

Traditional *kuhls* in the valley were of earthen. Under the Desert Development Programme (DDP) from Department of Rural Development, Govt. of India, the state government provides fund for cementing a very few *kuhls*. Irrigation development is taking place in one or two modes; (a) development of community irrigation systems (b) the development of agency operated systems (Coward, 1980). This is also true in case of the Lahaul valley. All the older *kuhls* in the valley had been constructed with the community participation. These *kuhls* are also managed by the decision makers from the community and water is shared among the right holders. Nowadays, state government also constructs new *kuhls* on public demand where community effort fails because of long distance of water sources and high cost of engineering works, like stone wall construction, hume-pipes, rock cutting along the gorge. The government constructs the *kuhl* and does repair work. However, the responsibility for regular management's like cleaning the canal and water sharing has been given to the farmers. The state government has constructed 26 new *kuhls* in different parts of the Lahaul valley with 1031 ha of command area. In other parts of the Himachal Pradesh, many *kuhls* have been constructed with the community efforts, or some system are constructed by the government, after completion of the construction, they are handed over to the local people for their use and management. Baker (1994) studied historical background of *kuhl* system in the Kangra valley. He found that the majority of the *kuhls* were constructed by the community work of the villagers in 17^{th} and 18^{th} century except a few *kuhls* which were supported by the Katoch kings of the Kangra area. Thirty nine *kuhls* which divert the water from the River Neugal, irrigated approximately 5,000 ha of land which is distributed in 240 hamlets located in 85 km^2 Neugal basin. Coward (1990) found that management and repairing of all *kuhls* were the job of the users including the *kuhls* financed by the Katochs. *Kuhl* management by the local community makes a *kuhl* system more viable and sustainable without any dispute in the community.

In Khoksar village, average per *kuhl* command area is 2.72 ha. At Kuthar it is 10.31 ha in Jahlma 28.13 ha and in Hinsa 32.53 ha the largest command area in the study villages (**Figure 3**). At the valley level, about 62.2 % land was under agriculture, 5.3 % under forestry, 31.1 % under cultivated grassland and 1.4 % under kitchen garden for vegetables. Though command area of the *kuhl* varies from one village to another but agriculture area is around 60 % of total cropped area in their villages. Cultivated grassland was second major land use type in all villages for secured fodder for lean period during severe winter months.

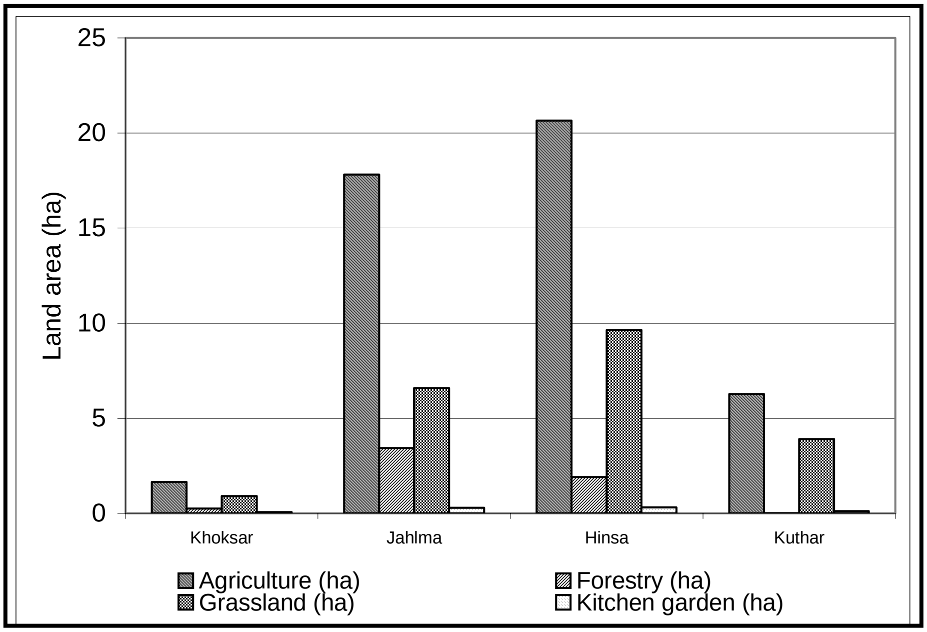

Figure 3: Land Use Types and Average Land under Kuhl Irrigation in Cold Deserts of the Lahaul Valley

Land Use Types under Irrigation

In all those four villages, 60.88 to 63.53 % land of the total area is devoted to agriculture (**Table 2**). In the land locked area of the Lahaul valley, agriculture was the prime source of revenue generation and food security to the farmers. In Khoksar, cash crops like potato and pea and in Jahlma potato, pea and hops are cultivated in more than 95% of the total land. Traditional food crops like barley, buckwheat, wheat, beans, vegetables (beet roots, cabbage, carrot cauliflower, pumpkin, radish, spinach, tomato and turnip) and medicinal herbs like *Saussurea lappa* and *Inula recemosa* are cultivated relatively in a smaller area to conserve the seed banks. In Hinsa village, cash crops like potato and peas are cultivated in about 70% of the total agriculture land. Traditional crops are cultivated on the rest of the land. Climatic conditions such as warmer climate and longer growth period upto the end of October at Hinsa and Kuthar villages permit second cropping immediately after a harvest of pea and potato. Traditionally buckwheat and mustarded are cultivated as second crop after a harvest of pea and potato and farmers need regular water supply from May to the end of the October. In the same way, at Kuthar village, farmers cultivate traditional crops only on major area of land except pea and potato on small scale. Kuthar is at a very far distance village from south eastern corner of the Lahaul valley; cash crops cultivated by the villagers are not picked up either by the traders or by the Lahaul Potato Society- a farmer's co-operative society- during harvesting season located at

Manali, outside the Lahaul valley. An irrigation frequency for agriculture varies for crops to crops. However, on an average, in Khoksar and Jahlma villages, 3.67 times irrigation for one crop was needed. In Hinsa village, 3.50 and in Kuthar village 4.00 times irrigation is required for good harvest. Flood irrigation is a prevailing form of irrigation for maximum crop yield.

Table 2: Irrigated and Through *Kuhl* in Cold Desert of the Lahaul Valley, North Western Himalaya (values in parenthesis are % of the total)

Land area (ha)	Villages			
	Khoksar n=12	**Jahlma n=41**	**Hinsa n=52**	**Kuthar n=17**
• Agriculture	6.63 (60.88)	35.63 (63.31)	20.66 (63.53)	6.28 (60.89)
• Forestry	0.54 (9.92)	6.88 (12.22)	1.91 (5.87)	0.01 (0.10)
• Grassland	3.65 (33.52)	13.16 (23.38)	9.64 (29.64)	3.91 (37.89)
• Kitchen garden	0.07 (2.57)	0.61 (1.08)	0.31 (0.95)	0.12 (1.16)
Total	10.89 (100.00)	56.28 (100.00)	32.52 (100.00)	10.32 (100.00)
Per household land holding (ha)	0.91	1.37	0.63	0.61
***n= number of household studied**				

Grasslands ranked second after agriculture land use ranging from 23.38 to 37.89% of the total land (**Table 2**). In the cold desert, fodder is a scarce commodity and grasslands are cultivated for hay which remains the source of fodder during lean period of extreme winters in the valley. These grasslands are the home of several high value medicinal plants like *Aconitum heterophyllum*, *Angelica glauca*, *Dactylorhiza hatageria* and *Ephedra gerardiana* (Kuniyal et al, 2004b). For high forage yield, regular irrigation was done. Irrigation frequency for grasses is more at Jahlma (5.72 times in one growing season) followed by Hinsa (4.04 times) and Khoksar (3.83 times) and is lowest in Kuthar village (3.17 times). Till October, animals are stall-fed and pasturing is not allowed. When fields are without any crop, immediately after harvest of second crop in the end of October, animals are allowed to graze on them.

Willow around villages for fuel wood and fodder are cultivated in the Jahlma (12.22% of the total land), Khoksar (9.92%) and Hinsa (5.87%) villages (**Table 2**). In Kuthar village, broad leaved and coniferous forest resources are available and farmers harvest fodder from the neighbouring forests and no more attention is given for willow plantation. In Kuthar village, only 0.10% of the total land is under forestry. Every Lahauli family has a kitchen garden to grow a variety of green vegetables. Land under kitchen garden ranges from 0.95 (Hinsa) to 2.57% (Khoksar) of the total land area in study villages. Kitchen garden needs more care and irrigations. In Jahlma and Hinsa villages, 8 times watering was done in kitchen gardens whereas at Khoksar and Kuthar villages, 7 times irrigation is given to vegetables.

Under agroforestry and forestry system in Khoksar village, willow (*Salix* sp.) and poplar (*Populus* sp.) are raised for fodder, fuel wood and timber (**Table 3**). Willow is most important species and about 97.48% of total trees are found under agroforestry system. Like other parts of the Himachal Pradesh, agroforestry was important source of fodder and fuel wood (Vishvakarma et al, 1998). In Jahlma village willow is also most important species and about 70.70% of the total trees are of willow. *Hippophae* sp. is second important species found on the margin of the agricultural fields, particularly, along the streams or water channels (Kuniyal et al, 2002). Apple is now being grown in the Jahlma and Hinsa villages where as in Kuthar apple is already an established cash crop. Here, poplar, plum, apricot and walnuts are also cultivated but in smaller numbers. In Hinsa village, willow was most important species and 96.41% of the total trees are of willow. Poplar, apple and walnuts are also found relatively in small numbers. In Kuthar village, trees under forestry and agroforestry are very few (415 trees) as compared to the highest number of 14,698 trees of Jahlma village. Apple is most important tree under agroforestry and forestry system followed by willow. Hazel nut is maintained for its better quality nuts basically for home consumption. In Khoksar, Jahlma and Hinsa villages, emphasis is given for cultivation of fodder and fuel wood trees; more than 90% of the total trees planted in these villages belonged to this category. However, in Kuthar village more emphasis is given to fruit trees because fodder can easily be available from the surrounding forests of this village.

The highest number of trees are in Jahlma (14, 698 trees) followed by Khoksar (2, 575 trees) and Hinsa (948 trees) and is in the lowest number in Kuthar village totalling as much as 415 trees (**Table 3**). Trees are regularly irrigated through *kuhls*. On the slopes, flood irrigation is not possible so the farmers make shallow *kuhl* across the slopes adjacent to the trees. Water runs through shallow *kuhls* making soil wet through seepage. Overflow of the *kuhls* irrigate the slopes under trees to maintain continuous level of moisture till the next irrigation comes. Average irrigation frequencies vary from 7.06 times in one growing season at Jahlma, followed by 4.96 times at Hinsa, 4.83 times at Khoksar and 4.29 times at Kuthar village. Extremely xeric conditions prevalent in village Jahlma requires more and frequent irrigation to maintain trees as compared to other three villages.

Table 3: Village Wise *kuhl* Irrigated Trees under Agroforestry/Forestry Systems in Cold Desert of the Lahaul Valley, North Western Himalaya (values in parentheses are % of the total trees)

Trees	Villages			
	Khoksar n=12	**Jahlma n=41**	**Hinsa n=52**	**Kuthar n=17**
Fuel wood/fodder				
Salix sp.(willow)	2510 (97.48)	10392 (70.70)	914 (96.41)	98 (23.61)
Populus sp. (poplar)	65 (2.52)	522 (3.55)	12 (1.27)	4 (0.96)
Hippophae rhamnoides (sea buckthorn)	-	2700 (18.37)	-	-
Fleshy Fruits				
Pyrus malus (apple)	-	1042 (7.09)	16 (1.69)	280 (67.47)
Prunus communus (plum)	-	26 (0.18)	-	-
Prunus armeniaca (apricot)	-	16 (0.11)	-	3 (0.72)
Pyrus sp. (pears)	-	-	-	2 (0.48)
Nuts				
Juglance regia (walnut)	-	-	6 (0.63)	10 (2.41)
Corylus avellana (hazel nut)	-	-	-	18 (4.34)
Total	2575 (100)	14698 (100)	948 (100)	415 (100)
- = absent in the village				

Development of forestry and agroforestry is dependent basically on two factors: (i) scarcity/ availability of fodder resources in the village, and (ii) availability of land for plantation. Both in Khoksar and Jahlma villages, fodder resources are very scarce. Farmers in Jahlma plant willow on large scale around the village settlements. However, under similar conditions due to lack of lands, the farmers at Khoksar can not plant trees beyond a certain limits due to narrow valley and high slopes. In Hinsa village, farmers get fodder and grasses from neighbouring forests along with willow plantation. So they do not plant more willow trees inspite of availability of land. In Kuthar village farmers lop broad leaved trees from forests and they do not pay more attention toward willow plantation. Willow is a second tree crop after apple under agroforestry system.

Yield Pattern of Cash Crops under Kuhl Irrigation

Ensured crop irrigation results in good harvest under extremely xeric environment. Per hectare yield of cash crops such as pea and hops is better at Jahlma village as compared to Hinsa, Kuthar and Khoksar villages (**Figure 4**). However, yield of potato is the best (33.22 MT/ha) at Khoksar village. The lowest yield of potato was 10.74 MT/ha at Kuthar village. The climatic conditions of Hinsa and Kuthar villages are more suitable for good yield. Because of better agricultural practices, superior seed input, timely cropping and better soil and water managements, farmers of Jahlma and Khoksar villages reap better harvest than the other two former villages. Pea is harvested from mid July to mid August exclusively for green vegetables. Harvest of hops is treated as a community work for which farmers support each others. Harvesting of hop is done by mid August. Potato is harvested relatively late and is sold through Lahaul Potato Society (LPS), a farmers' co-operative society that sells most of the produce in different parts of the country. Each year, the LPS ensures the initial supply of provisions and other essentials to the farmers in lieu of potatoes before the onset of winter and closing of the Rohtang pass. Under ensured *kuhl* irrigation conditions, cash crops economy has changed the socio-economic status of the people. Kuniyal et. al (2004a) in their study found that monetary efficiency of the cash crops is more than two times higher at Khoksar as compared to traditional crops.

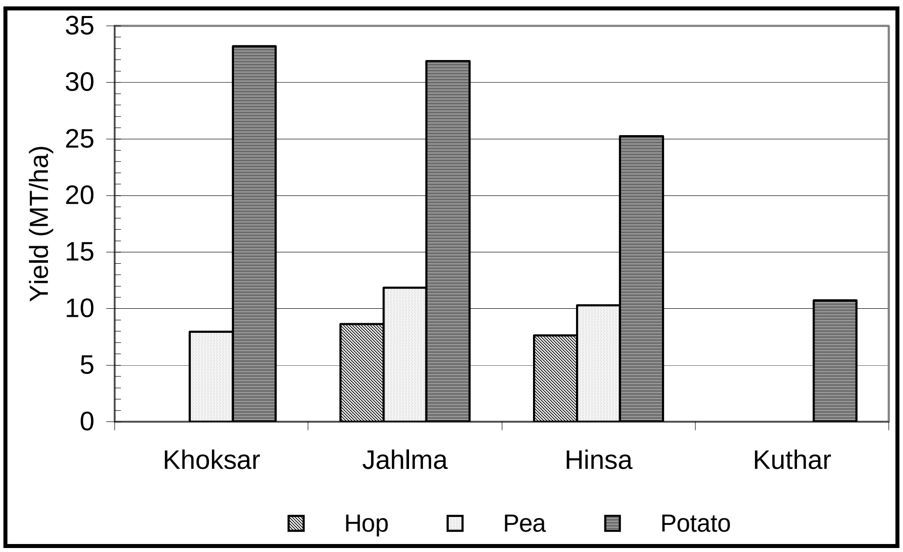

Figure 4: Yield of Cash Crops in Cold Dersert of the Lahaul Valley under Khul Irrigation

Water Sharing

Irrigation in a day is normally done from 6.00 a.m. to 6.00 p.m. (**Table 4**). Water is a right of every individual in the valley but only a right holder of a *kuhl* gets water from a particular *kuhl*. Here, entire discharge of main *kuhl* from 6.00 a.m. to 6.00 p.m. is called one-water. In Khoksar and Kuthar villages, one–water is used by one farmer. In Jahlma village discharge of the main *kuhl* is divided in two equal shares, thus two farmers simultaneously use one half-water. In Hinsa village, water of main *kuhl* is divided into 4 equal shares and simultaneously four farmers irrigate the land each using one quarter-water. For a distribution of water from the main *kuhl* to the branches, there is no water regulation structure and engineering work available in the valley. In Jahlma, the main *kuhl* is equally divided into two first order branches at one place and water equally flows in both of them. In the same way water of the main *kuhl* has been divided into four equal first order branches at one place. Dani and Siddqi (1989) in their studies in Pakistan found propositional weir (*Chaukhat*), like Sumatran *penaro* (Coward, 1985) and Nepalese *saacho* (Martin and Yoder, 1988) with four proportionate inlets. Irrigation is done in day time; in years of shortage of water, the same farmer can irrigate his crop in the night after 6.00 p.m. also. In nights if water can not be used for irrigation, third order branches diver water to nearby streams. There are no as such storage facilities of water during night so that it could be used in a day time. Dani and Siddqi (1989) found that in Pakistan, farmers had developed reservoir for storage of water at a stage of third order branches and use the same in day time. Night storage system are found in Ladak area in India and in supper Mustang area of Nepal. (Baskota and Chalise, 2000)

Table 4: Mechanism of Water Sharing and Management of *Kuhls* in Cold Desert of the Lahaul Valley, North Western Himalaya

Attributes	Villages			
	Khoksar	Jahlma	Hinsa	Kuthar
A. Water sharing				
1. Roster (days)	17	14	9	No roster
2. Available water for irrigation	One-water[a]	One half-water	One quarter-water	One-water
3. Irrigation duration	6.00 a.m. to 6.00 p.m.	6.00 a.m. to 6.00 p.m. In case of water shortage in *kuhl*, farmers irrigate crops in night also	6.00 a.m. to 6.00 p.m. In case of water shortage in *kuhl*, farmers irrigate crops in night also	6.00 a.m. to 6.00 p.m. --
4. Basis of water sharing	House holds	Land holding size	Land holding size	When ever required
5. Amount of water available	I water	1/2 to 1/8 share of *kuhl*'s water. 3-4 households of small landholdings are clubbed together in 1/2 share of water in one day for	1/4 to 1/16 share of *kuhl*'s water. 3-4 households of small landholdings are clubbed together in 1/4 share of water in one day for	Farmers of small landholdings, in one day several farmers irrigate the crop

		irrigation	irrigation	
B. Management				
1. Main *kuhl*	Nowadays initial cleaning and repairing of the *kuhl* given to contractors. Regular cleaning is done by the users.	Nowadays initial cleaning and repairing of the *kuhl* given to contractors. Regular cleaning is done by the users.	Farmers provide 5 man power for initial cleaning and ongoing repairing of the *kuhl*	Farmers provide 5 man power for initial cleaning and ongoing repairing of the *kuhl*
2. Branches	Users living along the branch regularly clean and maintain themselves.	Users living along the branch regularly clean and maintain themselves.	Users living along the branch regularly clean and maintain themselves.	Users living along the branch regularly clean and maintain themselves.
[a]One-water = Entire discharge of the main *kuhl* where water distribution starts from 6.00 a.m. to 6.00 p.m.				

There is no separate share of water for irrigation of agriculture, forestry, grassland and kitchen garden. Water share is also not done on the basis of location of the lands. If a farmer has land on different locations he has to irrigate the land during his turn in any part of the command area. However, if there is surplus water in once share, he can share mutually his water with other farmer; in return he would get the same amount of water from the receiver's share. In a family, water is divided with a ratio of the inheritance of the land. Suppose a father has one half-water in his share and his property is divided into his two sons. Both the sons shall get one quarter-water in their share. In the same way, if some one sale his lands to other person, his water share for that part of the land shall also goes to the new owner of the land. Relatively in larger villages like Jahlma and Hinsa, 3-4 marginal farmers' irrigation is clubbed in one half-water or one quarter-water for Jahlma and Hinsa villages, respectively. Sharing is done in such a way that no single farmers in the village could suffer crop damages due to lack of irrigation water. In Jahlma and Hinsa villages, 2-3 families have more than one day water in their share because of either higher landholding or higher amount of contribution paid by their ancestors at the time of construction of the *kuhls.* More than one day water of the *kuhl* can be also possible by purchasing new land area from other right holder of the same *kuhl*. In Khoksar village, turn of the same farmer comes after 17 days, in Jahlma this turn comes after 14 days and in Hinsa 9 days. In Kuthar village no roster has been made because of relatively smaller landholding size (0.61 ha per household) and lesser numbers of users (total 17 users), when water is needed farmers could use it after waiting a few hours.

Water sharing in all the villages shows three distinct distribution patterns among right holders: (i) water sharing is on the basis of numbers of households in the village as in Khoksar irrespective of the land holding size. This practice was a common feature in the small villages, (ii) water sharing basis on land holding size in a larger villages like Jahlma and Hinsa, and (iii) there is absence of any water sharing mechanism, when farmers need water they can take it after mutual negotiations. This system is possible fit only where land holding is very small and water users are less in number such as in Kuthar village.

Kuhl Management

Management of main *kuhl* is done through participation of labour by its users. Initial cleaning and repairing of the *kuhl* is done before starting cropping season in the month of April every year. Every household provides 5 man days per year for cleaning, repairing of the damaged part of the main *kuhl* and regular repairing and removal of stones, pebbles and sediments, etc. (**Table 4**). Repairing work is supervised by a nominated member among the *kuhl* users itself called *mukhiya* (in Hindi) or *lapha* (in Lahauli). *Mukhiya* is a senior *kuhl* user who has adequate knowledge for *kuhl* management and water sharing from it. He is nominated for a period of one year. In a few villages, like Rapring near Jahlma, *mukhiya* is hereditary; a gesture provided by the Fate *kuhl* (synonym Rapring *kuhl*) users. Fate *kuhl* was constructed by grand father of the present day's *mukhiya* Mr. Shiv Chand Thakur of Rapring village. Later, other members of the Rapring village joined the initial cleaning and regular repairing of the *kuhl*. Nowadays, about 50% native population reside out of the valley for jobs. Senior citizens are residing in the villages; every household in Khoksar and Jahlma villages hires two agricultural labourers. So job for initial cleaning and repairing in Jahlma and Khoksar villages is given to Nepalese contractors. Expenditure for the contact is met by a combined contribution of the users in accordance with ratio of their water share. Regular vigilance of the main *kuhl* is done by the villagers as per instruction of the *Mukhiya* from the man power provided to him on turn basis out of the total users. All the branches of the *kuhls* are repaired and maintained by such contribution of the users along the branches.

In the cold desert environment, management of *kuhl* is difficult job. Several options regarding management problems are asked from the farmers. The responses from different villages are also found different (**Table 5**). However, in all the four villages, damages due to landslides, deposition of mud, pebbles and gravels etc., and damages at an origin site of *kuhl* due to floods and destruction by animals are common problems. In Khoksar and Kuthar villages, households being very few in a smaller command area the people could not observe seepage from *kuhl* any more as a problem. In the villages like Jahlma and Hinsa, per household landholding and number of users of *kuhls* are more than the Khoksar and Kuthar villages, and people acknowledged the seepage as a major problem and favoured to design these with concrete. Moreover, in Jahlma and Hinsa villages, total length of the *kuhls* are also long as compared to Khoksar and Kuthar villages (**Table 1**) so seepage losses is very high upto 50 % of the total intake in the *kuhl* at its origin point. The state government provided funds for minor repairing of *kuhls* to all the study villages. For reducing the seepage loss from lengthy *kuhls,* concrete lining is one of the best options. Under DDP some parts of a few *kuhls* have also been cement plastered.

Table 5: Problems in K*uhl* Management in Cold Desert of the Lahaul Valley, North Western Himalaya (values in parentheses are % of the total respondents)

Attributes	Villages			
	Khoksar n=6	Jahlma n=18	Hinsa n=26	Kuthar n=9
. **Problems in management**				
· Seepage	-	11 (61)	13 (50)	2 (22)
· Landslide	4 (67)	6 (33)	2 (8)	9 (100)
· Mud, gravel and pebble deposition	5 (83)	17 (94)	25 (96)	9 (100)
· Flood	6 (100)	17 (94)	5 (19)	9 (100)
· Animal destruction	5 (83)	4 (22)	13 (50)	-
. **Role of government**				
· Granting money	6 (100)	18 (100)	26 (100)	9 (100)
. **Causes of lesser amount of water**				
· Less snowfall from last 6-7 years	5 (83)	18 (100)	10 (38)	-
· Receding glacier	-	15 (83)	12 (46)	6 (67)
· Climate change	4 (67)	5 (28)	11 (42)	6 (66)
· Increase in agriculture area	-	-	2 (8)	2 (22)
· Lesser rainfall	-	· -	8 (31)	8 (89)
. **Remedial measures**				
· Plantation	1 (17)	· 14 (78)	21 (81)	2 (22)
· Cementing of kuhl	-	· -	22 (85)	4 (44)
· Can't say	1 (17)	5 (28)	4 (15)	5 (56)

n = Number of family interviewed, - = indicates no any respons

It is felt by the farmers in the entire valley that the amount of the water is reducing in the streams and subsequently also in the *kuhls.* When learned and experienced senior citizens are asked its reasons, continuous reduction in snowfall from the recent last 6-7 years, receding of glaciers and changes in climate are identified as the major causes. The unpublished work of the principal author showed that there is a rise of 2.47 °C in annual maximum temperature and reduction of 115.9 cm in annual snowfall in the 10^{th} decade of 20^{th} century as compared to the 9^{th} decade of the same century at Tandi (12 km far from Jahlma). Similar trend is also noticed in the Kullu valley where 1.1 °C rise in maximum temperature and 0.35 °C in minimum temperature is noted in the 10^{th} decade of the 20^{th} century as compared to the 9^{th} decade of the same century. Snowfall comes late and melts at much faster rates so when more water for irrigation is needed, shortage of water in the stream is obviously visible.

Increase in irrigated area and reduction in rainfall and subsequently more requirement of water are recognised as the major reasons by respondents in Hinsa and Kuthar villages. Successive cropping of the second crop after harvest of cash crops like pea and potato is also one of the causes of more demand of water. Remedial measures suggested by the people, includes massive plantation in the valley and cementing of *kuhls* to reduce seepage losses. From all the four villages there is a category of respondents who could say "can't say" such category ranges from 15% in Hinsa to 56% in Kuthar villages.

CONCLUSION

Kuhl system is a unique traditional irrigation system which is suitable to the local climatic condition under the cold desert environment. Seepage losses from *kuhl* could be a serious problem with an increase in water demand for more cultivation and simultaneously amount of water availability is also reducing in the streams. Better water conservation technique like concrete lining of *kuhl* is one of the best options to minimise water losses from the system. Moreover, massive plantation work around the villages is needed to stabilise slopes, reduce impact of climatic changes and increase greenery with a better use of aforesaid water management practices.

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EXPERIENCES OF WATER HARVESTING SYSTEMS AND PATTERN OF GOVERNANCE IN THE TRANS-HIMALAYAN REGION OF NEPAL

UMESH NATH PARAJULI[1]

INTRODUCTION

Nepal is predominantly a mountainous country with over 85 per cent its area covered by hills, mountains and Himalayas. In some places, the country extends towards the north of high Himalayas, usually referred to as the "Trans Himalayan Region". Some times the area is also referred to as "Inner Himalayas". The Upper Mustang and Dolpo in Nepal are examples of such areas. These areas lie in complete rain shadow of high Himalayas. Culturally and topographically the inner Himalayas of Nepal are very much similar to the Tibet region of China and Ladakh in India.

