PART III: TRUST SUPPORTED ACTIVITIES

FORMATION OF NEW FARMER MANAGED IRRIGATION SYSTEMS AND THEIR DYNAMISM[1]

MIN BIKRAM MALLA THAKURI, TEJ PRASAD SUBEDI,
AJAY CHANDRA LAL AND RUPA LAMICHHANE[2]

GENERAL BACKGROUND

Agriculture is one of the primary sectors in Nepalese economy. It contributes about 40 percent of the Gross Domestic Product and provides employment to more than 80 percent of work force. The irrigation has been identified as one of the main inputs, which can accelerate, intensify and sustain the agricultural growth. Inadequate provision of irrigation facility has been identified as the key reason of poor performance of the agriculture sector in Nepal.

The farmers of Nepal have been developing and managing the irrigation systems since the time immemorial. These indigenous systems have been built with little or no support from state or other agencies all over the country and they are popularly called Farmers Managed Irrigation Systems (FMIS). Some of them have abandoned due to one reason or other in the course of time but most of them have sustained themselves over the decades.

With the increase of population and intensification of human activities in land resources, the demand for irrigation water has also increased very rapidly. Indigenous irrigation systems coped fairly well in the past, nowadays they are becoming more and more inadequate to meet the ever-increasing demand of the user farmers. Moreover, the necessary supports for Operation and Maintenance (O&M) for FMIS at the present degraded environmental condition is beyond the capacity of the user farmers. Similarly, there exists a vicious circle of *low income- low saving- low investment- low production* and again back to low income in our rural society. Considering the importance of irrigation facilities, large numbers of irrigation systems have been intervened either by constructing new or rehabilitation of existing indigenous systems after 1980s

1 Study conducted under the Research Grant of FMIS Promotion Trust.
2 Members, Young Interdisciplinary Team of Researchers.

The past studies suggest that about 69 percent of the country's total irrigated areas are covered by the FMIS (Parajuli, 1999). These systems vary in size from less than a hectare to larger than 15,000 hectares. The total number of FMIS in Nepal has been estimated to be about 17,700 in numbers (Pradhan, 1989). Of which 15,000 are located in hill and mountain ecological regions covering about 322,000 hectares and remaining 1,700 are located in Terai ecological region covering about 520,000 hectares (Poudel, 1992). These FMIS are contributing considerably in the national economy and that has become the main livelihood for the farmers in Nepal. The practice of self-governing systems and strong community participation are important and common features throughout the management of these systems. Local innovativeness and skills have been applied over the ages to develop and manage these systems. FMIS have been changing according to the situation and have sustained themselves over the decades. Dynamism is the heart of FMIS.

Process of FMIS formation is changing as compared to past. The farmers' access to resources has been increasing and farmers now have better knowledge on irrigation technology at larger scale. It is the need to study dynamism behind the formation of the new FMIS in the context of (i) wider access to outside resources; (ii) more knowledge to farmers about irrigation technology; (iii) changing biophysical environment; (iv) new political scenario in the country; and (iv) Government policy for FMIS development and management.

In this background, it is pertinent to identify enabling factors for the formation of New FMIS and track the changes in it to identify necessary measures for the sustainability of irrigation systems.

OBJECTIVE OF STUDY

The overall objective of the study is to identify the enabling factors behind the formation of New FMIS and the process of resource allocation and mobilization in the changing socio-economic and political contest.

Specific objectives of the research include:

- To study the enabling factors behind the formation of new FMIS;
- To study the pattern of resource generation and mobilization for the creation of new FMIS;

- To study local level institutions and its impact on creation of new FMIS;
- To study the technology choice in system development and influencing factors; and
- To analyze the dynamism in the new FMIS.

STUDY METHODOLOGY

The study was carried out in two phases as described below:

Inception/Desk Study Stage

During this phase of the study, secondary data related to FMIS and agency support programs were collected. Based on review of literatures and data, the following activities have been completed during this phase of the study:

- Development of field instruments; and
- Development of indicators.

Field Investigation Stage

The main objective of the field study was to verify the data collected during the desk study stage, seek additional data, and also collect on-the-spot data and information. To collect relevant data in the field, various tools were applied, which include (i) data collection from local offices of study area; (ii) system walkthrough; (iii) interviews with key informants; (iv) PRA; (v) observation and field measurements; and (vi) household survey.

The information and data collected were analyzed and synthesized to understand the dynamism of the New FMIS. The inferences were drawn from the analysis and synthesis of information and data collected during field investigation using different tools and techniques.

LIMITATION OF STUDY

This study is primarily based on detailed field investigation made on selected three newly formed FMIS (*Gadkhar* – Nuwakot, *Bhutlung*-Jhapa and *Laugain*-Kapilbastu). Although, sampling has been made in such a

way that they represent the entire newly emerging FMIS, the result based on three systems may not represent the entire systems.

SYSTEM INFORMATION

Gadkhar Irrigation System

The *Gadkhar* Irrigation System (GIS) is located in the Chaughada Village Development Committee of Nuwakot District of the Central Development Region of Nepal. It is linked with 12-km long fair weather road to Gangate/Battar, a point on the Kathmandu – Trisuli highway.

Gadkhar FMIS Command Area

The system named after the *Gadkhar* Village constructed during implementation of Rasuwa-Nuwakot Integrated Rural Development Program (RNIRDP) (1976-1982), financed by International Development Agency (IDA)/World Bank. For GIS, IDA/World Bank provided 67 percent of the construction costs and remaining cost was borne by His Majesty's Government. The system was rehabilitated three times (1994, 1998, 2001). Major rehabilitation and extension of command area was done in 1994 with the financial and technical assistance of Department of Irrigation.

Paddy Field in Gadkhar FMIS

Bhutlung FMIS

The *Bhutlung* FMIS is located in Topgachhi Village Development Committee (VDC) of Jhapa district in the Eastern Development Region of Nepal. The irrigation command area is located around 9 km east–south of Damak Municipality. The system is accessible through 4 km-gravel road from the Mahendra Highway (*Rajmarg*). The command area of *Bhutlung* FMIS is about 182 hectares. The irrigation system was initiated in 1956 by a landlord Narendra Bdr. Basnet. In the beginning, it was like a personal property. In 1961 other farmers from ward number 3 of Topgachi VDC also participated in the irrigation system.

At the initial stage, the headwork was temporary in nature and used to be damaged time to time due to flood during rainy seasons. Ultimately, in 1995 the farmers constructed a concrete diversion structure (dam) with the loan and grant of ADB/N. The total construction cost of the system was NRs.1,443,642.20 (60% grant, 10% labor contribution and 30% loan from ADB/N).

The canal (P*aini)* was rehabilitated by the farmers for the first time in 1963. After that, the canal has been rehabilitated five times. The system has been receiving external assistance mainly from ADB/N since 1995 only. Before that period, the farmers used to rehabilitate the irrigation systems out of their own resources.

Brahman, Chhetri, Rai, and Newar are the main settlers/users of this system. The command area covers two villages (*Bhutlung* and *Samayagad*).

Laugain FMIS - Command Area

Laugain FMIS

The *Laugain* Irrigation system is located in Motipur Village Development Committee in Kapilvastu district in Terai of the Western Development Region. It is at a distance of 35 km west from Butwal. Most of the settlers

of this community are migrants from Gulmi, Arghakhanchi and Pyuthan districts. Whereas most of the original settlers (the Tharu) have migrated to the Southern part of the district. At present there are only four landless Tharu households in this area.

The water to the *Mauja* (command area) is supplemented through *Tin Gaun Kulo* System off-taking from the *Banganga* River at *Singheghat.* Likewise, there are 2 Deep Tubewells (DTWs) to supply water to the area. The system was an offspring of Groundwater Irrigation Development Project, Butwal-1990. The Project provided 60 percent of the construction costs as grant and remaining cost was borne by the farmers themselves to install DTWs. The farmers took loan from ADB/N under Small Farmers Development Program (SFDP) to make their share in DTW installation. The *Laugain* Irrigation system was planned, designed and implemented with total construction cost of about NRs.0.8 million under the supervision of the project.

The *Laugain* irrigation system has been providing the supplementary irrigation to the *Laugain Mauja* for more than 50 years. The system was built at the initiation of local farmers to supplement water for paddy and winter crops mainly mustard and wheat. However, the farmers have started growing improved wheat crop in limited areas since last ten years. As the water in the source is inadequate for year round irrigation, farmers have explored ground water as alternative source of irrigation to irrigate dry season crop like maize and off-season vegetables. In addition, it provides irrigation facility to irrigate fruit farms like banana, mango etc. This is an excellent example of conjunctive use of groundwater and surface irrigation system managed by the farmers at local level.

The system information is enlisted in **Table 1**.

Table 1: System Information

Headings	Gadkhar FMIS	Bhutling FMIS	Laugain FMIS
District	Nuwakot	Jhapa	Kapilvastu
VDC	Chaughada	Topgachhi	Motipur
System Type	Surface	Surface	Surface & Ground
Water Source	Likhu Khola	Bhutlung Khola	Badganga river + DTWs
Command Area (ha.)	105	182	53
Households	121	159	325
First Intervention	1979	1995	1990
– Supporting Agency	DIHM under RNIRD Program	ADB/N	DoI, Groundwater project under ILC program
Major Maintenance Year	1994, 1998, 2001	1996, 1997	1998, 2000

ENABLING FACTORS BEHIND THE FORMATION OF NEW FMIS

In previous days, bunds across the water source (River) used to be constructed using forest products and soil, but due to increasing awareness for environment and labor shortage such activities became difficult. Similarly, due to population increase and hence the water demand enforces the farmers to reorient their irrigation system to meet their increased demand. These factors along with other institutional and government policies prompted for the formation of new FMIS. The enabling factors for formation of such FMIS are enlisted in **Table 2**.

Table 2: Enabling Factors for Formation of new FMIS

Enabling Factors	Gadkhar	Bhutlung	Laugain
Government Policy:			
Enactment of Water Resources Act -- 1992, and the Irrigation Policy – 1992 (revised in 1997): (Need for formation of WUA, need license to use water etc.)	√	√	√
Government huge investment of loan and grant funds after mid 1980s	√	√	√
Farmers access to power (Political decision makers)	√		√
Establishment of democracy (increased people's empowerment & participation)		√	√
Social: Social unity	√	√	√
Exposure, increased awareness,		√	√
Agriculture: Irrigation for dry season			√
Meet production demands and agricultural needs of farmers	√	√	√
Technical: Interest for permanent structure (to decrease the labor requirement for repair and maintenance)		√	√
To mitigate the effect natural disaster on irrigation system.		√	
Interest for increasing volume and reliability of water.		√	
Economic: Increased access to the market for inputs as well as for outputs		√	√
Dependency in agriculture for livelihoods.	√	√	√
Farmers increased access to financial resources (ADB loan etc., subsidy)	√	√	√
Institutional: Existence of institutions (informal WUA, farmers' group)		√	√

DYNAMISM IN NEW FMIS

The field investigation of the three selected FMIS revealed the fact that the intervention in these systems has brought change in different aspects of agriculture practices in which irrigation is one of the components. In the part days, these systems were developed and managed on *adhoc*

participatory basis while at present it is managed by the formal WUA. The dynamism in these systems was analyzed in different aspects like social, institutional, technical etc. The information gathered from the field were analyzed to understand the performance level of the systems in three different time period i.e.

- Situation before intervention;
- Situation during the intervention; and
- Situation after the intervention (at present).

The detail findings of the analysis for each aspect is presented below:

Institutional Aspect

Major dynamism in new FMIS was found in the institutional aspect as shown in **Table 3**. Significant changes were observed in the power, composition, legal status, activeness, etc. of Water Users Association (WUA).

