Report on

Training cum Observation

on

Rapid Appraisal Methods and Water Users

Association Activities

International Irrigation Management Institute

March, 1989.

1. Introduction:

1.1 This training was organized in Nepal for the Bhutanese officials of Agriculture Department of Ministry of Agriculture, Royal Government of Bhutan. This training program took place between 20-28 February, 1989.

1.2 During the time of IIMI personnel's visit to Bhutan in June 1988 to establish official relation of IIMI with the Department of Agriculture, it was decided that 8 Bhutanese will be given training in the field of Rapid Appraisal Methods and Beneficiary organization as one of the IIMI-Bhutan programs.

1.3 Hence, this training program was jointly organized by Water and Energy commission Secretariat (WECS) of His Majesty's Government of Nepal, International Irrigation Management Institute (IIMI) and for the officials of Royal Government of Bhutan.

2. Program content.

2.1 The program was divided into three activities.

2.1.1 The first part of the program contains lecture, discussions, slide show and video film on irrigation.

2.1.2 Irrigation issues of Nepal and Bhutan were discussed.

2.1.3 Rapid Appraisal Methods, its rationale, checklist and report writing were discussed in a participatory mode.

2.1.4 Experiences of Water User Association formation, farmer-to farmer exchange program to train the farmers in organizational activities were discussed.

2.2 The second part of the Program was field observation.

2.2.1 Pithuwa Irrigation System in Chitawan District and Tall Kulo, Thulo kulo in Chherlung and Raj Kulo of Argali in Palpa district were observed.

2.2.2 The farmer officials of the irrigation systems gave the briefing on history, physical conditions, management and organization, resource mobilization, operation and maintenance of the system.

2.2.3 Following the discussions, walk through was conducted in order to get the feel of the physical condition of the systems.

2.2.4 The participants were then divided into groups depending on the size of the system to collect information though record book, interview with the officials and farmers.

2.3 Report writing of the systems observed.

2.3.1 Participants were divided into groups to prepare the report in the field itself on the basis of the information collected. Before writing the report, oral presentations were given and discussion among the participants took place either to add further information from other participants or the clarification of the issues.

2.4 The third part of the program was field report preparation. Seven written reports were prepared.Each participant of the program was assigned to present the finding of the observation of the systems.

3 Details of the program is given in Annex.1.

4 Name list of the participants.

Details about the participants were not received until they arrived Kathmandu. Communication between Bhutan and Kathmandu seems difficult. The last telex from Bhutan says that eight participants were to arrive Kathmandu via Calcutta by I.C. 247 on 18 February 1989.

4.1. Participants and their designations.

L.N.Sharma.	Section Officer
Lhapchu	Section Officer
Tempa Gyeltshen	Section Officer
Uygen Duckpa	Section Officer
Rinchen Dorji	Section Officer
Chhophel Dorji	Section Officer
Tashi Dorji	Gup

4.1.1.Mr.L.N.Sharma,Mr. Lhapchu, Mr. Sonam Chogyel,Mr. Rinchen Dorji and Mr. Chophey Dorji are from Irrigation Division of Agriculture Department. They are currently working in the irrigation support cell which was recently established in the Irrigation Division with the objective of providing support service to strengthen the beneficiary organization to take O&M

responsibility of the systems.These five participants from the Headquarters have Diploma in Civil Engineering and work there as Section officers.

Mr. Tempa Gyeltshen,Mr. Uygen Duckpa and Mr. Tashi Dorji come from the district called Tashigang.Mr. Gyeltshen holds Diploma in Civil Engineering,Mr. Duckpa is Agriculture Supervisor and Mr.Dorji is Gup.(Gup is village headman elected by the people but the salary is paid by the government. He has responsibility to look after the irrigation systems as well.) The Royal Government of Bhutan is introducing new program in the district so people working in the district were sent for the program.

4.2. Jiban Bajracharya has been assigned on behalf of WECS to participate in the program and to assist in the training program.His assistance is highly appreciated.

5.Housing of the Participants.

The participants stayed in Gautam Hotel,King's Way, Kathmandu.

5.1.The venue of the training program was the meeting hall of Gautam Hotel.

6.Material Distribution.

6.1.Following training materials were distributed to them on arrival along with the folder and schedule.

6.1.1.Training Program Schedule (Annex 1.)

6.1.2.Prachanda Pradhan. 1988. Increasing Agriculture Production in Nepal: Role of Low cost Irrigation Development through Farmer Participation, IIMI. (Kathmandu) (Annex 2.)

6.1.3. Prachanda Pradhan.1988. Irrigation development in Bhutan, IIMI (Kathmandu) (Annex.3.)

6.1.4. Robert Yoder and S.B. Upadhaya,1987. Reconnaissance/ Inventory study of Irrigation systems in the Indrawati Basin of Nepal in Irrigation management in Nepal, IIMI (Kathmandu) (Annex.4.)

6.1.5. Prachanda Pradhan et.al.1987. Guidelines for Rapid Appraisal of Irrigation Systems Experience from Nepal in Irrigation Management in Nepal, IIMI. (Annex.5.)

6.1.6. Prachanda Pradhan, 1989. Institutional Development of water users Associations.(Annex.6)

6.1.7. N.C. Pradhan, Robert Yoder, 1989. Improving Irrigation System Management: Knowledge Transfer through Farmer to Farmer Training.Examples from Nepal IIMI.(Annex.7.)