People living in the Trans-Himalayan region of Nepal derive their livelihood mainly from farming, which comprises of production of cereal crops, livestock raising and cultivation of fruit and farm-grown trees. As these areas fall on rain shadow of high Himalayas, agriculture is completely dependent on irrigation. Further, in these areas, settlement without a source of water cannot be imagined.

Depending on the sources of water and its need, people living in the inner Himalayas have developed indigenous water harvesting systems (IWHSs) since centuries. Use of indigenous knowledge and strong community participation are the basis for the development of these systems.

This paper is an attempt to draw information largely from studies conducted in the Upper Mustang (Nepal) and Ladakh (India) regions[2]. While doing so, the paper first presents an overview of the Upper Mustang area, which is followed by the description of water resources management and patterns of governance. Finally, the paper discusses on the policy and program aspects of IWHSs with a brief concluding remarks.

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1 Senior Divisional Engineer, DOI, Kathmandu, Nepal.

2 Please see: Parajuli and Sharma (2000); Agarwal and Narain (1997); Dawa et. al, 2000.

AN OVERVIEW OF THE UPPER MUSTANG REGION

In general, the Mustang district is divided into Upper and Lower Mustang. The area that extends from the north of Jomsom village to the border of Tibet (China) is referred here as Upper Mustang. The Kali Gandaki River, which runs from north to south, further bisects the area into two parts and has carved the deepest gorge in the world. As the area adjoins Tibet, this area shares the spectacular high desert landscape of the Tibetan Plateau.

The area lies in the complete rain-shadow of the great Himalayan peaks, Nilgiri (7,223 m.), Dhaulagiri (8,172 m.) and Annapurna (8,072 m.). The average annual rainfall is about 300 mm, about 71 per cent of which occur in summer (June-September). Precipitation, which occurs in winter, is mostly in the form of snow.

The climate of the Upper Mustang area is semi-arid; so the area resembles a cold desert. The wind velocity often exceeds 25 knots during daytime in the spring season (Gurung and Shrestha, 1997). Great temperature differences occur between sun and shade, and night and day. Average mean monthly temperature varies between 4.34 and 17.47 celsius. Usually freezing starts from the second half of November and then snowfall starts. At altitudes lower than about 3,500 m, usually snow does not remain more than a month. Snow in the areas above 5,500 m starts melting in April.

Landscape and Land Use

Landscape of the area is highly undulating with large altitudinal variations (ranging between 2,900 and 6,000 m from mean sea level) within a short horizontal distance. Based on the topography of the area, available lands are categorized into four types. They are: (a) moranial terraces; (b) canyon slopes; (c) ridge land and bare ground; and (d) grassland and forested slopes.

Moranial terraces where irrigation water is available are cultivated. But some areas in moranial terraces where irrigation water in not available remain as a grassland and bare ground, though they are suitable for cultivation. Similarly, in canyon slopes, rugged and difficult attributes of terrain restricted cultivation and development of other infrastructure. **Table 1** presents the estimated land use pattern of the Mustang District.

Table 1: Land Use Pattern of the Mustang District

Land Use Type	Area in ha	Percentage
Agriculture land	5466	1.5
Tree cover (natural and planted)	12324	3.4
Rock outcrop	148572	40.8
Bare slope with thin bushes	150604	41.4
Snow cover	30581	8.4
Rivers and others	16410	4.5
Total	363957	100

At present, considerable areas of land, which were cultivated in the past by the native people are lying fallow. If managed properly, these lands could be irrigated with the existing water harvesting systems. It is amazing that people are not much interested to cultivate crops and fruits in these lands. Shortage of labor and other inputs, and lack of market are the reasons for this. Recently, villagers started cultivating farm-grown trees in such abundant terraces.

Table 1 further suggests that in the Mustang area, natural vegetation is sparse. It is mainly due to dry and wind-swept ecology. Plant density is high along the canals and along natural drainage/depressions, implying that scarcity of moisture in other areas is the main reason for sparse vegetation. **Figure 1** presents overall Landscape of the Upper Mustang area.

Figure 1: Landscape of the Upper Mustang Area.

Farming System

The farming system in the area comprises of production of cereal crops, livestock raising, and cultivation of fruit and farm-grown trees, all of which have strong interrelations for the entirety of the agro-eco system. Villagers predominantly practise traditional subsistence agriculture[3]. The principal

[3] Production from the cultivated land is hardly sufficient for five to six months.

cereal crops grown are buckwheat (*Fagopyrum esculentus*) in the summer season and naked barley (*Hordeum sp.*) in the winter season. The commonly grown fruits include apricot and apple, while the commonly grown farm grown trees includes *Populas ciliata* and *Salix spp.* with irrigation. For the past one decade, plantation of farm-grown trees has increased considerably. Other than these crops, wheat, maize, mustard and vegetables occupy nominal amount of land, mainly for domestic and livestock consumption.

Irrigation water, farmyard manure and labour are the main inputs for the cultivation of these crops. Of these inputs, irrigation water is the main. Naked barley and buckwheat usually requires three to five irrigations. Other crops such as vegetable, fruit orchard and farm grown trees also require time-to-time irrigation.

The Villages and Human Resources

Villages in the Upper Mustang area are sparsely distributed. Usually, it takes more than an hour to reach from one village to another. They are located in such locations where basic resources like land and water are available. Also, the location of a village and houses in it are designed applying defensive mechanism for emergency period. The houses are perfectly Tibetan style with a flat mud roof that is used for storing fuelwood for emergency.

Unlike other parts of the country, population (human resource) in the Upper Mustang area is sparsely distributed. Though the population density with respect to the total land area of the district is quite low (about 4 persons per sq km), the population density per arable land is quite high (251 persons per sq km) (CARE, 1994).

The people of the Upper Mustang mostly belong to Bhote-Gurung and Bista ethnicity and speak a Tibetan dialect. Bhote-Gurung are Tibetanized Gurung with strong Buddhist influence. In this community women enjoy greater freedom.

WATER RESOURCE AND ITS MANAGEMENT

Sources of Water and its Uses

Snow and glaciers are the main sources of water in the Upper Mustang area. Other sources include winter precipitation and summer shower on small scale, which, however, do not fulfill the water demands of the villagers.

On the basis of priority, the main usages of water are household consumption, livestock uses[4], irrigation and operation of water mill. In irrigation, cereal crops receive the first priority, followed by fruit orchards and farm-grown trees. The present levels of water demand for both domestic consumption and livestock uses are less than the level of supply. However, for irrigation, the present level of demand exceeds the level of supply, mainly during the spring season. Even during summer, water as an essential input for cultivation would not become surplus if not managed properly. Thus, villagers have developed elaborate water management practices for irrigation use, which are discussed separately in a forthcoming section.

For irrigation use, spring (February-April) is the most water-deficit season, while for domestic consumption and livestock uses, winter is the most scarce period. The reason is, during winter, water freezes at most of the places. For irrigation use, the recent demands for increased water supply are for the months of February to April.

Water Harvesting System

Snow and glaciers that melts in the upper reaches of watershed flow downhill in the form of water, which ultimately take a shape of a stream. Water from such snow-fed stream is diverted through the open canal and is collected in a tank before being distributed to various uses. **Figure 2** presents an overall schematic diagram of the watershed and water harvesting systems for tapping the glacier in the Trans-Himalayan region.

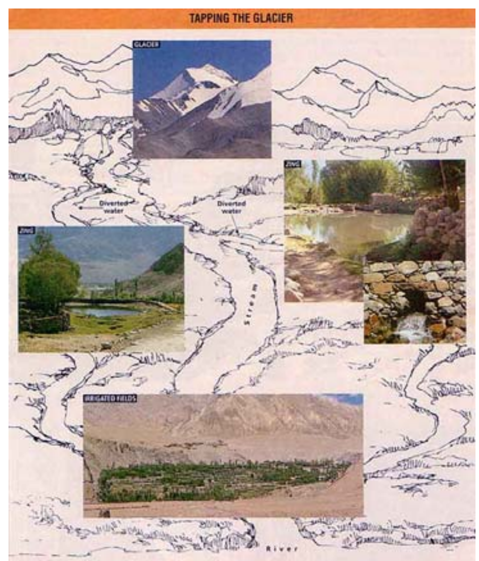

Figure 2: Schematic Diagram of the Watershed and Water Harvesting Systems

***Source*:** Agarwal A. and Narain S., 1997

The flow characteristics of a snowfed stream are entirely different from those of spring-fed (rainfed) streams. In the Upper Mustang area, as snow and glacier melt slowly through the day, the stream flow increases considerably

[4] Drinking and dipping are the main uses of water for livestock.

in the late evening compared to that in the morning. In general, evening flow in a small stream located in the upper reaches of the watershed may increase by 4 to 5 times the morning flow. Such a wide variation in the river flow across the day occurs only during summer. The reason is, in summers the snowmelt is maximum.

Water harvesting system in the area consists of several components. These include run-off-the-river type of gravity canal, intermediate balancing tanks, water mill with a bypass canal, distribution canals for irrigating crops, and livestock tanks. A Simple diversion structure built across snowfed stream/river supplies water to the respective gravity canal, which in turn transport water to the balancing tank. The balancing tank then supplies water for several uses.

Except during winter (mid-November to mid-January), these systems operate continuously round the year. During winter, however, these systems freeze due to freezing cold temperatures.

Of these components, the balancing tank, water mill with bypass canal, and the livestock tanks are special features of the indigenous water harvesting system. Following few paragraphs describe them.

The Blancing Tank

The run-off-the-river type of gravity canal (also known as feeder canal) leads to an artificial tank referred here as balancing tank, where water is stored through the night and released the following morning. These tanks are small in size and designed to store the flow available through the night. They are constructed simply by excavating earth in a natural ground. The topography of the area where the tank is constructed determines its shape.

Such tanks are locally known as *ching.* A *Ching* helps in regulating and distributing water among different users. Use of such small tanks in the water harvesting systems in Upper Mustang is very popular. Not only in Nepal but also in the Indian Himalayas, the use of this type of tanks by villagers has been widely documented (D'souza, 1997; Singh, 1997; Sengupta, 1993). D'souza (1997) further notes that in Ladakh, such tanks are locally known as *zing.* Surprisingly, the local names given to the tank in both the Mustang and Ladakh areas sound strikingly similar despite their separation by a distance of over 800 km. **Figure 3** shows a *ching*.

It is to be noted that, in the middle mountain region, use of such intermediate balancing tank in run-off-the-river gravity canal systems is not that common. This raises a question - why then the technology of intermediate balancing tank became important in the Upper Mustang areas? The reasons are of three folds.

Figure 3: A Ching

First, during the winter season (January-February), as many of these systems tap water directly from the glacier melt, the flow available in the canal is very small – of the order of even less than 10 lps (Parajuli and Sharma, 2000). This flow further reduces at the farm inlet if applied directly. Such a small flow is not enough for surface irrigation by border method[5]. The reason is, most of such small flow seeps into the terrace and may not advance through them. Therefore, irrigation by border method requires considerably large flow. Larger flow advances faster, which in turn minimizes the losses by deep percolation below the root zone. A tank, therefore, helps in collecting the small flow for longer duration and releases the increased flow for shorter duration.

Second, during the spring season, available flow in the stream (and also in the canal) fluctuates considerably across the day. As snow and glacier melt slowly through the day, canal flow increases considerably in the late evening, too late for irrigation. This water is collected in balancing tank for the use of next day. The balancing tank therefore re-regulates the fluctuating flow into steady flow. Note that for the purpose of irrigation, spring season is the most water-deficit season.

Third, these systems (tanks and feeder canals) also supply water for all domestic needs other than drinking for human being. These balancing tanks help in maintaining buffer stock of water for both the livestock and domestic uses in case the gravity canal does not operate for a few days due to either canal breach or heavy snowfall.

5 For irrigating cereal crops, a terrace is sub-divided into several long strips of land, and surface irrigation by border method is practised.

The Watermill and Bypass Canal

Each village in the Upper Mustang area has its own watermill for grinding cereals. Usually the water mill is operated by the gravity canal system, and is located downstream of the balancing tank close to the main distribution canal. A bypass canal, which bifurcates from the main distribution canal, leads the flow to watermill. The tail-race canal leads the flow back into the main distribution canal.

The watermill belongs to the community, and no specific person is allocated for its operation. One who needs to grind his food-grain has to divert the water to the bypass canal and operate the water mill himself.

The Livestock Tank

Each village in the Upper Mustang area has one livestock tank located in the middle of the village. Livestock drinks water from this tank. A livestock tank is much smaller in size than the balancing tank. **Figure 4** shows a livestock tank.

Figure 4: A Livestock Tank

Of the several distribution canals receiving water from the balancing tank, one such canal is aligned through the village and is known as village canal. The village canal supplies water for domestic uses and is linked with a livestock tank.

During the winter season, usually, the water in the livestock tank freezes. Every morning the villagers have to puncture the frozen upper layer with a steel rod to allow their livestock to drink water from the lower layer.

Pattern of Governance in Managing the Water Harvesting Systems

The term governance simply means administering the functioning of a system. Governing a water harvesting system involves multiple activities including the management of the water, infrastructure and the people. Thus, administrating all these management activities in a coordinated way to achieve functioning of the system is termed here as governance. Following few paragraphs describe organizational and operational arrangement for managing IWHSs.

The Village Organization

Each village in the Upper Mustang area has a single-tiered village level organization[6], which is unique in the country. These village organizations have their own written rules, which may differ from village to village. Each of these organizations is headed by a group of a few people (on the basis of joint leadership) designated as *gempa.* The senior most members of each household in the village are general members of this organization. These members have strong internal cohesion against other villagers or outsiders, which is often enforced by the local legal system.

Each village has two or more *gempa* depending on the household size. The larger the household the more is the number of *gempa*. For example, the Chaile Village having 13 households has two *gempa* whereas the Ghyakhar Village with 17 households has three[7]. Of the several *gempa* in a village, usually the oldest one acts as the chief and others act as deputy.

Gempa are selected for one year among its general members through a lottery method[8]. Who ever win the lottery has to become *gempa* for that particular year. The process is repeated every year. For example, the Ghyakhar village has 17 households (means 17 members), and this village organization is headed by three *gempa.* In the lottery method, the three winners have to become *gempa* for that particular year. For the following year, again the lottery method is used among the remaining members to select the *gempa*. This means the senior most member of each household has to become *gempa* once in every six to seven years.

As a remuneration, each *gempa* receives about 15 *pathi*[9] of naked barley per year, which is collected from all the households on equal basis. Usually the *gempa* are not allowed to leave the village without permission, even during

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6 These village organizations do not have any defined institutional linkages with the Village Development Committee (VDC). However, since the VDC (comprising several villages) is the only officially recognized organization, it forwards all the development, administrative and legal issues of a village to the higher authorities in the government for implementation.

7 In some bigger villages, *gempa* are further assisted by their subordinates, known as *chowa*. The main responsibility of a *chowa* is to communicate messages from *gempa* to the villagers. For example, the Tetang village organization, having 51 households, has three *gempa* and four *chowa.*

8 The lottery method is discussed later in this section.

9 *Pathi* is a measure of volume. One *pathi* of naked barley approximately equals 3.5 kg.

winter. If any of them leaves the village, he has to pay one *pathi* of naked barley per night as a penalty; such a fine goes to the village fund.

The *gempa* provide overall leadership for all social, agricultural and development activities in the village. Though *gempa* have the decisive power, they do not have the right to change those social norms that are being practiced for centuries. The main responsibilities of the *gempa* are to enforce social rules and regulations, protect public property and resources, manage public funds, summon village meetings and impose fines (usually in kind) on those who do not follow social norms. For example, whenever the village meeting is held, there is a rule that each household should send its one representative of age between 18 and 59 to attain the meeting. If a household fails to do so, it has to pay 4 *pathi* of naked barley as fine. Such a fine goes to the *gempa* and is equally shared by them. In contrast, if a *gempa* does not attend the village assembly, he must pay a fine double than that paid by the general members. Such a fine goes to the village fund. *Gempa* are accountable to the villagers. At the end of their office term, the village account is thoroughly investigated by the villagers and also by their successors. Ramble et. al (1998) note that in some villages, where the *gempa* sold the village property for private benefit, the villagers punished them.

All village problems or disputes are discussed in the village meeting chaired by the *gempa*, which is held regularly. Women also take part in the village meeting.

Clearly, the present day traditional village organization, in which *gempa* are accountable to the general members, indicates high level of community organization for managing all the village resources and enforcing social rules in society. However, officially, these organizations are not recognized by the prevailing government policies.

Women and Village Organization

In each village, women gather frequently, mainly to perform religious activities. In such gatherings, they also discuss all kinds of social and development-related issues. Ramble et. al (1998) note that this women's forum plays an advisory role to the main village meeting, and the decisions reached at village meetings are merely formalization of extensive prior discussions held in women's forum. In this sense the women's role in the village meeting is influential, though indirect. Usually, women are not eligible for the post of *gempa* (Ramble et. al 1998). But, in the case of a female-headed household, a woman can also become a *gempa* (Parajuli and

Sharma, 2000). Unlike the male *gempa*, a female *gempa* would not perform the job of a messenger, which requires moving around the village and informing the villagers about some decisions. Such a job is performed by some other male *gempa*. Selecting a female as a *gempa* and making no gender restriction to take part in the general assembly indicates high involvement of women in the decision making process. The decision making process is very much democratic. It is discussed below.

Process of Decision-making

Depending on the issue, three methods, namely lottery, consensus, and open voting are used in the process of decision making. The following few paragraphs describe and discuss each of these methods of decision making individually.

Lottery Method

The lottery method is the most commonly used method of decision making, especially when some persons are to be identified to execute some job. For example, when irrigation starts, the question arises who will irrigate first. In such a situation, this method is used to identify the irrigation turn in a rotational water distribution method.

In this method, two dices, locally known as *para*, each having a number ranging from one to six, are used. The game is played by slowly rolling down the *para* in a leveled ground and the numbers obtained on the top surface of the *para* are noted. In this game, the maximum number one can get is 12, while the minimum number is 2. Each member, irrespective of gender, plays the *para* one time and the number each of them receive is recorded by *gempa*. The person receiving the maximum number wins the lottery. **Figure 5** shows a picture of the villagers playing *para.*

Devkota (1997) notes that the Tetang Village in Upper Mustang uses small wooden pieces of similar shape and size for the lottery method of decision making. He further notes that in this method, the total number of wooden pieces is kept equal to the total number of households. A

Figure 5: Villagers Playing Para

few wooden pieces, equal to the number of villagers to be selected for some job, are marked and all the wooden pieces are kept in a closed container. Each member is then required to pick one wo oden piece from the closed container. The villagers who pick the marked wooden pieces are selected. In this method, however, it is very cumbersome to make wooden pieces of similar shape and size, and to mark some of them. For this reason the lottery method using *para* is most popular in the Upper Mustang area.

Consensus

This method of decision making is used when other methods are not appropriate. For example, if the villagers have to nominate a person to represent the village, lottery method cannot be used because this method does not look at the capability of person for the said task. In such a situation, this method is used. This method of decision making is becoming popular, especially for deciding issues related to development works.

Open Voting

The open voting method of decision making is used to decide major issues in the village. Allocating development funds, fixing the priority of resource mobilization for various development activities are some examples of such issues.

In this method, one member of each household, irrespective of gender, has the right to cast one vote. Small pieces of stone are used as the ballot. Before the starting of voting, *gempa* define the issue and the members have to vote stating yes or no. Usually the voting starts with the seniormost person by putting small pieces of stone at defined places. After completion of voting, the result is declared by the *gempa*. The majority is the basis of decision making.

Operation of IWHSs

Operation of the IWHSs includes water allocation, distribution, system maintenance and conflict resolution. Following few paragraphs describe them briefly.

The principle of water allocation varies with its uses. For all uses other than irrigation, water is allocated according to need.

For irrigation, however, water demands usually exceed the supply. Thus, rationing the water is essential. In terms of priority of irrigation, cereal crops receive the first priority, followed by fruit orchards and farm-grown trees. For irrigating cereal crops, water is allocated according to villagers' shares, locally known as *chyure*, which is believed to have fixed long ago by the native people. It is also believed that the basis of allocation is with respect to land. Transfer of land right automatically transfers the water right attached to it.

The *gempa* manage the distribution of water to all users as per the individual's water share. Water is distributed to villagers on rotational basis. Modality of rotation varies from system to system. Usually irrigation starts in the morning and ends in the evening when the balancing tank becomes practically empty. Depending on the cropping season, the *gempa* decide the time to open and close the tank. Further, the responsibility of opening and closing the tank at the specified time also lies to the *gempa*.

System maintenance involves repairing of the intake, cleaning of the canals and desilting of the balancing tank. Maintenance of the IWHS is done twice a year by mobilizing labor resources based on the villager's water shares. The *gempa* decides the day of maintenance and the number of labor to be mobilized.

The *gempa* resolve minor water related disputes between villagers within the system. Major dispute if any is resolved by the general assembly following the villagers legal system.

DISCUSSIONS: WATER HARVESTING, GOVERNANCE AND PREVAILING STATE POLICIES

The Upper Mustang region has abundant cultivable land under moranial terraces, but without water it is a vast, bare slope desert. Unlike in the middle mountain area, rainfed agriculture is not possible. Thus, the present agriculture is completely dependent on assured irrigation.

In this Trans Himalayan region of Nepal, water as a usable resource is scarce, though the country is rich in water resources. Snow and glaciers are the main sources of water for human uses, which melts in the upper reaches of watershed and flow downhill in the form of water. People tap these waters for several uses including irrigation. As snow and glacier melt slowly through the day, canal flow increases considerably in the late evening, too late for irrigation. This water is collected in a balancing tank for the use in the following day

Main uses of water include household consumption, livestock uses, irrigation and operation of water mill. In irrigation, cereal crops receive the first priority, followed by fruit orchards and farm-grown trees.

The physical aspects of Indigenous water harvesting systems – especially the balancing tank, the *Ching* and the water distribution system - as designed and constructed by the local people, may not be highly efficient in saving scarce water, but it is still a wonderful invention that took into account ecological and socio-cultural considerations of the area. This suggests that the villagers are knowledgeable and capable actors who can develop and manage socially and technically sound water harvesting systems with practical experience.

Each village in the Upper Mustang region has a traditional village organization which is very efficient in managing the water resources irrespective of their uses. These village organizations not only manage water resources but also deal with all social, agricultural and development issues.

Different types of such organizations have existed throughout the country for centuries. Pattern of such organizations varies with the social structure, physical system and agro-ecological conditions of an area. Some of these organizations have written rules while some of them simply operate on the basis of social norms and values, which have been accepted by the community as unwritten constitution. Also, some of these organizations have been developed to manage specific water uses while some of them manage various aspects of society. Usually, these organizations are headed by experienced and socially-recognized persons who can convince the users regarding the social norms of water uses. In some areas, chairpersons are elected while in some the post of chairperson is hereditary.

Though various forms of traditional organizations exist throughout the country to manage water resources, the prevailing state policies do not officially recognize them. In contrast, the state policy requires formation of specific water users' associations with elaborate constitutional arrangements, which is often not required to manage small water resources systems in the mountain community. Such organizations need to be registered with the government as a prerequisite for receiving external assistance. This is mandatory for all the water uses such as irrigation, drinking water and small hydropower. The Water Resources Policy also presumes that the registered water users associations continue to manage water in a better way.

However, the story is somewhat different in actual practice. Much of these organizations are formed and registered with the government simply as a prerequisite for receiving government assistance, not for improving the management of water. Past studies in Nepal have shown that such sponsored organizations simply acted as construction committees and provided witness for the external expenditure. The majority of these organizations became defunct with the closure of the external funding. Despite the assumptions of improved operation and greater agricultural productivity of water harvesting systems, traditional organizations continued their operation as before intervention.

CONCLUSIONS

The paper suggests that the IWHSs - in which pattern of water control and governing system already exist - represent a living sociotechnical entity in the given ecological context. These characteristics of IWHSs need to be well recognized while modernizing them. Failure to do so can erode the local governing system and the contribution that IWHSs make to local livelihoods.

It has been accepted that without full participation of the local community, sustainable development of water resources cannot be achieved. To involve the community in water resources development, it is essential to promote their organizations and recognize them officially.

There is growing interests among the researchers on the study of institutions that can manage water, land and vegetation in an integrated way. The Upper Mustang area provide unique example for IWRM. Thus, further study in the area from the perspective of IWRM needs to be continued.

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SUITABLE INTAKE STRUCTURE IN SMALL SCALE MOUNTAINOUS RIVERS/STREAMS AND WATER GOVERNANCE (FOCUSING ON FARMERS MANAGED HILL IRRIGATION SYSTEMS)[1]

BHOLA CHHATKULI[2]

INTRODUCTION

Farmers and government of Nepal alike recognize that irrigation is vital to farmers' prosperity and national agricultural production. Department of irrigation (DOI) is providing its continuous efforts to develop irrigation facilities in the hills. However such a long and costly efforts are not giving inspiring results. The productivity of the agriculture sector is less than one third. Food deficit is a common problem in the remote hills. Presently in agricultural sector - all season irrigation facility is available only in less than 20% of arable land. Out of total command area under Government Managed Irrigation System the actual area receiving irrigation service is estimated at 60 percent and 29 percent of the net command area in summer and winter season respectively. There might be several reasons behind these deficiencies in the irrigation systems but some major causes are the inefficiency in the repair maintenance, operation, management and defective design of the systems (HMG Ninth Plan). An irrigation system that can provide reliable, adequate and equitable irrigation service needs to have suitable diversion Intake/head-works to match the requirement in terms of water acquisition in various flow conditions, withstand against hydraulic and other adverse conditions. Intake/headwork in general is one of the most expensive and crucial structures. For an efficient irrigation system, this structure should have easy for construction, operation and maintenance and also cost effective.

Therefore to have efficient irrigation systems the irrigation project should be developed in such a way that water can be delivered and utilized in harmonized, effective, and sustainable manner. For this the designer should be able to select and construct the necessary structure - components which are appropriate and suitable for that particular irrigation scheme.

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[1] This is abridged version of the paper presented in the Seminar. Interested individuals can approach Mr. Chhatkuli for full paper at e-mail: chhatkuli@ntc.net.np.

[2] Engineer, Department of Irrigation, Jawalakhel, Nepal.

PROBLEMS IN INTAKE STRUCTURES/HEADWORKS

Intake/Headwork is referred to as water acquisition structure normally constructed across or in the bank of the source river. The Intake structures are most essential part of any water resource scheme including irrigation system. If the Intake structure does not perform well, the over all functioning of the irrigation system will be ineffective.