Table 3: Dynamism in the Institutional Aspect

Subject	Before Intervention	During the Intervention	At Present
– Existence of WUA	Very active informal WUA in 2 schemes (Bhutlung and Laugain)	Active WUA	Active
– Legal status	Not registered in all systems	Registered	Re-registered in Gadkhar, Timely Renewal in Bhutlung
– Composition	Landlords/elites, higher caste and political leaders	Increased participation of all groups	Equal participation of all (caste, areas, income level)
– Structure	WUA	WUA, loan committee, construction com.	– WUA, branch-committees, subcommittees – Separate management com. of 2 DTWs at Laugain and branch com. at Bhutlung
– Power of WUA	Very powerful	Strong in Bhutlung and Laugain Weak in Gadkhar	Strong
– Relation of WUA and sub/branch committees	-	-	– Increased power and independency of sub/branch comm.
– Selection procedure of WUAMC	– High influence of political leaders and landlords – No regular selection	– High influence of political leaders and landlords	– Mass approval (High participation) – Reconstitution of committee in one year in Laugain and 2 years in Bhugtlung and Gadkhar
– Meeting	Ad hoc basis	Regular	Ad hoc

– Record Keeping	No	Yes	Yes (not satisfactory)
– Account keeping	No	Good	Poor
Relation with GOs	Only relation with VDC level	Increased access to irrigation related organizations and banks	Increased relation with irrigation as well as other organizations
Gender participation in WUAMC	No provision of women participation	Not involved	Increased participation (Women: 3 in Gadkhar, 1 in Bhutlung)
Conflict resolution by WUAMC	Able to solve all irrigation related problems	Dependent to others in Gadkhar Independently able in Bhutlung and Laugain	Independently able
– Responsibility	Solely responsible for overall activities of irrigation	Supported by loan com and construction committee	Assisted by branch and sub-committees
– Political intervention	High	High	Low

Resource Generation and Mobilization

Before the intervention, the irrigation technology was labor intensive, while after the intervention it has been changed to capital intensive. Due to the change the FMIS management has compelled to collect fund for O&M. According to the need, WUA has been collecting fund from the beneficiaries. Likewise, it has been approaching to the external agencies for the financial support for major maintenance works and new construction. Major features of the changes are shown in **Table 4**.

Table 4: Dynamism in Resource Generation and Mobilization

Subject	Before Intervention	During the Intervention	At Present
Access to external support	Little support from VDC and DDC in Bhutlung and Laugain	– Major rehabilitation & construction from external support (mainly under DoI and ADB/N)	Maintenance of systems from the external support (mainly under DoI and ADB/N)
External support			
• Gadkhar	-	DIHM under RNIRDP Rs.29,46,793/-	DoI support 4.8 million on 1995,1.5 million on 2001, and little support at required time for maintenance
• Bhutlung	– VDC, DDC 50000/- in different periods	ADB/N Support 60%	ADB/N support 60% of the total cost (twice) for maintenance
• Laugain	-	ILC support 75%; Rs.9,24,829/-	VDC and ADB/N support at required time
Internal Resource	– Ad hoc cash and kind collection from	– Labor and Cash Contribution from beneficiaries in the	– Creation of O&M fund – Regular collection of water

Generation	beneficiaries – High labor contribution – No regular water charge collection – Fine collection from defaulters	const./rehab cost – No O&M fund	charge – Fine collection from defaulters – Interest collection by mobilizing the collected fund – Able to generate fund for operation only – Not enough fund to maintain the system – New membership fee coll. in Bhutlung and water selling to Ghatta in Gadkhar

Social Aspect

Significant changes were observed in the migration, gender participation and availability of active labor force after the intervention as described in **Table 5**.

Table 5: Dynamism in the Social Aspect

Subject	Before Intervention	During the Intervention	At Present
Social unity & harmony	Good unity	Good unity	Good unity
Ethnic Composition	Around 95% Rais *in Gadkhar* Majority of Brahamin & Chhetris in *Buthlung* and Laugain	Increased population of Higher caste, decrease in pop. of Tharu and other deprived groups	Increased population of Higher caste
Migration	Low in-migration of higher caste and out migration of ethnic group	High in-migration of higher caste and out migration of ethnic group	High in-migration of higher caste and out migration of ethnic group
Land fragmentation	Low land fragmentation	High land fragmentation	Increase in land fragmentation
Gender Participation	No women participation in decision making and irrigation O&M activities	– No women participation in decision making	– Involvement of women in committee – Participate in distribution of water to the field.
Economically active population	Sufficiently Available	Started to migrate out of community in search of job	Increased the trend of out migration of this population.

Agricultural Aspect

Major changes were observed in the cropping intensity and cropping pattern after the intervention as shown in **Table 6**. The farmers are more interested toward high value crops after the availability of irrigation facility.

Table 6: Dynamism in the Agricultural Aspect

Subject	Before Intervention	During the Intervention	At Present
Crop coverage Area (% of total)	About 160% cropping intensity (CI)	About 230% CI	About 240% CI
Summer season	Millet (100%) in Gadkhar Paddy (100%) in others	Paddy (100%)	Paddy (100%)
Winter crop	Fallow- Gadkhar Wheat - 20% in others	Wheat 40%	Wheat 40%
Spring season	Maize (about 20%)	Maize (60%)	Maize (60%) Early paddy (6% in Gadkhar and Bhulung)
Main Cropping patterns	Paddy–Wheat–Fellow Paddy–Fellow–Fellow Paddy–Fellow–Maize	Paddy– wheat- maize Paddy-mustard-maize Paddy-wheat-E. paddy Paddy-Potato-maize Paddy-wheat-potato	Paddy– wheat- Maize Paddy-mustard-maize Paddy-wheat-E.paddy Paddy-Potato-maize Paddy-wheat-Veg/Po.
Agriculture Practice	Tradition technology, local materials and seed use	Introduction of improved farming techniques Use of improved seed, imbalanced use chemical fertilizer, imported tools	Increased use of improved seed, imported tools. Balanced use of chemical fertilizer
Availability of inputs	Use of local inputs	No timely availability	Easily accessible

Technical Aspect

The technical aspect deals with the methods of water extraction, conveyance and distribution. The structure constructed during the intervention for the purpose is functioning as per the need of the farmers and whether the farmers are capable for operating and maintaining these structures are some aspects that have been tried to analyze. The analysis focuses that the intervention has increased the water reliability, water adequacy and checked the environmental degradation to some extent. At the same time it has increased the dependency of the farmers on external agency for maintenance work. The details of dynamism in technical aspect is presented in **Table 7**.

Table 7: Dynamism in the Technical Aspect

Subject	Before Intervention	During the Intervention	At Present
Water Source	• No specified discharge in the canal • Frequent flooding in the low lying flood plain	• Discharge was calculated as per suggested cropping pattern. • The designed discharge was diverted to the canal system • Ground water is harnessed for winter crop in Laugain	• An approach channel construction in Gadkhar • A temporary bund of Gabions is constructed annually to divert water to the approach channel.
Intake	• Temporary side intake made up of boulders and forest products	• Side intake in Ghadkhar • Concrete weir across Bhutlung • Temporary bund across Banganga	• Side intake in Ghadkhar is in dilapidated condition
Type of canal	• Earthen	• Reshaped and lined where ever required in Gadkhar and Laugain	– In Bhutlung, canals are in dilapidated condition
Main and branch canal	• Main Canal • Preliminary branch canal	• Branch canals constructed	– Lined branch canal in Bhutlung – Pipe (HDPE) canal in Laugain for ground water
Command Area Development work	• No Command area development work in Gadkhar and Bhutlung	• Command area development work initiated	– Command area development work continued – Covered canal in settlement area in Laugain
Distribution System	• Politically active and upper caste people were getting more water	• Rationale distribution system in accordance with the command area was developed • Proportional distributors were constructed	– Rationale distribution system adopted strictly
Construction Quality/ Material	• Poor/earthen	• Lined canal, Concrete, brick work in Gadkhar and Bhutlung, HDPE in Laugain	– Improved skilled of local farmers, quality is maintained with limited resource
O&M Procedure	• O&M in ad hoc basis	• Defined regular and periodic maintenance practices	– Trained farmers – Better O&M practice
Water Adequacy and reliability	• Poor	• Satisfactory	– Satisfactory – Better in Laugain

Operation and Maintenance

As the technology has changed, the skill is required for efficient operation and management. The local farmer has to get proper training about operation schedule and techniques. There have been notable changes in contribution requirement, O&M practices, support staff etc. Before the

intervention, the farmers used to undertake the O&M activities on adhoc basis but after the intervention the farmers are trained to undertake O&M as per the annual calendar for O&M prepared by WUA. The detailed changes are enlisted in **Table 8**.

Table 8: Dynamism in the Operation and Maintenance Aspect

Subject	Before Intervention	During the Intervention	At Present
Cash and kind contribution	• High labor contribution	• Low cash and kind contribution	• Need of high cash and labor contribution
Affordability	• Beyond the farmers' capacity		• Beyond the farmers' capacity
O&M practice	• Frequent maintenance with the labor mobilization		• Depend on the external support for large maintenance • Canal cleaning and small maintenance carried out twice in a year
Support staff	• None in Bhutlung and Gadkhar • 1 Badghar and 1 Chaukidar in Laugain	• Two Dhalpales • One Chaukidar in Bhutlung • No change in Laugain	• Addition of support staff to manage distribution of water (Panipales, Dalpales)

Financial/Economic Status

In early days the system used to run on faith and trust on each other but after the intervention, capital instead of labor contribution increases and hence the need of transparent accounting system was felt. Therefore, in many systems bank account and water charge collection system have been adopted. Similarly the agriculture extension services and local market have been explored for marketing of agricultural products. The economic condition of the people in the command area has changed manifold. The shift in economic situation is outlined in the **Table 9**.

Table 9: Financial/Economic Status

Subject	Before Intervention	During the Intervention	At Present
Bank Account	– No	– Yes	– Yes
Balance	– No	– Satisfactory	– Nominal (not adequate)
Account keeping	– No	– Yes	– Satisfactory in Gadkhar and Laugain – Not satisfactory in Bhutlung
Regular collection	– No	– No	– Yes
Market for Agriculture prod.	– No	– Need to transport prod. to the market	– Dealers and brokers come to the village
Food	– Not sufficient	– Sufficient	– Sufficient

adequacy			
Impact of external shocks	– High	– Low	– Low
Income level	-	-	– Increased
Access to public facilities	– No bank, no telephone, no cooperative institution, no dairy	– Establishment of bank, better motor able roads,	– Facilities of bank, telephone, fear weather motorable road, school etc.

Environmental Aspect

Forest product and earth were used for construction of dam across the river for water diversion annually. As a result, the soil erosion and deforestation was severe in the area. The environment was degrading and the fertility of the soil was threatened. After the intervention in the form of permanent headwork has reduced the environmental degradation drastically. The environmental change in brief is presented in **Table 10**.

Table 10: Environmental Aspect

Subject	Before Intervention	During the Intervention	At Present
Deforestation	– High use of forest products to divert water	– Little during construction	– Comparatively low
Occurrence of natural disasters	– High flooding, landslides	– Decreased	– Low

Conflict/Conflict Resolution Mechanism

The conflict used to be minimum before the intervention as the functioning of the organization used to be very transparent and money involvement was also minimum. During the intervention and after the intervention, conflict regarding the water charge, water distribution etc increases, however WUAs are given enough mandate by the local farmer to resolve the conflict through the participatory approach. The details are described in **Table 11**.

Table 11: Conflict/Conflict Resolution Mechanism

Subject	Before Intervention	During the Intervention	At Present
Conflict on source of water	– Less	– High	– Still existing
Distribution conflict	– Domination of influential persons	– High	– Still high but regularly solved by WUA
Cash/kind contribution	– No	– High	– Little (solved by WUA)
Access to power (Representation in WUA)	– Domination of influential persons	– Increased	– Increased (solved by increasing participation)
Responsible persons	– Solved by political leaders and WUA	– Solved by political leaders & WUA	– Solved by WUA in assistance of branch and sub- committees
Method	– Top down method	– Top down method	– Participatory approach

Others

Besides the above-described parameters, the intervention has also affected the following aspects as shown in **Table 12**.