6.1.8. Description on Pithuwa Irrigation Project.

6.1.9. Edward Martin and Robert Yoder,1986. Institutions for Irrigation Management in Farmer Managed Systems: Examples from the hills of Nepal, IIMI (Annex.9.)

7. Orientation.

7.1. The participants were met by Prachanda Pradhan in Gautam Hotel. They were informed about the program and what they can expect from the program. They were asked to read the background materials on 19 February 1989.

7.2. They were also informed about the field visit and the gears that they need to buy.

8. Inauguration of the Program.

8.1. The training program started with the inaugural note by Dr.C.K. Sharma, Acting Executive Secretary of Water and Energy Commission.(WECS)

8.2. Dr. Robert Yoder, Head, Field Operations, Nepal informed to the participants the role and activities of IIMI in Nepal.

8.3. Dr. Prachanda Pradhan described the objectives of the program and program details.

9. Beginning of the Training Program.

9.1. Dr. Robert Yoder and Dr. Prachanda Pradhan took the responsibility of initiating discussions according to the training schedule.

9.2. Altogether there were seven discussion sessions besides the video program.

10.Field observation:

10.1. After completion of discussion on methodologies both for Rapid Appraisal and Water Users Associations, five days field trip to observe 4 irrigation systems were organized.

10.2. The irrigation system of Pithuwa represents the irrigation system of tarai.

10.3. Three hill irrigation systems were observed in Palpa district.

11. Report Preparation.

11.1. Participants had discussion on the systems observed.

11.2. They were divided into groups to write sections of report and again in the group to write group report.

11.3. Those reports prepared by the group were processed in the computer and print out was given immediately for correction if they want to do.

11.4. At the end of the day, they prepared 7 reports on the basis of their observation in the field and notes taken during their visit.(Their reports are attached in this report as Annex.10.)

12. Report Presentation.

12.1. On 28 February, the participants assigned among themselves the responsibility to present the report. The last session was assigned for the presentation of the reports. The participants have shown their understanding of the system and confidence on the report during the time of their report presentation.

12.2. The last session indicates the effectiveness of the program and the participants acquired sense of achievement.

13. Departure of the Participants.

The participants departed from Kathmandu for Bhutan via Calcutta on 1 March 1989.Connecting flight from Calcutta to Paro could not be arranged so the participants took responsibility to arrange travel by themselves onward from Calcutta.

TRAINING PROGRAMME

TO STRENGTHEN BENEFICIARY ORGANIZATION : PROGRAMME

FOR THE OFFICIALS OF ROYAL GOVERNMENT OF BHUTAN ORGANIZED BY INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE (IIMI) AND WATER AND ENERGY COMMISSION

SECRETARIAT, (WECS)

Introduction

Bhutan has irrigated agriculture in the terrace fields around valley for many years. These systems were being managed by the farmers themselves. With the process of modernization of agriculture in Bhutan, irrigation development occupied important place in the agriculture development. The First Five Year Plan of Bhutan had the target of providing assistance to irrigation systems managed by the farmers. In 1969, Irrigation Division was established under the Department of Agriculture. Irrigation started to get specialized attention for rehabilitation and improvement. By 1980's several donor agencies provided assistance for the improvement of irrigation schemes. The donors include ADB, UNCDF, WB, IFAD, EEC etc.

Change in the Approach of Irrigation Development

Previous to 1961, there was no assistance to irrigation systems. Since 1961 to 1988, lot of resources were put in to improve and develop the irrigation systems. This has to some extent, rendered the farmers to be dependent on the government resources for routine maintenance and operation of the system as well.

Royal Government of Bhutan has recognized that the farmers through the Water Users Association have to take the responsibility to maintain and operate the system. Draft legislation is being prepared and discussed.

Need of Orientation in the Changing Context

The irrigation employees, farmers and agriculture extension people need to be exposed the process and procedures of functioning of water users association. High level government officials and policy makers are interested to see the water users associations be properly formed and make them functional for better irrigation management.

Proposal for Observation Tour and Training Programme in Nepal

Both Bhutan and Nepal have many similarity in topography and irrigation developments. The observation of some of the irrigation systems run by the farmers themselves would give exposure to the participants on the role and function of the Water Users Association or irrigation organization. Hence, Nepal is selected to be the observation and Training Site.

Objectives of the Observation cum Training Programme

The Objectives shall be;

(a) to be exposed to the irrigation personnel on the Rapid Appraisal

Methodology

(b) to make them capable of collecting information at short period of time

(c) to make them prepare the report on site

(d) to expose the farmers on the organization and function of the irrigation organization. This will be farmers to farmers training programme.

(e) to make the agriculture extension people aware on the water management under different water situation like water scarcity system, water abundance system etc and show the relationship between the crop choice and water availability.

Composition of members in the Group

A group consisting 6 - 8 people is preferred. The group should consist of irrigation personnel, farmers (real farmers) and agriculture extension personnel.

Duration of the Programme

The program shall be of 12 day including field trips, and travel time between Bhutan and Nepal.

Systems to be observed

The systems to be observed shall be of small hill irrigation systems with the exception of one 800 ha system at the foothill in the valley.