The Nepalese rivers and streams run through several climatological and topographical reaches so are very dynamic and violent. They are generally entrenched or partly entrenched channel with straight or irregular bedrock single channel and sometimes-regular meanders, high velocity rivers. The whole Himalayas comprises a geologically active zone where instability due to tectonic activity and continuous on going erosion, is everywhere apparent. The watershed conditions of the Nepalese hills are being deteriorating. Scientist believe that the major part of the Himalayan rivers are located upstream of the river reaches where the classical science, the theories, the observation techniques and the empiricism of river hydraulics are developed (Stole, 1993). Sediment transport in these rivers is of an extremely complex nature. The sediment carried then usually ranges from sand and gravel to boulders and even large rocks, and some times it can include trees and other debris. Landslides and mass wasting may at times boost the sediment loads during floods. Sedimentation and violent behavior of hilly rivers is a major threat to the sustainability of the intake structures.

Not a standard approaches and technologies are practiced for the design and the construction of headwork in the irrigation systems of Nepal. In the similar type of geomorphologic and other condition, in some places concrete weirs are being constructed where as in some other cases gabion weir or simple side intakes are constructed. So the different types of headwork are being constructed and the performance of these headwork structures is variable. Although, some efforts are made to adopt suitable design of intake in hill irrigation has been devised in Nepal with the introduction of side intake and Bottom rack (Tyrolean) type diversion structures, performance of such structures are also not up to the desired level due to the design defects in number of locations.

Transparency and public participation are important ingredients to achieve effective water governance. However, in practice, participatory decision-making approach is not sufficiently applied while selecting and designing the intake structures. In very few cases, participatory decision process in minimum degree was found adopted but the form of participation is not clear.

Stakeholders' participation can contribute a lot to establish a cooperative water distribution system between the multi users and eliminate the conflicts and also to design a sustainable intake structure in our context. As we do not have sufficient hydrological data of small rivers and streams, and difficult to predict the behavior of the Nepalese rivers and streams, the designers can get hydrological and other several information from the local peoples which is very important while designing the suitable intake structures for that particular scheme. In some irrigation systems, farmers are involved during the fixation of the intake location, but in most of the cases, farmers are not encouraged to participate in the design of intake structure. In practice, farmers will know about the type of intake when it is constructed and designer dose not feel necessary to take the suggestions from the users while deciding the type and the components of the intake structure.

No matter how well designed and constructed, a headwork fulfill its intended functions only when properly operated and maintained. Unfortunately in many irrigation systems the headwork is not properly maintained. In some cases farmers and department both are in confusion on their responsibility. Farmers think that the responsibility of maintenance of the headwork belongs to the District Irrigation Office and DIO think that this is farmers' responsibility. Thus the intake/headwork is not maintained properly and get damaged quickly seeking for extensive rehabilitation. The headworks of Godawari Rajkulo Irrigation Project in Lalitpur, Chapakot Tar Irrigation Project in Syangja, Bijayapur Irrigation Project in Kaski, and Mahadev Khola Irrigation Project in Bhaktapur are the example of such poor O&M. In many headworks, the mechanical parts such as gates, trash racks etc. are not maintained timely and some are in defunct condition. Thus effective management is another crucial issue of sustainable intake structure/headworks

Quite often, the intake structure constructed by the agencies have been broken by the farmers for not being acceptable to downstream water users according to their traditional water rights (Parajuli 2001). There are cases where the water sharing conflicts between the users' results serious problems in the operation and maintenance of the intake/headworks. Example of this can be taken as the water sharing conflicts between the users of Lahachowk and Ghahachowk irrigation systems in Kaski, Pangrang and Bachha irrigation systems in Parbat, Darshan tar and Khadgabhanjyang Phant irrigation systems in Nuwakot and many others. Therefore, cooperative water management mechanism with greater understanding among the multiple users is very much necessary to have a good water sharing management in the Intake.

In many Hill Irrigation Systems the intake and diversion structures frequently get damaged. Some times they are washed away during flood seasons and the systems cannot deliver water regularly, though there is sufficient water in the sources. In some cases sophisticated intake structures such as modern weir with under sluice and mechanical gates are constructed without considering the financial, technical and institutional capability of the local people, which results poor operation and maintenance of the intake and interruption of the water supply to the canal system. Traditional farmers' diversion intake systems are also in critical stage and in many cases these traditional farmers' diversion systems are also not appropriate mainly due to decreasing availability of forest products and increasing labor requirements for continual repair and maintenance. In many cases due to the absence of hydraulic control, hazard floods cannot be managed by the intake and entered into the conveyance system damaging down stream protection works and other structures. There are many examples that due to the intake failure many projects were abandoned. These problems led to other several problems like; low efficiency in irrigation system, less return from the irrigated agriculture, dissatisfaction of the farmers, blames on professionals. In this context, this paper concentrates on the study of intake structures suitable for small-scale mountainous river of Nepal.

NEED FOR CURRENT RESEARCH

An acquisition structure intake, is most essential parts of the irrigation or hydro system. What is the best Intake and what function should a successful Intake have to be fulfilled? This is a very crucial question needs to take care of several factors while addressing this question in real life. Therefore to choose a suitable or cost-effective, functional and sustainable intake structure is not only a challenging job but also a vital decision, which affect directly the performance and the cost of the whole system.

Suitability of Intake structure in terms of technology depends upon the project and site specific. Suitability of Intake structure/headworks is influenced by Hydraulic efficiency, structural durability/stability, environmental soundness, social acceptance, users' friendliness, and institutional capability for operation and maintenance of the users. Besides these, the financial and economic is another important aspect for appropriateness of intake structure. An intake can be said suitable or appropriate if it matches the acceptance level of above criteria. In brief, an intake structure can be said suitable if the construction cost is justifiable by the project economy, allows abstraction of water from the source in all seasons in require amount with minimum possible sediment intrusion, minimum environmental hazards, minimum maintenance and operational costs, and adequate measure of protection against damage.

In recent years, several research works have been done on irrigation. Most of them are heavily on management-oriented. The research on hardware and technology aspects have not been given due consideration. Huge investments have been made for the construction of considerable numbers of intake structures/headworks and many of them are working with numerous problems. Several intakes are being washed out each year during monsoon season. Consequently, the irrigation services either disrupted or operation and maintenance costs become higher. However the concerned institutes such as Department of Irrigation, NGOs never tried to make a diagnostic analysis why the intake structures constructed in many irrigation systems are getting failed? What are the reasons behind the frequent failure of the intakes? May be due to inappropriate location or due to defective design, or due to poor construction and O&M or due to improper selection of intake type? Which intakes are more suitable and in what condition? What are the features of a suitable intake structure and how it can be achieved? All this issues can be clarified only from extensive research and study works. Considering these facts, the researcher feel necessary to conduct a study on "Suitable intake structure in small scale mountainous river" based on performance evaluation of already constructed intakes mainly in hill irrigation systems of Nepal.

OBJECTIVES

The objectives of this paper shall be

- To make a comprehensive assessment of different types of intake structures,
- To compare the failure/problematic intake structure with the functional one representing, and same river regime.
- To recommend the suitable type of intake structure based on the preceding analysis

DATA ON INTAKE PERFORMANCE

The performance evaluation in the eco-technological and socio-economical aspects of various intakes is presented in the **Table 1** and **Table 2** in the following pages:

Performance Evaluation in Weightage Basis

(As per total average weightage)

S. N.	Type/Indicator	Tunnel Side Intake w/o Diversion Structure	Side Intake with Temporary Diversion	Side Intake with Combination of Gabion Diversion with Core Wall	C. weir w/o under sluice in spring type river	Bottom Rack (Tyrolean) Intake	Rockfill Weir with undersluice	Concrete/ Masonry weir with undersluice	Gabion diversion weir with Side Intake
		1	2	3	4	5	6	7	8
1	Intake Hydraulic Efficiency (19.61%)	18.60	12.00	16.30	18.60	16.70	16.30	16.30	12.60
2	Structural safety (22%)	19.80	13.00	17.40	17.60	18.20	16.00	16.00	6.00
3	Economy (construction and O&M cost) (16.4%)	14.80	14.50	11.70	9.10	8.60	6.60	6.60	10.80
4	User's Friendliness(12%)	10.00	11.40	7.80	5.60	6.00	6.00	4.60	6.10
5	Social Acceptability 11%	11.00	10.50	9.20	11.00	10.50	10.50	10.50	5.50
6	Environment (9.68%)	9.68	9.00	8.10	7.70	7.70	7.70	7.30	4.50
7	**Sub-Total**	**83.88**	**70.40**	**70.50**	**69.60**	**67.70**	**63.10**	**61.50**	**45.50**
8	Institutional Strength (9.3%)	5.00	7.00	6.30	7.00	5.80	5.80	6.30	4.90
9	Total Score	88.88	77.40	76.80	76.60	73.50	68.90	67.80	50.40

Performance Evaluation in weightage Basis

(As per researcher)

S. No.	Type/Indicator	Tunnel Side Intake w/o Diversion Structure	Side Intake with Temporary Diversion	Side Intake with Combination of Gabion Diversion with Core Wall	C. weir w/o under sluice in spring type river	Bottom Rack (Tyrolean) Intake	Rockfill Weir with undersluice	Concrete/ Masonry weir with undersluice	Gabion diversion weir with Side Intake
		1	2	3	4	5	6	7	8
1	Intake Hydraulic Efficiency (20%)	19.00	12.00	16.60	19.00	18.00	18.50	19.00	12.90
2	Structural safety(20%)	18.00	14.00	15.90	16.00	17.50	14.50	14.00	6.00
3	Economy (construction and O&M cost) (20%)	18.00	17.70	14.30	11.10	10.50	8.00	8.00	13.10
4	User's Friendly in O&M (15%)	14.00	14.25	10.00	8.00	7.50	7.50	7.50	7.00
5	Social Acceptability 5%	5.00	4.80	4.10	5.00	5.00	5.00	4.30	2.50
6	Environment (10%)	10.00	9.38	8.40	8.00	8.00	7.60	7.60	7.00
7	Sub-Total	84.00	72.13	69.30	67.10	66.50	61.10	60.40	48.50
8	Institutional Strength (10%)	5.00	7.00	6.30	7.00	5.80	6.30	6.30	4.90
9	Total Score	89.00	79.13	75.90	74.10	72.30	67.40	66.70	53.40

OBSERVATIONS ON DIFFERENT INTAKE TYPES

Simple Concrete Weir (Headwork/Intake) without Under Sluice

4 Nos. of sample sites were taken for the study. These intakes are constructed in different irrigation projects of Bhaktapur district in small scale spring type rivers having small catchments area and river width about 4 - 8 m. The river slope is nearly 1: 10 to 15. Normally such situation is not available in most of the mountainous rivers.

The main components of these types of intake are concrete weir, a groove (under sluice) near intake and orifice with trash-rack. No gate has been constructed. A small orifice but sufficient for the supply of design discharge is constructed with vertical trash-rack which helps control debris from entering the canal. No excess water can enter into the canal during the flood. So intake can manage the hazard flood safely discharging floodwater to the d/s(**Figure 1**).

Figure 1 : Katunje Irrigation System, Bhaktapur District

Conventional Masonry/Concrete/Reinforced Concrete Weir with Under Sluice

This type of Intake/Headwork is constructed in several districts and different river geo-morphological condition of the country in medium and large hill irrigation projects of Nepal. For the performance evaluation study 7 Nos. of intakes constructed in different irrigation systems are considered. Main components of these intakes are concrete or masonry weir

Figure 2: Mahadev Khola Rajkulo, Bhaktapur District

parts, under sluice with regulating gate, Intake orifice with regulating gate and trash rack, d/s and u/s protection works (**Figure 2**).

Rockfill Weir

Very few rockfill weirs are constructed in the hill irrigation systems of Nepal. For the study purpose two-rockfill weirs were taken as sample site. In both site d/s rockfill work and other gabion protections are completely damaged or washed out. Only the main weir wall and other cutoff wall are standing seeking maintenance work.

Figure 3: Sange Patyani Irrigation System, Tanahu

During the monsoon period, several floods occurred in the river and every year more or less the gabion and rock fill works get damage by the floods. Therefore after each monsoon season, maintenance is required. The intake of Sangepatyani Irrigation Project (IP) is rehabilitated extensively in F/Y 2045/046 at the cost of NRs. 9,00,000.00 Except this, maintenance works of the intake is done several times after this rehabilitation work but the records were not available at the time of field visit The rockfill weir of Sangepatyani IP is in more critical condition, and presently rehabilitation of the whole Sangepatyani Irrigation system including intake (headwork) is going on in progress (**Figure 3**). Similarly the intake of Hyangja Irrigation Project is also in poor condition and needs urgent maintenance work to save from further deterioration.

Semi-Permanent or Gabion Diversion Weir

Gabion diversion weir (**Figure 4**) is a very common type of Intake structure, which is extensively used to divert water mainly in the government assisted irrigation projects of Nepal. During the study 11 intakes of gabion diversion, (2 from Lalitpur, 4 from Tanahu, 5 from Syangja) were chosen as sample sites for the performance evaluation. During the field visit, researcher got to know that among 11 gabion diversions intakes, 5 gabion diversion were washed out in the first monsoon season of the same year of construction, 2 gabion diversion weirs were washed out after few years of its construction, 2 are working with accountable problems and 2 are in good condition. At the time of observation visit, the researcher found that in most of the cases, the gabion diversions were constructed as weir, raising about 0.60 m to 0.75m high from the river bed level and no sufficient foundation was provided for this structure. Thus after the construction of gabion diversion, a drop is formed at the gabion weir axis.

Figure 4: Barha Bishe Irrigation System, Buldi Khola, Tanahu District

Intake with Combination of Gabion and Core Wall Diversion

In this type of intake, concrete or masonry wall across the river is constructed with combination of gabion. In general, the core wall and gabion is constructed up to the riverbed level as check structure (**Figure 5**). In some cases depending upon the size of the river, 1/2 to 2/3 length of core wall, about 15 - 20 cm is raised from the river bed level. Now a days, use of this type of intake is in increasing order.

For the study, 7 intakes (2 from Bhaktapur, 1 from Lalitpur, 1 from Tanahu, 1 from Kaski, 1 from Parbat and 1 from Syangja) of this type are taken as sample sites. Among the 7 intakes, 5 are in intact condition and functioning well, the intake of Jahare irrigation project in Parbat is functioning with some problems and one intake from Tanahu in Barra bot irrigation project is in defunct condition.

Figure 5: Intake with Combination of Gabion and Core Wall Diversion of Harishidi Irrigation System, Lalitpur District

Bottom Rack (Tyrolean) Intake

Bottom or Tyrolean Intake structures were developed for mountain torrents in Switzerland and Austria. Now, Bottom Intake structures are constructed in several irrigation projects of hilly areas in western development region of Nepal. Similarly Bottom Rack Intakes are frequently used at small-hydro projects in steep rivers. In most of the cases this type of intakes are functioning well. For this study two intake sites of this type were taken as sample site. One is from Gyandi irrigation project and other is from Phalebas irrigation project. Both projects are located in Parbat district.

Figure 6: Bottom Rack (Tyrolean) Intake, Myagdi District

Bottom rack intake of Tatopani small hydropower project (2 Mw) at Myagdi district (**Figure 6**) was constructed in 1989. The river is steep and the slope is about 1:15 to 20.

If Bottom rack intake is constructed in the rivers having confined channel, steep slopes, and less sediment concentration especially bed loads, performance will certainly be good. During the field visit, it is reported that most of this type of intake constructed in hill irrigation projects of western development region are functioning well except the Bottom Rack intake constructed in Tatopani Hydropower and Surahi irrigation project. But as the construction cost for Bottom rack intake needs more, the designer should justify technically as well as economically for choosing this Bottom Rack (Tyrolean) intake especially in irrigation and micro-hydropower projects.

In performance analysis, this Bottom Rack intake got 73.5 score which seems lower and it happens because of the higher value of construction and maintenance cost/ha of Gyandi intakes. It sows that Bottom intake is technically feasible in the steep river having slope more than 1:50 and the bed load concentration is low, but should be justified economically.

Side Intake with Temporary Diversion

For centuries, farmers have been showing their ability of diverting water from surface streams into their canals by constructing temporary diversion structure (weir). In more than 90 % intakes of farmers managed irrigation systems of Nepal, they have side intake with temporary diversion. For this study, 8 intakes were taken as sample sites, (3 from Parbat, 1 from Kaski, 1 from Tanahu, 3 from Dhading). All 8 intakes are functioning well. Intake of Dhairing irrigation project, Parbat, intake of Baradi Lower canal in Tanahu, intake in Parewatar irrigation project (**Figure 7**), Gomati irrigation project, and Manpang irrigation project in Dhading are working satisfactorily level. Intake of Patichaur Irrigation project in Parbat is working with some problems. The problem is mainly created by the excessive entry of water into the canal during rainy season. The researcher found that this is happening due to the absence of orifice (hydraulic control) at the intake.

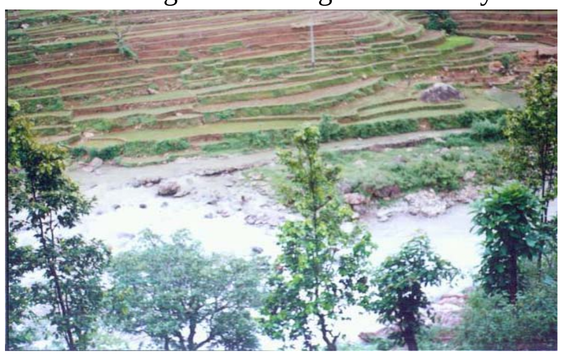

Figure 7: Side Intake Parewatar Irrigation System, at Thoppal Khola, Dhading District

This traditional intake can be constructed in most of the rivers where the fluctuation of water level is not much. This type of intake is also appropriate even in the rivers where construction of a concrete weir or other type of intake is technically as well as economically not feasible. For example, side intake with temporary diversion is working with satisfaction level in the Parewatar irrigation project, at Thoppal Khola, Dhading where the width of the river is about 100 m and river carries large quantities of rolling boulders as bed loads. From the study it is found that when the other type of intake is damaged or washed out, irrigation engineer and farmers both agree to replace by side intake with temporary diversion.

Tunnel Side Intake without Diversion Structure

Such intake (Headwork) is constructed in few irrigation projects of the country. For the construction of this intake a pond with vortex form and rocky banks are essential. Such favorable site is rarely available in practice.

For this study purpose, intake of Rampur Phant Irrigation Project is taken as sample intake (**Figure 8**).

The intake is located on the left bank of the river, the Nisti khola, where a deep pond is formed. At the Intake site, the river has sharply bent due to which there is always high turbulence during the flood season. The intake is located at the left rocky bank and in outside of the river bent.

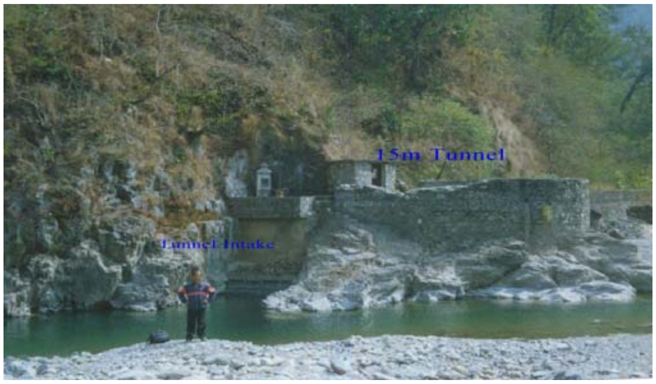

Figure 8: Tunnel Side Intake of Rampurphant Irrigation Project at Nisti Khola, Palpa District

In the performance evaluation analysis, this intake got highest score, which shows the best performance of the intake. From the above explanation, it is obvious that this intake needs not much cost for the construction and O&M also. It has excellent hydraulic control and abstraction capacity, users' friendly and environmentally sounds. The main strength is that this intake is working efficiently without any problem for last 15 years.

The engineers should study seriously during the service whether construction site suitable for such intake or not. If such site is available, the engineer can choose this type of intake for the construction.

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FMIS GOVERNANCE: ASSESSMENT OF KEY-EFFECTS IN DHAULAGIRI, WESTERN NEPAL

KHEM RAJ SHARMA[1]

BACKGROUND

The Dhaulagiri Irrigation Development Project (DIDP) funded by Danish Development Cooperation (DANIDA) was a technical cooperation project of His Majesty's Government of Nepal (HMG/N) and the International Labor Organization (ILO). It was a major component of the Nepal Special Public Works Program which was a labor-intensive rural infrastructure project with people's participation. DIDP was implemented by HMG/N through the Department of Irrigation (DOI) from November 1989 to 1996 in all the four hill districts (Mustang, Myagdi, Baglung and Parbat) of Dhaulagiri zone. The project was a labor intensive, demand-driven rural multi-sectoral infrastructure program. The long-term objectives of the project were to secure food production and improve the farmers' living conditions through the establishment of self-reliant farmer managed irrigation systems (FMIS) and the development of complementary social and economic activities.

DIDP completed 67 small irrigation schemes with a total command area of about 2,600 ha. The project carried out socio-economic surveys at 4 representative project sites with a view to measure at a later stage the impact of the project on food security, income and employment and the standard of living of the farmer beneficiaries. The socio-economic baseline survey of those 4 sites was done in 1992 and the follow up impact survey in 1996. Key-effects monitoring (KEM) surveys on particularly agricultural production and socio-economic issues had been carried out for 6 years in 15 subprojects on an annual basis to monitor changes in subprojects and facilitate documentation of longer term effects and impacts. The paper is based on findings of the KEM as well as the socio-economic surveys.

CANAL OPERATION AND MAINTENANCE

Resource Mobilization

DIDP activities were oriented towards the objective of strengthening local farmers' institutions. As a result, the irrigation systems are operated and managed by the their organizations of user farmers.

[1] Chief, System Management and Training Program, Department of Irrigation, Kathmandu, Nepal.

Labor contribution by the user farmers was the main source for operation and maintenance (O&M) of the irrigation systems. The need to mobilize labor to operate and maintain the system was a task, which all Water Users' Management Committees (WUMCs) constituted during DIDP implementation had in common. The improvement of the physical infrastructures of the irrigation systems under DIDP in general reduced the number of working labor days for canal maintenance (**Table 1**). In Jahare irrigation system in Parbat district, for example, prior to the canal rehabilitation in 1992, each household contributed 33 person days for canal maintenance, most of these were spent during rainy season when regular

Table 1: Details of Household (Labor Days Involved in System O&M)

District	Irrigation System	Command Area (ha)	Ave.Farm Size/HH(ha)	Days (Range)	Person Days in 1997
Parbat	Jahare	60	0.40	5-33	15
	Kurgha	80	0.32	5-17	5
	Lampata	30	0.51	6-9	6
	Setophant	20	0.24	3-8	3
Baglung	Amalachaur	35	0.4	3-12	7+Mill owner
	Arjewa	20	0.19	4-5	5 (ISF@Rs 100/ha
	Hugdisir	9	0.28	4-6	6
	Bhingithe	32	0.43	13-22	22+Mill owner
Myagdi	Pipalbot	31	0.46	4-14	4+Mill owner
	Ranabang	60	0.53	4-12	4+Mill owner
	Serephant	15	0.31	4-10	5+Mill owner
	Pakhu	25	0.46	4-8	4
Mustang	Thini	90	0.35	3-16	3 (ISF@Rs 589/ha)
	Tiri	11	0.81	2-5	5(ISF@Rs 987/ha)
	Khinga	45	0.63	15-77	15

Source: DIDP, 1992-1997

maintenance was required. This was reduced to 15 labor days per household in 1997. However, no clear pattern of labor contribution had been set in this system. Those farmers who did not contribute in canal maintenance were not asked to pay fines, though the system of penalty was there. Anarchy resulted where group norms and values were not observed. Water was then considered as a resource to be extracted for individual benefit. In some systems, such as Khinga and Thini in Mustang and Jahare in Parbat district, the need for large number of labor mobilization was the governing factor for which the farmers were organized. The majority of the systems, which were comparatively small such as Tiri of Mustang and Hugdisir of Baglung district, had also organized farmers' committees for the purpose of labor mobilization. The DIDP sample subprojects in general, for which KEM survey was carried out presented good examples of farmers' organizations. The farmers' active involvement during the entire process of system development/rehabilitation and their contribution in cost sharing increased motivation and improved quality of work. These opportunities generated skills, which was helpful in system operation and management later on.

Basis for Labor Mobilization

As mentioned before, contributions of labor by the farmer-members were the most common form of resource mobilization. In a few systems, such as Arjewa of Baglung district and Thini and Tiri of Mustang district, farmers also contributed cash in the form of Irrigation Service Fee (ISF) for the management of their canal systems. The method in which the labor contribution requirement was calculated differed from system to system, usually figured in terms of how much labor a farmer (household) must contribute for the entire period when group maintenance or repair of channel structures was being done.

Labor contributions calculated in proportion to the landholding within the command area sought to achieve equity between big and small landholders. Those with big holdings were required to contribute to group work more than small landholders. However, in many systems the labor contribution for canal system O&M was on household basis. This could be for the reason of simplicity and overly uniform small holdings. But in few systems, such as Lampata of Parbat district, the farmers contributed labor on the basis of their holdings. Cases of dominating roles of big farmers were also reported in few systems (e.g. Kurgha and Jahare in Parbat district and Pipalbot of Myagdi district).

Cash Contributions from Farmers/Mill Owners

There were systems where besides some labor, the WUMCs had fixed rate of cash contribution on the basis of land holding. In Arjewa subproject of Baglung District, NRs. 100/ha was collected in cash for maintenance of the system. In Thini and Tiri subprojects of Mustang District many young people moved out of the locality to get employment or had engaged in business entrepreneurship does where. It created a void in the process of labor mobilization as used to be in old days. Hence, the WUMC formed by the farmers decided to collect ISF @ Rs 589/ha and Rs 982/ha respectively and contract out the O&M responsibility to private contractors.

Some farmers had got permission from WUMC to establish water mills in the canal alignment. In Ranabang subproject of Myagdi District, the mill owner was required to pay some amount to the WUMC to cover part of the canal O&M expenditures. Similar cases were reported also in Pipalbot and Seraphant subprojects.

Collection of Cash for Penalties

In systems where labor contributions were required for O&M, provisions for fines were made against those members who failed to provide the required labor contribution. In Amalachaur and Arjewa irrigation systems of Baglung District, Rs 50/day was fixed as fine to the collected from those defaulters. Similarly, in several systems (e.g.Thini in Mustang, Ranabang and Pipalbot in Myagdi) NRs. 100/day was the rate for penalties from the defaulters. In Jahare irrigation system, though there was provision of asking for fines, the rules were not strictly enforced.

Resource Mobilization to Meet Emergency Situations

All systems had some mechanism for emergency management activities. Labor contribution was the major source for ordinary emergency maintenance. Big damages required mobilization of all residents of the villages within the command area. If the necessary steps were not taken immediately, the crop could be lost or the physical system might sustain major damage.

The intensity of the emergency situation differed with the type of irrigation structures. In Arjewa irrigation system of Baglung district, the reservoir intake tank, which used to be damaged frequently was repaired with DIDP assistance, thus avoiding the vulnerable point of emergency damage. But in Bhingithe system of the same district, because of the unstabilized intake and a landslide seepage problem, frequent emergency maintenance requirement was reported to be a regular problem. Likewise in Tiri system of Mustang district, the polythene pipe in the canal alignment required frequent cleaning.