Table 12: Dynamism in Participation

Subject	Before Intervention	During the Intervention	At Present
Ownership feeling	– High in certain section/group – Overall low	– Low in Gadkhar – High in Bhulung and Laugain	– High in all
Community participation	– High in certain section/group – Overall low	– Top down method	– Participatory approach
Dependency	– No	– Increased dependency on external resources	– Increased dependency on external resources

MAIN FINDINGS

Every coin has two faces and the FMIS is not the exception. The indigenous irrigation practices of farmers in Nepal have manifold socio cultural and democratic values rather than mere irrigation value. The management practices in such FMISs can teach numerous lessons to well trained managers of today. However there is need to equip these farmers with new tools and techniques to enhance their capabilities on one hand and their quality of life on the other. The analysis of the dynamism in these systems indicates that the intervention has certainly improved the performance level but it has also brought some negative aspects. The

farmers in these systems wanted interventions but in their terms and conditions so that it can deform the existing social and managerial fabric to least possible extent. The analysis of socio-economic, technical and institutional strength also demand for limited intervention in changed water demand and socio-political condition of the country so that the FMISs can sustain over decades with minimum input.

The major advantage (positive aspect) and disadvantage (negative aspects) of intervention of FMISs are enlisted as below

New FMIS have following positive aspects:

- Management Committee (MC) able to make quick decision
- Cost effective management
- High ownership feeling, social unity, community participation
- Increased group efforts (formation of other groups)
- Highly effective to resolve conflict
- Through knowledge of MC on social, institutional and geographical settings

Negative Aspects in new FMIS

- Increased dependency on external assistance
- Use of technology beyond the capacity of the local farmers

In this review, it is pertinent to note that the farmer and their interest should be centrally placed in any short of interventions. The following aspects should be given high priority for better performance of the FMISs in changed context:

- Participation of farmers/WUA should be increased from the beginning in decision-making process.
- Training should be provided to WUA in management and O&M aspects
- The capacity of farmers for O&M should be considered at the time of Technology choice

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RECRAFTING THE ROLE OF EDUCATION FOR FMIS KNOWLEDGE PROMOTION

LAKSHMI NARAYAN CHOUDHARI AND HARI KRISHNA SHRESTHA[1]

BACKGROUND

Of the total potential irrigable area of 1.9×10^6 ha, irrigation facilitated land is currently about 1.089×10^6 ha in Nepal. Irrigation system in Nepal can be broadly classified into two categories, depending upon the responsibility of management, —. Farmer managed and agency managed irrigation systems. Irrigation systems that are developed by farmers' own initiation and investment are called Farmer Managed Irrigation Systems (FMIS). These systems are designed based on indigenous technology to suit the agro-ecological settings. Irrigation systems, which are developed and managed by the government, are referred to as Agency Managed Irrigation Systems (AMIS). Engineers, taught at universities with modern technology, design such irrigation systems. However, due to lack of management components in their design, performance of many of these systems in terms of water delivery to users remained inefficient, especially in a developing country like Nepal.

It is estimated that there are about 16,700 FMISs in Nepal (1,700 in Terai and 15,000 in hills). The size of these systems range from 10 ha to 15,000 ha. All these systems are being managed by farmers themselves since several decades. Currently, 33% of the total irrigable area of Nepal is under AMIS and 67% under FMIS (Pradhan, 1989).

In FMIS, water share is determined by consensus and often based on the area to be irrigated. Each user group receives the fixed share of water either on proportional division or on rotation (in case of scarcity of water) by constructing distribution structures. These distribution structures have many names. In western Nepal, it is called *Sancho*. The distribution systems developed adopted by FMIS are clear and transparent to everybody. Water is equitably distributed among all the users. Everybody understands how much water is flowing and where it is going. Such

[1] Lakshmi Narayan Choudhari and Hari Krishna Shrestha are Associate Professors at the Department of Civil Engineering, Nepal Engineering College (nec), Bhaktapur/ Pokhara University, Nepal.

systems are in use not only in Nepal, but also in Indonesia, Sri Lanka, Philippines, Laos, Thailand, India, etc.

Water distribution in AMIS is based on the crop water requirements derived from the calculation with respect to plant, climate and soil moisture, This gives flexibility in operation of distribution structures. The design principles and objectives of water distribution structures in FMIS and AMIS are given in **Table 1**.

Table 1: Basic Differences between FMIS and AMIS Based on Design Principles

S. N.	Design Principles of Irrigation Infrastructure	FMIS	AMIS
1.	Operation Objectives	Simplicity Transparency Equity Flexibility	Flexibility
2.	Irrigation Duty	Technical and Social Requirements	Technical Requirements
3.	Functions	Hydraulic and managerial	Hydraulic

Source: Parajuli, U. N. (1999)

In many cases of AMIS three practical problems occur. They are: unequal and untimely water distribution, unwanted interference of farmers in operation, and breaking of gates. All these problems are interrelated. The cause of these problems is the gap between knowledge and expectations of managers of AMIS and farmers. This gap, in turn, results from the way technical manpower is trained at formal academic institutions. In order to narrow this gap, FMIS Promotion Trust and nec joined hands and tried to revise, and recraft, if necessary, the current curriculum of irrigation engineering.

RATIONALE

Since a decade ago, with good intention of improving efficiency, FMIS intervention has been given a high priority in Nepal. Such intervention in irrigation system encounters challenges due to complex social and environmental problems. The decision-makers engaged in such process have seldom any training to tackle these issues. They acquire experience and knowledge by performing the jobs. Studies have shown that programs to improve the FMIS system have failed due to inappropriate planning. There are many reasons of failures. One major reason is the gap between the field level problems and the type of education and training provided at the academic institutions (Universities/colleges) to solve the problems.

One previous study found seven major reasons for traditional engineering curriculum concentrating only on physical aspect of irrigation and completely ignoring socio-economic dimensions (Dimer and Slabbers, 1992). Narrowing the gap requires a shift in irrigation design practice from the conventional one to the one that incorporates the socio-economic, cultural and political issues, besides the field of engineering. Role of education institutions in farmer friendly irrigation training and research has become essential to protect and promote indigenous knowledge and skills of FMIS. This indicates a need to reform the current curriculum of irrigation engineering.

The current curriculum of irrigation engineering at many universities in Nepal, including Pokhara University, lacks information on FMIS. The syllabus is based on engineering and agronomic principles. It does not include indigenous knowledge, and local technology and practices of irrigation. The faculties associated in teaching irrigation subjects are also trained in the conventional system of irrigation design. Unless the curriculum is revised to include chapters in FMIS, the faculties have no incentive to update their knowledge developments in FMIS. This reflects a need to revise the syllabus on irrigation.

Since the share of FMIS land is more than that of AMIS in Nepal, agricultural productivity is not going to improve without improvement in FMIS. To improve FMIS, knowledge and understanding of the system is a prerequisite. So, to effectively intervene and improve on the existing FMIS, trained technicians with sensitivity to the traditions and customs of FMIS is required, which can only be achieved through change in existing curriculum.

The need to reform current syllabus 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 & 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 has not changed so far.

The indigenous knowledge of local farmers has been one of the main reasons for sustainability of FMIS in Nepal. In order to improve agriculture in Nepal, "the local knowledge should be integrated with

external (traditional engineering) knowledge" (Shrestha, H., 2001). With a view to maintain the continuity of indigenous knowledge and skills of FMIS, it is pertinent to reform the current curriculum on irrigation subject. The reformed design needs to be compatible to farmers concept and ecological setting and must address the social issues. It should be socially acceptable, economically viable and environmentally sustainable. The new curriculum, if applied in training the faculties and students, will help design environmentally sustainable irrigation systems in accordance with the farmers' concept, knowledge and preferences.

OBJECTIVES

The ultimate objective of the project is to produce technical experts in the field of irrigation engineering that have knowledge and understanding of the skills and techniques used in FMIS, are sensitive to and willing to learn traditions and customs of the area, and have feeling for real needs of the farmers.

The specific objectives of the study are:

- To find gap between current curriculum of Bachelor of Civil Engineering and farmer's needs, in relation to irrigation component, and suggest changes required in the existing curriculum;
- To revise existing syllabus, if appropriate, to introduce basic concepts of FMIS; and
- To recraft a new syllabus, to be offered as an elective, to provide detailed knowledge on all aspects of FMIS.

METHODOLOGY

To achieve the specific objectives of the project, the following methodology was used.

Expert Discussion

To find the gap between academic curriculum and the needs of the farmers, the study team conducted several rounds of discussions with academicians and professionals. To determine the relevance of academic training in irrigation management at bachelor level of engineering, the team had extensive discussions with field engineers at irrigation offices who have several years of experience in FMIS and AMIS of Nepal.

Collection and Review of Literature

Based on the results of the expert discussion, the gap between the academic approach and farmers' approach was identified. To identify and select appropriate educational materials to fill the gap, the study team collected and reviewed several pertinent literatures related to FMIS and AMIS.

Workshop

Based on the experts' comments and review of literatures, the study team prepared draft version of two different syllabuses. The first syllabus was a revision of current POKHARA UNIVERSITY syllabus in irrigation engineering. In the first syllabus, attempt was made to introduce a separate chapter in FMIS without altering the overall content of the curriculum. This was achieved by deleting some sub-chapters that were covered in some other subjects. The second syllabus was a completely new syllabus to be offered as an elective subject in the final years of the 4-year civil engineering program. The second syllabus was intended to provide in-depth knowledge in technical, social, and legal aspects of FMIS.

Once the draft versions of the two syllabuses were prepared, the study team conducted interactive workshops to bring together ideas of various experts from different fields, so that coherent and comprehensive syllabuses can be formulated. The basic aim of the workshop was to put the draft version of the syllabuses to the review of the experts.

Water Distribution Model

In order to bring awareness on FMIS to the future engineers, the study team conducted small group meetings with the students of nec, and encouraged them to participate in a model competition for water distribution structures. The intention of this process was to involve the senior level students in designing the syllabuses by getting their feedback on the draft version of the syllabuses.

Field Visit

To get the real feeling of how FMIS are managed, the study team conducted field visits. During the visits, the team has extensive discussions the farmers and managers of various FMIS. Field surveys were conducted

to collect opinions of stake-holders on recrafting the role of education in FMIS knowledge promotion. The questionnaire of the surveys was focused on getting the farmers' feedback on what they felt was lacking in an engineering graduate. The ultimate purpose, again, is to make sure that the new syllabus will cater to the farmers' need.

Based on the inputs from various sources, the study team revised the draft versions of both the syllabuses.

RESULTS

The expected result (output) of the project was preparation of two syllabuses that incorporates appropriate inputs from academicians, professionals, farmers and FMIS managers. As stated earlier, the inputs were obtained through expert meetings, literature survey, workshops, students' involvement in design, and field surveys. The following are the summary of the outputs of the activities up to March 2002 of the program.

a) A revised draft copy of the syllabus for introduction of FMIS into existing syllabus of Water Resources Engineering - I (**Track 1**); and
b) A revised draft copy of the new syllabus of FMIS to be offered as an elective subject (**Track 2**).

The details of the outputs, which are the revised versions of syllabuses, follow.

a) **Track 1**: (Introducing a chapter on FMIS on existing syllabus)

Chapter Heading: Introduction to Farmer Managed Irrigation System (5 hrs)

Sub Headings

1.	Introduction of FMIS in Asian and Nepalese context	0.5
2.	Characteristics of better performing FMIS	0.25
3.	Use of Uphoff's Matrix on irrigation management	0.5
4.	Introduction to optimization techniques (LP & MCDM)	0.5
5.	Water Policy Legislation	1.5
	5.1 Water Resources Act, Policy, Legislation	
	5.2 Environment Act, and guidelines	

5.3 Formation and Management (participatory approach) of FMIS organization

6. Water Diversion, Conveyance and distribution 1.75
   - 6.1 Water right issues-statutory and customary rights
   - 6.2 Water allocation and distribution arrangement
   - 6.3 Water related disputes and disputes resolution
   - 6.4 Rational of proportional weir

b) **Track 2**: (Subject to be offered as an elective subject):

Subject: Farmer Managed Irrigation System (3 Credits)

	Theory	Practical	Total
Sessional	30	20	50
Final	50		50
Total	**80**	**20**	**100**

Course Objectives: After studying this course, students should be able to understand

(i) The historical development of irrigation system;
(ii) The differences between the hierarchical and bifurcating irrigation systems;
(iii) The style and pattern of farmers managed organization (including operation and management);
(iv) The issues of equity and sustainability (gender and poverty alleviation); and
(v) The issues related with water diversion, conveyance and distribution.