Output of the Programme

1) Irrigation personnel will be acquainted to apply Rapid Appraisal Methodology. The acquaintance will help to undertake Rapid Appraisals in Bhutan to understand the variations in the irrigation systems.

2) The farmers will be exposed to what they can and how they can do in managing the irrigation systems. Seeing is believing. The horizontal communication from farmer to farmer will be effective one. These farmers will be resource in future in organizing WUA in Bhutan.

3) The agriculture extension personnel will be exposed on the decision process by the farmers in crop selection. The crop selection process and interaction of WUA in water management will be demonstrated from the field.

Programme Coordination

The programme in Nepal will be coordinated by IIMI/Nepal in consultation with Water and Energy Commission of His Majesty's Government, Nepal.

In Bhutan, the programme will be coordinated by Dasho Tshering Dorji, Superintending Engineer, Department of Agriculture.

Program Schedule

20 February, 1989

(9 Fagun, 2045)

Time 10.00 - 11.00

- Introduction of the program
- Inauguration by Dr. C.K. Sharma, Executive Secretary, WECS.
- Details of the program
- Administrative details/announcements.

Time 11.00 - 12.30	-	Irrigation Development in Nepal - Issues.
Lunch 12.30 - 1.30		
1.30 - 3.00	-	Irrigation Development in Bhutan - Issues. (Slides)
3.00 - 3.30		Tea break
3.30 - 5.30	-	Inventory preparation.

21 February, 1989

(10 Fagun, 2045)

10.00 - 11.00	-	Rapid Appraisal methods/ Rationale procedures
11.00 - 12.00	-	Check list on Rapid Appraisal
12.00 - 1.00	-	Lunch
1.00 - 2.00	-	Report writing
2.00 - 4.00	-	Water users Association: Experiences of IMP in Nepal.
4.00 - 5.30	-	Video Film - Hill Irrigation Systems in Nepal.

22 February, 1989

(11 Falgun)

7.00 AM.	-	Travel to Chitwan
	-	Pithuwa Irrigation System
11.00 AM.	-	Briefing on Pithuwa Irrigation system.
12.00 - 1.00	-	Lunch at Chitwan Hotel

1.00 - 5.00	-	Briefing on Pithuwa by the Members of Management Committee of Pithuwa Irrigation System.
	-	Walk through of the system in the main canal and distributries.
6.00 - 8.00 PM.	-	Discussion on Pithuwa System preparation for Rapid Appraisal/Group formation for information collection.
8.00 PM.	-	Dinner at Chitwan Hotel.

23 February, 1989

(12 Fagun, 2045)

7.00 AM.	-	Breakfast
8.00 AM	-	Information collection in Pithuwa by the participants.
12.00 - 1.00	-	Lunch
1.00 - 5.00	-	Report writing on Pithuwa Irrigation system.
5.00 - 7.00	-	Tour to Institute of Agriculture and Animal Sciences, and Narayanghat Bazar.

24 February, 1989

(13 Fagun, 2045)

7.00 AM.	-	Breakfast
8.00 AM.	-	Travel to Chherlung
12.00 - 1.00	-	Lunch at Sri Nagar Hotel
2.00	-	Trek to Chherlung

25 February, 1989

(14 Fagun, 2045)

8.00 AM.	-	Introduction of Tallo Kulo committee members, walk through and information collection.
12.00 - 1.00	-	Lunch at Thulo Kulo.

1.00 - 4.00	–	Meeting with members, walk through, information collection
4.00 - 6.00	–	Walk to Jorti

26 February, 1989

(15 Fagun, 2045)		
8.00 AM	–	Raj Kulo, Argeli
11.00 AM	–	Lunch at Jorti
12.00 Noon	–	Travel to Kathmandu via Butwal

27 February, 1989

(16 Fagun, 2045)	–	Report writing/preparation for presentation

28 February 1989

((17 Fagun, 2045)		
7.00 - 10 AM	–	Presentation
10.00 - 12.00 PM	–	House Keeping
	–	After Lunch free day

1 March, 1989 (19 Falgun, 2045)	–	Departure

INCREASING AGRICULTURAL PRODUCTION IN NEPAL: ROLE OF LOW COST IRRIGATION DEVELOPMENT THROUGH FARMER PARTICIPATION

BY
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MAY 1988

File-name: FARMER1

INCREASING AGRICULTURAL PRODUCTION IN NEPAL: ROLE OF LOW-COST IRRIGATION DEVELOPMENT THROUGH FARMER PARTICIPATION

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International Irrigation Management Institute
May 1988

INTRODUCTION

Irrigation is one of the important inputs for increasing agricultural productivity in Nepal. This paper attempts to analyze the role of irrigation in agriculture from the perspective of 1) the national targets set in the sector strategy, 2) cost recovery and financing considerations, and 3) improved performance of the systems through farmer participation and management of operation and maintenance (O&M).

There are at least three actors in the irrigation sector: the national policy-making agencies, irrigation agencies, and the users. Each of these actors places different priorities on the objectives of the sector. The policy-making agencies have invested public resources in irrigation systems with the aim of achieving increased and stable production at the national level at a reasonable O&M cost. The irrigation agencies place priority on minimizing agency costs and assuring the economic security, stability, and power of the agency. The users value adequate and reliable water delivery to enable them to achieve increased production which will increase the benefits to the household and decrease household costs (Uphoff 1988:5-6).