Similarly, the Khinga System's (Mustang district) gabion intake and landslide zone required stabilization to avoid emergency damages. Part of the canal in Khinga passes through a cliff supported by a retaining wall which was often washed away during rainy season. In Jahare irrigation system of Parbat district frequent damages at the intake was reported for which the WUMC mobilized the farmers and repaired the diversion. However, in many of the sample subsystems there were reduced canal maintenance needs due to physical improvements carried out by DIDP. Most importantly the WUMCs were in a position to mobilize the farmers for maintaining the canal systems.

AGRO-ECONOMIC IMPACT

Baseline Survey

DIDP carried out two socio-economic surveys in four representative irrigation subprojects to investigate the impacts of the projects. In 1992 and 1996 the survey results indicated some contradiction regarding the growth of population. The total households and the population were reported to have remained constant, whereas the on-farm population had an increasing trend. Similarly, the landholding of a household had declined meaning that there had been population growth over the years. Though majority of the population were engaged in on-farm activities in all those four systems, the off-farm income was substantially higher than the on-farm income indicating that the population was engaged in agriculture only for a short period and the increased farm income due to increased productivity was not sufficient to reduce seasonal migration for earning off-farm income from short term employment. The findings collaborate with the land holding size of those houdeholds.

FARMING AND FOOD

Irrigation Water Availability

The water availability scenario is presented in **Table 2**. It shows that water was sufficiently available during rainy season when there was adequate discharge at the river especially for the paddy crop. As reported by the sample farmers in most of the systems, water was not adequate during dry season especially during spring season when the river flows were minimal. Since the river flows were not monitored and the water balance studies had not been conducted it would not be justifiable to conclude that there was not adequate irrigation water during the non-rainy seasons.

Table 2: Water Availability and Cropping Pattern in the Irrigation Systems Commands

No.	District	System	Climate	Annual Rainfall (mm)	Cropping Pattern	Water Availability
1 2 3 4	Parbat	Jahare Kurgha Lampata Setophant	Subtropical to Temperate	2166	Paddy Wheat Maize Potato Oilseed Vegetables	Sufficient Inadequate for wheat and maize Inadequate for wheat and maize Inadequate for Maize
5 6 7 8	Baglung	Amalachour Arjewa Hugdisir Bhingithe	Subtropical to Temperate	1950	Paddy Wheat Maize* Potato Oilseed Vegetables	Sufficient for paddy, Short for Wheat, Maize
9 10 11 12	Myagdi	Pipalbot Ranabang Seraphant Pakhu	Subtropical to Temperate	1800	Paddy Wheat Maize Potato Oilseed Vegetables	Sufficient for paddy Short for Wheat, Maize Short for Maize Short for Maize
13 14 15	Mustang	Thini Tiri Khinga	Temperate Cold alpine	162	Naked Barley Barley Buckwheat Maize Vegetables, Fruits, Potato	Sufficient Sufficient Water-short for NB, BW

*** In Hugdisir subproject, maize was not cultivated.**

Source: DIDP, 1992-1997

Use of Chemical Fertilizer

Before DIDP intervention, most of the farmers had some knowledge and availability of chemical fertilizer. Since fertilizer transport costs were heavily subsidized by the government in1992, farmers in lower belt (e.g. Amalachaur in Baglung, Ranabang in Myagdi and Thini in Mustang) where socio-economic baseline studies were conducted, were using chemical fertilizer for paddy, wheat, maize, barley or naked barely. Only in Hugdisir scheme of Baglung district, farmers had hardly any knowledge about chemical fertilizer. In Khinga scheme of Mustang district, farmers hardly made use of any fertilizer.

The total use of fertilizers of all formulations (Urea, Diammonium Phosphate, Complex, etc.) had increased tremendously after the DIDP intervention since 1993. The annual national average of fertilizer use was reported to be in the range of only 14 to 26 kg/ha. The remarkably higher use of fertilizer in DIDP schemes could be attributed to the assured supply of irrigation water. The opening of the Pokhara –Baglung road should have definitely accelerated imports of fertilizer. Rates of increased fertilizer consumption was found very high in Parbat followed by Myagdi, Baglung and Mustang districts.

The present rate of fertilizer application in the DIDP schemes would imply a significant impact on local crop production in comparison to 1992, and appears mainly attributable to the improved irrigation facilities as well as the newly constructed roads. Also, part of the increase had to be attributed to the use of improved varieties which were more responsive to timely and adequate irrigation water application.

Most of the fertilizer (generally Urea, DAP and Complex) was used for paddy, wheat, maize and barley (naked). The fertilizer response was very high for small initial amounts. Yields increments were less striking for local varieties. This implies that though the KEM surveys did not report on the type of crop varieties used, the considerable increase in paddy, wheat and maize yields could be due to increased use of higher dose of fertilizer and improved high yielding varieties. Small and medium farmers were found to be using more chemical fertilizer than large farm households. Further, the average use of chemical fertilizer was also high and so was the case with manure.

The present level of fertilizer consumption in the areas was still below the quantities farmers would like to apply. But the application rates practiced by the farmers exceeded the rates recommended by the national agriculture research farms.

However, the recommendations were not based on the soil fertility analysis. The farmers' demand for more fertilizer indicated a significant change in their awareness as all were reported to be aware of the use and benefits. Limiting factors reported were the lack of cash to buy, limited supply and late deliveries of chemical fertilizer.

Though farmers' awareness on the use and benefits of fertilizer had increased, In the opinion of some farmers, the use of chemical fertilizer increased the crop yields but it also affected the soil fertility. Once it was used it was to be continued for ever which eventually made the soil hard and sticky and plowing the field became difficult. The overriding reason for this problem could be due to unbalanced dose of nutrient application (Nitrogen, Phosphorus and Potash along with micro nutrients).

Manure or Compost

Findings of the KEM survey suggested that the application of manure and compost had also increased in recent years. This was absolutely a good sign for the sustainable irrigated agriculture. Though no soil tests had been made, the areas with higher dose of manure application (also included straw, fodder waste, twigs etc.) kept the soil rich in organic matter content. Even if the command area was far away from the settlement, farmers managed to apply manure. Instead of carrying manure they shifted the cattle in the field and fed the straw and used the dung in the field.

How far this could be maintained was a serious concern? In other hill districts where economically active population have tendency of going out for non-agricultural jobs and the forest resource, which is the source of the avail for livestock fodder, is dwindling.

Crop Diseases and Pests

Many (40 to 95%) of the sample farmers had the knowledge to identify diseases/pest that affected the major crops. The major diseases of paddy were: 'Maruwa', Root cutter, 'Kathouni', 'Padero', 'Fulne' and 'Beruwa'. 'Gabaro', Kalopoke' and 'Bohone' were the common diseases observed in maize. Similarly, 'Sindure' and 'Kalopoke' were diseases usually affecting the wheat crop. Daduwa (blast) was a common disease in potato. Most of the farmers uprooted the affected plant and used it as fodder. Due to these diseases and pests, about 10 to 15% of the crop yield was reduced. More loss was reported in paddy as compared to wheat and maize. About 14% of the crop yield was reported to have been lost in naked barley.

Some of the farmers made use of indigenous pesticides to treat the crop diseases. They used 'Khirro', a kind of leaf and 'Surti' (tobacco) to eradicate the pests. They made a mixture of 'Khirro' and ' Surti' and sprayed it on the affected plant. They also sprayed ash as the local corrective method.

In Arjewa scheme of Baglung district, monkey and porcupine were also considered as the pests damaging the crops.

Though the farmers were aware of crop pests and diseases, no farmer had applied any pesticides.

Labor Exchange

All the farming operations irrespective of farm category were carried out by family, hired and 'perma' laborers. The perma system is a reciprocal labor exchange arrangement which has had a long tradition in the Nepal hills. The types of labor applied in the project schemes included family, hired and perma with overall percentage of 50, 21 and 29. It would be relevant to add that the information about labor provided by the farmers should be read with caution as it was very difficult on the part of the farmers to recall the exact number of the laborers employed in farm operations. The hired labor was higher in the large farm category (>1.5 ha) than in the small (<1 ha) and medium farm category (1-1.5 ha). How much labor was required on a hectare basis could not be derived as the KEM-surveys were not specific about the units used. Both poor and relatively well-to-do families depended on the traditional system of mutual assistance. Plowing which was relatively a hard job was done by men, women and children did sowing, transplanting, and weeding. Harvesting was equally done by both men and women. Much of the plowing work was done by hired labor.

Impact on Crop Productivity

Crop productivity is influenced by various farm and external factors, such as use and timing of inputs (fertilizer, farm yard manure, seed, irrigation), climatic conditions. In depends on whether yields are physically measured by crop cuts in the field or estimated by farmers on a recall basis. The sample of farmers selected also influences the results. Variations in all these factors cause significant changes in recorded yield levels between years.

In the KEM survey, the yield data were collected not by the crop cuts surveys in the field, but by asking the sample farmers in the project areas. Since the farmers had to recall their memory, the information about the crop yields provided by the farmers may not be exact as it was difficult on the part of the farmers to monitor and recall the yields of various crops. Further, every year some new farmers were interviewed replacing some of the previous ones. This might have added to the reported crop error.

With this expected variance of data on productivity levels of various crops, the details of yields collected in the KEM surveys as well as the base yields were compiled. As some of the KEM survey reports were missing, the yield data for some years could not be presented.

Table 3 presents the average yields of the major crops estimated for 1992 to 1997 as compared to the base yields prior to the project interventions. An average yield increase in Parbat, Baglung, Myagdi and Mustang districts was respectively, 73%, 20%, 37% and 12%. Generally, an increasing trend of crops yield were noticed year after year.

Table 3 : Comparison of Base Yields with the Yields of Major Crops over the Years

District	Base Yield (t/ha)	Yields Average of Major Crops* (1992-1997) (t/ha)	Percent Increase
Parbat	1.59	2.76	73
Baglung	2.15	2.58	20
Myagdi	1.85	2.54	37
Mustang	2.41	2.70	12

*** Paddy, wheat and maize were the three major crops in Parbat,Baglung and Myagdi districts. Naked barley and buckwheat were the major crops in Mustang.**

Source: DIDP, 1992-1997

The longer-term trend for crop productivity was significantly positive for maize, wheat and paddy in Parbat, Baglung and Myagdi districts. Similar situation was observed for naked barley in Tiri and Helkhu schemes of Mustang district. Buckwheat indicates the date of stagnating productivity. As a remedy of stagnated production, farmers shifted to barley cultivation which has higher productivity.

DIDP Crop Yields in Regional Context

In Nepal, crop yield levels of even irrigated area are very low. The productivity of cereal crops lies within the range of 1.6 to 2.4 t/ha only, although improved varieties of paddy and wheat, and to some extent also maize are widely used. The major reasons for low yields are reported to be the use of degenerated crop varieties, lack and improper use of chemical fertilizers, lack of crop husbandry practices, inadequate plant protection measures, lack of technical know-how regarding improved technologies, lack of or inefficient irrigation practices, and unavailability of good quality seeds.

The overall yield figures of cereals from DIDP sample schemes, as compared to national statistics were therefore very encouraging. On an average, yield of paddy (3.5 t/ha) in 1997 in DIDP schemes was substantially higher than the regional figures (2.3 t/ha). Similarly, productivity of maize (3.1 t/ha) was significantly more than the regional figure of 1.9 t/ha. The national average of maize productivity was even lower at 1.65 t/ha. Likewise, wheat production in DIDP schemes (average 3.1 t/ha) remarkably surpassed the national average of about 2.0 t/ha. It could be concluded that though DIDP did not provide agriculture extension and inputs, even then with better irrigation water delivery and strong farmer organizations, farmers were able to secure increased crop productivity.

Spin-off Effects from Improved Irrigation

Vegetable gardening, fruit trees, water mills, hydropower, drinking water, fish farming and swimming were reported to be the irrigation related effects other than those directly associated with agriculture and economic activities.

Vegetable gardening was the most common spin-off activity. DIDP promoted women's saving groups (WSGs) in the project area and women's position as water users was confined mainly on supply of drinking water and timely supply of irrigation water to vegetable gardens. In those irrigation systems where market facilities were available, farmers had started to grow vegetables at commercial scale. In many schemes farmers appreciated the awareness brought about by irrigation, like composting of manure, women saving group, health and hygiene programs etc. The project was primarily active in promoting kitchen gardens, cash crops like ginger production, fruit-tree cultivation, agro-forestry nurseries and poultry. With the cultivation of vegetables and fruit trees, as well as raising the poultry birds, the people of project area have enhanced their nutritional levels and were considered better nourished.

Out of the total of 15 schemes, canal water was also used for drinking purpose in a schemes. Generally, the women farmers used the canal water for washing purposes and managed to fetch drinking water from some spring sources which were less contaminated. This had a big impact in reducing the drudgery of women in fetching drinking water for their household chores and livestock. Similarly, some individuals used canal water for fish farming in Jahare scheme of Parbat district. In Arjewa scheme of Baglung district, the intake tank was also used as a swimming pond by the children.

Water mills along the canal alignment were installed in Amalachaur, Bhingithe, Pipalbot, Seraphant and Ranabang schemes. As a result, farmers especially the women doing the milling need not to travel outside their village for the milling purpose of their food grain. The water mill of Pipalbot had water shortage during the winter and pre-monsoon season. The nearby farmers of Seraphant allowed to divert their canal water for the mill for certain hours during night. As an exercise of reciprocity the mill owner discounted them 50% in the milling charge. In Pipalbot, the mill owner also contributed a bigger share for the O&M of the irrigation scheme.

A micro hydropower plant was installed in Khinga scheme of Mustang district, making power available for the beneficiary farmers for their domestic use. An important condation followed was that the electricity generation should in no way hamper the efficient delivery of irrigation water in the command area. Care was taken not to waste the tail water but rather was made available for irrigation. The amount of money collected for the use of electricity by the WUMC far exceeded the income from irrigation maintenance charges. This activity was very much appreciated by the beneficiaries. Another similar type of micro hydro plant was also constructed in the Marangsing irrigation subproject, of Parbat district. DIDP was thus able to link irrigation canal development with other community development activities such as hydropower generation and improved water mills. Electricity and grain milling facilities provided benefits to marginalized groups like landless people and women.

EMPLOYMENT, INCOME AND EXPENDITURES

Off-farm and out-of-region employment opportunities and returns had increased and preferred especially by younger people. This increased the opportunity costs for agricultural labor.

The economic dynamic in the project districts was mainly related to off-farm activities (labor, teaching, remittance, business, mule transport) and much less in agriculture with no significant surplus production. Of course the DIDP irrigation schemes were instrumental in generating productive employment, increasing the staple food and some spin-offs benefits for the people in the region. However, diversification of crops and introduction of high value crops for improving the income of farmers had not been the focal point. This could partly be attributed to the fact that DIDP did not provide direct support for agricultural production programs. As a result, despite the yield increase, there was not much diversification towards high value crops, and a market strategy which could have let to more substantial on-farm income increases. The farm sizes were small and cereals were the main crops cultivated. Producing food on a small farmer's plot kept the farmer at the subsistence level. In almost all the irrigation schemes where KEM survey was carried out, the percentages of farmers receiving less than 25% of their total annual household cash income from agriculture were overwhelmingly high. However, it should be understood that the information about the income was more or less biased as most of the respondents were hesitant to disclose their annual income.

The intensive cultivation as reported in earlier section certainly indicated an increase in the average farm workload. The daily domestic workload of women, on the other hand, had also increased due to temporary migration of the husband and other economically active family members and having the children in school. The reduction of the workload of women due to the availability of drinking water and water mills might have at least counterbalanced these adverse effects on women's workloads.

People, in general, would like to look for better employment opportunities to add out to their earnings, agriculture is still the most important economic activity in the region and so is the importance of the irrigation schemes. Agriculture income is still dominant household consumption. The increased intensity of cultivation and higher yields along with the spin-offs in terms of vegetable gardening and fruit trees, the impact was profound compared to many other hill districts in the country. The standard of living and quality of life of the people has either increased or at least they have been able to sustain their quality of life in spite of increases of population in the region.

Changes in Skills and Attitudes

DIDP during its implementation conducted several training programs to enhance the skill of the user farmers and WUMC functionaries. The participatory approach pioneered by the project significantly enhanced the possibility for communication among different ethnic groups and social segments. New opportunities to meet and discuss were created by the users' involvement in physical construction and the maintenance of irrigation infrastructures. All these training programs and interactions over the years have gradually enhanced skills, created awareness and changed attitudes at the level of individuals so that they could share and manage the common resource like irrigation scheme.

Some relevant and interesting insights on changes in attitude and perceptions of local people could be gained through their level of satisfaction on the distribution of water and the contribution in system maintenance. It was observed during the KEM surveys that with some exceptions, the beneficiaries were satisfied with the pattern of water allocation and distribution. Though equal labor contribution as against the land area irrigated were practiced only in a few systems, farmers. In view of their smallholdings they were satisfied with system of labor contribution on the basis of a household. Though many ethnic groups (Brahmin, Chhetri, Thakali, Magar, Kami, Sarki, etc.) had been sharing the facility from the same irrigation scheme, no one was reported feeling left out in the society. This attitude of working together and sharing the resource is crucial for system sustainability. Processes relating to the satisfactory maintenance level of irrigation infrastructures are the testimony of this attitudinal change.

One striking feature in the project area was the mobility of people for off-farm employment. The mobility of women in comparison to that of men was less. The women's saving groups and related group activities enhanced women's awareness. The husband would be irrigated for earning. The wives were occupied with the farm and household work and the education of their children. The general improvement in food security and availability of drinking water had naturally improved the conditions for women and children. Though education, literacy classes etc. had certainly contributed, part of these achievements could be attributed to the project intervention.

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Education and Information Dimension

DEVELOPMENT AND INTRODUCTION OF FMIS CURRICULUM

LAKSHMI NARAYAN CHOUDHARI[1]

BACKGROUND

The present curriculum of irrigation engineering at many universities in Nepal including Pokhara University lack the information on Farmer Managed Irrigation Systems (FMIS). The syllabus is based on engineering and agronomic principles. It does not include indigenous knowledge and local technology and farmer adopted practices on irrigation. The faculties associated in teaching irrigation subjects are also trained in conventional system of irrigation design. Unless the curriculum is revised to include chapters related to FMIS and elective subject on FMIS, the faculties have no incentive to update their knowledge in FMIS. This was the need to revise the syllabus on irrigation.

Since the share of FMIS land is more than that of Agency Managed Irrigation Systems (AMIS) in Nepal, agricultural productivity is not going to improve without improvement in FMIS. Thus, improvement of FMIS knowledge and understanding of the system are prerequisites. Hence, to intervene effectively and improve the existing FMIS knowledge, trained technicians with sensitivity to traditions and customs of FMIS is required which can be achieved through the inclusion FMIS components in the existing curriculum.

The need to reform current syllabus on irrigation engineering has already been realized by professionals involved in irrigation sector and concerns have been raised in different forums. A seminar on FMIS held in Kathmandu has unanimously concluded "that, by doing so, engineers can understand the local environment (physical and social) where the system is to be designed. Further, such training provides opportunities for incorporating indigenous knowledge in all aspects of irrigation development." (Parajuli, U.N., 2001). Despite the need for the new training and research activities, conventional curriculum in irrigation engineering subjects had not changed so far.

In order to ensure the improved and sustained agri-farming in Nepal, the local knowledge should be integrated with external (traditional engineering) knowledge. With a view to maintain the continuity of indigenous knowledge and skills of FMIS, it is necessary to reform the current curriculum of

[1] Associate Professor, Department of Civil Engineering, Nepal Engineering College.

irrigation subject. The reform designed needs to be compatible to farmer's concept and ecological setting and it must address the social issues. It should be socially acceptable, economically viable and environmentally sustainable.

An agreement was made in April 2000 between the Farmer Managed Irrigation System Promotion Trust (FMIST) and Nepal Engineering College (*nec*) to reform the existing curriculum of irrigation engineering subject. As per the agreement, a two-year program was launched starting from May 2000 to come up with various strategies to introduce FMIS concept in civil engineering students of Nepal.

OUTPUT

The final amended syllabuses are given as follows:

Track-I

Introducing a chapter on FMIS on existing syllabus. There are already nine chapters in the existing course of irrigation engineering. Introduction of FMIS course has been put in the Chapter 10 separately and allotted five lecture hours.

Chapter 10 Heading

Introduction to Farmer Managed Irrigation System 5 hrs

<u>Sub headings of Chapter 10</u>

1. Introduction of FMIS in Asian and Nepalese context

2. Introduction to Water Policy Legislation
   2.1 Water Resources Act, Policy, Legislation
   2.2 Environmental Act and Guidelines
   2.3 Formation and Management of FMIS Organizations (participatory approach)

3. Water Diversion, Conveyance and Distribution
   3.1 Water Right issue-Statutory and Customary rights
   3.2 Water allocation and distribution arrangement
   3.3 Water related disputes and dispute resolution
   3.4 Use of Uphoff's Matrix on irrigation management

Track-II

FMIS subject to be offered as an Elective subject in the seventh & eighth semesters is given below:

	Theory	**Practical**	**Total**
Sessional	30	20	50
Final	50	-	50
Total	**80**	**20**	**100**

Course Objectives

The main objective of this course is to expose the students to the knowledge on FMIS and make them able to work in the design, construction and operational phases of such system compatible with the local knowledge.

Course Contents

1.0 Introduction 5 hrs

1.1 History of irrigation development (ancient and modern)
1.2 Evolution of FMIS
1.3 Characteristics of FMIS
1.4 Approaches and emerging trends on study of FMIS

2.0 Water Allocation and Conservation and Organizational Role 2 hrs

2.1 Water allocation and equity principles
2.2 Water use practices & water conservation practices
2.3 Role of WUA, NGOs, CBOs

3.0 Aspects of Water Resource Management 4 hrs

3.1 Water Resource Strategy, Policy, Plan, Act, By-laws, Regulations relevant to irrigation particularly to FMIS
3.2 Water acquisition, allocation, distribution and equity aspects
3.3 Model FMIS constitution, variation depending upon locations, social and ethnic diversities and resource availability
3.4 Dispute and dispute resolution mechanism
3.5 Water right issues-Statutory and customary rights

4.0 Use focused Design, Construction and Maintenance of Diversion Work, Storage and Canal system — 9 hrs

4.1 Use of Indigenous knowledge and practices for design and construction of storage
4.2 Design of Lined and unlined storage pond
4.3 Control of Seepage
4.4 Proportioning Weirs
4.5 Uphoff's Matrix
4.6 Techniques of upgrading/renovation/maintenance of storage and canal system

5.0 Social and Economic Issues in FMIS — 4 hrs

5.1 Water Trading
5.2 Gender Issues
5.3 Tariff Setting, Resource Mobilization
5.4 FMIS linkages with NGOs, local government units private sector Service providers and field level line agencies

6.0 GIS in FMIS — 8 hrs

6.1 Application of GIS in FMIS
- GIS module concepts
- GIS application demo in FMIS

6.2 Introduction to database and software
- Database concepts
- Details of relational database

6.3 Application of Database in FMIS
- MIS relational database
- Query development in FMIS
- Form and Report preparation

7.0 Application of Optimization Techniques — 9 hrs

7.1 Introduction to Optimization Techniques
7.2 Application of optimization in irrigation system planning & management
7.3 Introduction of Multi Criteria Decision Making (MCDM) Approach
7.4 MCDM tool introduction for Compromise Programming and Goal Programming

8.0 Case Study 4 hrs

Case study of a successful and an unsuccessful FMIS

Field Visit

A field visit will be conducted for collecting relevant data and observing a FMIS. Students will be evaluated for their practical marks based on an individual report of the field visit.

Textbook

1. Course Manual on Farmer Managed Irrigation Systems

Reference Books

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Training of Trainers (ToT)

To prepare teaching faculty and teaching materials in the area of FMIS, a training of trainers (ToT) was conducted during April 6-8, 2003 at NCIT, Gwarkhu, Lalitpur as the continuation of the formulation of the course. In addition to six participants from Nepal Engineering College and one participant from FMIS Promotion Trust two teaching faculties from each of Kathamndu Engineering College, Kantipur Engineering College, Institute of Engineering, Khwopa Engineering College had attended the said training. At the end of training, certificates of participation were given to the trainees.

Preparation of FMIS manual

Since the teaching materials of FMIS related topics are not available at one place, a course manual on FMIS has been prepared.

Water Distribution Model

To give the essence and bring awareness on FMIS to the future engineers, the activity committee conducted a meeting with the students of *nec* and encouraged them to participate in a model design competition of water distribution structure. Three groups of senior students participated in the design and drawing competition and winner was awarded with cash prize. Based on that design, a small physical model has been constructed in the compound of *nec* on the left bank of Manohara river.

Approval by PU

The final syllabus, of Track-I and Track-II, thus prepared, were sent to Pokhara University for approval so that it could be implemented immediately. It is nice to mention here that Pokhara University has already approved the said courses.

Implementation of FMIS Track-I and Track- II Courses

The course related with Track-I has already been offered in all the engineering colleges running Bachelor of Civil Engineering affiliated with Pokhara University. The elective course on FMIS (Track-II course) has been successfully implemented in Nepal Engineering College in which 19 students had opted and appeared for the final examination.

CONCLUSIONS

From the above exercise, we find that their is lacuna in engineering education. Hence, the problem had to be tackled at that point itself. To resolve the problem, FMIST, Kathmandu proposed this matter to *nec*. Nepal Engineering College in collaboration with FMIST carried out all the necessary activities to reform the irrigation-engineering syllabus. In the whole exercise, main focus has been given to set up the procedures of reforming the syllabus.

The idea is if such task is successfully completed in one unit of curriculum, then similar procedures may be followed to develop other curriculums also. Hence, ideas and perspectives of inter-department should come up. Also, if this is the perspective, then in which perspective it is looked by others, how do they take it, especially the end users, is important. The activities related with field visits and literature review as many have done PhD in this areas, are matters of procedure. Also the approval from Pokhara University to run the said course is the matter of governance, a kind of control mechanism.

Once the system of procedure is set up, anybody can follow that. There is nothing to restrict it. There is nothing like copyright. As others take it, it will grow wider and stronger. We have to distribute and disseminate this widely. This is how the procedural activity goes on. This is also to re-orient Nepal Engineering College: for the capacity building of *nec* teaching faculty to undertake similar task in future. Now, as it will go ahead with the development of syllabus, so it will become more realistic, more useful and more effective for the whole community. And thus, this procedural set up will be established at Nepal Engineering College.

Although, this course is prepared to implement it under Pokhara University curricula, looking at the efforts given in preparing this course for the last two years, it will be highly appreciated if both Tribhuvan University (TU) and Purbanchal University (PU) run this course as well. It will be useful if TU and PU also adopt these courses. Once this is implemented, it is believed that there will be attitudinal change among our engineer friends; it will bring important shift to classical civil engineering approaches and prepare them for more farmer friendly concepts and practices that would be effective and sustainable and help to save the FMIS cultural heritage of Nepal (Pradhan, 2003) in the long run.

Furthermore, it is hoped that, this exercise will help to shape our future generation of engineers to be future leaders with positive thinking. Lastly, it is expected to have good understanding of managing the local resources at the grass root level.