Course Contents

1.0 Introduction (6 hrs)
- 1.1. Irrigation practices in South Asia
- 1.2. History of irrigation development (Ancient & modern)
- 1.3. Evolution of FMIS
- 1.4 Characteristics of FMIS
- 1.5 Approaches and emerging trend on study of FMIS

2.0 Water Allocation Principles (2 hrs)
- 2.1 Water allocation principles
- 2.2 Water User's Association (WUA), Strengthening WUA
- 2.3 Water use practices & Water conservation practices

3.0 Legal Aspects of Water Resource Management (2 hrs)

3.1 Water Resource Act and Environmental Act
3.2 Legal provisions for water acquisition, allocation & distributions.

4.0 Design, Construction and Maintenance of reservoirs and canals in FMIS (10 hrs)
4.1 Use of Indigenous Knowledge for design and construction
4.2 Lined and unlined Reservoir Design
4.3 Reducing water seepage
4.4 Proportioning Weirs
4.5 Uphoff's Matrix
4.6 Techniques of upgrading old reservoirs and canals

5.0 Social Issues in FMIS (2 hrs)
5.1 Water Trading
5.2 Gender Issues
5.3 Tariff setting, Resource Mobilization
5.4 Contribution of NGOs in participation promotion

6.0 GIS Application in FMIS (9 hrs)
6.1 Introduction to GIS
6.2 Demo Application of GIS in FMIS
6.3 Introduction to database
6.4 Demo Application of database in FMIS

7.0 Introduction to Linear Programming in FMIS (9 hrs)
7.1 Introduction to Optimization Techniques
7.2 Application of LP in irrigation system planning and management with real case examples
7.3 Solution using LP softwares (LINDO and TORA)
7.4 Introduction to Multi Criteria Decision Making Approach
7.5 MCDM tool introduction for compromise programming, goal programming

8.0 Case Study: Case study of a successful and an unsuccessful FMIS. (5 hrs)

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.

ACTIVITIES UNDERTAKEN

The project is yet to be completed. The following activities are yet to be done.

a) Conduct field visits to obtain inputs from diverse section of farmers.
b) Conduct interactive workshop to obtain comments from academicians, professionals, farmers and FMIS managers on the revised syllabuses.
c) Finalize the syllabuses.
d) Present the syllabuses to Pokhara University for approval and incorporation in curriculum.

CONCLUSIONS

Based on the works completed up to now, the following conclusions are made.

a) Many FMIS need improvement, especially in infrastructure aspect. Most FMIS are excellent in management affairs. Improvements in infrastructure cannot be achieved without fully understanding overall aspects of FMIS.
b) The need for infrastructure improvement is growing with time due to changed context in
    i) Reduction of forest area from where farmers get materials for their indigenous technology of FMIS.
    ii) Migration of youth population towards urban areas that reduce the number of labor required for sustaining indigenous techniques FMIS management.
c) There is a definite gap between the need of farmers under FMIS and the input an engineering graduate can provide.
d) The gap is the result of combination of factors. They are:
    iii) Irrigation syllabuses not covering topics related to FMIS issues.
    iv) The literatures on FMIS studies can be obtained only in specialized offices.
    v) Most of the civil engineering faculties are not exposed to FMIS issues.
e) Careful designing and implementation of irrigation engineering syllabuses in undergraduate level courses can narrow the gap.

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SUB-WATERSHED STUDY IN KHADGABHANJYANG, NUWAKOT

SHIVA KUMAR SHARMA[1]

INTRODUCTION

A team of researchers tested a number of methodologies to carry out water use inventory at watershed level. The team based their research at Bhorle Khola Watershed in Nuwakot District (**Figure 1**). The team also attempted to explore the status of water use within the watershed. This paper attempts to summarize progress made by the team thus and for proposes further research work based on their initial findings.

Administratively, the watershed under the study falls under Khadgabhanjyang Village Development Committee (VDC) Ward Number 4, 5, 6 and 7 and Charghare VDC Ward Number 7, Nuwakot District, Bagmati Zone. Geographically, it is situated at 85° 05' 45" to 85° 06' 57" E longitude and 27° 52' 07" to 27° 53" 32" N latitude. The area of the watershed is 2.45 sq. km. and has an altitude of 515 m amsl to 1,000 m amsl. The watershed lies in the middle mountain range of Nepal with southward facing steep slope. Subtropical climate persists in the area with average annual rainfall of 1,847 mm and maximum to minimum temperature variation of 38° C to 6° C.

WATER RESOURCES

The main stream within the study area is Bholre Khola. This Khola has different names at various location along its 3.4 km length, Gandapani Khola at the head, Bhorle Khola next, then as Judi Khola, and finally as Dware Khola before entering the Trishuli River. It has four named tributaries Rakte, Simpani, Majhi and Ganpani Khola and a few others having no names. The Khola starts at an altitude of 955 m amsl and ends at 515 m amsl. The estimated mean monthly flow of the river is presented in **Table 1**.

[1] Senior Engineer, Ministry of Water Resources, Nepal.

Table 1: Estimated monthly flow

Month	Discharge lps*
January	45
February	41
March	34
April	29
May	33
June	114
July	470
August	595
September	469
October	207
November	73
December	49

* Using WECS Method

IRRIGATION SYSTEMS

There are 15 irrigation systems utilizing water from the watershed, of which, 9 systems divert water from the main stream and the remaining 6 from the tributaries (**Figure 2**). The total command area of these systems is 178 ha of which 11 ha is served by 13 irrigation systems and lies within the watershed and the remaining 167 ha is served by two irrigation systems, namely Archalephant (15 ha) and Pokharephant Kulo (152 ha), lies outside the watershed. The general features of the irrigation systems are shown in **Table 2**.