The objectives of irrigation development in Nepal from the planning commission perspective are: 1) to achieve increased agricultural production through investment in the irrigation sector; 2) to recover the cost of the investment and have O&M costs borne by the users; and 3) to promote the active participation of the farmers in the management of the systems.

In 1985 His Majesty's Government of Nepal (HMGN) adopted the policy to fulfill the nation's basic needs by the end of this century. One of the effects of this policy has been to further increase the role of irrigation for achieving higher agricultural productivity. Consequently, the National Planning Commission has been investigating the nation's resource base to determine what further investments are necessary in order to fulfill this objective. A note of caution is required here: the development of the water resources of a nation is a long-term policy and program requiring that careful consideration be given to implications that extend beyond the end of this century. There are opinions that investment in rehabilitation and small irrigation systems with short gestation periods will bring positive results. Improvements in the management of the present systems have also been shown to increase the efficiency of the system and, thus, to increase agricultural productivity. Recently, most of the loans in the irrigation sector have revolved around this concept. However, the large scale and long gestation period required for water development projects beyond the year 2000 must not be ignored. Long-term and short-term goals need to be spelled out so that one is not sacrificed for the sake of the other.

OVERVIEW OF IRRIGATION DEVELOPMENT IN NEPAL

Water is one of the primary resources of Nepal. The people have been utilizing the water resources in agriculture through the construction of irrigations systems for many centuries and irrigation development remained in the domain of the people for many years. This tradition gave birth to the farmer-managed irrigation systems (FMIS) scattered all over the country. The contribution of FMIS to the national economy is quite substantial. These systems produce about 50 percent of all rice grown in the country.

Government did not take an important role in irrigation development until recently. The first public sector irrigation system, "Chandra Nahar," was constructed in 1923. Before this period, there were a few "Raj Kulos" having state patronage. In the 17th century King Ram Saha issued an edit that irrigation and its management were the responsibility of the community and conflicts relating to irrigation were to be resolved by the community. Hence, there is a strong tradition of irrigation development and management by the local community.

In Nepal's First Five-Year Plan (1956-61) the existence of FMIS was not even recognized. The existence of farmer-managed irrigation systems in the Nepalese economy was noted only in 1981 (WECS 1981:36-43). Government now realizes that farmer managed-irrigation systems are very important resources for the agricultural development of Nepal.

Nepal's irrigation systems can broadly be categorized into two types based upon where the responsibility for management lies: agency-managed systems and farmer-managed systems. In FMIS, the farmers take the responsibility for water acquisition, water allocation and distribution, and the overall management of the system on a continuous basis. Any external assistance to farmer-managed systems is occasional as specific needs arise. In agency-managed systems government personnel are responsible for the management of the system with varying levels of farmer participation. While the farmers may be responsbile for aspects of O&M, (as in jointly-managed systems), government assistance and presence is ongoing. Approximately 350,000 hectares (ha) are under agency management and 608,000 ha are managed by the farmers. The Agricultural Development Bank of Nepal (ADB/N) has developed about 106,000 ha.[1] Although there has not been agreement on the extent of the area under farmer-managed irrigation, it can safely be concluded that a greater area is under farmer management. It is estimated that approximately 1,700 FMIS exist in the Tarai and over 15,000 of these systems are functioning in the hills of Nepal.

The total cultivated area in Nepal is estimated to be 3.1 million ha.

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1. The Water and Energy Commission Secretariat (WECS) Water Resource Inventory of Tarai District reports the existence of 458,000 ha of FMIS in the Tarai. It is estimated that in the hills of Nepal there are more than 150,000 ha of FMIS. ADB/N has thus far developed 106,000 ha employing different forms of irrigation technology (Gorkhapatra. 29 September 1988:1).

The irrigable area is 1.9 million ha. Out of this area, 1.6 million ha are in the Tarai and 0.3 million ha in the hills. If we combine the farmer-managed systems and agency-managed systems, the total area under irrigation comes to 1,058,000 ha, which indicates that about 33 percent of Nepal's cultivable land is under irrigation. Thirty-three percent of this total area is presently under agency management and 66 percent is farmer managed. It is estimated that 350,000 ha, or only one-third of the irrigated area in the country has perennial irrigation. Others have facilities lasting only one season.

AGRICULTURAL PRODUCTIVITY TARGETS

With the adoption of the policy for the fulfillment of basic needs by the year 2000, two important interrelated targets were set: wheat production will be increased from 1.25 metric tons (mt)/ha to 2.5 mt/ha and paddy from 2 mt/ha to 3.5 mt/ha. The total production per year is targeted for 6 mt/ha which is almost double the amount of the present production level. However, production trends during the late sixties and seventies are not very encouraging. Not until the mid-eighties has there been some improvement in paddy production (see Table 1, Average yield of major crops during 1960s, 1970s, and 1980s).

Table 1. Average yield of major crops in metric tons per hectare (mt/ha) during the 1960s-1980s.

Crops	1961/62-1970/71 (mt/ha)	1971/72-1980/81 (mt/ha)	1986/87 (mt/ha)
Rice	1.92	1.88	2.03
Wheat	1.20	1.14	1.24
Maize	1.89	1.69	1.33

Source: Department of Food and Agricultural Marketing Services 1988.