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INNOVATIVE MECHANISUM FOR EFFECTIVE FMIS COMMUNICATION

RAJAN SUBEDI AND UPENDRA GAUTAM

Background

Nepal is characterized by the indigenous irrigation systems popularly called as the Farmer Managed Irrigation Systems (FMIS). These systems are developed and managed by the farmers since ancient times. They differ in nature depending upon the agro-ecological condition and social setting. FMIS are there in all four ecological zones of the country-mountains, hills, river valleys and *Terai* (plain area). They have been found operating in an altitude up to 2500 meters above the sea level (Devkota, 2001). The variable ecological zones also indicate the socio-economic and cultural diversity of FMIS, which are uniformly spread across the country.

It is estimated that 70 percent of the country's total irrigated area and over 89 percent of the irrigated areas in the hills and mountains are covered by FMIS that are scattered all over the country. This shows that the FMIS has contributed considerably in the national economy and has also become the main source of livelihood of the farmers.

Following three basic issues have been emerged on FMIS management and its sustainability. (a) Dependency on local resources for the development and management of these FMIS is in crossroad as the natural resource base like forest products, watersheds are depleting day by day. Therefore, exploration and adoption of alternative resources, materials and methods is essential. (b) Pressure on irrigation water is rising due to the competing demand that has initiated changes in policies, procedures and programs both at the local level and the central level of the governance. (c) Increasing per unit cost of the agricultural production has threatened the financial viability of the production and has been loosing the charm of the younger population in the sector as an occupation.

In this context, FMIS, a backbone of country's economy, deserve high attention of the concerned agencies for their long term sustainability. In the circumstances that most of the fertile areas have already been developed for irrigation, the challenge lies on achieving increased production from the improved management of irrigated agriculture. In this perspective, importance of promoting FMIS to cope with the new challenges is paramount.

Bringing FMIS in the front yard of the country by their proper exposure has indeed become a burning question, solution of which needs strong social, political and economic commitment from all the concerned developers and planners. FMIS Trust in its endeavor to understand basic hindrances and problems concerning promotion of FMIS, has identified communication as a critical issue in bringing them to main stream of country's development scenario.

EXISTING PRACTICE OF COMMUNICATION

During the implementation of its regular activities, the Trust has noted that one of the major obstacles for promotion of FMIS is the lack of effective means of communication. This is depriving them from having information from the concerned organizations and ministries and vice versa. The process of change in the rural setting to the semi-urbanization has also created a need to look for the alternative means of communication among the FMIS and its users.

FMIS, though individually well organized, are not collectively so. As they are scattered through out the country into several thousand units, communicating with them have been extremely difficult. This severely reduces the development effectiveness on FMIS. As a regular activity, radio and TV programs are the principal source of communication to the FMIS. FMIS level issues have never been a subject of consideration in formulating policies at the center on a regular basis. However, in the external agencies assisted projects, other means of communication such as community mass meetings, farmer-to-farmer dialogue, exchange visit, and research and development dissemination through media and public hearing have been used to make development works accountable to the stakeholders.

This study intends to share FMIS Promotion Trust's experience and initiative that try to test ways and means to establish a working communication mechanism for the FMIS and analyze the information collected from the 237 FMIS of Kathmandu District. Sharing of these experience and initiative are expected to help external assistance agencies, which may include government, community, non-government and private sector organizations, in reaching FMIS with transparency and accountability that could best serve the interest of the FMIS.

PROBLEM STATEMENT AND STUDY NEED

Infrastructure of FMIS Communication

Being predominantly mountainous terrain with more than 75% area covered with hills and mountains, the country's quality and coverage of infrastructure is poor and that too is mostly limited to urban centers and district headquarters. **Table 1** summarizes the current status of infrastructure development and proposed target of the Tenth Plan (2003-2007).

Table 1: Status of Infrastructure Development and Proposed Development Targets

S N.	Infrastructure	Ninth Plan Status	Tenth Plan Target
1	District with road (in number of district)	60	70
2	Irrigation facility (in thousand ha)	1,121	1,417
3	Telephone connection (per thousand people)	14	40
4	VDC with telephone connection (No. of VDC)	1,761	3,913 (100%)
5	VDC with computer network (No. of VDC)	-	1,500
6	Population with electricity access (in percentage)	40	55
7	VDC with electricity facility (No. of VDC)	1,600	2,600
8	Agriculture and rural roads (in km)	326	10,000

Source: *Tenth Plan – 2059/2064*.

Many of the district headquarters are still not connected with the road networks [1]. Even in with-the-road network connection, round the year transportation is not possible due to absence of all weather roads. Only about half of the district headquarters enjoy round the year road transportation facility. The limited road network had also limited the reliability of public postal services. Fifty five percent of the Village Development Committees (VDCs) had no access to telephone services and in many of them services are not regular[2] and service qualities are poor and inefficient. There are several inaccessible places inside these districts where only means of communication is by trekking. Other media facilities like television are not affordable to the farmers, though electricity was formally available in 41 percent of the VDCs. No VDC had got computer-based information technology. The country is yet to develop a network of agricultural and rural roads. More than 80 percent of

[1] Nepal is divided into five development regions, 14 Zones and 75 districts. Among the 75 districts, 16 lie in the Terai and inner Terai regions, whereas the remaining districts lie in the hills and mountainous.

[2] The problem is much aggravated now by the rebels' activity in the remote hills and mountains in the country.

the FMIS are in hilly and mountainous areas and many of them have almost no access to any communication and transportation facilities (FMIS Promotion Trust, 2000). In these conditions, establishing communication amongst the FMIS and between the FMIS and external assistance agencies require enduring efforts for combining right institution with appropriate information technology to effectively carry out targeted development activities

STUDY NEED

Despite several research and studies on FMIS in Nepal, there hardly exists any study on the pattern of communication amongst FMIS and between the FMIS and external assistance agencies. Absence of such study may be attributed to i) lack of a communication mechanism amongst and between FMIS and external assistance agencies, and ii) failure of external assistance agencies to understand and appreciate the positive relationship between effective communication mechanism and development effectiveness.

Trust's Experience in Approaching FMIS

In the given situation, the Trust has continued conducting its FMIS award and knowledge building activities for the last five years. In this respect, it tested different approaches to transfer and receive certain information in the form of questionnaire survey. This information transfer and reception was an integral part of the Trust's reiterative activity relating to recognition of FMIS best practices and knowledge building. This was expected to lead to establishment of a much regular communication with FMIS by using the existing communication mechanisms. Each one of the chosen communication mechanisms was used to identify its i) coverage in the country, ii) relevance to local development and governance, and iii) public accountability.

Each communication approach used has its own organizational context and process. The *central line agency approach* is associated with the Ministry of Local Development (MLD). The Ministry is responsible for administering the development works to provide basic infrastructure and facilities to raise the quality of life at the local level. The Ministry administers and executes its program through a local development officer (LDO). It has appointed a LDO in all 75 District Development Offices. In the district, the LDO works with the elected representatives of the DDC. He also supervises the local development works of the Village Development Committees (VDC) and municipalities where the Ministry also appoints the secretary or administrative officers. This is the Ministry, which has the most extensive access down to the villages/municipalities and their wards (Joint HMG-Donor Review, 2000).

The *media approach*, on the other hand, is associated with the *Gorkhapatra* publication house, a public corporation of the government. The publication house publishes the oldest and widely circulated vernacular daily newspaper *Gorkhapatra*, a name that is almost synonym to the body of newspapers to the reading people in the past. This newspaper is circulated to all the local bodies (VDCs, municipalities, DDCs and most of the schools). The publication house is administered by a board of directors, who are appointed by the Ministry of Information and Communication. The publication house's major publication *Gorkhapatra* is responsible for disseminating more pro-government news and developmental information than news and views relating to policy debates and governmental irregularities. Information-professional, academic, or business-published in *Gorkhapatra* is considered authoritative and valid to the extent that it could be referred to as an evidence in the court of record (Sunday Dispatch, 2000).

The third approach that the Trust had to adopt after the experience of previous two approaches, is based on the *local government* bodies and their association. After the advent of democracy in the country in early 1990s, various interest groups had started forming alliances in the form of federation or association. One of such federations/associations is the Association of District Development Committees of Nepal (ADDC/N). All 75 DDCs, that is, district level local government units, are members in ADDC/N. DDC representatives are elected by the local people. Each DDC consists of several VDCs. The main objective of ADDC/N is to protect the autonomy and rights of the DDCs against the tendency of centralization and partisan policies and prejudiced laws of the central government. Their major responsibility is to plan and manage development of the district and help render the services for the betterment of the people and the local community. The secretariat of ADDC/N is located in Kathmandu, the capital city and is managed by a contractually hired executive secretary-general (Joint HMG-Donor Review, 2000).

Central Line Agency Approach

In 1999, the Trust administered the process for the selection of the best practicing FMIS on the theme of "conservation measures in irrigation systems" (FMIS Promotion Trust, 1999). It dispatched about 20,000 questionnaire attached application forms to the total estimated number of the FMIS-WUAs in the country through the Ministry of Local Development. The Ministry, at the request of the Trust, wrote a covering letter addressing the Local Development Officers (LDO) to provide enclosed packet of five copies of the questionnaire to each Village Development Committee (VDC) in their respective district. The questionnaire were sent to most of the District Development Committees (DDC) by means of private courier services. In nine districts lacking private courier service, questionnaires were dispatched through the public postal services. The Trust received filled up questionnaire forms from 64 FMIS/WUAs of 43 districts through the public postal services. The participating number of FMIS was clearly lower than expected, though they came from across 57 percent of the districts. Dissemination of information in the right time to the right target group was essential to realize intended objectives of the FMIS Award. However, the public bureaucratic agent did not seem to be able to help disseminate the information to the target group in a transparent and non-partisan way. Factors that might have affected its ability to deliver the questionnaire to the targeted group may include inaccessibility of FMIS to some extent. But the public agency's partisan favor for some FMIS, and the widely prevailing suspicion in the society about any NGO-sponsored activity appeared to be the more constraining factors. The Trust staff, after a number of spot-checking, also confirmed that LDOs generally sent the questionnaire forms to that VDCs only where they presumably thought the best performing FMIS were located. VDC leaders also behaved in the same way. Another reason was that the FMIS officials/farmers never imagined/believed that they could be the potential candidates for this award. The flow chart showing the Central Line Agency Approach has been presented in **Figure 1**.

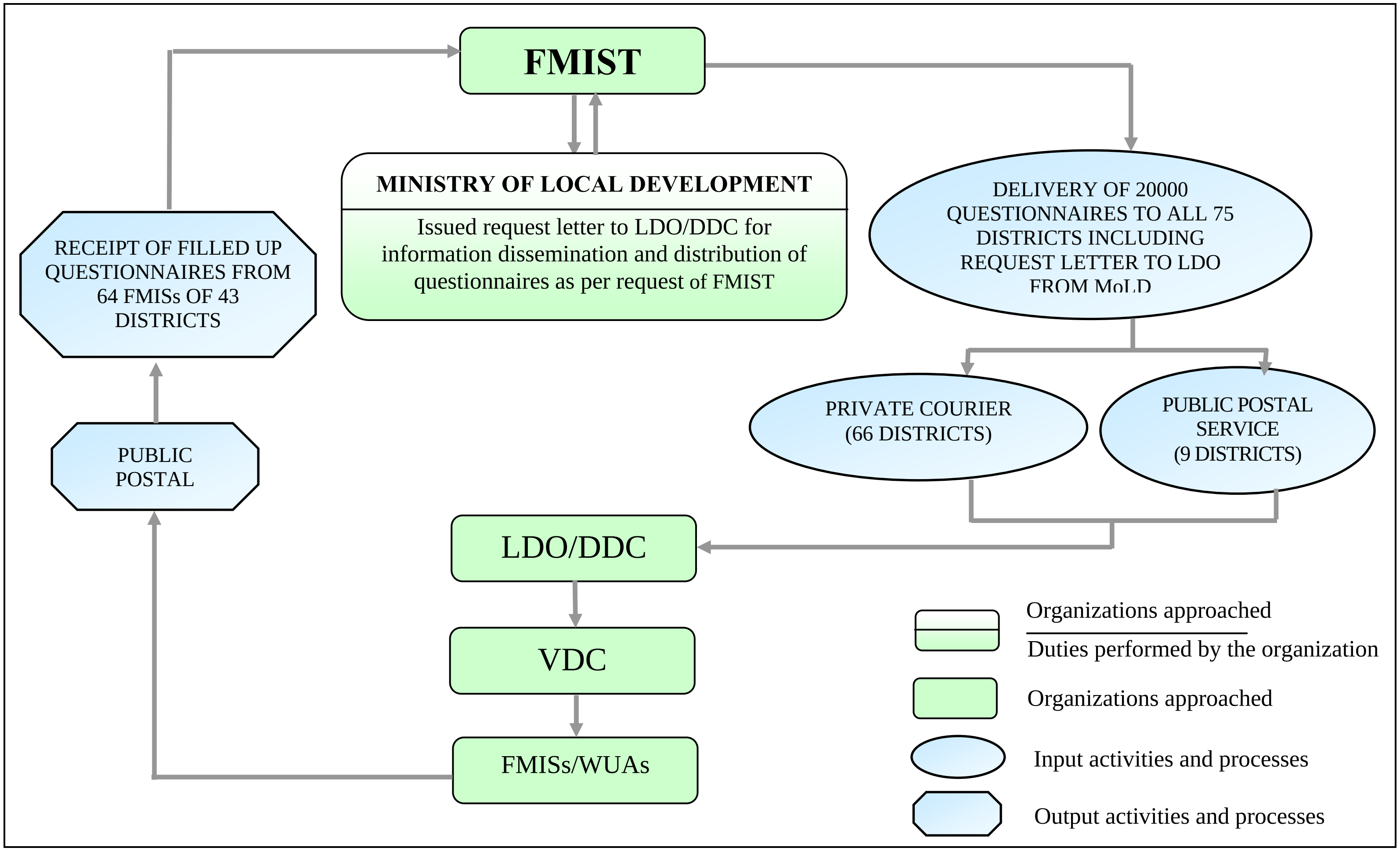


Figure 1: Flow Chart Showing Central Line Agency Approach
(First Award On The Theme " Conservation Measures In Irrigation Systems" – 1999)

Media Approach

The lessons learnt with the central government channel compel the Trust to opt for a media approach for the administration of second FMIS award in 2000. The Trust administered the process for the selection of the best practicing FMIS on the theme of "resource mobilization for operation and maintenance" (Gautam et. al, 2001). It published the Application Form along with the questionnaire in *Gorkhapatra*, which is considered as the most known and oldest national daily newspaper in circulation. Circulation of the paper covered each and every local government units (DDC, municipality and VDC). Support of the five Regional Irrigation Directorates (RIDs) and 75 District Irrigation Offices (DIOs) were obtained for disseminating the information published in this newspaper. Application procedures for the award were aired over the popular agricultural program of the Radio Nepal. However, the outcome was rather disappointing. The Trust received only 13 duly filled-up questionnaires from ten districts within the four months of the specified time for the application. This has brought interesting questions about the role of DIOs vis-à-vis FMIS in each district and the out-reach efficacy of the "known" vernacular newspaper.

On one hand it was observed that people at the grassroots level did not take the message conveyed by the newspaper seriously. On the other hand, DIOs were seen not engaged in any type of regular participatory works and dialogue with FMIS. The flow chart showing Media Approach has been presented in **Figure 2**.

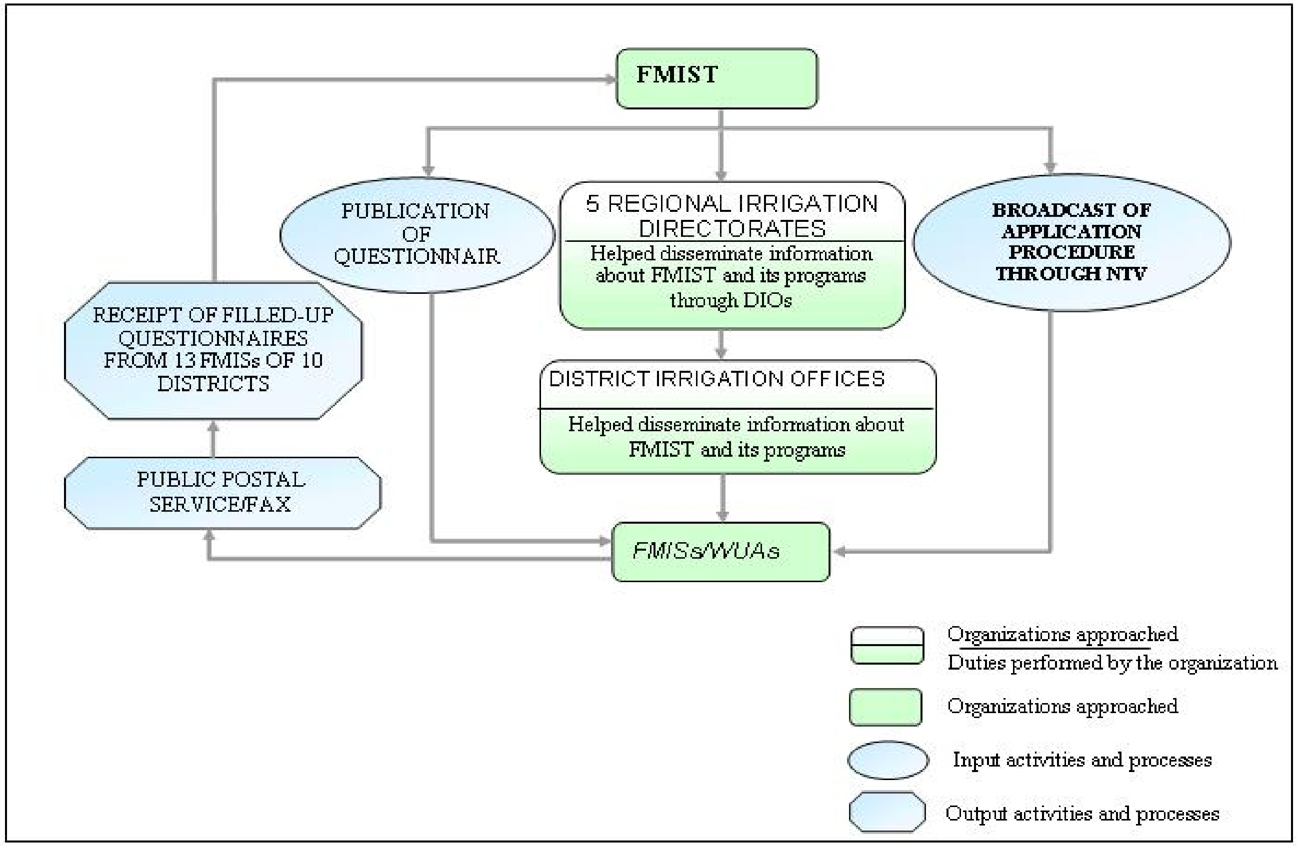
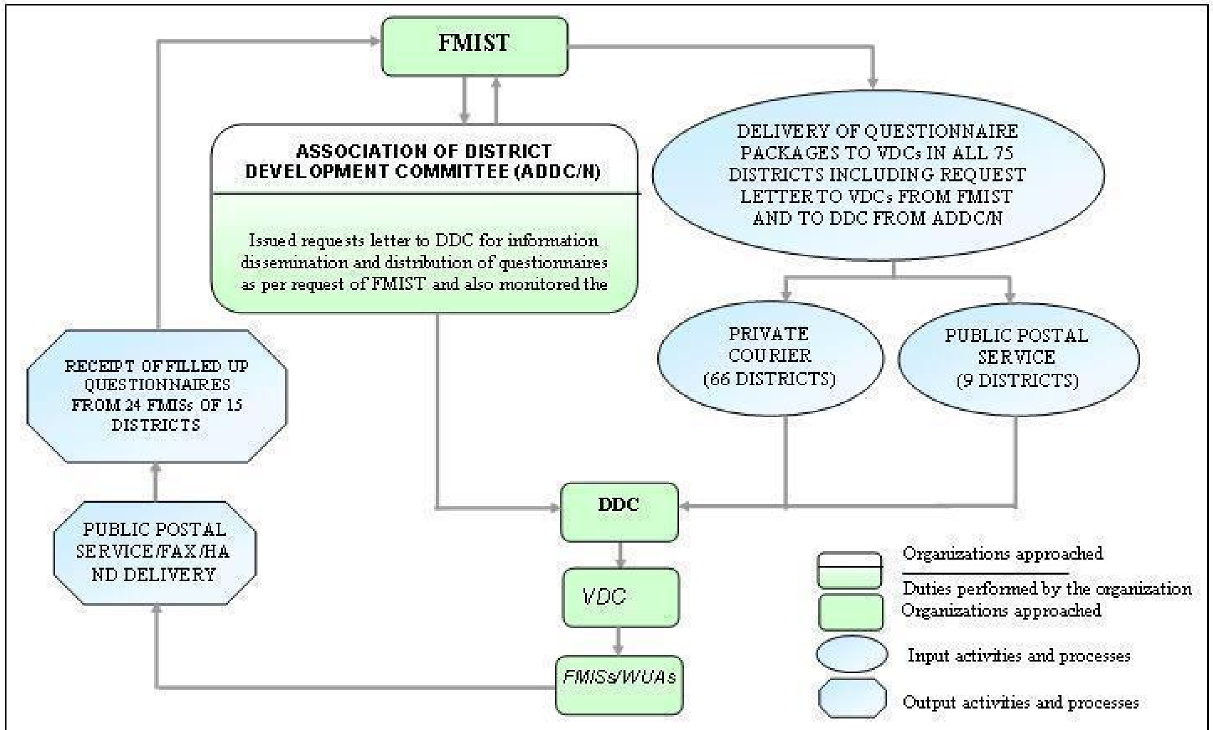


Figure 2: Flow Chart Showing Media Approach (Second Award on the Theme "Resource Mobilization for O & M" – 2000)

Local Government Approach

The dismal outcome of the media approach further forced the Trust to test yet another alternative. For the year 2001 FMIS award, the Trust decided the theme "diversification of FMIS activities for sustainable development." It approached the Association of District Development Committee of Nepal (ADDC/N), the non-governmental outfit of 75 DDCs, to assist in the dissemination of questionnaire to FMIS through the VDCs. As per the Trust request, ADDC/N secretary general wrote a detailed covering letter to each DDC chairperson explaining the objectives of the FMIS Promotion Trust, its activities and the process being adopted for the purpose of selecting the best practicing FMIS on the theme. The questionnaire packets to DDC Chairpersons were sent by private courier services except the nine districts where there was no such private sector service available. The public postal service was used for dispatching the questionnaires in those nine districts. An amount of NRs 50, 000 was paid to ADDC/N to recruit a staff and to cover the telephone expenses for monitoring and follow-up the distribution of questionnaire to the target group. The Trust received filled up questionnaire forms through the public postal services from 24 FMIS of 15 districts (20 percent of the 75 districts) within the period of eight months. The flow chart showing the Local Government Approach has been presented in **figure 3**.



Note: Due to the worse response obtained during six months, the trust afterward adopted direct Trust-FMIS Approach and so far received 100 filled questionnaires from FMIS across the country

Figure 3: Flow Chart Showing Local Government Approach

(Third Award on the Theme "Diversification of Fmis Activities for Sustainable Development" – 2001)

The federal organization of DDCs seemed to be more motivated to deal with local politics in the central power corridor of Kathmandu, but entirely in a partisan manner and not with the feeling to serve the people in the constituencies. ADDC/N, which was run by a hired Secretary General, found it more rewarding to clinch projects from the donors than communicating information with its constituents.

The Trust in the light of the meager response from FMIS decided not to go ahead with its schedule for the selection of the best practicing FMIS for 2001. Meanwhile, it decided to adopt a direct Trust- and-FMIS approach to disseminate the Trust program to FMIS. After adoption of this approach, the Trust has so far received 100 filled questionnaires from the FMIS across the country in a period of eight months.

Thus all these downsides of the existing communication networks in the FMIS context reflect the fact that there is a need to find an innovative communication mechanism.

OBJECTIVES

The problem associated with lack of reliable communication mechanism with and among FMIS has been realized from the experiences of FMIS Promotion Trust mentioned in the earlier section. Therefore, this study has been initiated with an overall objective of finding means and mechanism to establish effective communication with the FMIS scattered throughout the country. The specific objectives of the study are:

- Identify the current system and process of communication;
- Analyze the scope and limitation of available means of communication; and
- Suggest the better alternative communication mechanism for future.

APPROACH

Following approaches were followed for accomplishment of the study:

Interactive Meeting and Literature Review

In a process of identifying the communication mechanism existed in the country, different agencies that are operating at the grass-root level were reviewed. Discussions were held with the officials of the Participatory

District Development Program, UNDP and Federation of Community Forestry Users, Nepal (FECOFUN). Several interactive meetings were held with Kathmandu District Unit of National Federation of Irrigation Water Users Association Nepal (NFIWUAN) to discuss the various issues pertaining to communication mechanism with and among FMIS. Furthermore, along with the review of concerned literatures, lesson learnt from the Trust's own experiences has also been thoroughly reviewed and analyzed.

Formulation of Questionnaire

In view of identifying current system of communications and thereby to analyze their scope and limitations to suggest a better alternative mechanism for future, the Trust, in close consultation with the representatives of the Katmandu District Unit, NFIWUAN, developed a questionnaire (**Appendix 1**). Questionnaire was formulated to identify the present modes of communications and their use frequency prevalent in the WUA communication system. The questionnaire to be administered at all the WUAs of the district tries to explore the modes and use frequency of communication with the WUAs from external agencies and among WUAs members of themselves**.**

Field Visit

All 237 WUAs within Katmandu Valley (Sambhu Dulal and P. Pradhan, March 2002) were visited and key persons of each of these WUAs were interviewed. The interview was primarily focused to reflect the following major aspects on the basis of the structured questionnaire:

- current means of communication;
- access to electricity among WUA member;
- possession of radio, television among WUA member;
- possession of telephone, fax and e-mail among WUA member;
- subscription of newspapers, magazines by WUA members;
- postal distance from WUA and efficiency of its delivery system; and
- reliability of available means of communication.

ASSESSMENT OF CURRENT SYSTEMS OF COMMUNICATION

Communication between WUAs and External Agencies

Frequency of Use of Different Communication Modes

The conducted survey revealed that out of 237 WUAs, 28 and 26% are communicating with the EAs through telephone and postal delivery system respectively. On the other hand 18 and 13% find it convenient to receive communications through television and radio respectively. Or on a regular basis 18% of them watch television and 13% listen radio. Use of newspapers and fax for communication purpose is rather insignificant as shown in **Table 2**.

Table 2: Percentage of WUAs Using Different Modes of Communication

Mode of communication	Most frequently used (% of 237)	Less frequently used (% of 237)	Least used (% of 237)	Absolutely not used (% of 237)	Not responded (% of 237)
Telephone	28	31	18	19	4
Post office	26	48	14	8	4
TV	18	18	27	33	4
Radio	13	48	22	13	4
News papers	1	25	34	36	4
Fax	0	1	3	92	4

Source: Field Survey, 2002.

Though Telephone has been found as most commonly used mode of receiving messages by larger number of WUAs viz. 28%, but yet it is a matter of consideration that 19% of the WUAs have never used them for the purpose. If we consider the "less frequently used" and "least used" categories as a means in use with more potential and add it with the "most frequently used" category, the figure comes to 88, 83 and 77% for postal delivery system, radio and telephone respectively. Newspapers and fax are still far from the access.