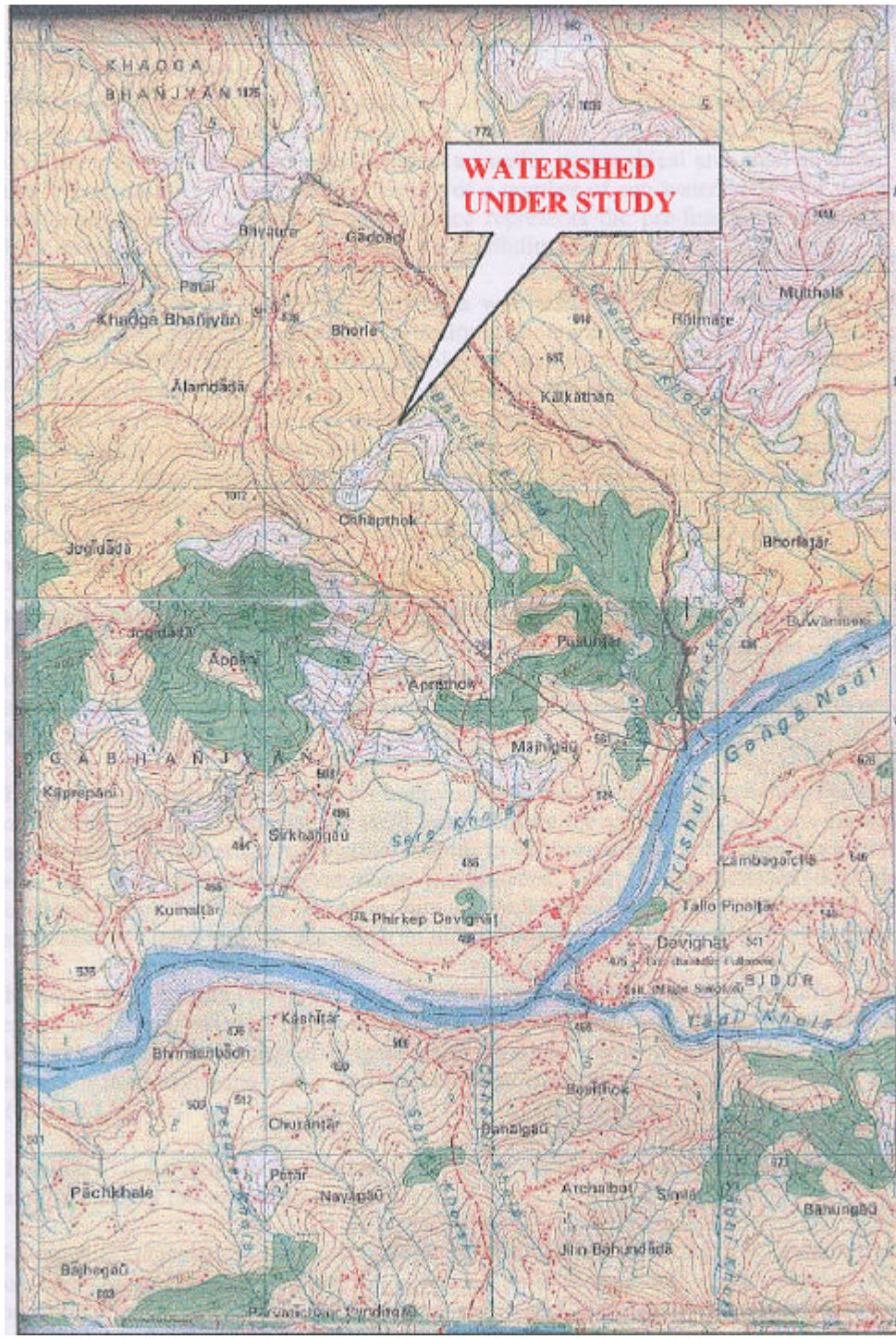

Figure 1: Location Map

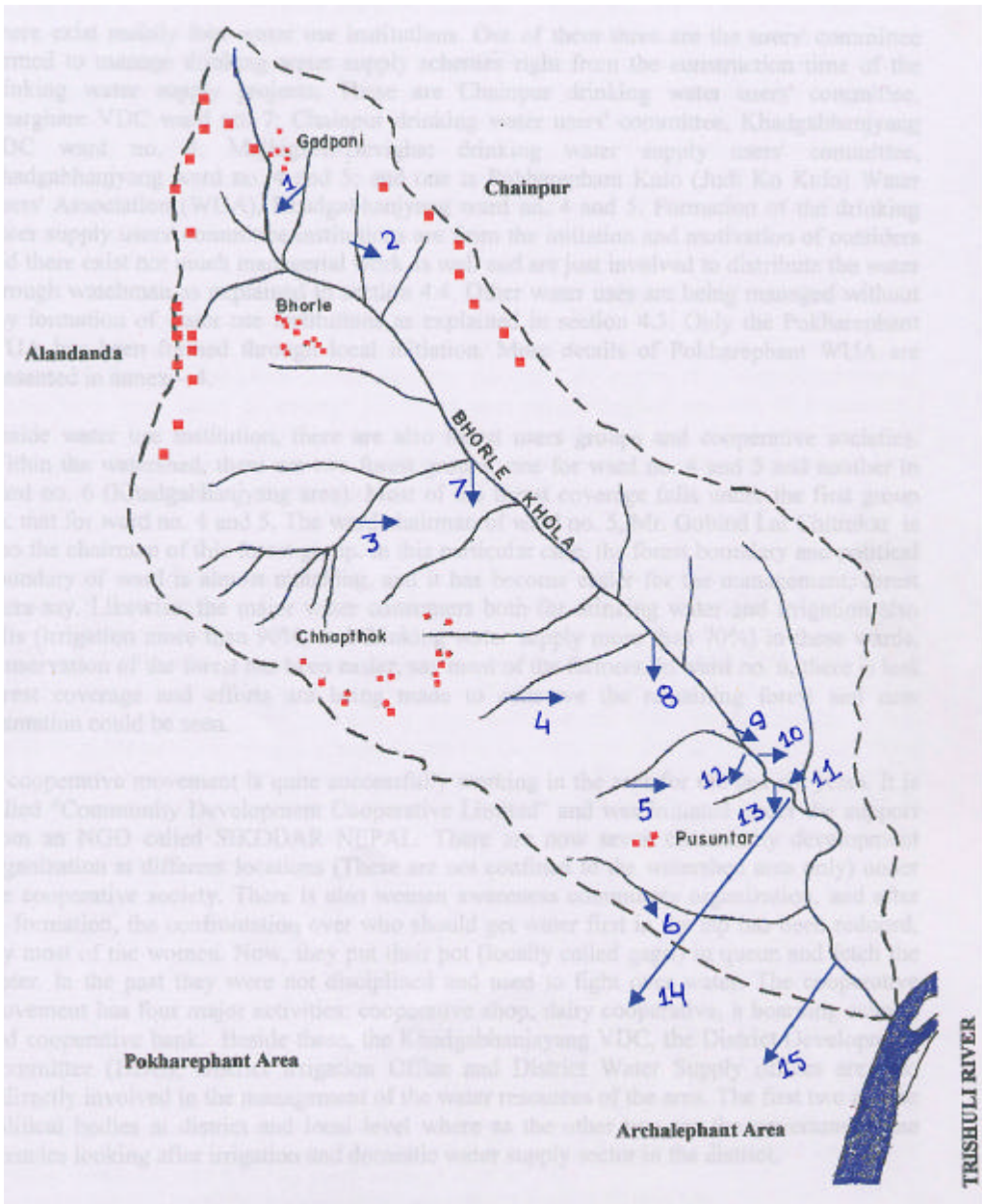

Figure 2:Streams with Irrigation Offtakes

Table 2: General Features of Irrigation Systems

Diversion No	Sources	System/ Command Area Name	Length of Main Canal (m)	Command Area (ha)	Major Crops	Number of Users	WUA Status	Remarks
1.	Gandapani	Gandapani	600	0.6	Paddy, Maize	3	does not exist	
2.	**	**	500	0.7	Paddy, Maize	4	"	
3.	Rakte	**	900	1.2	"	6	"	
4.	**	**	400	0.5	"	3	"	
5.	Simpani	Pusuntar/ Majhigown	400	0.5	"	3	"	
6.	Gandpani	Gandpani khet	200	0.55	"	4	"	
7.	Bhorle Bandh	Judi Khola	1200	2.2	"	14	"	
8.	Judi Khola	Gadahare Khet	1200	1.0	"	3	"	
9.	Judi Khola	Amare Khet	200	0.75	"	7	"	
10.	Judi Khola		250					
11.	Majhi Khola		100					
12.	Judi Khola	Judi Khet	500	3.0	"	14	"	
13.	Judi Khola	Judi Khet	-	-	-	-	"	
14.	Judi Khola	Pokharephant	1400	152	Paddy, Wheat, Maize	299	11 member WUA exist	
15.	Judi Khola	Archalephant	1000	15	"	17	"	

** Name not specified.

All the irrigation systems have temporary brushwood type weir for diversion and small earthen canal for conveyance. Formal organization for system operation and maintenance exists only in Judi Kulo. Operation and maintenance of the canal system is performed on mutual understanding.

DOMESTIC WATER USE

In the past water supply for domestic use was from small springs. People used to carry water from the springs in *Gagris* and *Ghaintos* (metal containers) (eastern vessels). It was only in 1990 that pipes were laid for supplying water for Pusuntar and Pokhariya. The project faced resistance from the irrigation users at the beginning marking the beginning of the intra-sectoral conflict on water.

There are 5 intakes for drinking water supply within the watershed. Out of these schemes, 3 intakes (Rakte, Simpani and Majhi Khola) are providing service within the watershed. One intake (at Gandapani Khola) is provides service outside the watershed (Charghare VDC). The remaining one providing partially outside the area. It is observed that there exist a few pipelines being laid individually to fetch the spring water to the tap. General features of the water supply schemes are given in **Table 3**.

Table 3: General Features of the Water Supply Schemes

Area	VDC Ward No	Intake/Source	No of Water Taps	Household Served	Remarks
Pusuntar, Majhigaun, Pokhariya	Khadgabhanjyang 4,5	Thulo Pandhero, Simpani, Majhi Khola	14	154	piped supply
Chhapthok	Khadgabhanjyang 4	Rakte Khola	6	50	piped supply
Chainpur	Khadgabhanjyang 4	Gandpani Khola	5	52	piped supply also supplies outside watershed area.
Chainpur	Charghare 7	Gandapani Khola	4	29	piped supply, are all outside watershed.
Nuwakot-Jogidanda	Khadgabhanjyang 6	Bhyaure Khola	1	29	Brings water from outside the watershed.

Each of the public water supply systems has a diversion intake usually located away from the settlement area, a main conveyance system, collection reservoir and network of taps. Maintenance has been very minimal although some systems use to raise money and employ a person to carry out the work. The user organizations that were formed during construction phase have remained largely inactive.

OTHER WATER USE

Water is used for livestock and other rituals. Previously, few ghattas (water mills) were in operation but they do not exist any more after they were replaced by electric driven mills in 1987.

OBSERVATIONS

Although the watershed area is small, water use in the area is very intensive; characterized by 15 irrigation systems of different sizes, five

drinking water supply schemes and various other water uses such as livestock consumption and traditional water mill.

Water is highly competitive as the land and human requirement (demand) exceed the water resources (supply). The research team noted a few cases of conflicts, especially when the water supply scheme was being initiated. The team also noted the absence of formal mechanisms to share the water resources both for drinking water and for irrigation at the basin level. (However, the Water Resources Act, 1993 states the order of priority of water use. Drinking water is first priority and irrigation is given second priority).

In the recent years, the increase of population associated with increased activities such as increase in agriculture intensification and change in water use habits of the people such as use of piped water for drinking and sanitation, has resulted in increase in the demand of water in the basin. The supply of water already falls short of the demand. The demand aspect of water resources is compounded with the existence of two agricultural areas, namely Pokharephant and Archalephant, which though located outside the physical boundary of the watershed are dependent on the water available in the watershed. These facts have initiated conflicts among the users with regard to which system in the area has prior use right with respect to the other. Although, the conflict is not very apparent at present, it is going to be serious as the pressure of the resources increases in the future.

It is typical of many small and medium sized watershed areas in the hilly region like Pokharephant and Archalephant. They are heavily dependent on the water resources of the watershed. This has prompted the research team to conceptualize the approach of water use domain for understanding a watershed. The available water meets the water demand at present and for the coming future too based on the potential water consumption scenario for the area within the physical boundary of the watershed. However, including the committed flow for the dependent areas, the watershed is already exhausted. The study of a watershed area without due consideration of water use domain outside the physical boundary may mislead the conclusion.

As the water resources become stressed, water users in an area naturally start transforming themselves into a number of ways. The people in the Bhorle Khola watershed area have also realized the situation and started taking remedial measures. The research team had noted two important

changes taking place in the watershed, the first is the proper management of the watershed and the other is the introduction of water harvesting techniques. The first is a management tool and the second is an adoption of a new technology. Similarly, the farmers in Archale have started lifting water from the Trishuli River, the outfall of the watershed area. There has been a study recently concluded to supply water from the Trishuli River to Pokharaphant under an irrigation project in the area. In other words, the stressful situation of the resource has prompted to seek for technological intervention.

Water available within the watershed is not only used for irrigation, but also for domestic and other uses. Due to increased economic activity and population growth, competition over the use of the resource is increasing. As irrigation being the largest consumer of water, irrigation sector has been on more pressure as compared to others. Irrigation alone used to be dominant water use element in the past, but population growth and other economic activities have now necessitated the irrigation sector to accommodate them in its consumption spectrum. Within the irrigation sector itself, there is competition between the upstream and downstream users. The challenge ahead is to satisfy the demand of all sectors and also to develop efficient linkages between upstream and downstream users so that the scarce resources will be used optimally. The Bhorle Khola watershed is a typical case, which involves all these processes. An in-depth study of the linkages in the watershed would provide a window for basinwise planning or planning at watershed level addressing all types of needs.

NEED FOR FURTHER RESEARCH

With increased competing demand of water between and among different sectors, it is evident that the planning and development of water resources should not be based on the single sector approach as it used to be in the past. There is thus a need to take into account the multiple use of water in a watershed with sound understanding of linkages between the uses of different sectors, within each of the sectors, at different locations of the watershed and at different spreads of the time. It is very recently that a need of adopting an integrated approach of water resources development on a basin wide basis has been realized. There have been little research works, especially in Nepalese social economic setting, which could give a direction for adopting a correct approach for a basin wide planning. The proposed study will be a significant endeavor to pave the way for such research in this area.

The proposed study is different from the previous study in that the previous study tested methodologies in preparing the resource inventory of the area while the present study aims to examine the pattern of the social and technological interfaces under the given geophysical setting of the area. Although the area of watershed is relatively small, the study is expected to provide good lessons and sufficient groundwork to carry out future study in detail in bigger area to learn more on basin wide water resources planning under Nepalese socio-economic setting.

The methodology of preparing inventory of water uses would help develop the tool, which can be used in other watersheds. The outcome of the study will help water resources planning for the benefit of FMIS at micro level as well as at the district level. In analyzing the multiple use of water, GIS and other technologies will be tested.

OBJECTIVES

The objectives of the study are to investigate on the various uses of water in the Bhorle Khola watershed with special focus on the linkages between them, identify issues and constraints for an integrated approach of water resources development, establish and test methodologies and suggest an appropriate approach for basinwise water resources planning.

The objectives of the study, in particular, are to:

- Identify the multiple use of water within a watershed;
- Study and document pattern of negotiation for the resource utilization between different sectors;
- Study and document pattern of negotiation for water use between upstream and downstream users; and
- Access environmental impact on the availability of water use.

METHODOLOGY

The methodology for carrying out the research work would constitute of the following:

Literature Review

This part of the activities would constitute review of a broad spectrum of literatures in a number of disciplines which can throw light on integrated

planning of water resources in a basin, optimization of water use, and linkages between different sectors on water use on social, geographical and spatial interfaces. Literatures, case studies and project studies that involve participation of users in resource allocation and distribution between different sectors and at different time and space will be reviewed. Literatures, which have documented the process of environmental changes in relation to the water use and water demand over time, will also be studied in detail. The main aim of literature review will be to review and have a good understanding of the present status of knowledge base.

Field Works

The fieldwork will be carried out in three phases as follows:

Primary Fieldwork

During this stage of the fieldwork, the research team will visit the Bhorle Khola watershed area in order to have first hand information of the study area, re-verify the information collected during the previous study lead by Mr. Puspa R. Khanal, identify key informants in the area, conceptualize the nature of data that are available in the field and the required format of questionnaires and data sheets to fetch them in the detailed fieldwork phase.

Detailed Fieldwork

This part of the fieldwork will start immediately after completing a brief study phase following the primary fieldwork. The research team will collect detailed information from the field using questionnaires and data sheets, walkthrough in the area, simple surveys and observations and interaction with the people in the area.

Supplementary Fieldwork

This part of the fieldwork will take place during and at substantial completion of the study and analysis. This part of the fieldwork is aimed to collect time variant data from the field as well as to verify some hypothesis and assumptions that would arise during the study and analysis.