Looking at productivity by district, 69 districts produce about two metric tons of paddy per ha. (See Table 2, Ranking of districts by paddy production.) Only six districts have higher production; Kathmandu, Bhaktapur, and Lalitpur top the list, producing between 4-5 mt/ha. There are reasons for this: the Kathmandu valley has access to more agricultural inputs and markets, extensive irrigation facilities, and productive soil. The higher productivity of the Kathmandu valley highlights the fact that irrigation alone is not sufficient to increase productivity but irrigation is a contributing factor, provided other conditions are also available.

Table 2. Ranking of districts by paddy production in 1987/88.

No. of Districts	Range of mt/ha	Districts with high paddy yields	Area (ha)

46	Less than 2 mt/ha	-	-
21	2-2.50 mt/ha	-	-
1	2.50-3 mt/ha	Parsa	46,320
2	3-4 mt/ha	Chitwan, Bara	28,500 + 56,980
3	4-5 mt/ha	Kathmandu, Bhaktapur, Lalitpur	10460 + 5190 + 4590
2	No paddy production	(Manang & Mustang)	-
TOTAL	-->	-->	152041 ha 10.68 percent

Source: Department of Food and Marketing Services 1988.

Increases in the area brought under cultivation was the primary way in which productivity was increased.

Another important target in the effort to achieve the fulfillment of basic needs is to bring an additional 853,835 ha under irrigation. The World Bank estimates that to maintain the present rate of food consumption, Nepal needs to bring an additional 35,000 ha under irrigation each year just to keep up with population growth. The target of providing irrigation facilities to an additional 853,835 ha by the end of this century means an additional 65,679 ha must be brought under irrigation each year. (See the graph showing the trend of achievement in irrigation.)

The major agency in irrigation development is the Department of Irrigation (DOI). Performance during the past 30 years indicates that the DOI has developed irrigation facilities for up to an additional 10,000 ha each year. According to DOI reports, the Department brought an average of 18,000 new ha per year under irrigation between the years 1975-87. (See the bar chart of annual achievement of irrigation in Nepal.) To meet the target objective of irrigating 65,679 additional hectares each year will require that the irrigation agencies receive substantial support and appropriate policies and mechanisms to mobilize the people's participation and resources must be implemented.

Table 2a. Area, production, and yield of principal food grains.

Food Grain	Year	Area (ha)	Production (mt)	Yield mt/ha
Rice	1984/85	1,376,860	1,709,430	1.97
	1987/88	1,465,640	2,981,780	2.03
Maize	1984/85	578,720	819,150	1.42
	1987/88	673,810	901,500	1.34
Wheat	1984/85	449,960	519,960	1.16
	1987/88	596,640	744,090	1.25
Millet	1984/85	134,370	124,430	0.93
	1987/88	164,770	150,130	0.91

Source: Department of Food and Agriculture Marketing Services 1988, and HMGN, Ministry of Finance 1985.

The Sectoral Lending Strategy paper prepared by the Department of Irrigation cites the goal of developing irrigation facilities for 463,985 more hectares through sectoral lending by the end of the century (DOI 1988). Out of this, 99,000 ha of existing FMIS will have improvements. The ADB/N is assigned the responsibility of developing 226,950 ha through shallow tube wells and community irrigation schemes. The remaining 162,900 ha will be developed through implementation of large irrigation schemes.

Table 3. Irrigation development targets for the sector lending program.

Region	7th Five-Year Plan (1985 - 1990) (ha)	8th Five-Year Plan (1991 - 1995) (ha)	9th Five-Year Plan (1995 - 2000) (ha)	Total
Eastern	28,935	54,000	27,000	109,935
Central	20,940	34,400	32,000	87,340
Western	24,065	50,100	37,000	111,165
Mid-Western	11,700	35,000	25,100	71,800
Far Western	22,245	36,000	25,500	83,745

TOTAL	107,885	209,500	146,600	463,985

Source: Department of Irrigation 1988.

With the recent reorganization of the irrigation-related agencies, major responsibility for irrigation development activities is given to the Department of Irrigation. The ADB/N engages in promoting irrigation facilities in the private sector through loans. About 25 percent of the irrigation sector's total target for the next 12 years will be undertaken by the ADB/N.

POTENTIAL FOR IRRIGATION DEVELOPMENT IN NEPAL

Surface and underground water are available for irrigation development in Nepal.

Surface irrigation. Surface irrigation has been the practice in Nepal. Both agency and FMIS are surface irrigation systems. Appendix 5 gives details of the productivity of irrigation systems in Nepal.

In the sectoral program, the rehabilitation of farmer-managed irrigation systems is also identified as a potential area for investment that may provide a quick return. However, several questions need to be answered before embarking on a large-scale rehabilitation scheme for FMIS. Some of the questions are: 1) What should be the objectives? 2) How can rehabilitation be best achieved? 3) Who can do it best? 4) How would the farmers be involved? 5) What factors inhibit farmer participation? Some of these questions will be reexamined in the later section on institutional development.

Ground water utilization for irrigation. There have been several studies on the potential for ground water development for irrigation in the tarai regions in Nepal.

Both shallow tube wells (STW) and deep tube wells (DTW) are installed in tarai regions. By 1986, the ADB/N and other agencies had installed over 14,000 STW units in the Tarai and about 17,000 ha receive irrigation water from DTW in the Tarai. The total potential of ground water for irrigation has yet to be fully explored.