Location of Post Office and its Effectiveness

According to the survey, post office was found in the vicinity of minimum 50 m (Matatirtha Sinchai) to maximum 9 km (Mahankal Ghattekhola and Mahankal Ghattekhola Gamkot) from WUA offices. Besides, the study also revealed that 27% of the WUAs are situated within 1 km. distance from post office and about 50% WUAs are at the distance of 1 to 3 km from post office. WUAs lying at a distance of 4-6 km. from post office constitute only 10% and those lying more than 6 km is 3%. 10% WUAs didn't furnish any information in this regard. The time for receiving materials delivered from within Katmandu through postal delivery system, as expressed by 79% of WUAs, is of one week and less. 20% of them, however, reacted that the time for such a delivery through post may take up to one month, sometimes even never reach them. Only 1% WUAs maintained their indifference to this information.

Reliability of Communication Means

In response to the query regarding the most reliable mode of communications that would have been favored by the WUAs for communication with EAs, the following results as stipulated in **Table 3** were observed.

Table 3: Reliable Means of Communications with External Agencies

Mode of Communications	Priority 1 (% of 237)	Priority 2 (% of 237)	Priority 3 (% of 237)	Priority 4 (% of 237)
Telephone	35	13	6	0
Radio	31	9	10	0
Television	14	20	3	2
Post delivery	16	29	2	1
News paper	1	1	6	1
Personal visit	0	0	4	0
Fax	0	0	0	0
Not responded	3	28	69	96

Source: Field Survey, 2002

The survey revealed that out of 237 WUAs, 35% are in favor of Telephone as the most reliable means of communication with EAA, whereas 31% WUAs stated that Radio should be kept in 1st priority for communication from EAA. Nevertheless, taking account of all the categories of priority and adding them together, Telephone and Radio have been preferred as most reliable means by 54 and 50% of WUAs respectively followed by 47 and 37% of WUAs favoring postal service and Television respectively. In contrary, only few WUAs consider newspapers and personal visits as a reliable means. Use of fax in the context of WUAs is still a sophisticated means as none of the respondent was found in favor of fax.

Communication between WUA and its Members

Effort made by the respective WUA to overcome all the challenges that arise on the way of managing different tasks related to its FMIS further enhances the interaction among the users. It ultimately strengthens the sustainability of the FMIS concerned. Obviously, such a success is impossible unless there is good communication between WUA and its members. Trust's attempt to gather information on existing process of communication between WUA and its members from 237 WUAs within Katmandu valley was on this perspective.

Communication Mode being used to Communication between WUA and its Members

The survey revealed that most of the WUAs are using different means of communication randomly as per their convenience. A large number of WUAs, i.e. 86% out of 237, use social gathering most frequently for communication between the WUA and its members. However, as per the situational convenience, this mode is often combined or replaced by the other available modes like telephone, use of passers by, use of peon. Number of WUAs using telephone in addition to the social gathering for such a communication constitutes 22%. The traditional way of communicating with each other by *Jhyali*[3] is in existent only in 4% of WUAs. Instead, still there is a trend of sending message through passers by. Number of WUAs using passers by in addition to social gathering for communication comes to 44%. Out of these 44%, 23 of them are additionally using telephone as well. Only 3% WUAs have been communicating with its members by sending message with its Peon. 9% WUAs employ *Katuwal*[4] for sending message. Moreover, meeting at workplace, meeting at public well during collection of water, personal visit, oral notice and post delivery have also been now and then used for communication purpose. **Table 4** below shows this scenario.

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3 A traditional way of conveying message by beating a drum for alerting community about important happening.

4 A person employed to convey messages especially place date and time of meetings or some other events.

Table 4: Communication Between WUA and its Members

Social Gathering(SG)	Telephone in Addition to SG	Passers by in Addition to SG	Katuwal	Jhyali	Peon
86%	22%	44%	9%	4%	3%

Source: Field Survey, 2002

POSSESSION OF COMMUNICATION MEANS

To analyze the scope and limitations of each of these modes and thereby to suggest alternative means, it is worthwhile to compare the above outcomes with the possession of different means of communications by WUAs.

The survey revealed (**Table 5**) that Radio is being possessed by 100% households in large number of WUA i.e. 39%. Television and FM also have wide coverage. Although, telephone was claimed as most reliable means of communication between WUA and EAA and as well as among WUAs, yet possession of this mode by 100% households was observed only in 1% of WUA. Besides, the study also laid open the fact that none of the households has access to telephone in 39% of WUA. Use of Fax is limited in only one WUA namely Dhobikhola Sinchai WUA.

Table 5: Status of Possession of Different Modes of Communication by WUAs (% of 237)

Mode of Communication	WUA having HH with 100% Possession	WUA having HH with 75-99% Possession	WUA having HH with 50-74% Possession	WUA having HH with 25-49% Possession	WUA having HH with <25% Possession	Not having at all	Not responded
TV	9	14	36	15	19	4	3
Radio	39	11	30	10	4	3	3
FM	9	5	21	28	28	1	8
Telephone	1	2	3	3	33	39	19
Fax	**Only Dhobikhola Sinchai WUA, Mahankal has this facility.**						

Source: Field Survey, 2002

SCOPE AND LIMITATIONS OF AVAILABLE MEANS OF COMMUNICATIONS

In terms of communication, today's world has been narrowed by the rapid development of Information Technology (IT). This development has eased people of two different hemispheres to communicate with each other within few seconds. Rapid expansion of IT sphere, especially in urban area of Nepal, can easily be observed. But so far as most of the villages of Nepal are concerned, where the majority of our FMISs are located, establishment of such a communication facilities are still a long way. Among others, economy, illiteracy, lack of awareness etc. are some of the constraints on the use of such technology.

Telephone has been responded as the most commonly used mode by larger number of WUAs and most of the WUAs preferred it as most reliable mode of communication among their members and with EA as well. But one can not ignore the crucial fact that considerable number of WUAs has not used telephone for communication purpose at all. On one hand, Telephone could be a best solution in terms of effectiveness of two-way communication whereas on the other hand the fact that telephone has not been possessed by any of the households in 39% of surveyed WUA indicates that there is still a lot to be done for making telephone a convenient means. Technology like mobile phone could have been an efficient mode for two-way communications between WUAs and EA. Mobile telephone, being a recently introduced technology in Nepal, seems to have a high future potential. However, considering financial status of WUAs and the basic premises required for establishment of the technology, it could take time for the wider application of the technology.

Reliability and timeliness of postal delivery system still stand as a challenging question. The fact, as stated by number of WUAs, that the items delivered through post from within Katmandu sometimes takes even one month to reach to them put a big question mark on the timeliness of the system and henceforth on its reliability. Furthermore misplace and disappearance of the delivered documents is often the case.

Newspapers- both national and local level-could be one such means but still face problems due to lack of transportation facilities at many areas. Use of media for passing each and every information is costly and may not be appropriate for all-purpose. Other means of communication such as community meetings, farmer-to-farmer dialogue, exchange visit and public hearing to make development works accountable to the stakeholders, need to be explored to establish an effective communication mechanism.

On the one hand, the use of primitive mode of communication like *Katuwal, Jhyali* and *Dabali*[5] are decreasing with the increasing influence of urbanization in the area and on the other less access to the modern technologies, lack of transportation facilities, unreliability of existing postal delivery system has put the communication system in real transition.

This study has been conducted in the WUAs of Kathmandu district. These WUAs enjoy relatively better infrastructure privileges due to their location close to the capital city. Due to different topography, varying level of infrastructure development and different socio-economic conditions, the outcomes undoubtedly vary while replicating the study to other districts.

ALTERNATIVE COMMUNICATION MECHANISM FOR THE FUTURE

Due to the topography (difficult in transportation), unaccountable postal system, less coverage of electronic media and partisan politics, the effectiveness of the communication system is in dilemma. There is no such evidence where a means has proved effective to reach to the mass. In such circumstances, only one way of communication cannot be effective in Nepal. Communications, as stated earlier, can be established in many ways, but it is worthwhile to mention here that the provided technologies should always be compatible to the environment, where it is placed. Furthermore, for each modes of communication the basic and fundamental premises have to be established beforehand. For instance, use of e-mail, Internet, mobile telephone or fax may take still long time to be the common mode considering farmers' affordability and the operational complexities of such technologies.

The findings of this survey indicate that any particular means cannot be generalized as effective due to the variable stages of infrastructure development and unequal access to modern communication facilities even within a district. Telephone is obviously effective for two-way communication with EA where the required infrastructure has reached whereas, radio having a wider coverage can be effective for communication from EA. Besides, local bodies and representatives also can be effective with the improvement in the governance situation. So far as the communication

5 A special platform or a stage used for performing ritual ceremonies/cultural programs and as well as for the purpose of mass-communication.

within the WUAs and between the users of a WUA is concerned, they find it still convenient to use the social and human contacts and gatherings.

Only one alternative offered here may not be the exact solution to the problem of communication. Hence, combining two or more alternatives together may be the right choice. This indicates the need to make efforts for establishing a network of different channels of communication, which would be effective and regular in terms of information transfer and exchange amongst the FMIS and between FMIS and EA.

In this background, analyzing reflected viewpoints of the surveyed WUAs, the Trust would like to recommend the followings in regards of the communication mechanisms for future:

- Establishment of information centers at every district unit of NFIWUAN and at central level in Kathmandu could act as the networks for communication channels. Besides acting as networks for communication, these centers would also act as documentation centers documenting the facts and figures about FMIS scattered throughout the country. How the farmers themselves can strengthen the communication links with the external world whereby they can get benefit out of the changes in the government policy, available technology and market may be one of the questions that too will justify establishment of a network of FMIS communication centers.
- District inventory, as being initiated by the Trust, is important to assess the location and communication status of a FMIS. Communication aspect also needs to be considered while preparing the inventory. Further division of a district into blocks is necessary to enhance the communication status of FMIS/WUA.
- Most of the WUAs were found in favor of Telephone as the most reliable means of communication. Furthermore, the study also revealed that this mode of communication is being used by large number of WUAs for communication with EA. In this circumstances, extension of telephone services further to each WUAs office at least and each of its members if possible could be the reliable alternative. The Trust recommends providing them facility of connecting Telephone-line without being on queue. Similarly, subsidy on connection fee could be an idea to lure them towards it. Such telephone can be used for public purpose on minimum pay basis as a means of generating income.
- Location of the post offices have been found in the convenient proximity from the the WUAs. Efficient and timely delivery, indeed, can make the

postal system more trustworthy means of communication, as almost all the WUAs have somehow access to it. For this, the Trust thinks that it is on the part of postal department to shed off its age-old mentality of sluggish and irresponsible modus operandi and revamp the existing process of delivery to keep pace with the challenges posed by 21st century's state-of-the-art technology so that misplace of documents, belated delivery etc. could be avoided.

- Considerable numbers of WUAs were found in favor of Television as the use is expanding with the increasing coverage of electricity facility. By this time numerous private channels are on the air. FMIS can exploit the opportunity of airing their activities and other informative programs through such private TV channels.
- Proper application of radio stations at central, regional and local level can be another approach, as there are already many local and regional radio stations at different parts of the country. Local FM stations can be used for propagating the activities of FMIS. Kathmandu district unit, NFIWUAN can make such arrangement with Radio Sagarmatha regarded as the pioneer community-based FM in South Asia.
- Despite other means, social gathering and personal visits are the common modes (former being used extensively) that are being adapted for communications among the WUAs member. Such social gathering should be held on a regular basis so that sharing of information could be accomplished in an efficient manner.

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Appendix 1

INNOVATIVE MECHANISM FOR EFFECTIVE FMIS COMMUNICATION

Questionnaire

A. General Information

1) Name of WUA …..

2) Number of Household …..

3) Location:
VDC …. Ward No….

4) Name and Designation of Respondent ….

B. About the Communication between WUA and External Assistance Agencies

1) What are the current means of communication existing in your WUA for exchanging the information? Please give numbers in the right hand boxes with first prioritized means as 1, then 2,3,4,…….

Radio	☐	Newspaper	☐
Television	☐	Post Office	☐
Telephone	☐	Specify, if any other	☐
Fax Machine	☐		

2) Can your WUA be contacted through Telephone?
If so and give the following details (up to three nos.).

S.N.	Contact Person	Designation in WUA	Telephone Number
1.			
2.			
3.			

3) Does your WUA have access to Fax service?

Yes ☐ No ☐

If yes, mention the Fax number. ……

4) Does your WUA entertain e-mail service?Yes ☐ No ☐
If yes, mention the e-mail address. ……..

5) Does your WUA subscribe any newspaper?
If yes, furnish the following details.

S. N.	Name of Newspaper	Daily	Weekly	Others
1.				
2.				
3.				
4.				
5.				

6) How far is your WUA from the nearest Post Office (in km)? ………..

7) How long does it generally take to reach the postal parcels sent from within Kathmandu to your WUA?
Within a week ☐ Within a month ☐
More than a month ☐

8) Can any information to your WUA be sent through the nearby VDC?
Yes ☐ No ☐
If yes, give the address of VDC with its Telephone no., Fax no., and also e-mail address (if possible).

9) What do you think is the most suitable and reliable means of communication between your WUA and External Assistant Agencies? ………………………………………………

C. *About the Communication between WUA and its Members*

1) What are the current means your WUA is employing in communicating with its members?
Katuwal ☐ Peon ☐
Jhyali ☐ Passer-by ☐
Social Gathering ☐ Specify, if any other ☐

Telephone ☐

2) Does every member of your WUA have access to electricity?

Yes ☐ No ☐

If no, how many members do have access to it? …………………

3) Does every member of your WUA possess Radio?

Yes ☐ No ☐

If no, how many members do? …………………

Also state, how many members do have F. M. band? ………….

4) How many members of your WUA do possess Television? ………………….

5) How many members of your WUA can be contacted through Telephone? …………………………

6) What do you think is the most suitable and reliable means of communication between your WUA and its members? ………………………………………………

DISTRICT IRRIGATION INVENTORY PREPARATION: A MEANS TO STRENGTHEN DISTRICT UNITS OF NATIONAL FEDERATION OF IRRIGATION WATER USERS' ASSOCIATION, NEPAL

PRACHANDA PRADHAN

INTRODUCTION

An organization becomes active when it has to fulfill its objectives. National Federation of Irrigation Water Users' Association, Nepal, (NFIWUAN) as the representative organization of farmers is to promote and protect right and welfare of the irrigated agriculture farmers. When the districts units become representative organization of the farmers and perform these activities to protect and advocate the rights of the farmers, the federation becomes strong. National federation alone becoming strong would not help strengthen the cause of the farmer in general unless the farmers through the district units will be able to articulate their demand and need for the improvement of their conditions and agriculture development. At present, 66 districts are the constituent members of NFIWUAN.

The overall objectives of the NFIWUAN are to be translated through the activities of the district units. They are to promote and protect the interest of the farmers of the districts. The district units have to help promote the autonomy of the operation of the systems. The District units can play the role as follows:

- Laisioning with district service units in order to make the services easily available to the farmers of the irrigation systems.
- Help develop human resources at the village level.
- Help the farmers to strengthen the farmers irrigation organization.
- Interact with district level government agencies district level agriculture and irrigation planning and development.
- Help diversify crops.
- Help farmers grow cash crops.
- Help farmers organize saving and credit groups, and other social activities.
- Promote sustainable irrigated agriculture for the assured livelihood of the farmers of all categories.

- In order to intensify the cropping systems , promote micro-irrigation systems in order to utilize the low volume available water in the irrigation systems for the cultivation of the off-season vegetables which would bring good income to the farm families.

HOW CAN DISTRICT UNITS BE ACTIVE AND EFFECTIVE ?

In order for the district units to be active, they need to know what exist in the district and what resources are available. They should have information about the condition of the district level irrigation systems. Such information can be made available by preparing district level irrigation inventory. Inventory means listing of information on natural, social, agricultural, organizational and physical features of the irrigation systems inside the district. Inventory is important tool for planning and programming of irrigation and agricultural activities at the district level.

Farmer Managed Irrigation Systems Promotion Trust (FMIST) has helped several districts units of NFIWUAN who are desirous to prepare the inventory. The Kathmandu unit of NFIWUAN took initiative to prepare the inventory of irrigations systems in the Kathmandu district. Trust provided fund for local transportation and cost for food while the members of the unit are in the villages for the preparation of the inventory. The inventory was prepared on the basis of the river system but information collection units are the Village Development Committee area. After Kathmandu District unit , many other districts also expressed their interest to prepare the irrigation inventory of the district level. The present status of the participating districts for inventory preparation is as follows:

Kathmandu	250 units
Bhaktapur	91 units
Dolakha	347 units
Ramechap	under preparation
Okhaldhunga	298 units
Banke	under preparation
Kailali	under preparation
Kanchanpur	128 units
Mugu	171 units
Bajura	76 units

Total irrigation systems of 7 districts as of now is 1261 units.

PROCESS OF IRRIGATION INVENTORY PREPARATION

Kathmandu District unit decided to start preparation of the district level irrigation inventory. FMIST agreed to provide technical assistance to the District Unit of NFIWUAN. It includes preparation of the questionnaire for the information collection. The model of the questionnaire is given in the **Appendix 1**. Then the Kathmandu unit took the responsibility of administering the questionnaire. The Kathmandu district unit members became active in this job and they work on this inventory preparation on voluntary basis. The contact institutions for them in the field are the Village Development committees (VDC) and other institutions at the VDC administrative unit. The VDCs also mobilized WUAs or other informed persons from the irrigation systems. It took 4-6 months for the preparation of the district level inventory at Kathmandu district.

Collaborative activities between FMIST and District Unit of NFIWUAN were agreed before the start of the work. Inventory questionnaire preparation and data processing after information collection will be done by FMIST. Based on this agreement, Trust helped processing data and the report was prepared on that basis and it was given to the District unit for their use and report was circulated under the authorship of the Kathmandu District Unit. For other districts also, Trust had similar arrangements

EXAMPLES FROM KATHMANDU DISTRICT INVENTORY

After processing the data of Kathmandu District unit , following problems were identified:

- Many rivers in Kathmandu district have lower river bed due to excessive sand mining on the permission of the District Development Committee. District Development Committee collects revenue for issuing license to the contractors to mine the sand in the rivers within the jurisdiction of Kathmandu District. Such activities have resulted into decreasing level of river bed causing non-functional irrigation systems due to excessive mining of sands specially in the Manahara Khola and others.
- It is found that there is negligence for Operation and Maintenance of the irrigation systems. Collective effort for the maintenance in many systems are not found. Maintenance of the system is on individual basis.
- In many systems, inactive WUAs are found. The members of irrigation stakeholders are not organized into water users associations.

- It is reported in the inventory that many irrigation systems are suffering from increased risk of flood and landslides. This situation was caused by deforestation in the upper catchment area.
- Sources of irrigation systems are facing shortage of water in the irrigation canals. This is also due to deforestation and carelessness in the watershed area.
- For many people , agriculture is only part time job in peri-urban areas therefore they have apathy in system maintenance. This is also reinforced by the urban influence in the periphery of the Kathmandu district.
- After some level of education, young people are attracted in the urban based jobs. This has caused burden of agriculture work to women and old people.. They have to undertake both irrigation maintenance and agriculture activities.

PROBLEM ANALYSIS

While carefully analyzing the problems as reported in the inventory of irrigation systems at Kathmandu valley, following problems came prominently.

One of the major problems identified is the inter-agency ill-coordination. The activities of other agencies also directly influence the performance of the irrigation system. It is not only the farmers that they are directly responsible for the performance of the irrigation systems. Gravity irrigation systems in Kathmandu district have source of water from the local rivers and streams. The steady supply of water depends on the balanced ecological maintenance in the upstream and downstream of the rivers and streams. According to the Local Administration Act, the sand and gravels and stones in the river are the property of the local agencies. These district level agencies can make income by selling the sand, gravel and stones from the rivers. The Kathmandu District Development Committee (DDC) also gave permission for mining of sand in the rivers of Kathmandu district by charging loyalty as the income for the DDC. There is high demand of sand in the building construction business. There has not been conscious effort from this agency for the protection of source of water and preservation and protection of the irrigation systems in these rivers. Similarly, with the introduction of carpet factories between Sundarijal to Baudha area , Bagmati river got polluted by the industrial waste and sewerage of the new townships. Such changes have adverse impact in agriculture activities and irrigation systems. Looking at the inventory , the problems caused by the lack of interagency coordination deserve attention by the civic society, users and government agencies. Here, one can see several agencies involved in the better irrigation management and performance like forest agencies regarding the preservation and protection of the forest at the source of the water, district development committees for the protection of the river banks and river beds, environmental agencies for the quality control of water, industrial agencies for proper disposal of industrial waste, drinking water agencies to make drinking water supply, agriculture agencies for the choice of crops and agriculture technology, water users association for the management of irrigation systems.

Table 1: Agencies Involved in Irrigation Management

Agencies	Functional Linkage
Department of Irrigation	To provide technical and maintenance support, strengthening and recognizing WUA,
Department of Forest	Water source protection and preservation of forest at the source, community mobilization for forest protection
Ministry of Environment	Setting the standard for water quality and pollution control
Department of Industry	Control of industrial waste and approval of environment friendly industry
District Development Committee	Regulation on sand mining ,etc.
Ministry of Public works and Building	Regulation for drinking water supply, management of conflict on water right for irrigation and drinking water
Municipality	Swerage regulation and prevention of river water pollution
Department of Agriculture (District Office)	Training on crop choices, new agriculture technology, marketing of products, regulation of input supply, etc.
Water Users Association	Management of the system and protection of the farmers water right ,etc.

The **Table 1** shown above indicates that irrigation performance has multi-sectoral impacts. Decisions of several agencies make the irrigation systems functional or dysfunctional. In order to make irrigation systems properly function, there is need to have integrated water resource management (IWRM). Instead of sectoral approach for irrigation management, there is need to promote IWRM approach. This kind of approach can not be implemented only by individual irrigation systems. Hence, there is need of organization like District unit of Nepal Federation of Water Users Association in order to promote inter-agency coordination and promotion of integrated water resources management to protect and strengthen the individual irrigation systems. For example, the regulation on sand mining in the river system can not be tackled by individual system but the Federation of the WUAS of District unit can mobilize number of agencies to draw attention towards this grave situation caused by sand mining in the rivers of Kathmandu district or water pollution caused by industrial waste.

Change in the natural resource endowment- deforestation at the source of water: There has been change in the natural resource endowment and depletion of forest resources. This situation caused problems in the supply of water in the irrigation systems. Where the forest area is protected, irrigation systems have difficulties in procuring forest products for the repair and maintenance of the irrigation systems.

Change in the social values: With the investment on education to the children by the families in the rural areas, the young people leaving the village would not like to come back to the village and engage in the agriculture activities. They prefer to take jobs in the urban areas. Such situation has put burden on old people and women in the village and they have to engage in the irrigation operation and maintenance as well.

Lack of cooperative spirit: Cooperation among the villagers have gradually eroded due to individualistic values of the urban life. People are divided in the villages on the political party lines.

Weak irrigators organization: Irrigation organizations lost social capital. Mutually beneficial collective action hardly took place regarding the irrigation management. Irrigators made effort to bring water either by small group of farmers or individual farmers.

DIFFERENT PROBLEMS IN OTHER DISTRICTS

The problems identified in other districts during inventory preparation are as follows;

Lack of Market to Sell the Agriculture Products

Efforts are made by the farmers to produce agri-products. Thy have difficulty to sell them. Due to lack of road transportation , agriculture products can not be taken easily to market place.

Construction Materials for Rehabilitation Getting Expensive

The irrigation systems in the villages depend on the forest products for operation and maintenance. Due to deforestation and control over the remaining forest either by the government or by the community, forest products for maintenance of the irrigation systems are not easily available. Hence, these systems have to depend on gabion wire, cement and iron rods.

These materials are expensive on the one hand and they are not easily available in those villages.

Deforestation as a Factor for Drying up the Source of Water

Deforestation also became factor for dysfunctioning of irrigation systems as the water sources either dried up or deforestation expedited landslide and floods as well causing severe damage to the irrigation systems and agriculture lands.

Need for Strengthening the WUA

In some systems, WUA is active in O&M of the irrigation system and in others, they are very weak. Hence, there is need to strengthen WUA which can be active in O&M as well as to look at the overall development of irrigation management.

Lack of Co-ordination with the District Line Agencies

Except some systems, many systems do not have inputs from district line agencies. There is need to establish co-ordination between district line agencies and irrigation systems in the district.

EXAMPLES OF WUA STRENGTHENING ACTIVITIES FROM KATHMANDU UNIT

Efforts to Strengthen the System Level WUA

The Kathmandu District Unit has made efforts to strengthen system level WUA and their activities. At the initial stage, an NGO called ACTION AID program provided skill training as well as finanacial resources to strengthen five WUAs in five systems.

Preparation of Manpower as Facilitators for Assisting the WUAs

The Kathmandu unit trained five of their members as facilitators for WUA strengthening activities Since the facilitators come from the village background, the farmers of the irrigation systems felt homely working with them. They were quite effective in assisting the formulation of the rules and regulation for the management of the irrigation systems in collaboration with the farmer members of the irrigation systems. In the meantime, they helped the volunteers from the village as well as from other district also to learn the skill of the facilitation to help form WUA.

Assistance to Five Systems to Strengthen WUA

In five systems (in Sankhu, Machey Naryan, Sangla, Baluwa and one more) , the Kathmandu unit helped formed WUA, rules and regulations in consultation with members of the systems, preparation of the list of the members of the system, and socio-economic information of the members of the irrigation systems as well as the sketch map of the system. The facilitation took a month exercise in the system to strengthen the WUA.

Farmer to Farmer Training Program (F-F Training)

F-F training program was organized to have exposure to the facilitators about the functioning of WUAs in other systems of other districts. Five member facilitator team visited Argeli and Chherlung systems of Palpa district, Chhatis Mauja of Rupendehi district and Pancha Kanya system of Chitawan district. The F-F training program gave to the participants the opportunity to compare the rules and regulations of the irrigation systems where they observed with those that they helped to formulate in those five systems.

Interaction with the District Level Line Agencies

Kathmandu District unit organizes interaction program by inviting the members of the WUAs, district level government officials, DOI staff and other NGO members. Such interaction helps coordination of district level line agency activities.

Management Role of WUA vs its Resource Mobilization Role

Effort is being made by Kathmandu unit to educate the members of WUAs on irrigation management activities along with resource mobilization activity. There are many other activities that they have to perform. As of now, many of WUAs at Kathmandu district have only single functional.

Inspiration of Kathmandu Unit

Kathmandu unit has been inspiration to nine other district units and following its footstep, they took the responsibility of irrigation system inventory preparation.

HOW TO ESTABLISH COMMUNICATION AMONG THE IRRIGATION SYSTEMS WITHIN A DISTRICT

After inventory preparation, it is found that there is no mechanism to establish communication easily among these systems. This has become a major problem. FMIST also faced this problem of communication when TRUST tried to send information regarding the award for best performed WUA.

Kathmandu unit realized the gravity of the situation. The unit plans to form sub-district units where 15-20 units of the irrigation systems will exist. The representative of these systems form a committee of sub-unit of the district. The information to be given to the systems will be channeled through these committees of sub-units of the districts. The break down of the sub-units would help even to district level line agencies to establish linkages and provide services to the irrigation system. Such arrangement helps develop two way communication between the Kathmandu unit and irrigation systems within the district.