Study and Analysis

The data collected from the field will be analyzed in the background of conceptualized approach during literature review phase. The inventory of various uses of water in the study area will be prepared. Suitable GIS tools will be utilized to present and analyze the data. In doing so, a procedure will be followed and documented for use at later stages. The experience gained and particular lessons learnt during the study will also be documented. A number of assumptions will be hypothesized to establish linkages of the resource utilization between different sectors, different locations and different time frame. These assumptions will be tested against the information obtained from the field. The availability of water resources over time will be observed at various critical locations of the basin which will be useful to draw critical conclusion on water utilization and allocation and to access environmental impact of the availability of water use. The assumptions and analysis will be supported with the supplemental information to be collected during the supplemental fieldwork.

Change of Study Area

The study team investigated on the alternative sites that would better cover the objectives of the study. In this regard, three possible sites in Ilam district namely Ghatte khola, Jhutre Khola and Dhuwa Khola were identified and a brief site visit to the area was carried out. Out of the three sub-basins, Dhuwa Khola Sub-basin appeared most suitable for the purpose of the study.

Dhuwa Khola Sub-basin lies to the north-west of Ilam town in Ilam district of Nepal. The Sub-basin has an area of about 20 sq. km and covers two VDCs namely Jamuna and Mabu. A large part of the basin is covered by forest and the remaining is used for agriculture. The water of the basin is widely utilized for irrigation in the area with numerous traditional irrigation systems built by the farmers themselves. Department of Irrigation through its Irrigation Sector Project has supported one of the irrigation systems namely Dhuwa Khola irrigation sub-project. The VDCs are very active in water resources development and conservation. They have a good record of resources in the area. With the cooperation from a local NGO named Namsaling Community Development Center, they have prepared VDC profile identifying the resources and framing out development activities which include water resources, forest conservation,

rural roads, schools and health posts. They are also hosting Area Water Partnership (AWP) organizing activities under Nepal Water Partnership/GWP. AWP is a stakeholders' forum which helps in promoting Integrated Water Resources Management (IWRM) at the local level.

There exist a power generation plant in the area of the capacity of 10 Kw and another plant of about 14 KW is under study. There are three or four more potential sites for micro hydro plants.

This area seems more appropriate than Khadgabhanjyang in Nuwakot in the following counts:

- The area of Dhuwa Khola is 20 sq km compared 2.45 sq km of Khadgabhanjyang, which will provide better coverage of the issues related with water resources. The outcome of this study on Dhuwa Khola Sub-basin would provide better scope of replication.
- The local organizations related with water resources are multiple and in better shape in Dhuwa Khola.
- The local organizations are active in environmental conservation in Dhuwa Khola.
- The water resources management aspects in Dhuwa Khola are matured compared to those in Khadgabhanjyang.
- There is hydropower plant in Dhuwa Khola area with more likely to come in future while in Khadgabhanjyang there is no possibility of such plants. This would provide one more interface to the study to look at.

Given the above benefits of Dhuwa Khola Sub-basin over Khadgabhanjyang Sub-basin, the study team has decided to select the Dhuwa Khola Sub-basin as the next study area. The name of the study henceforth will be: *Sub-Watershed Study on Dhuwa Khola, Ilam.*

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INVENTORY OF IRRIGATION SYSTEMS IN KATHMANDU DISTRICT, NEPAL

SHAMBHU PRASAD DULAL[1] AND PRACHANDA PRADHAN

INTRODUCTION

The fertile land of Kathmandu district and the network of canal systems for its irrigation are considered as the unique feature of this district which has contributed for the promotion of art and architecture reflected in the temples, art and artifacts as well as social tradition of this district. We shouldn't ignore this fact while studying the irrigation management of this district.

According to the findings prepared on the basis of inventory (**Attachment 1**) 51 Village Development Committees (VDCs) of this district have 13,114 ha irrigated land whereas the report in 1997 (Nirmal Kumar et. al., 1999 District Profile. Kathmandu: National Research Associates) shows that Kathmandu district has 4,400 ha irrigated area.

Systems

From preliminary data, it shows that there are 238 irrigation systems in 51 VDC. Among them, 14 systems are Rajkulo (State supported Irrigation Systems in Kathmandu District).

Transportation and Irrigation System

From the survey, it is found that 44% of irrigation systems are located in less than 1 km from road head, 22% are 1 to 3 km, 7% are 3 to 5 km and rest others are (17%) more than 5 km away from road head.

Water Source and Irrigation System

Among 238 systems, 18% of irrigation systems have reported that spring is the source of water. 21% has stream as the source of water and the others (61%) have rivers as the source of irrigation water. The main rivers in

[1] Secretary, Kathmandu District Unit, National Federation of Water Users' Association, Nepal.

Kathmandu District are Bagmati, Bishnumati, Dhobikhola, Manohara, Ghattekhola, etc. Every irrigation system has adverse impact due to water pollution and mining of sand from the rivers.

Water Availability

From the data, 44% systems have sufficient water. 14% reported that they have only seasonal irrigation. 28% did not responded in this regard. Among the total number of irrigation systems, 14% can not get water for spring crops.

Construction Year

Out of the total systems, 9% are constructed between 1 to 20 years ago, 4% are constructed 20 to 50 years ago, 3% are constructed between 50 to 100 years ago and 81% of systems were constructed more than 100 years ago. Information of 3% systems are not available.

Source Management

Sources of 53% systems are open gate, 25% have control structures and 22% have temporary intake structures.

Length of System

Out of the total systems, 74% of systems have canal length between 1 to 2 km, 22% have 2 to 4 km, and 4% have 5 and above.

Command Area

13% systems have less than 10 hectares command area, 52% systems have 10 to 40 hectares, 19% systems have 40 to 100 hectares and rests of the systems have more than 100 hectares.

Topography

154 systems are in valley bottom at the plain area and 102 systems are in hill terraces. Altogether 20 systems are found in both plain and terrace areas.

Present Condition of System

Among the systems, 12% systems are considered in good condition, 38% have average condition and 38% are in bad condition. Other system's condition (12%) is not mentioned in the report.

No. of Users

- 5% systems have less than 100 users;
- 32%, systems have between 100 to 300 users;
- 39% systems have between 300 to 1000 users;
- 20% systems have more than 1000 users;
- 10 systems have above 4000 users;
- Information is not available in 4% systems; and
- It's necessary to activate WUA to take data about the users.

Water User Association

In the preliminary data, 52 systems choose their WUA members by election, 3 systems are governed by appointed persons. 107 systems are managed by other persons who are not related to the systems and 76 systems have no information in this regard.

WUA Meeting

There is no system of arranging any meeting in 85% irrigation systems. 10% systems hold meeting once or twice in a year and 0.4% systems arrange meeting 3 times or more in a year. WUA is not activate in many systems.

Water Distribution

Water distribution plays important role in water management. 46% farmers distribute water by themselves. WUAs distribute in 8% and 46% have no management in water distribution. In such situation, the conflicts regarding water distribution occur frequently. With the "Might is Right" principle reigning in the distribution of water, there is much disproportionate distribution of water. This might have resulted due to lack of WUA organization or its weakness. In 34% systems, water distribution is continuous and other 64% systems have rotational water distribution. Under rotation system, water distribution is very important. 2% of systems

have no information about water distribution.

Resource Mobilization

In many systems, labor is mobilized as internal resource for operation and maintenance. Among all those 238 systems, 128 systems mobilize labor as the main source of resource, 12 systems mobilize cash and labor and 40 systems mobilize cash collected from external source. Only 75% systems reported the method of resource mobilization for the irrigation system management.

Maintenance

Situation of 5% of the systems is good, 57% are in average condition and 32% are in very poor condition. These days, 32% systems are in very bad condition. The rest 6% have no information in this regard.

Agricultural Condition

There are 14 irrigation systems, which cultivate only one crop. 217 systems cultivate one to two crops in a year. There is only one system which has cropping intensity over 200 in a year.

Possibility of Increasing the Irrigation Area

64% of the irrigation systems have possibility of increasing the irrigated area. 36% systems have no possibility at all. 79% of the system shows the possibility of intensification of the irrigation and 20% systems indicated that there is no possibility of such practice. 77% systems have reported enough water for irrigation whereas 19% have acute shortage of water for irrigation.

Main Problems Observed during the Study

- Decrease of bed-level of the river with excessive sand mining for building constructions in the urban areas around Kathmandu Valley;
- No appropriate mechanism of maintenance and repair;
- leakage of water from the canal;
- Inactive and passive WUAs;
- Risk of flood and landslides;
- Water shortage;

- Lack of people's participation; and
- Inequitable water distribution.

The summary of the findings is shown in **Table 1**.

Table 1: Kathmandu District Irrigation Systems Inventory

Total No. of VDC	Total No. of Irrigation System	Total No. of Rajkulo	Distance from Main Road (in km.)					Source of Water		
			Up to 1	1 - 3	3 - 5	Above 5	Not Available	Spring	Stream	River
51	238	14 (6%)	114 (48%)	53 (22%)	16 (7%)	40 (17%)	15(%)	43 (18%)	51 (21%)	150 (61%)

Water Availability				Construction Year (in year)					Type of Source			Length of Canal (in km.)		
Abundant	Seasonal	Shortage in Spring Season	Not Available	1 - 20	20 - 50	50 - 100	Above 100	Not Available	Open/Not Controlled	Controlled	Temporary	1 – 2	2 - 4	Above 4
106 (44%)	34 (14%)	34 (14%)	66 (28%)	21 (9%)	10 (4%)	8 (3%)	192 (81%)	7 (3%)	126 (53%)	60 (25%)	52 (22%)	177 (74%)	51 (22%)	10 (4%)

Total Command Area (in ha)	Command Area (in ha)				Topography		Present Condition of Canal				No. of Users				
	Less than 10	10 - 40	40 - 100	Above 100	Plain	Terrace	Good	Average	Bad	Not Available	Less than 100	100 - 300	300 - 1000	Above 1000	Not Available
13114	37 (16%)	125 (52%)	44 (19%)	32 (13%)	154	102	28 (12%)	92 (38%)	90 (38%)	28 (12%)	12 (5%)	76 (32%)	93 (39%)	48 (20%)	9 (4%)

Member of WUA				Annual Meetings			Water Distribution				Water Right	
Appointed	Elected	Not Related to Committee	Not Available	No Meeting	1 - 2 Times	3 and above	Who Supervise	Continuos	Rotation	Not Available	Over the System	Individual Farmers
52	3	107	76	213 (89%)	24 (10%)	1 (0.4%)	Farmers 109 (46%) WUA 19 (8%) No supervise 110 (46%)	80 (34%)	153 (64%)	5 (2%)	213	211

Resource Mobilization						Condition of Maintenance				Agriculture Practices Crops Grown in a Year		
Internal			External			Good	Average	Bad	Not Available	Less than 100%	100-200%	Above 200%
Labour	Cash	Kind	Labour	Cash	Kind							
232	12	x	x	40	x	12 (5%)	136 (57%)	76 (32%)	14 (6%)	14	217	1

Problems							
Expansion of Compound		Irrigation Intensity Increase			Enough Water		
Yes	No	Yes	No	Not Available	Yes	No	Not Available
152 (64%)	86 (36%)	188 (79%)	48 (20%)	2 (1%)	183 (77%)	46 (19%)	9 (4%)

Attachment 1

INVENTORY OF IRRIGATION SYSTEMS IN KATHMANDU DISTRICT

Form No:……..

Name of the Irrigation System.....

A. Location: VDC Name: Name of the village(s)
Distance from nearest roadhead

B. Physical Characteristics

Source of Water Spring ☐ Stream ☐

River ☐ Name……
.

Water availability in command area Sufficient ☐ ☐

Seasonal ☐ Shortage in spring

Year of construction …….

Number of Irrigation systems Upstream ☐ Downstream ☐

Intake Free ☐ Regulated ☐ Temporary ☐

Canal length ……. Command area…….

Terrain Plain ☐ Terraces ……

Present condition of the channel……

Problem identified

C. Institutions

Number of users:…….