The ADB/N is planning to install 74,000 units of STW in the Tarai by the year 2000. The Ground Water Development Board is also exploring the possibility of expanding DTW and conjunctive use of ground water (World Bank 1987:8-32).

The same study suggests that the per hectare cost for developing STW is between Rs 4,000-6,000 (US$ 200-300) and the per hectare cost of DTW is approximately Rs 21,000 (US$ 1,050) at 1986 prices.

The potential for increased ground water irrigation needs further exploration because it provides services quicker, promotes the participation of the beneficiaries both in cost sharing and management, and has tremendous potential for improving cropping intensity, agricultural productivity, and expansion of irrigated area.

Current HMGN policy gives priority in irrigation development to low-cost projects of short gestation period that do not create a heavy recurrent cost burden. In this context, World Bank reports indicate that the most attractive option is offered by STW development by the private sector with support from an institutional credit system. In this program, small farmer ownership of the facilities has to be encouraged. However, deep tube well systems would be jointly managed by the agency and beneficiaries. A higher subsidy level may be required to encourage investment by the small farmer groups. Compared with capital investments in all public sector irrigation development which are wholly subsidized, these subsidies would be very small on a unit area basis (World Bank 1987:44-45).

COST RECOVERY ISSUE

Cost recovery is an important issue in financing irrigation systems. Most of the irrigation systems are financed through loans to be paid over a period of time. There are two types of cost recovery: direct and indirect. Direct cost recovery collects the charges or tax directly from the beneficiaries. Costs may be indirectly recovered through a land development tax or increases in land revenues. In Nepal, cost recovery has been considered only during the time of loan negotiation when donor agencies express their concern for recovering the costs of the investment. The financing of irrigation development in Nepal has been basically from external resources through loans as compared to grants. (See Table 4, Foreign aid in the irrigation sector in Nepal.) Since dependency on external resources is very high, Nepal must develop a policy which will enable it to recover the costs of expenditures in the irrigation sector so that the loans can be repaid.

Table 4. Foreign aid in the irrigation sector in Nepal (reported in Rs in millions[a]).

Fiscal Year	Grant	Loan	Total Amount	Grant Percentage	Loan Percentage
1975/76	1.3	22.7	24.0	5.4 %	94.6 %
1976/77	7.5	28.7	36.2	20.7 %	79.3 %
1977/78	16.9	29.3	46.2	36.6 %	63.4 %
1978/79	46.9	75.0	121.9	38.5 %	61.5 %
1979/80	54.3	78.7	133.0	40.8 %	59.2 %
1980/81	41.9	106.8	148.7	28.2 %	71.8 %
1981/82	54.2	146.5	200.7	27.0 %	73.0 %
1982/83	133.7	134.2	267.9	49.9 %	50.1 %
1983/84	87.9	249.6	337.5	26.04%	73.96%

1984/85	154.8	294.4	449.2	34.5 %	65.5 %
1985/86	103.3	473.9	577.2	17.89%	82.11%
1986/87	59.7	455.0	514.7	11.6 %	84.4 %
TOTAL	762.4	2094.8	2857.2	26.68 %	73.31 %

[a]US$ 1.00 = Rs 24.00 in 1988.
Source: HMGN, Ministry of Finance. 1987/88:62-63.

Water fees are fixed but the collection rate is very low. In some cases, the collection cost is higher than the actual fees collected (Pradhan 1985:71-77). Even the O&M of the completed systems are subsidized by the government. It has been proposed that at least the O&M contribution be collected from the beneficiaries. This requires institutional rearrangements to transfer O&M responsibilities to the farmers.

The cost recovery issue is concerned with the cost of development of the system. The cost requirement per hectare for irrigation development varies, depending upon the agencies involved and the type of irrigation system developed. The Department of Irrigation in the Sectoral Lending Strategy paper suggests a cost of Rs 50,000 per hectare for medium and minor irrigation development and Rs 5,000/ha for the rehabilitation of farmer-managed irrigation systems.

In the irrigation sectoral program, ADB/Manila took responsibility for irrigation development in the central and eastern regions of Nepal where it estimated a cost/ha of Rs 30,000 for the Tarai and Rs 60,000 for hill systems.

The experiences of the ADB/N and Farm Irrigation and Water Utilization Division (FIWUD) in gravity irrigation systems indicate that with the farmers' participation, irrigation systems have been developed at a per hectare cost of around Rs 5,000/ha to Rs 15,000/ha (US$ 250-750 at the 1986 exchange rate).

The cost aspect becomes an important issue when one talks about the enormous acreage to be developed in 13 years. Will the very high cost/ha encourage the farmers in general to participate in irrigation development? Will the government alone be able to pay the cost of expensive irrigation development? Examples from other countries have indicated that giving the farmers loans for the design and construction of irrigation facilities has tremendously reduced the cost/ha of irrigation construction.

The cost recovery issue raises a number of questions needing resolution: What kind of development is expected? How much infrastructure is necessary per hectare? How can the investment on high-cost structures be balanced with the reliability of water in the system?

Table 5 reports the funding requirements designated in the Sector Loan Plan according to scheme. The Sector Lending Strategy paper defines small-scale projects as irrigation systems of 50 ha or less in the hills and 500 ha or less in the Tarai. Medium-size projects include systems of 50-510 ha in the hills and 500-6,000 ha in the Tarai. Projects covering hill systems over 510 ha and Tarai systems larger than 6,000 ha are defined as large-scale (Department of Irrigation. 1988.)