IMMEDIATE IMPACTS OF INVENTORY PREPARATION

Inventory helps planning to rehabilitate the systems. Candidate systems can be objectively identified.

District unit has developed human resources as facilitators for institutionalizing and strengthening WUAs. They can now provide the services to strengthen WUAs in irrigation systems within the district as well as in other districts.

The knowledge and skill acquired by the members of the district unit is sufficient to act as facilitators for WUA organization. They can help other systems to strengthen WUAs.

Irrigation development planning based on river system rather than individual irrigation system needs to be initiated. This will provide opportunity for planning in a broader context taking these irrigation systems as the resource for agriculture development.

Multiple use of water has made Integrated Water Resource Management important. Multi-sectoral identification of the problems raise the concern for an intersectoral and institutional solution. Such problem can not be resolved by individual effort.

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Appendix 1

INVENTORY OF IRRIGATION

Inventory of Irrigation Systems in District: ………………..
Form No:……….. Province…………………….
Name of the Irrigation System…………………….

A Locations
Name of the village(s)
Distance from nearest road head

B Physical characteristics
Source of Water: Spring ( ) Stream ( ) River ( ) Reservoir Name........
Technology: Pump ( ) Gravity ………….. Others
Water availability in command area : sufficient ( ) seasonal ( ) shortage in dry season ( ) Year of construction……………………….
Number of Irrigation systems: Upstream ( ) Downstream ( )
Intake: free ( ) regulated ( ) temporary ( )
Pump: capacity
Canal length ………………. Command area…………………….
Terrain: plain Terraces…………
Present condition of the channel……..
Problem identified if any

C Institutions
Number of users:……………….
Users Committee members: Recruited ( ) elected ( ) appointed ( )
No official ( )
Annual meetings: No ( ) one time ( ) two times ( )
Who supervises water distribution…………………………………….
Is there water distribution rules………Punishment for water theft…..
Water distribution : Continuous ( ) Rotation ( )
Water right at the system level: Yes ( ) No ( ) At farmers level: Yes( ) No( )
Resource mobilization for O&M: Labor ……Cash…….. Kind……
Internal resources…………….External resources………………….
Present Status of maintenance: Good ( ) Fair ( ) Poor ( )
Collection of FundDeposit in bank ……………. Use of Fund…...…
Record Keeping
Punishment system if any for non-compliance……………………….
If conflict occurs, how is it solved?…………………………………..

D Agriculture
Crop Coverage by area %. Paddy………..Paddy……. Maize……..Others……… .

Crop/ month	J	F	M	A	M	J	J	A	S	O	N	D
1												
2												
3												

How many crops a year? Paddy Paddy Maize/? Others
Area covered (ha) ……… ……. ………

E. <u>Problems identified</u>
Can area be expanded?
Can intensity be increased?
Can there be assured supply of water?
Have O&M satisfactory
Have VDF collection as planned

F <u>Others</u>

Part III : Farmers' Panel on FMIS Goverance

PART III: FARMERS' PANEL ON FMIS GOVERNANCE

This penultimate plenary session was chaired by Mr. Bishnu Hari Devkota, Panchakanya Irrigation System in Chitwan district of Nepal and coordinated by Dr. Upendra Gautam. Three WUA representatives dwelt on different aspects of FMIS governance in this session. They also responded to questions fielded by the participants. Following are their presentation in detail.

PERSPECTIVE OF NATIONAL FEDERATION OF IRRIGATION WATER USERS' ASSOCIATION, NEPAL

KESHAB NEUPANE[1]

National Federation of Irrigation Water Users' Association, Nepal (NFIWUAN) was established in 1998 comprising of 13 WUAs from 8 districts. It received its legal status in August 1998 after being registered in district administration office in Kathmandu. NFIWUAN held its first national assembly meeting in Kathmandu in which 91 WUA representatives from 30 districts had participated. In the second national assembly meeting held in January 2004 at Janakpur, there were 2139 participants from 66 districts .

Following are the basic objectives of NFIWUAN:

- Promote leadership of WUAs and assist coordination among the agencies of government to get the services to WUAs;
- Make aware and inform WUAs about policy, acts and regulations relating to water resources of country;
- Motivate WUAs towards effective participation;
- Identify the problem of WUAs related to agriculture and irrigation and initiate measures to increase agriculture production;
- Motivate WUAs towards the multiple use of water resources;
- Conduct research study related to the role of WUAs in effective use and management of water resources;
- Motivate WUAs to participate in the development of completed, ongoing and forthcoming schemes for the sustainable development;
- Organize WUAs from all across the country;
- Promote the equitable participation of women in WUA;

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[1] Chairman, National Federation of Irrigation Water Users Association, Nepal.

- Promote NFIWUAN as a representative institution of WUAs and assist government agencies in the planning and implementation of the programs;
- Make WUAs aware towards rights and duties; and
- Constitute district chapters as per the requirement.

Following are the implemented programs/activities to achieve its objectives:

- NFIWUAN conducted interaction programs in 16 districts participated by 1181 WUA representatives.
- It carried out group formation and constitution formulation. 5 Water Users' Group (WUGs) from 4 districts took part in it.
- It has organized different Training Programs. Training of Trainers (TOT) was provided to 43 participants. It also conducted leadership development training aiming to uplift women and disadvantaged groups. 23 woman representatives and 46 representatives from disadvantaged groups were directly benefited through this training. Besides, it also exposed 30 participants to gender equity training. In the awareness campaign launched by NFIWUAN, altogether 1650 WUA representatives were involved.

ROLE OF DISTRICT UNIT IN TRANSLATING THE OBJECTIVES OF NATIONAL FEDERATION OF IRRIGATION WATER USERS' ASSOCIATION, NEPAL INTO PRACTICE

SHREE RAM ACHARYA[2]

Kathmandu unit is the district chapter of National Federation of Irrigation Water Users' Association, Nepal (NFIWUAN). It has 157 WUAs as its members which represent more than 60% of existing FMIS in this district. Previously, only those WUAs registered in government authority were eligible to become the member of NFIWUAN. After the recognition of those WUAs which are not registered in the concerned authority, they also became the member of NFIWUAN. This way, many WUAs have become the members of this unit. Its organizational structure is as follows:

- District convention comprising of 161 members;
- District Assembly comprising of 47 members;
- District Secretariat comprising of 7 members;
- Area committee comprising of 19 members; and

[2] Chairman, Kathmandu District Unit and Central Member, NFIWUAN.

- Water Users' Groups comprising of 157 units.

Its main objectives are:

- to translate the objective of center into practice; and
- to attract young generation into the agri-farming.

It has implemented following programs to achieve the envisioned objectives and thereby strengthen the WUA unit:

- Preparation of the district inventory of WUA (250 WUA units identified);
- WUA formation following appropriate process and constitution formulation;
- Training of local level facilitators;
- WUA governance training;
- District level interaction program;
- Agriculture production and market management program; and
- User awareness campaign.

GENERAL INTRODUCTION OF CHHATTIS MAUJA IRRIGATION SYSTEM

RUKMAGAT PANDEY[3]

The geographic alignment of Chhattis Mauja Irrigation System starts from Kanya Dhunga, Butwal Municipality and ends at Thatariya at Gangolia VDC, Rupandehi district. This system having 11km long main canal is in operation since 200 years with active and wide participation of farmers. It irrigates 3500 ha and serves 26,000 beneficiary households. Earlier, its command area was spread over 36 Maujas and thus the system earned its famous name Chhattis Mauja. However, it has 60 Maujas at present. The WUA of this system is called Chhattis Kulapani Samiti which is an autonomous organization. Its office is at Shankarmagar VDC-5, Rupandehi.

This committee arranges regular meetings and systematically maintains the minutes. In every 2 years, it holds election of the executive committee. It consists of 15 members including Chairman, Vice-chairman, Secretary, Treasurer, and 11 other members. Among these 11 members, 9 members hail from each 9 *Ilaka* (sector) and rest two are nominated by the Chairman necessarily including at least a woman. General assembly meeting takes place annually and passes budget and guidelines to the executive committee.

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3 Chairman, Chhattis Kulopani Samiti, Shankarnagar, Rupandehi.

This committee has its own set of rules and regulations for canal operation as well as own mechanism of their enforcement. The routine maintenance of the canal is carried out once a year in January-February as per the decision of the main committee. For this purpose, labor contribution is done from each household for consecutive 5-7 days. The committee assigns *Mukhtiyar* to mobilize labor.

As regards the water distribution, it is continuous in monsoon whereas rotational distribution prevails in case of long drought. Moreover, rotation among Maujas is compulsory during winter.

The committee imposes penalty ranging from NRs. 1,000 to 3,000 for those defaulters who steals water or violates the rotation system. *Mukhtiyar* and *Sipahi* are responsible for monitoring the rotational supply and maintenance requirements. Regarding its resources, this committee meets its expenses from internal resources mobilization besides the penalty and donations. Most importantly, financial transparency has been strictly maintained by the committee through the annual auditing.

Part IV: Experts' Panel on FMIS Governance

PART IV: EXPERTS' PANEL ON FMIS AND GOVERNANCE

As the final item of the Seminar, an experts' panel was held on FMIS governance in order to have insights into the future direction of the Trust. This plenary session was coordinated by Surya Nath Upadhyaya, honorary member, FMIS Promotion Trust and chaired by Dr. Prachanda Pradhan. Dr. E. Walter Coward, Jr.; Charles Lindsay Abernethy; Dr. Robert Yoder, IDE-International, USA; Dr. M.A. Quassem, Water Resources Planning Organization (WARPO), Bangladesh; and Dr. Ganesh P. Shivakoti were the panelists.

Initiating the session, Mr. Upadhyaya said, "I would like to raise a couple of issues related to the governance on FMIS. These are: (i) Water Users' Associations (WUA) have to be recognized as legal entities, and (ii) the question of “who owns the water?” (government, community, individual) has to be resolved. There are much ambiguity and contradiction as to the application of different acts such as Water Resources Act and Local Governance Act vis-à-vis the claim of the ownership of the water resources. I would like to conclude that the gamut of the ownership status of water resources has to be properly and unambiguously articulated by removing the hodge-podge sort of legal environment."

After the coordinator's remark five panelists made their statements in the following order:

COMMUNITY: ENHANCING MARKET OPPORUNITIES

E. WALTER COWARD, JR.

Suggesting how others should act in the future is always an audacious act and I presume to do this only because FMIS friends and colleagues have so requested. Here are some thoughts from a familiar stranger to Nepal.

- I believe the most important principle that should underlie the Trust’s future planning and actions is that the community irrigation sector will remain important in Nepal, indeed in much of Asia, well into the future. While FMIS can be found in many different states of health, they are not an endangered species not mere remnants of a now defunct solution to irrigation needs. They are here to stay and so should the Trust. Moreover, given the importance of FMIS is other parts of Asia and the success of the FMIS Trust in promoting the wellbeing of these systems in Nepal, I hope the Trust will be open to the possibility of assisting interested parties elsewhere to consider, plan and create similar Trust-like organizations.

- Second, the development of FMIS federations in Nepal at different levels – districts and national – is an extremely important phenomenon that was introduced at the Third International Seminar. The FMIS Trust has already played an important role in the emergence of these federations and I wish to underscore the importance of FMIS continuing such involvement. The roles that such federations can play in assisting individual FMIS across a broad landscape is immense. But, to do so, they will need reliable buttressing from talented and committed individuals with a variety of experiences. The FMIS Trust can have an important impact of the federations by helping to mobilize and deliver this assistance through consulting, research, communication and so on.

- The Third International Seminar also introduced participants to a few case studies of FMIS in the cold deserts regions of Nepal and other parts of the Himalaya. This was a welcome expansion of the Trust's scope of work and I encourage more attention to this topic in the future. While the numbers of people in these regions may be small, the ecological importance of these regions provides a rationale for this attention. It also is the case that analysis of these cold-desert situations is likely to yield comparative information that will advance FMIS thinking and practice. If the Trust chooses to follow this suggestion, I would also suggest that the Trust reach out to the small, but significant, number of scholars who have been engaged in similar work in areas such as Ladakh and the northern regions of Pakistan. Their working, largely academic in character, needs to be brought into our discussions.

- Finally, I suggest that the FMIS consider sponsoring research to look at the current and potential roles of FMIS in the "buffer zone" economies of Nepal and neighboring regions. By the "buffer zone economies", I refer to the rural areas that lie adjacent to national parks and other protected areas where villagers are being asked to defer their dependence of certain forest resources and find livelihood substitutes, sometimes including agricultural production for the market. Community irrigation could enhance such opportunities in some circumstances. FMIS research and investigation could help illuminate this matter.

I submit these suggestions for your consideration and look forward to continuing to follow the progress of the FMIS Trust.

FORMING A VISION FOR FUTURE

CHARLES LINDSAY ABERNETHY

In one of the presentations at this conference, it was stated that agriculture is the occupation of 85% of Nepal's work-force, and that it contributes 40% of the Gross Domestic Product. The presenter said that these data indicated the importance of agriculture to Nepal.

But it is also possible to interpret these figures in a different way. They show that the other 15% of the workforce are generating 60% of the Gross Domestic Product. With a little arithmetic we can see that this means that the value per person generated in other sectors of the economy is about 8.5 times more than the value per person generated in agriculture.

Similar ratios can be seen in many other Asian countries, if we perform the same arithmetic with data that the World Bank and others present in annual reports. We may doubt the accuracy of the basic data, but there is no doubt at all that the product value per person in agriculture is very much below what is achieved in other sectors of the economies of the region.

This situation represents a great challenge to the future of farmer managed irrigation systems. In particular, we should expect to see decline in numbers of their work-forces, and increase in average age, as young people will migrate to the urban economy, where they will expect to find greater opportunities of earning a living and supporting a family. This trend has been evident, throughout the region, for a decade or two, and is probably increasing at present.

The threat that this presents to FMIS is very clear. There is a growing risk that local organisations, which may have existed for a very long time, will find it difficult to continue, as there are fewer new, energetic people willing to take up functions in running these organisations. How can an organisation like the FMIS Promotion Trust react to this?

I suggest that the Trust could perform a major service by forming a vision for the future, looking forward say ten or even twenty years, and trying to map out a scenario in which the well-known strengths of FMIS can be adapted, and can continue to be viable in the new economic environment. To form such a vision there would have to be a process of wide discussion, with an emphasis on collecting the views of younger people, both within the FMIS communities themselves and within the professional and academic groups that have various kinds of relationships with FMIS.

Over the past twenty years, there have been many papers about FMIS, and in recent years the Trust has contributed effectively to this growth of literature and of understanding about the history and internal organisation of FMIS. We have now many studies about their present status, and about their past. But I think we have not seen much analysis about their possible future evolution. This is what the Trust now should address.

Maybe our value systems are out of date. It seems possible that admiration for these self-organised, self-governed systems can obscure the fact that, like everything else, they must continue to change and adapt themselves, if they are to survive. Even centuries of past performance are not a guarantee of future survival.

There is a real risk of FMIS becoming what I shall call “cultural fossils” : they may be preserved in a few cases, perhaps by public subsidy, because of their interesting past, but may lack relevance to the current context. This is what could be happening in Sri Lanka. The recently-elected government has adopted a policy of restoring ten thousand of the traditional village-scale “tanks,” or local small-scale reservoirs with low earthen dams. The policy is based on the idea that Sri Lanka’s well-known history of user-managed irrigation, which goes back perhaps two thousand years, can be revived. But the fact that these facilities, which were for the most part built and maintained by local effort, now have been allowed to deteriorate, in such a large number of cases, and need government assistance to revive them, suggests that the traditional user-based model no longer fits the modern context or the economic aspirations of the present user communities.

The low economic performance of traditional systems is, of course, closely connected with the low prices of major agricultural products, especially rice. It was good to hear, during this seminar, that some of the well-known Nepali FMIS are encouraging changes of crop strategies. Panchakanya, we heard, is venturing into flower production ; Chhattis Mauja may make some money be selling the sediments in its canals for building purposes. I think there should be many more such initiatives. I would hope that in ten years from now these systems will be selling their products, such as fruit or flowers or vegetables, in the high-value export markets in Japan or Europe. I would hope even that leaders of these organisations will themselves visit such countries to negotiate production contracts.

But we will have to recognise that the changes, that can make the irrigation systems more profitable, will also involve changes in social relationships. Higher-value crops involve more financial risk ; prices fluctuate much more than the prices of rice and other cereals. For this reason alone, the traditional social model of a FMIS, where all members are approximately equal, does not fit so well, as people differ in their attitudes to accepting risk. Contract farming also requires new disciplines of quality control, grading of products, packaging, timing, reliable delivery, and much else.

The traditional FMIS, in Nepal and in other countries, is organised around a single function, water distribution. Today, water is no longer the major problem for the farmers. If we go among communities using irrigated agriculture, and ask them to rank their problems or needs in some priority order, we usually do not find that water delivery is near the top of the list. They are more likely to identify such aspects as equipment, credit, supply of fertilisers and other inputs, marketing, transportation, storage and other post-harvest needs.

There are different options for responding to such needs. Either the FMIS organisation can diversify itself and take up these new functions, or the FMIS may remain as the water-distributing organisation that serves the entire community, while a new organisation (or perhaps several new organisations) may be created to undertake these other functions. In my own opinion, the latter alternative seems preferable, as it allows groups of members of the FMIS to form new organisations, for example a company to buy inputs or to market products, and members can decide for themselves whether they want to take the financial risk of buying shares in such a company.

However, that is only my personal view. The challenge now for the FMIS Trust is to start a debate about all such alternative strategies, and to try to formulate a vision of an economically attractive path for the evolution of these management systems, to adapt them for continued survival in the modern context.

FINDING WAYS FOR SYSTEM TURNOVER

ROBERT YODER[1]

It has been a pleasure to be part of this Third International Seminar on Farmer Manager Irrigation Systems and Governance Alternatives.

As an engineer I've found research and development of FMIS a stimulating endeavor given the wide range and type of physical structures one finds. Diversions from mountain streams using local materials remain an ongoing challenge. FMIS irrigators have found an eloquent solution for distributing water equitably among themselves using various types of proportional dividers like Nepal's saancho. Some FMIS use tunnels to protect against landslides or to cut through ridges, or as in the case of the Karez or Quant of Iran and Afghanistan, use tunnels to lead groundwater to the surface by gravity flow. However, drawing lessons from the invisible part of FMIS, the institutions for governance, has been the most fascinating and perhaps the most instructive part of our study of FMIS.

I was pleased to see that a number of students have joined this seminar. Some who have concluded their field work and have presenting their findings, others who are just embarking in their field work. It is satisfying to see continuing recognition of value of understanding the dynamics of managing irrigation systems as national and local conditions change over time. FMIS governance systems must change to meet needs and conditions of the irrigators as opportunities for employment, transportation, cropping systems, and markets change. Documenting these changes and drawing lessons from them have wide-reaching impact. I see FMIS lessons as essential in our understanding of issues faced in transferring government built systems to farmer management, i.e., the "system turnover."

I agree with the statements of Charles Abernethy in his address. System turnover has not been an overwhelming success and remains on my list of urgent issues that the study of FMIS can address. It is in the planning and construction of their physical infrastructure that a group of farmer irrigators identify and begin to address their governance issues—how will they allocate the water among themselves, leadership, record keeping, group consensus for critical decisions, and resource mobilization (labor, material, cash, and expertise). Governance options were in general not dictated to emerging FMIS but evolve with need, were tested and changed as necessary. Finding

[1] Director of Water Development, IDE-International, USA.

ways to have system turnover programs incorporate similar governance creating experiences will be essential to the success of such programs.

Other issues on my list of urgent activities for those working to understand and improve FMIS include:

A gap remains between irrigation development and increasing agriculture productivity. The emphasis remains on expanding area irrigated and not enough on enabling irrigator households increase their income or livelihood by shifting away from subsistence to market production.

There are few countries that have a comprehensive list and detailed information about their FMIS. Improvements in GPS based measurement systems and GIS generated maps will greatly facilitate the task of completing a detailed inventory. A complete inventory would identify both the value that FMIS bring to agriculture production and identify the needs to be addressed in making them more productive.

Water conservation needs will continue to increase. Research should continue in finding cost-effective ways to harvest and store rainwater for use in irrigating small areas of high-value crops. Awareness and availability of low-cost drip systems for water distribution needs to be expanded.

Related to the above are the opportunities to expand the number of crops grown in FMIS in situations where the dry season water supply was not sufficient for delivery by earthen canal with high losses. With the availability of low-cost drip distribution systems, adding a plastic pipe to convey the water from the source to the command area during the dry season should be investigated as a means to boost farm income.

Development of domestic water systems and development of irrigation systems have much in common but are generally completely isolated from each other. There are situations where the two can be combined safely and with significant cost savings. IWMI is currently leading an action research project to investigate past experience and expand this opportunity. It should be noted that most traditional FMIS were multiple use systems and met a community's domestic (drinking, cooking, dish wash, clothes washing, bathing) water requirements, provide water for animals, were key in fire protection, all in addition to irrigation for crops. We need to draw lessons from the multiple use functions of FMIS that can be applied in the design of new water systems.

Finally, there is need to continue our study of FMIS as a means of improving both the policy environment and the lessons that can be shared among FMIS for improving their performance. I see this as an important function of the

FMIS Promotion Trust in Nepal and encourage participants from other countries to find ways to establish similar advocacy organizations.

I want to take this opportunity to again thank the organizers for the effort they have put into once again bringing together the FMIS users, students, practitioners, researchers, and others interested in the advancement of FMIS.

SERVING THE FARMERS

M. A. QUASSEM[2]

First of all, I thank the organizers, particularly Dr. Prachanda Pradhan for offering me an opportunity to learn about various aspects of and issues related to farmers management.

Here, I am supposed to speak a few words on the FMIS Governance. I find myself very embarrassed to do that because I know it well that the Nepalese farmers are the best to do that in Nepal. I had a teacher in the Institute of Hydraulic Engineering in the Netherlands who used to say - when you have a problem, ask the people whose problem it is; they have the answers. Learn from that. I always try to follow it.

Nevertheless, being inspired by the proceedings of this seminar, I feel tempted to make a few small remarks

- This has been a high "quality" seminar. Seminars are quite frequent nowadays and no longer very attractive for me unless it has some special features. I first met Dr. Pradhan in Dhaka during the SAWAF III Seminar (July 2004) where he presented a very interesting paper a sharp variant so far as the concept and the contents are concerned. That made me interested in Dr. Pradhan and in the FMIS Seminar when he invited me. I can tell you that I found this a very special one -firstly, it's not donor or project driven routine activity. Secondly, the papers are all taken from real life at the grass root level. I have learnt lot from the deliberations on different relevant concepts and issues of the farmer management irrigation system.
- Few decades back, moral rearmament, integrated rural development (IRDP), need based development, and many alike had been the jargons. Nowadays participatory management, water governance, equitable distribution of water, irrigation management transfer are the foci. We, in Bangladesh are not

[2] Former Director General, WARPO, Ministry of Water Resources, Bangladesh.

different. The key note speeches which dealt with these issues are thought provoking and stimulating.

- It is to be noted and praised that the FMIST has been pursuing a process to address these issues from the point of view of local culture and heritage, and the management practices of their own farmers, rather than submitting to external donor driven prescriptions. In this respect, you are unique.
- You are trying to promote bottom up development by empowering the farmers and institutionalizing them in their chosen way, instead of top down, bureaucratic methods. What I like to emphasize here is that this is a different way of doing things - doing it bottom up, learming from the farmers, highlighting the success stories of the farmers. This way of doing things, which is different, require a different type of professionals who will step out side the prevailing bureaucratic ways. They will consider their mission as to serve the farmers; consider themselves accountable to the farmers; learn from the farmers instead of teaching them; respect the values, culture and heritage of the farmers.

I hope FMIS will continue upholding this and consider on initiating a process to motivate the young professionals in this respect and organize those who already believe in this philosophy, so that they don't find themselves alone and get lost under the catchwords and jargons coming-from various directions.

NEW DIMENSIONS

GANESH P. SHIVAKOTI

Accomplishments of the past two decades in understanding and modifying governance and management of irrigation systems have been considerable. However, the 21st century brings new challenges. Population growth and urbanization place municipal, industrial, and environmental water needs in competition with water previously allocated for food production and ever increase the need to use water more efficiently for food production. While management responsibility is being transferred to local users' groups, property rights and rights to water often remain unresolved issues. The transfer of irrigation system governance and management has often overlooked the need to modify information systems and access to information necessary for responsible governance. Thus, the following three integrating themes will be of considerable importance over the next few decades**.**

Responding to Competition for Resources

Transfer of water and irrigated land from agriculture to other uses (municipal and industrial) and its impact on agriculture

- Aquifer depletion, water quality degradation and water reclamation
- Trans-basin and trans-boundary water transfers; and challenges to FMIS water rights
- Property rights: water, land, infrastructure (including the planning, information and administrative requirements of these)
- Linking downstream and catchments stakeholders in watershed and basin management (including information and communication requirements)

Accountability and New Partnerships

- Transfer of authority for irrigation system management
- Changing government roles to regulation, provision of support services and capacity-building based on the principle of co-management and "polycentric" governance integrating farmers' institutions of irrigation management
- New accountability mechanisms: service agreements, management audits, asset management plans (including information requirements)
- Redesigning government subsidies: matching investments, transparent and agreed allocation criteria, incremental infrastructure improvement

Reform, Synergy and Economic Productivity

- Scheme-level WUA federations and new opportunities for WUA's hiring their own agricultural/agri-business development agents
- New Information/communication systems for market identification and networking
- Using new demand-oriented irrigation services to promote crop diversification and commercialization
- Expanding the economic niche of farmers beyond cultivation to agri-business (input production and supply, crop processing, production of manufactured agricultural /horticultural products)
- Joint monitoring for irrigation operation: diverse methods of data collection, storage and processing into information, public access and sharing of information.
- Transition of irrigation operation policy beyond water provision to cope with changing economic context and WTO requirements

- Exploring mechanisms for alternate mechanisms for governance and management of irrigation into the larger context of economic integration, competition for water and the need for water conservation and land resources.