Users Committee Recruited ☐ Elected ☐

members

Appointed | No official

Annual meetings No | One time | Two time

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

D. Agriculture

Crop Coverage by area Paddy… Wheat… 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 Wheat Maize/? Others

Area covered (in ropani) …… …… ……

E. Problems identified

Can area be expanded?
Can intensity be increased?
Can there be assured supply of water?

F. Others

IRRIGATION SYSTEMS IN THE HIGHLANDS OF NEPAL: EXAMPLES FROM TILA RIVER OF JUMLA DISTRICT

DEVI DUTTA DEVKOTA[1] AND PRACHANDA PRADHAN

INTRODUCTION

This paper is the summary of the functioning of irrigation systems which were surveyed and analyzed by Devi Dutta Devkota under the supervision of Prachanda Pradhan. The detail report is prepared in Nepali. They are documented in Farmer Managed Irrigation Systems (FMIS) Promotion Trust's Library.

[1] Researcher and Social Worker, Jumla District, Nepal

Jumla is one of those water abundant districts of Nepal. There are many river systems in this district. The rivers that flow from this district contribute water to other major rivers of Nepal like the Karnali River which is one of the major rivers of Nepal with 28,000 m^3/s of water during peak period and about 350 m^3/s during lean period at Chisapani of Kailali district.

This is one of the highland remote districts of Nepal. Besides livestock and horticulture, paddy cultivation also occupies important place. The paddy cultivation is done mainly in Tila Valley and Sinja valley of this district. It is estimated that there is 1,507 hectare irrigated land. The yield of paddy is reported to be only 2.0 ton/ha.

Study Area

The study is confined to the area of the Tilla river and its tributaries. Accordingly, 12 irrigation systems from Danasangu to Kurai have been selected for detail study. The summary of the study is given in **Table 1**. The selected irrigation systems are the bigger ones. Out of those 12 systems, nine of them have enough water for paddy cultivation. Out of twelve systems, six of them were 600 years old and other six systems were 200-500 years old. It is believed that the paddy cultivation started in Jumla in 1460 (Bikram Sambat) i.e. in 1516 A.D. The legend says that the paddy was imported from Kashmir by Chandannath Baba, the protector God of Jumla District. The paddy cultivation revolves around the instructions circulated by Chandannath Baba temple. The date for seed bed preparation and transplantation of the seedlings would be announced by the temple priest and the paddy cultivators follow the schedule strictly.

Features of the Irrigation Systems

The study shows that the longest channel is of 11km long and the shortest one is of 2 km long. The average length of the canal is 5.5 km long. Among those 12 systems, the largest command area is of 50 hectare and smallest one is of 4 hectare. They are earthen channels. There are many leaking points along the channel.

In those difficult places, the water would be conveyed with the help of wooden aqueducts locally known as "panala". In all those 12 irrigation systems, wooden aqueducts were installed. Thinke system of 4 km long with 11 hectare irrigated area has 13 wooden aqueducts of different sizes and shapes whereas in Gairung system of 2 km with 31 hectare land has

only one aqueduct. The wooden aqueduct is made locally out of pine trees by the local craftsmen. They need to be replaced in 4-5 years time.

IRRIGATION MANAGEMENT SYSTEM

The paddy Jiula (land) belongs to the land owner. The land owners select between 2-6 canal operators (Kumthi in local language) in the month of February each year.

Functions of the Canal Operator (Kumthi)

- To make the water flow smoothly in the channel.
- To undertake annual and emergency maintenance
- To distribute water to the paddy fields of the water users. Sometimes, water distribution will be on rotation basis.
- To inspect the channel daily and undertake minor repair and distribute water to each paddy field
- To apply different types of water distribution mechanism to ensure the supply of water in the paddy field.

Facilities to Canal Operators

The Kumthis will be remunerated for their job in kind. A quintal of paddy/ hectare will be remunerated to the Kumthis. Some land owners pays NRs. 1600 to the canal operator (Kumthis). In most of the case, paddy will be remunerated. However, cash payment is also frequently taking place.

Regulations Governing the Punishment and Fines

If it is found that water stealing has taken place, the culprit would be identified, a fine of NRs. 20-100 will be imposed. If he disobeys the fine, the water supply to his farm will be cut off.

Labor contribution for annual maintenance or emergency maintenance is to be made by the landowners. Those who fail to be present during such occasion, fine will be imposed on them at the rate of NRS. 50-150. The amount thus collected will be shared by those "Kumthis".

Annual worshipping to the canal takes place at the time of first flow of water in canal in that year. The money collected out of those fines would be used for such purpose.

Water distribution is, in some systems, done through proportioning weirs. The proportioning weirs are made of stone and mud. Such distribution system includes "Aat" (branch canal) and "Cheta" (outlet).

Paddy Cultivation Methods in Jumla

Tilla valley is situated at an altitude of 2500 meter. Hence, paddy cultivation requires special preparation.

- In March (Chaitra 12) the paddy seed would be soaked in water for 4 days. This job will be done at the village itself.
- In March (Chaitra 16), seed would be taken out from water
- The seed would be kept in warm place inside the house. This will allow to sprout the seed.
- In March (Chaitra 20), paddy seed bed would be made and allow the paddy seedlings to grow.
- In first week of June, paddy transplantation takes place. Paddy seedlings would take two month to grow.
- Hence, the canal repair and maintenance has to be completed by Chaitra 12. This is the date when first activity of seed bed preparation takes place.
- During plantation period, water distribution will be done on the basis of day. In some village, the distribution schedule is fixed. In some village distributions schedule will be agreed in the meeting of the irrigators.
- Paddy harvesting would be done in October- November (Kartik). It takes about 8 months for paddy to ripe. The paddy crops remain in the field for 6 months. Altogether it takes 8 months to grow paddy in Jumla.

Table 1: Summary of 12 Irrigation System in Tilla River Valley

S.N	Name of VDC	Name of the System	Village Name	Water Source				Water Availability			Construction Year
				Spring	Stream	River	Name	Abundant	Seasonal	Shortage in Spring Season	
1.	Mahat Gaun	Raulajiulo kulo	Ward No. 1-3	-	-	✓	Tila Nadi	✓	✓		After 1465 B.S
2.	Kattikshwami	Danasangu Kulo	Ward No. 1-6	-	-	✓	Tila Nadi	✓			Around 1461-1465 B.S
3.	Talium, Lamra	Aireni Kulo		-	-	✓	Tila Nadi				1800 B.S
4.	Pansayadara Kudari	Kudari Seri	Ward No. 1&2	-	-	✓	Tila Nadi	✓			1961-1965 B.S
5.	Kattikshwami	Silam Kulo	Ward No. 2-8	-	-	✓	Tila Nadi	✓			Average 200 years agro
6.	Chandannath	Sera Kulo		-	-	✓		✓			After 1460 B.S
7.	Chandannath & Mahat VDCs	Gairam Kulo	Chandannath VDC 1 & 8, & Mahat VDC 1-6, and Kattikshwami 1&2	-	-	✓	Tila Nadi	-	✓		After 1465 B.S
8.	Chandannath	Majh Kulo	Village of Chandannath	-	-	✓	Jawa Nadi & more stream	✓	✓		After 1562 B.S
9.	Chandannath & Mahat VDCs	Talichaur Kulo	Village of those VDCs	-	-	✓	Jawa Nadi	✓		✓	Average 400 years agro
10.	Chandannath	Thinke Kulo		-	-	✓	Jawa Nadi	✓			Around 1460-1465 B.S
11.	Hanku	Giddi Raj Kulo	Ward no. 1-9	-	-	✓	Gidi Ganga	✓			After 1462 B.S
12.	Kattikshwami	Upperkhet Kulo	Ward No. 1	-	-	✓		✓			Around 300 years ago

Diversion Structure			Length of Canal	Command Area	Topography		Present Condition of Canal	Identified Problem	No. of Users (in person)	Users		
open	controlled Gate	Temporary			Plain	Terrace				Appointed	Elected	Not Related to Committee
✓			5 km	10 ha		✓	Leakage & decrease in fertility					
✓			7.382 km	50 ha		✓	No maintenance					
✓			4.8 km	18.75 ha		✓	Can't get financial support from any sector					
✓				12 ha		✓	Changing direction by the river no maintenance					
✓			5.8 km	13.4 ha		✓	Canal is earthen so it will be damage several time					
✓			5.7 km	4.5 ha		-	-					
	✓			31.25 ha		✓	-					
✓			4.73 km	-		-	-					
✓			4.4 km	-		-	-					
✓			4.2 km	11 ha		✓	-					
✓			11.8 km	-		✓	-					
✓			1.9 km	-		✓	Can't maintain by users					

Meeting of Committee	Water Distribution					Water Right		Resource Mobilization for						Condition of Maintenance			Agriculture Practices					Others
								Internal			External						Crop Coverage by Percentage			Cropping Intensity	Crops Grown in a Year	
	who Supervise	Rules of Water Distribution	Punishment for Water Stealing	Continuos	Rotation	Over the System	Individual Farmers	Labour	Cash	Kind	Labour	Cash	Kind	Good	Average	Bad	Rice	Wheat	Other			
If needed then call for villagers (no committee)	Kumthis	✓	yes		✓			✓								✓	95%	5%	70 %		170 %	Canal from open intake, not internal financial source, more water leakage
Kumthi's discussing each other in Jestha & Ashad about the system (no committee)	Kumthis	✓	yes		✓			✓								✓						Problem from flood and deforestation
Kumthi's discussing each other in Jestha & Ashad about the system (no committee)	Kumthis	✓	yes		✓			✓		✓						✓	95%	1%	10 4%		200 %	Canal very poor & no maintenance

Kumthi's discussing each other in Jestha & Ashad about the system (no committee)	Kumthis	✓	yes		✓			✓		✓							95%	1%	10 4%		200 %	No financial help for maintenance from any sector
For emergency, they call for users (no committee)	Kumthis	✓	yes		✓			✓									90%	2%	10 8%		200 %	Canal conditions is very poor
For emergency, they call for users (no committee)	Kumthis	✓	yes		✓			✓		✓												
For emergency, they call for users (no committee)	Kumthis	✓	yes		✓			✓								✓	95%	3%	10 2%		200 %	
For emergency, they call for users (no committee)	Kumthis	✓	yes		✓			✓		✓						✓	95%	1%	10 4%		200 %	Canal should be structured water leaking
For emergency, they call for users (no committee)	Kumthis	✓	yes		✓			✓		✓						✓	95%	2%	10 2%		199 %	Canal situation is very poor & damaged from time to time

For emergency, they call for users (no committee)	Kumthis	✓	yes		✓			✓		✓						✓	95%	2%	10 3%		200 %	No water in canal leaking, of water, damaged in rainy season
For emergency, they call for users (no committee)	Kumthis	✓	yes		✓			✓		✓							97%	5%	98 %		200 %	Problem of flood, lack of water the source deforestation
For emergency, they call for users (no committee)	Kumthis	✓	yes		✓			✓		✓												

WATER USERS ASSOCIATIONS TOWARDS DIVERSIFIED ACTIVITIES

PRACHANDA PRADHAN AND UPENDRA GAUTAM

This paper proposes to look into the factors for the multifunction of Water Users Associations (WUAs) for irrigation management. Most of WUAs in Nepal are single water related function organization. One of the objectives of this paper is to look into the causes and factors why only a few multi-function WUA are operating in Nepal. In Nepal, many of them remain single function organization. Some of the reasons might be that the farming system in Nepal is subsistence agriculture. The economics is that you consume what you produce. As the result, there is not much surplus to exchange. Secondly, the agri-inputs are also supplied from within the households like compost manure and cow dungs, which are usually collected at the household level. The application of chemical fertilizer and insecticides are very low. They do not undertake collective activity for procurement of these inputs. On top of that, the application of these inputs are way below the prescribed dose. However, they are very active in water related activities from intake repair to desilting of canal and water distribution, maintenance of the system, and resource mobilization. By and large, except a few examples of multifunction WUAs from Philippines, People's Republic of China, Taiwan, Vietnam, Niger and countries in Eastern countries, there are many examples of single function WUAs in many parts of the world.