Table 5. Funding requirements under the Sector Loan Plan, according to scheme (reported in Rs in millions[a]).

Scheme	Seventh Plan (1985-1990) New Area to Irrigate (ha)	Cost	Eighth Plan (1990-1995) New Area to Irrigate (ha)	Cost	Ninth Plan (1995-2000) New Area to Irrigate (ha)	Cost
Minor and Medium Irrigation Schemes	71,175	3558.75 (Rs 50,000 per ha)	1,23,500	6,175 (Rs 50,000 per ha)	84,600	4,230 (Rs 50,000 per ha)
Improvement of FMIS	24,000 (Rs 50,000 per ha)	120.00	50,000	250 (Rs 50,000 per ha)	25,000	125 (Rs 5,000 per ha)
Ground Water						
(I) STWs	10,000 (Rs 9,000 per ha)	90.00	26.000 (Rs 9,000 per ha)	234	27,000	243 (Rs 9,000 per ha)
(II) DTWs	2,710 (Rs 25,000 per ha)	67.75	10,000 (Rs 25,000 per ha)	250	10,000	250 (Rs 25,000 per ha)
TOTAL	107,885	3,836.50	209,500	6,909	146,600	4,848

[a]US$ 1.00 = Rs 24.00 in 1988.
Source: DOI 1988.

In order to increase production through irrigation, FMIS must be considered as a valuable resource upon which the nation can capitalize. Many FMIS could increase their production if provided with appropriate assistance for structural or managerial improvements. However, farmer-managed irrigation systems have a tradition of mobilizing resources from within their communities. The resource mobilization methods of these systems need to be better understood before undertaking a rehabilitation assistance program. An appropriate assistance strategy that provides external support as needed but encourages the farmers to continue to manage their systems should be formulated. (For a description of resource mobilization in FMIS see Appendix 2.)

CHOICE OF PROJECTS

The emphasis on small- and medium-scale irrigation systems focuses on immediate return and results on investment. Water resource development needs to be considered from a long-term perspective. The choice of projects should no longer be supply driven by funding from donor agencies. The Sector Loan Strategy clearly states that the selection of irrigation schemes for assistance must be determined on a demand driven basis, in accordance with the needs of the country and the beneficiaries.

Effort needs to be made to mobilize internal resources and gradually build up the schemes which will serve posterity after 20-30 years. If we cannot embark on this line, Nepal will be only the water course for big rivers, but Nepal will not have right to use them. The nation needs to harness its water resources using its own resources. This requires a new strategy for resource mobilization from within the country and outside the country.

Looking at resources allocated between the development budget and the regular budget in the irrigation sector, 99 percent of the budget is allocated under development. Table 6 provides the figures for expenditures in irrigation allocated through each of these budgets.

Table 6. General and development expenditures in irrigation in Nepal.

Fiscal Year	General Expenditure (Millions of Rupees[a])	Development Expenditure (Millions of Rupees)
1974/75	1.8	74.0
1975/76	1.7	98.1
1976/77	2.2	127.4
1977/78	4.3	142.1
1978/79	3.9	226.3
1979/80	2.4	232.7
1980/81	3.2	288.2
1981/82	3.6	359.6
1982/83	4.7	487.4
1983/84	5.1	545.3
1984/85	5.8	652.2
1985/86	6.2	846.7
1986/87	6.9	846.8
Total	51.8	4926.8
Percent	1%	99%

[a]US$ 1.00 = Rs 24.00 in 1988.
Source: HMGN, Ministry of Finance 1988:56-58.

Ninety-nine percent of the government's expenditures in the irrigation sector in the country comes from the development budget. In any plan period, 60-70 percent of the development budget comes from donor funds, hence, irrigation development and its regular maintenance is heavily dependent on external resources. There is a world trend of decreasing investment in the irrigation sector and Nepal will not be excepted from the effects of this trend. This will have an adverse effect on the whole program of basic need fulfillment if Nepal is not careful. Furthermore, few resources have been available for operation and maintenance of systems as compared to funds available for the creation of new infrastructures. These issues raise the questions of not only how to mobilize external resources, but also how to mobilize internal resources to keep the system productive after construction.

As much as possible, loan money should be used to bring presently unirrigated areas under irrigation. Unless we enter into the development of new areas, we will be investing money in areas where irrigation systems already exist. For example, the East Rapti Irrigation Project has several components including the installation of irrigation facilities for about 9,500 ha (ADB 1987). The command area of this project happens to be in the area where there are already a substantial amount of FMIS,[2] therefore, the net new irrigated area to be developed might be very nominal. The people in this area might benefit from improved rural roads or river training but not from bringing a large, previously unirrigated area under irrigation.

What could be an alternative investment area? What policy shifts regarding investment are required, keeping in mind the objective to fulfill basic needs? One argument against investment in rehabilitation is that this provides greater opportunity for increased production to the section of the population that is comparatively better off already. Irrigation facility means access to higher productivity with improved seed and fertilizer. The Rasuwa/Nuwakot rural development program impact indicates that the World Bank-funded Rasuwa/Nuwakot Project helped the farmers of the river valleys more where they have access to irrigation. Equity considerations need to be considered. Why not go to new areas? Technology appropriate to providing irrigation facilities to new areas and to less privileged people needs to be developed. Along with the fulfillment of basic needs, extension of the means of production to the less privileged should also be considered in the selection of projects.