Annexes

Annex-1: Seminar Program

Seminar Program

Third International Seminar Program on

"Farmer Managed Irrigation Systems and Governance Alternatives"

Venue: Hotel Yak and Yeti, Darbar Marga, Kathmandu, Nepal
Date: September 9, Thursday and September 10, Friday 2004

I. Plenary- Initiation and Honor Ceremony at Room 1-Darbar Hall

September 9		
Time	**Activity and Person/s**	
8.30-9.00 am	Participants' Registration	Mr. Ganesh Khaniya, Mr. Samundra Sigdel, Mr. Hari Upreti, FMIS Promotion Trust
	Chair Report Conduction of Ceremony	Dr. Harka Gurung, Senior Geographer and Former Vice-chairman of National Planning Commission Mr. Mahendra Bahadur Gurung, Ministry of Water Resources Mr. Ajoy Karki, GTZ
9.00	Introduction of the Chair Welcome the Chair by offering the bouquet Welcome Speech	Mr. Ajoy Karki Dr. Prachanda Pradhan, Chairman, FMIS Promotion Trust Mr. Rajan Subedi, Member-Secretary, FMIS Promotion Trust
9.10	Introduction of the Seminar Theme	Dr. Prachanda Pradhan, Chairman, FMIS Promotion Trust
9.20	FMIS Promotion Trust in 2002-2004 Offering bouquet to Er. Lava Raj Bhattarai in appreciation of his contribution Announcement of FMIS Promotion Trust's Icons of Honor : Dr. E. Walter Coward, Jr. Mr. Charles Lindsay Abernethy Prof. Nyoman Sutawan Dr. Emmanuel Reynard Introduction of Icons of Honor	Dr. Upendra Gautam, Vice-Chairman, FMIS Promotion Trust Dr. Harka Gurung Mr. Ajoy Karki Dr. Vijaya Shrestha, Executive Member, FMIS Promotion Trust

9.30	Presentation of Honor: Dosallah Odhaer (presenting shawl) Presenting plaque Presenting bouquet To: Dr. E. Walter Coward, Jr. Mr. Charles Lindsay Abernethy Prof. Nyoman Sutawan Dr. Emmanuel Reynard Reading out the commendation plaques	 Dr. Prachanda Pradhan Dr. Upendra Gautam Mr. Rajan Subedi Mr. Govinda Das Shrestha, Executive Member, FMIS Promotion Trust
9.45	Keynote Speech : "Property and FMIS Governance: Two Books that may be Unfamiliar but that Inform the Discussion"	Dr. E. Walter Coward, Jr.
10.05	Keynote Speech: "Can Programmes of Irrigation Management Transfer be Completed Successfully?"	Mr. Charles Lindsay Abernethy
10.25	Keynote Speech : "The Need for Sustaining Farmer Managed Irrigation Systems"	Prof. Nyoman Sutawan
10.45	Keynote Speech : "Governance of Farmer Managed Irrigation Corporations in the Swiss and Italian Alps: Issues and Perspectives"	Dr. Emmanuel Reynard
11.05	Remark from the Chair	Dr. Harka Gurung
11.20	Vote of Thanks	Mr. Lava Raj Bhattarai, Member, FMIS Promotion Trust
11.25-11.45	**Refreshment at Darbar Hall Lobby**	

II. Parallel Seminar Sessions

Room 1-Darbar Hall	Room 2-Naach Ghar Hall
Session on Reform Dimension	
Session Coordinator: Mr. Ajaya Lall Shrestha, FMIS Promotion Trust	Session Coordinator: Mr. Binaya Shah, Integrated Consultant Nepal (P) Ltd (ICON)
Chairman: Mr. Sheetal Babu Regmi, Department of Water-induced Disasters Prevention, Ministry of Water Resources	Chairman: Dr. Binayak Bhadra, FMIS Promotion Trust
Reporter: Mr. Shiva Kumar Sharma, Department of Water Induced Disasters Prevention , Ministry of Water Resources	Reporter: Mr. Basistha Raj Adhikari ,Department of Irrigation.

<table>
<tr><th>Time</th><th colspan="2">Activity and Person/s</th></tr>
<tr><td>11.45-12.15</td><td>"Lessons of Farmer Managed Irrigation Systems Projects in Nepal: Towards Improved Governance"

Paper presentation by Mr. Kenichi Yokoyama and Ms. Ava Shrestha

Floor Discussion</td><td>"Responding to the Challenges of Asian Irrigation in Transition"

Paper presentation by Dr. Ganesh P. Shivakoti

Floor Discussion</td></tr>
<tr><td>12.15-12.45</td><td>"Lao Irrigation Systems: Governance Mode"

Paper presentation by Mr. Phalasack Pheddara

Floor Discussion</td><td>"Promoting Good Governance of Water Users' Associations in Nepal"

Paper presentation by Mr. Simon E. Howarth, Mr. Umesh Nath Parajuli, Mr. J.R. Baral, Mr. G.A. Nott, Mr. Basistha Raj Adhikari, Mr. D.R. Gautam and Ms. Menuka K.C.

Floor Discussion</td></tr>
<tr><td>12.45-12.55</td><td colspan="2">Group Photo at the Stair-case of Darbar Hall</td></tr>
<tr><td>12.55-1.55</td><td colspan="2">Lunch at Darbar Hall Lobby</td></tr>
<tr><td colspan="3">Session on Reform Dimension (Continued)</td></tr>
<tr><td colspan="2">Session Coordinator: Mr. Suman Sijapati, Department of Irrigation</td><td>Session Coordinator: Dr. Vijaya Shrestha</td></tr>
<tr><td colspan="2">Chairman: Dr. Shri Krishna Shrestha, Pro Public</td><td>Chairman: Mr. Arun Kumar Shrivastav, DOI</td></tr>
<tr><td colspan="2">Reporter: Mr. Ajay Chandra Lal, Institute of Engineering</td><td>Reporter: Mr. Ram Prasad Khanal, Mountain Resources Management Group</td></tr>
<tr><td>Time</td><td colspan="2">Activity and Person/s</td></tr>
<tr><td>2.00-2.30</td><td>" Participatory Irrigation Management in Vietnam"

Paper presentation by Mr. Nguyen Hong Khanh

Floor Discussion</td><td>"Surface Water Management and Poverty Alleviation in the Indian Sub-continent"

Paper presentation by Mr. Dirk R. Frans

Floor Discussion</td></tr>
<tr><td>2.30-3.00</td><td>“Participatory Water Management and Governance"

Paper presentation by Dr. Mohammed Abdul Ghani

Floor Discussion</td><td>" FMIS and Governance, Challenges and Opportunities: Evidences from India and Nepal"

Paper presentation by Mr. Balaraju Nikku and Ms. Pranita Bhushan Udas

Floor Discussion</td></tr>
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<tr><td colspan="3">Session on Socio-economic Dimension</td></tr>
<tr><td colspan="2">Session Coordinator: Mr. Abinash Pant, FMIS Promotion Trust</td><td>Session Coordinator: Mr. Rajan Subedi, FMIS Promotion Trust</td></tr>
<tr><td colspan="2">Chairman: Mr. Som Nath Poudel, Jalsrot Vikas Sanstha (JVS)</td><td>Chairman: Dr. M.A. Quassem, WARPO, Bangladesh.</td></tr>
<tr><td colspan="2">Reporter: Mr. Pradeep Mathema, JVS</td><td>Reporter: Mr. Amod Thapa, TECDA</td></tr>
<tr><td>Time</td><td colspan="2">Activity and Person/s</td></tr>
<tr><td>3.00 -3.30</td><td>"Performance of Irrigation Systems Managed by Indigenous and Migrant Communities in the East Rapti River Basin of Nepal"

Paper presentation by Mr. Devi Prasad Ghimire

Floor discussion</td><td>" Social Capital and its Role in the Sustainability of Irrigation Management: A Case Study of Sora- Chhattis Mauja Farmer Managed Irrigation Systems from Western Terai, Nepal"

Paper Presentation By Mr. Laya Prasad Uprety

Floor Discussion</td></tr>
<tr><td>3.30-4.00</td><td colspan="2">Tea Break at Darbar Hall Lobby</td></tr>
<tr><td>4.00 -4.30</td><td>"Evolving Irrigation Management Institutions in Sardar Sarovar Project, India"

Paper presentation by Mr. Jayesh Talati and Janwillem Liebrand

Floor Discussion</td><td>"A Decade Later: Continuity and Change in ILO- assisted Irrigation Systems: Possible Implications for Policy and Governance."

Paper presentation by Mr. Torsten Rødel Berg

Floor Discussion</td></tr>
<tr><td>4.30-5.00</td><td>"A Comparative Study of Multi-purpose and Single-purpose Water Users' Groups in Chitwan District of Nepal"

Paper presentation by Ms. Komal Kumari Magarati

Floor Discussion</td><td>"Governance Perspectives on Water Management Practices: A Case Study of Bhaktapur City, Nepal"

Paper Presentation by Mr. Ganesh Khaniya

Floor discussion</td></tr>
<tr><td colspan="3">September 10</td></tr>
<tr><td colspan="2">Room 1-Darbar Hall</td><td>Room 2-Naach Ghar Hall</td></tr>
<tr><td colspan="3">Session on Equity Dimension</td></tr>
<tr><td colspan="2">Session Coordinator: Dr. Divas Basnyat, Institute of Engineering (IOE)</td><td>Session Coordinator: Mr. Sushil Subedee, Researcher</td></tr>
<tr><td colspan="2">Chairman: Mr Iswer Raj Onta, Jalsrot Vikas Sanstha (JVS)</td><td>Chairman: Mr. Ratneshwor Lal Kayastha, Former Agriculture secretary</td></tr>
<tr><td colspan="2">Reporter: Mr. Ganesh Khaniya, FMIS Promotion Trust.</td><td>Reporter: Mr. Tula Narayan Shah, Researcher / Engineer, Institution for Integrated Development Study (IIDS)</td></tr>
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9.00-9.30	"A Study, under GAP-MOM Project, on Scheduling Water Delivery among the Farmers in a Tertiary Canalette System Operating by a Water Users' Association in Harran Plain, Turkey" Paper presentation by Dr. Huseyin Gundogdu, Mr. Rupert W. Ellis, and Mr. Fikret Eyupoglu Floor Discussion	" Farmer's Incentives to Participate in Irrigation Activities : Findings of Case Studies in Kathmandu Valley" Paper presentation by Mr. Fumio Osanami and Mr. Narayan R. Joshi Floor Discussion
9.30-10.00	"Water Sharing between the Jhankre Mini- hydropower Plant and Irrigation" Paper Presentation by Mr. Ajoy Karki Floor Discussion	"Irrigation Management Transfer and Water Users' Community in Cambodia." Paper Presentation by Mr. Kim Sreang Bouy Floor Discussion
Session on Eco-technology Dimension		
Session Coordinator: Mr. Naveen Mangal Joshi, Nepal Water Plan Preparation Project		Session Coordinator: Dr. Dhurba Pant, IWMI
Chairman: Dr. Emmanuel Reynard		Chairman: Mr. Charles Lindsay Abernethy
Reporter: Mr. Shushanta Adhikari, Small Hydro Power Promotion Project, GTZ		Reporter: Mr. Pravin Ghimire, CMS
Time	**Activity and Person/s**	
10.00-10..30	"Kuhl Irrigation: A Community Management System in Cold Desert of the Lahaul Valley, North Western Himalaya, India" Paper presentation by Mr. Subhash C.R. Vishvakarma, Mr. Yashwant S. Rawat, Mr. Santaram. S. Oinam and Mr. Jagdish C. Kuniyal Floor Discussion	"FMIS Governance: Assessment of Key-Effects in Dhaulagiri, Western Nepal" Paper Presentation by Dr. Khem Raj Sharma Floor Discussion
10.30-11.00	**Tea Break**	
11.100-11.30	"Experiences of Water Harvesting Systems and Pattern of Governance in the Trans-Himalayan Region of Nepal" Paper presentation by Dr. Umesh Nath Parajuli Floor Discussion	"Suitable Intake Structure in Small Scale Mountainous Rivers/Streams and Water Governance (Focusing on Farmers Managed Hill Irrigation Systems)" Paper Presentation by Mr. Bhola Chhatkuli Floor Discussion

<table>
<tr><td colspan="3">Session on Education and Information Dimension</td></tr>
<tr><td colspan="2">Session Coordinator: Dr. Rajendra Adhikari, Nepal Collage of Information Technology</td><td>Session Coordinator: Dr. Narendra Man Shakya, Institute of Engineering</td></tr>
<tr><td colspan="2">Chairman: Prof. Deepak Bhattarai, Nepal Engineering Collage</td><td>Chairman: Prof. Nyoman Sutawan</td></tr>
<tr><td colspan="2">Reporter: Mr. Upendra Gupta, CMS</td><td>Reporter: Mr. Rukmanath Paudel, Nepal Engineering College</td></tr>
<tr><td>Time</td><td colspan="2">Activity and Person/s</td></tr>
<tr><td>11.30-12.00</td><td>"Development and Introduction of FMIS Curriculum"

Paper Presentation by Mr. Lakshmi Narayan Choudhary

Floor Discussion</td><td>"District Irrigation Inventory Preparation: A Means to Strengthen District Units of National Federation of Irrigation Water Usears' Associations, Nepal (NFIWUAN)"

Paper Presentation by Dr. Prachanda Pradhan

Floor Discussion</td></tr>
<tr><td>12.00 – 1.00</td><td colspan="2">Lunch at Darbar Hall Lobby</td></tr>
<tr><td>1.00-1.30</td><td>"Innovative Mechanism for Effective FMIS Communication "

Paper presentation by Mr. Rajan Subedi and Dr. Upendra Gautam

Floor Discussion</td><td>"Towards Good Governance: Water Users' Schools in Kamala Paini"

Paper Presentation by Mr. Basistha Raj Adhikari and Mr. Simon E. Howarth

Floor Discussion</td></tr>
<tr><td colspan="3">Session on Farmers' Panel on FMIS Governance</td></tr>
<tr><td colspan="3">Session Coordinator: Dr. Upendra Gautam</td></tr>
<tr><td colspan="3">Chairman: Mr. Bishnu Hari Devkorta, Panchakanya Irrigation System, Chitawan</td></tr>
<tr><td colspan="3">Reporter: Mr. Deepak Pandey, CMS</td></tr>
<tr><td>1.30-2.30</td><td colspan="2"><u>Presentation on</u>[1]
"Perspective of National Federation of Irrigation Water Users' Associations, Nepal (NFIWUAN)"
Mr. Keshab Neupane

"Role of Kathmandu District Unit in Translating the Objectives of National Federation of Irrigation Water Users' Associations, Nepal into Practice"
Mr. Shree Ram Acharya

"General Introduction of Chhattis Mauja Irrigation System"
Mr. Rukmagat Pandey

40 minutes Presentation and 20 minutes Discussion</td></tr>
</table>

[1] Mr. Laya P. Upreti, Mr. Ajoy Karki and Dr. Prachanda Pradhan may act as interpreters.

2.30-3.00	**Tea Break**
Session on Experts' Panel on FMIS Governance	
Session Coordinator: Mr. Surya Nath Upadhyay, Honorary Member, FMIS Promotion Trust	
Chairman: Dr. Prachanda Pradhan	
Reporter: Mr. Laya Uprety, Tribhuvan University	
3.00-4.00	Dr. Robert Yoder Dr. E. Walter Coward, Jr. Mr. Charles Lindsay Abernethy Dr. M.A. Quassem Dr. Ganesh P. Shivakoti

Annex-2: List of Participants

List of Participants

A. Special Invitees at Initiation and Honor Ceremony

SN	Name	E-mail	Institution Involved
1.	Arun Kumar Srivastav	irrigation@wlink.com.np	Department of Irrigation (DOI), Nepal
2.	Bindeshwor Prasad Sinha		Ministry of Agriculture, Nepal
3.	Babu Ram Adhikari	irrigation@wlink.com.np	DOI, Nepal
4.	Charles Pradhan	charles@cco.org.np	Canadian Coopreation Office, Nepal
5.	Chhabi Lal Poudel		SSMP
6.	Georg Weber	georg.weber@helvetasnepal.org.np	Helvetas, Nepal
7.	Govinda Gewali	adbnrm@adb.org	Asian Development Bank (ADB), Nepal
8.	Luke Colavito	simi@wlink.com.np	Nepal Smallholder Irrigation Market Iniatiative (SIMI)
9.	Madan Regmi	chinasc@mail.com.np	China Study Center, Nepal
10.	Madhu Sudan Poudel	irrigation@wlink.com.np	DOI, Nepal
11.	Phil Salt	pesalt@attglobal.net	Sub-regional Transport Facilitation Project, Nepal
12.	Rajan Man Shrestha		
13.	Santam Singh Khadka	registry.np@undp.org	UNDP, Nepal
14.	Shiva Sunder Shrestha	shivasundar@hotmail.com	Agricultural Development Bank, Nepal
15.	Shyam Sundar Ranjitkar	sranjitkar@worldbank.org	World Bank, Nepal
16.	Umesh Lama	umn@umn.org.np	United Mission to Nepal, Nepal
17.	Lakshman Kumar Gautam	lakshman.gautam@fao.org	Food and Agriculture Organization of the United Nation, Nepal

B. Foreign Participants

S.N	Name	E-mail Address	Country/Institution Involved
1.	Akhtarun Nessa	quassem@gononet.com	Bangladesh
2.	Andreas Schmitt	andreaskschmitt@yahoo.com andreaschmitt@genion.de	University of Applied Sciences, Germany
3.	Arend van Riessen	asvanriessen@batman.wlink.com.np	Freelance Consultant, Nepal
4.	Balaraju Nikku	nikku21@yahoo.com	Wageningen University

S.N	Name	E-mail Address	Country/Institution Involved
5.	Bouy Kim Sreang	rwssdp@online.com.kh	Cambodia
6.	Charles Lindsay Abernethy	abernethy@itmin.com	United Kingdom
7.	Dirk R. Frans	dirk.r.frans@xs4all.nl	The Netherlands
8.	E. Walter Coward, Jr.	ewcoward@aol.com	United States of America
9.	Emmanuel Reynard	emmanuel.reynard@igul.unil.ch	Switzerland
10.	Fikret Eyupoglu	feyupoglu@yahoo.com	Turkey
11.	Fumio Osanami	osanami@agecon.agr.hokudai.ac.jp	Japan
12.	Hatice Eyupoglu	feyupoglu@yahoo.com	Turkey
13.	Hoang Ngoc Cach		Vietnam
14.	Huseyin Gundogdu	gundogduh@superonline.com	Turkey
15.	Jayesh Talati	j.talati@cgiar.org	IWMI/India
16.	Kenichi Yokohoma	kyokoyama@adb.org	Japan
17.	Leokham		Lao PDR
18.	M. A. Quassem	quassem@gononet.com	Bangladesh
19.	Mohammed Abdul Ghani	maghani@bdonline.com	Bangladesh
20.	Muge Gundogdu	gundogduh@superonline.com	Turkey
21.	Nguyen Hong Khanh	khanh508@yahoo.com	Vietnam
22.	Nyoman Sutawan	stw_trisula@yahoo.com	Indonesia
23.	Phalasack Pheddara	phalasack@hotmail.com	Lao PDR
24.	Phetsamone Seng Meuang		Lao PDR
25.	Pranita Bhushan Udas	bhushan@info.com.np	India
26.	Robert Yoder	ryoder@ideorg.org	Unied States of America
27.	Saravanan Subramaniam	s4021194@student.uq.edu.au	India
28.	Simon E. Howarth	simon.howarth@mottmac.com	United Kingdom
29.	Subhash Vishvakarma	ihedhima@yahoo.co.in scrvishvakarma@hotmail.com	India
30.	Sudarshan Suryavanshi		India
31.	Torsten Rødel Berg	trberg@humsamf.auc.dk	Denmark
32.	Zakir Kibria	banglapraxis@yahoo.com	BanglaPraxis, Bangladesh

C. National Participants

S.N	Name	E-mail Address	Country/Institution Involved
1.	Ajay Chandra Lal	ajay_ioe@hotmail.com	Institute of ingineering (IOE), Nepal
2.	Ajoy Karki	akarki@mail.com.np	GTZ, Nepal
3.	Amod Thapa	akthapa@wlink.com.np	TECDA
4.	Ava Shrestha	ashrestha@adb.org	ADB, Nepal
5.	Basistha Raj Adhikari	basistha@wlink.com.np	DOI, Nepal

S.N	Name	E-mail Address	Country/Institution Involved
6.	Basudev Prasad Banskota	mdmsktm@wlink.com.np	Department of Local Infrastructure and Agriculture Road (DOLIDAR), Lalitpur
7.	Bhola Chhatkuli	chhatkuli@ntc.net.np	DOI, Nepal
8.	Bhola Pokharel		Central Department of Economics, Tribhuvan University (TU)
9.	Vijaya Raj Updhayay	vijayshamila20043@yahoo.com	DOI, Nepal
10.	Binay Shah	bshah@ccsl.com.np	Integrated Consultant Nepal (ICON)
11.	Bishnu Hari Devkota		Panchakanya Irrigation System, Chitawan, Nepal
12.	Buddhi Kunwar	annapost@mos.com.np	Annapurna Post daily
13.	Dambar Dangi	gopa@mos.com.np	Gorkhapatra daily
14.	Deepak Bhattarai	nec@healthnet.org.np	Nepal Engineering College (nec)
15.	Deepak Lochan Adhikari	deepaklochan@yahoo.com	IDE, Nepal
16.	Devi Dutta Devkota	ndevkota@power.com.np	FMIS Researcher, Jumla, Nepal
17.	Devi Prasad Ghimire	ghimiredevi@yahoo.com	Institute of Agriculture and Animal Society (IAAS), Rampur, Chitawan, Nepal
18.	Dhurba Pant	d.pant@cgiar.org	IWMI, Nepal
19.	Divash Basnyat	divasb@hotmail.com	IOE, Nepal
20.	Ganesh P. Shivakoti	ganesh@ait.ac.th	AIT, Thailand
21.	Giridhari Shah		Freelance Consultant
22.	Gopal Shiwakoti 'Chintan'	wafed@ntc.net.np	Water and Energy Users' Federation (WAFED), Nepal
23.	Gopi Krishna Lamichhane	nfiwuan@wlink.com.np	Bhaktapur District Unit, NFIWUAN
24.	Gopi Krishna Sedain	propublic@wlink.com.np	Pro public, Nepal
25.	Govinda Basnet	govinda@uga.edu	Ph.D. Fellow
26.	Harka Gurung	newera@wlink.com.np	New Era, Nepal
27.	Iswer Raj Onta	onta@mos.com.np	East Consult, Nepal
28.	Jayaram Subedi	kamana@wlink.com.np news@newsofnepal.com	Nepal Samacharpatra Daily
29.	Keshab Neupane	nfiwuan@wlink.com.np	NFIWUAN
30.	Khem Raj Sharma	ofwm@wlink.com.np	DOI, Nepal
31.	Kiran Prakash Hada	kphada@wlink.com.np	Integrated Development and Management Center
32.	Komal Kumari Magarati	Komalmagarati@hotmail.com	FMIS Researcher
33.	Lakshmi Narayan Choudhari	lnchoudhari_4@hotmail.com	nec , Nepal
34.	Laya Prasad Uprety	layau@actionaidnepal.org	TU, Nepal
35.	Lok Prasad Bhattarai	lbhattarai@enet.com.np	DOI, Nepal
36.	Mahendra Bahadur Gurung		Ministry of Water Resources (MOWR), HMG, Nepal

S.N	Name	E-mail Address	Country/Institution Involved
37.	Narendra Man Shakya	nms@ioe.edu.np nmsioe@yahoo.com	IOE, Nepal
38.	Narayan Prasad Simkhada	nfiwuan@wlink.com.np	Kathmandu District Unit, NFIWUAN
39.	Naveen Mangal Joshi	namanjos@hotmail.com	Water and Energy Commission Secretariat (WECS), Nepal
40.	Neeraj N. Joshi	neerajnjoshi@hotmail.com nepal@ifri.wlink.com.np	IAAS, Rampur, Chitawan, Nepal
41.	Padam Aryal	nfiwuan@wlink.com.np	NFIWUAN
42.	Prabin Man Singh	wafed@ntc.net.np	WAFED, Nepal
43.	Pradeep Mathema	jvs@wlink.com.np	Jalsrot Vikash Sanstha (JVS)/Nepal Water Partnership
44.	Prem Sharan Shah	info@ncit.net.np	Nepal College of Information Technology (NCIT)
45.	Puja Neupane	nec@healthnet.org.np	nec, Nepal
46.	Rajendra Adhikari	adhikari_rajendra@hotmail.com info@ncit.net.np	NCIT
47.	Rajesh Kumar Dev	nec@healthnet.org.np	nec, Nepal
48.	Ram Prakash Yadav	yadavrp@prakash.wlink.com.np	Freelancer
49.	Ram Prasad Khanal	mrmg@wlink.com.np	Mountain Resources Management Group (MRMG), Nepal
50.	Rashmi Ghimire	rash_ghimire@hotmail,com	TU, Nepal
51.	Ratneshwor Lal Kayastha	rlkayastha@wlink.com.np	Former Secretary, Ministry of Agriculture, Nepal
52.	Rukmagat Pandey		Chhattis Mauja Irrigation System, Rupandehi, Nepal
53.	Rukmanath Poudel	info@nec.edu.np	nec, Nepal
54.	Sajol Bhattarai	sajal@ntc.net.np	TU, Nepal
55.	Santosh Nepal	santosh3nepal@yahoo.com	School of Environmental Management and Sustainable Development (SchEMS), Nepal
56.	Saroj Shakya	info@ncit.net.np	NCIT
57.	Shambhu Prasad Dulal	nfiwuan@wlink.com.np	Kathmandu District Unit, NFIWUAN
58.	Sheetal Babu Regmi	dept@ntc.net.np	MOWR, HMG, Nepal
59.	Shiv Kumar Sharma	shiv@info.com.np shiv130@hotmail.com	MOWR, HMG, Nepal
60.	Shree Ram Acharya	nfiwuan@wlink.com.np	Kathmandu District Unit, NFIWUAN
61.	Shri Krishna Shrestha	propublic@wlink.com.np	Pro Public, Nepal
62.	Shuku Pun	shuku_pun@hotmail.com	UNDP, Nepal

S.N	Name	E-mail Address	Country/Institution Involved
63.	Shushil Subedee	sushilsubedee@info.com	Freelancer
64.	Shwayam Bandhu Karki		Chhattis Mauja Irrigation System, Rupandehi, Nepal
65.	Shyam Prasad Rajbhandari	irrigation@wlink.com.np	DOI, Nepal
66.	Som Nath Poudel	alek@wlink.com.np	JVS, Nepal
67.	Suman Sijapati	suman@sijapati.wlink.com.np	DOI, Nepal
68.	Sushant Adhikari	sushant.adhikari@entecenergy.com	GTZ, Nepal
69.	Tika Bhattarai	sajal@ntc.net.np	Department of Sociology/Anthropology, Patan Multiple Campus, TU
70.	Tula Narayan Shah		Institute for Integrated Development Study (IIDS), Nepal
71.	Tunga Rai	tungarai@hotmail.com	Tribhuvan University
72.	Umesh Nath Parajuli	uparajuli@doi.wlink.com.np	DOI, Nepal

D. FMIS Promotion Trust Members

S.N.	Name	E-mail Address
1.	Abinash Pant	abinashpant@hotmail.com
2.	Ajaya Lall Shrestha	cmsnepal@cms.wlink.com.np
3.	Binayak Bhadra	binayak@icimod.org.np
4.	Deepak Pandey	dpandey@wlink.com.np
5.	Ganesh Khaniya	fmist@wlink.com.np
6.	Govinda Das Shrestha	bimala@mos.com.np
7.	Hari Upreti	fmist@wlink.com.np
8.	Lava Raj Bhattarai	lava@ccsi.com.np
9.	Prachanda Pradhan	pradhanp@mos.com.np
10.	Pravin Ghimire	cmsnepal@cms.wlink.com.np
11.	Rajan Subedi	fmist@wlink.com.np
12.	Samundra Sigdel	fmist@wlink.com.np
13.	Surya Nath Upadhyay	surya@upd.wlink.com.np
14.	Tirtha Maharajan	cmsnepal@cms.wlink.com.np
15.	Upendra Gautam	cmsug@cms.wlink.com.np
16.	Upendra Gupta	cmsnepal@cms.wlink.com.np
17.	Vijaya Shrestha	viysh@wlink.com.np

Annex-3: Photographs