OBJECTIVES OF THE STUDY

- This study is to find out the factors which encourage WUAs for adopting multi-function vis-à-vis single function.
- The second objective is to prepare the case study of examples of multifunction WUAs in Nepal
- The third objective is to look at the experiences of multifunction WUAs from the examples of other countries like Philippines, Vietnam, Taiwan, Niger, People's Republic of China, Sri Lanka and Eastern European countries.
- Fourthly, policy implications in Nepal for the multifunction WUA.

RATIONAL OF MULTI-FUNCTION WUA

The recent trend is that WUAS are taking up, besides irrigation and water management, other activities as well. They have to engage with the needs of the members for other services. As members of WUAs are engaged in many activities in the farming as well as for domestic work for decent income for themselves and to have a secure and enjoyable living in the community, irrigation and water management are not always the only problem for them.

Members of WUA are working in agriculture. The farming profession needs besides water service, such as supply of farm inputs and credits, transportation and marketing of products, processing of these products, settling of disputes among themselves, receiving services and assistance from outside agencies.

Farmers are also engaged in other economic activities, social undertakings and cultural affairs. These functions and activities are of minor concern. Attention is to be given on agriculture services in order to have farmer's need fulfilled. Many activities in the agricultural profession are done individually by the farm family. Other activities need joint actions of farmers to receive the desired and satisfactory results.

One of the services is water supply to the farm land. It needs cooperation with other water users, joint actions for Operation and Maintenance (O&M) as well as for small repair works. WUAs get established because proper irrigation management is the need of the farmers.

Other functions and activities may be taken up by WUAs because there is a need for such services to the members. This can be due to poor access to services, cost effectiveness of the delivery of services and lower cost to the members. The need for multifunction organization is due to institutional vacuum, increase in viability and profitability, need of leverage, credibility and legitimacy, limited managerial capacity in the village. These extra-services to the members of WUA are for effective agricultural production. How can members of WUA receive these services in time, effectively and sufficiently for agriculture production and marketing of produce? Which major bottlenecks or problems are there to receive these services effectively and sufficiently? Which agriculture services may be organized by WUA jointly and what are the advantages for WUA if they organize these services jointly by themselves? Favorable conditions for a farmer

organization to multi-functional and factors which make it more difficult for WUA to become multi-functional are to be looked into. What support is needed by a WUA?

CONTEXT OF MULTI-FUNCTIONAL WATER USERS ASSOCIATIONS

There are examples of multi-functional water users associations from African and Asian countries. There are reasons for them to adopt multi-function WUA. On the other hand, there are only single function WUAs.

Members of Irrigation Cooperatives in Niger described by Abernethy et. al., 2000, specially those cooperatives which were remote from roads, wanted the organizations to undertake purchase and resale of fertilizers and other inputs. The promoting agency had not anticipated this objective. The financial rules imposed on the organization made it very difficult for them to respond adequately to their member's wishes without risking bankruptcy. A result of this was alienation of the members from the organization and increased dependency of it on the promoting agency.

The objectives selected by the members may commonly be in such areas as input supply, marketing and provision of credit. However, organization may adopt much wider arrays of objectives and consequently multi-functions: fishing, forestry, crop processing, building of community centers, child care facilities, contract farming, transport facilities such as refrigerated vehicles, even hotels can be found among the activities and assets of specific organizations of irrigation farmers. Such examples are usually found from the experiences of People's Republic of China.

However, functional diversification has many risks. Frederiksen and Vissia (1998) warn against these multi-functional activities of irrigators organizations. They have negative view of multi-functional organizations: "the function and skills required for operation and maintenance of water sector services are quite straight forward and quite different from those commercial activities that could earn funds of any consequence. One does not find long established, successful water service entities engaged in activities unrelated to their water sector services".

This is sound guidance but it may not satisfy the present needs, specially in those countries where the private sector is weak or immature. Hence, farmers face real difficulties in some of the areas just mentioned. The problem (such as, Vietnam, that have followed central planning and

control of the economy until recent times and are now endeavoring to foster and active private sector) is that it may to- day seem logical for WUA to enter into a business such as fertilizer supplies. However, in course of time, we should also expect that merchants will appear who will have better business skills and will offer the same or better supply services than the committee of irrigators organization can provide. Hence, some of these diversified activities should be regarded as temporary.

In the newly formed WUAs in Eastern Europe like in Romania, it is proposed to have the formation of multi-function water users association. WUA development activity will include marshalling business support services to help WUAs improve their practices and operations. Over a period of several years, as subsidies to irrigation gradually disappear, WUAs will have to sustain themselves from their members' irrigated production and product marketing. WUA on farm water management is expected to improve the potential to produce for markets rather than subsistence. The support for commercial enterprise activity is expected to increase.

The same logic tells us that the organization will need rules to constrain the freedom of its leaders to engage in such business. Cases have arisen where committees have been so enthusiastic in pursuing the kind of essentially temporary business opportunities just described earlier. In such situation, WUAs would have to commit the finance of the organization's finances heavily. This might result into poor performance of the core tasks of operating and maintaining the water system.

It is important to look at the multi-function of WUA from financial points of view. The classical model of FMIS in Nepal did not have large needs for cash. Traditionally, they would collect fees from members in kind or labor. Office bearers and functionaries such as water guards might be remunerated in terms of quantity of paddy or labor exemption for maintenance. Resource mobilization might mean principally the mobilization of a labor force from among the member households, to repair head works after a flood and to remove silts from channels.

WUAs that are the objects of current management transfer programs often have more complex situation in the financial sense. They may have to meet energy bills every month in pumping systems. They are often expected to raise an irrigation service from their members, and may have to pass a proportion of this to a government agency in return for water

delivery or other services. Their members may demand that they work with banks or others to develop a credit service.

There is a substantial amount of literature about the irrigation service fee and other aspects such as the collection efficiency, the mode of calculation and degree to which an irrigation service fee can cover normal operational costs. But on the other hand, there is remarkably little literature on the question of start up capital that a new organization will require. Often it seems to be assumed that if the fee is computed to exceed the operation costs, a reserve fund will accumulate, and the organization will be able to undertake capital investments of its own after a few years.

This void in the literature is remarkable. A WUA, after management transfer, is a type of business organization and should be evaluated as such. A businessman knows that the excess of income over expenditure, while it is necessary condition of business success, is not sufficient. Without adequate capital, a business will always be weak and struggling and unable to generate enough activity or perform enough services to maintain the support of its own stakeholders. It is just the same with an irrigators organization as with any form of business activity.

The amount of start up capital that such organization need must vary widely and will rarely be as high as in Niger example (because these are pump system in a country where energy is virtually all imported at high cost). Research on these requirements and on the impact of different ways of furnishing them (from government, banks, or members, by loan, grants or share purchase) is an urgent need.

EXAMPLES OF MULTIPLE FUNCTION WUAs

How can WUA get mandate for multi-function activities?

Vietnam

Agriculture Cooperative is also made responsible for irrigation management and water distribution, O&M of the irrigation systems. An Agriculture Cooperative undertakes multiple functions like irrigation management, negotiation with River Basin authority for allocation of water to the irrigation systems, agriculture input supply to the farmers, rice mill operation as business proposition and dealership of fertilizer distribution. On the other hand, such activities are also undertaken by

private shop keepers. However, the shop keepers get the supply from those co-operatives.

China

People's Republic of China has developed a system where water charge collection is done by WUA itself. WUA also plays a role in determining water charge in the sense that it adds a percent to water charge after taking into consideration the O&M and improvement needs of the irrigation sub-system, which is under its management jurisdiction. There is no provision of government subsidy for O&M in China. In order to mobilize the required resources, WUA is allowed to look for number of alternatives for resource mobilization. They are encouraged even to undertake small enterprises for the resource mobilization in order to sustainably manage the irrigation sub-system, and make further improvement therein. Diversified resource generating activities would include raising of fruit trees, operation of fishponds and vegetable farms, and opening of the irrigated area for recreation and entertainment. Desilted clay from the canal for brick making and renting out the agricultural equipment such as tractors are other examples of income generating activities (**Box 1**).

Box 1: Changtang Branch Canal WUA

The Changtang Branch Canal WUA in Tieshan irrigation and drainage district in Hunan Province, which covers 5 villages, 44 village groups, and has 1693 households with 7723 farmers and command area of 6087 mu (405.8 ha.), was established in 1995 immediately after the establishment of China's first WUA in Hongmiao, Jingmen Municipality in neighboring Hubei Province. Nine more WUAs have been established since then and their number is increasing. There is a plan to establish 5 more WUAs to cover the entire command area of the Tieshan northern irrigation canal by 1998. The reported cause for this popular acceptance of WUA include, in addition to the similar benefits as reported by the Hongmiao WUA of Hubei: generation of resources by getting into the diversified economic activities such as operating fish ponds, running a rice mill, provisional goods shop and the renting out a part of WUA office building; expansion of irrigation to parts of dry land; and substantial saving in emergency canal repair cost that farmers used to bear. However, they seek support in terms of lining of their canal and advanced training on on-farm irrigation management, WUA operations and accounting.

Source: Upendra Gautam (1998). Bank Review Mission Report on SIDD Status Hubei and Hunan Provinces in China. The World Bank, April.

Sri Lanka

Sri Lanka has program to make WUA as multi-function organization. Instead of WUA, they have given name as Farmers Organization and tie in the Farmers organization for increasing agriculture production for consumption within the country and at the same time, these farmers organizations have to be capable to interact with environment brought by globalization of economy.

Taiwan

Taiwan has most effective WUA. WUA is effective technically and economically. Extension activities would go through WUAs so it has been effective there. Secondly, WUA has undertaken business activities like operation of the Farmers Bank. Farmers have confidence with the co-workers so they deposited their savings in Farmers bank. They have become even politically powerful because they have accumulated enough deposit in the bank. They even channel their deposit for the investment in the industrial sector.

POLICY ENVIRONMENT FOR DIVERSIFIED ACTIVITIES OF WUA IN NEPAL

- How can policy promote multi-function WUAs?

As of now, WUA is considered as non-entity in Nepal. They are not considered as the organizational resource at the grass root level. It is equally important to know about the environment whether they are allowed to undertake multi-function activities. On many occasions, WUAs are formed by the government only for rehabilitation of the irrigation systems. After rehabilitation, the importance of WUA gradually diminishes. It is also evident from the organization of WUA federation where about 340 government registered WUAs are the members in the National Federation of WUAs. They either ignored the existence of other thousands of FMIS WUAs in Nepal or they do not want to recognize them. This federation is the government sponsored organization. It has government support organizations only.

- Registration Process of WUA

They are registered under Association Act of Nepal

There are other provisions for the registration of WUA. It can be registered at District Water Resources Committee or under the District Irrigation Office under the new Irrigation Regulation. It can be registered under Cooperative Act as well.

Decentralization Act does not recognize WUA at the grass root. It mentions that VDC as well as Municipality and DDC have jurisdiction over the management of the irrigation systems within their geographical areas. There is no provision of users group in the Decentralization Act of Nepal.

- How do other agencies of the government look at WUAs?

The Department of Agriculture does not recognize WUA. They form separate commodity based small groups and extension would be provided through such groups. Even under Second Sector Irrigation Project where provisions were made for agriculture development and budget was allocated in the project for this purpose. The agriculture extension activities were undertaken through the farmers group formation, not through WUA which was formed at the time of rehabilitation. So WUA was forced to confine its activities only on water related activities.

Nepal Food Corporation could be important motivating organization for WUA to undertake multi-function while procuring annual quota of paddy and wheat. They could have fixed a certain level of price and enter into contract with WUAs for the procurement of the amount of food from them. Such approach could bring tremendous change in the activities of WUAs.

Agri-Input Corporation could have developed its network for seed production as well as for input distribution through the Water Users Associations. However, such activity to encourage the multi-function of WUA has not been encouraged.

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