UNIFORM POLICY IN SMALL-SCALE IRRIGATION DEVELOPMENT

Two agencies are directly involved in small-scale irrigation development: the ADB/N proposes to promote irrigation development through private initiatives, and the Department of Irrigation provides grants for irrigation development. ADB/N makes financing available to the individual or

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[2].About 55 farmer-managed irrigation systems with high productivity and water users organizations functioning were identified within this command area. See Khatri-Chhetri, T.B. et al. 1987.

individuals through loans.

Keeping in view the overall strategy for irrigation development, a uniform policy enforced by both the Department of Irrigation and ADB/N would be useful. The uniform policy should provide for the following:

1) Beneficiary participation should be made compulsory in the identification, design, development and maintenance of a system.

2) The grant/loan ratio needs to be uniform irrespective of the implementing agency.

3) Irrigation development activities should be undertaken through a water users' group in which all beneficiaries hold membership.

4) A minimum size command area or the number of beneficiaries qualifying for assistance needs to be specified with the objective of providing benefits to a larger group of people.

5) The willingness of the beneficiaries to contribute labor/cash should be considered.

6) A ceiling for grant/loan assistance must be fixed based on either the total amount or per hectare cost.

7) The responsibility of the district or the regional office must be spelled out regarding the amount of resources that can be spent for particular projects.

INSTITUTIONAL REARRANGEMENT FOR IRRIGATION DEVELOPMENT IN NEPAL

At present one of the issues in irrigation development is how to bring technical and institutional development together. For the last 30 years irrigation agencies have focused on the technical questions of construction of systems. Limited attention was given to strengthening and developing institutional and management capacity through water users associations and the participation of the farmers in irrigation management. Institutional development aims at improvement of the systems through farmer participation. One of the major thrusts of the 1988 Sectoral Loan Strategy is to promote the participation of the farmers during the identification, construction, and O&M of the system.

The institutional development question hinges on the legalization of water users associations (WUA), farmers sharing responsibility for O&M of the system, establishment of a water fee collection mechanism, and for some systems, joint management or transfer of management responsibilities from the agency to the farmers. This implies that a new relationship must be established between the agency and the water users. Government must assume a supportive role and convince the beneficiaries that by sharing the responsibility for O&M they are assured of a more reliable water supply because they have more control over their system.

Water user associations do not have legal status. They cannot enter into any meaningful interaction with the agency. There has been a recent realization that in order to promote the participation of the farmers, legal status must be given to the water users associations.

Besides legal recognition for water users associations, there is a need to organize and train the farmers to make the association functional. The formation of functional water users associations requires the dedication of agency time and energy. Not only is there a need to educate the irrigators to achieve a viable irrigation organization, but agency technical support staff have to accept the WUA as resources for better management of systems.

A national policy to promote the participation of the farmers in the design, construction, and O&M of the system needs to be established. Policy-level officials must be committed to such a policy.

REORGANIZATION OF IRRIGATION AGENCIES

The Department of Irrigation has been reorganized with the provision of five Deputy Director Generals to look after specific division activities. These are: 1) Small Irrigation and Water Utilization Division, 2) Large and Medium Irrigation Division, 3) Ground Water Division, 4) Planning and Management Division, and 5) River Training and Environmental Division.

The irrigation development responsibilities of FIWUD (Agriculture Department) and the irrigation activity responsibilities of the Panchayat and Local Development Ministry is amalgamated in the Department of Irrigation. ADB/N is given greater responsibility for irrigation development. Previously, ADB/N activities were confined only to small farmer development projects (SFDP). With the reorganization of the irrigation agencies, ADB/N can undertake activities throughout the districts and it does not have to confine its activities only to SFDP.

The Regional Directorates, five in number, are strengthened to provide technical assistance and supervision to the District Offices.

District Irrigation Offices (DIO) were established in 70 districts. Wherever the Regional Directorate is located, it functions as the District Irrigation office as well. The DIO has the responsibility of carrying out the principles of the Decentralization Act. It is responsible for undertaking feasibility studies, construction and implementation of district-level projects once they have received approval, river training, and organizing the beneficiary groups to manage the irrigation systems after completion.

The District Irrigation Office also provides assistance for repair, rehabilitation, and improvement of farmer-managed irrigation systems. In doing so, local resources will be mobilized and the participation of the beneficiaries will be promoted (Gorkhapatra 11 May 1988).

The irrigation sector is going through a rapid transformation from a construction to a management orientation. However, the transition will take some time and a 140 percent increase in the 1988/89 budget has again forced the Department to give priorities to construction activities because evaluation of the Department and its personnel is based on the amount of project expenditures made. Construction of infrastructure usually costs more, therefore compelling the Department to give more emphasis to this aspect with the result that management development and other lower cost alternatives receive little attention. Nevertheless, if the irrigation sector is going to achieve its target growth and then sustain the O&M of the expanded irrigated area, policy directives and resources must be directed to encourage the participation of the beneficiaries and a management perspective for the DOI.

There are several unconventional types of projects in the DOI. They are the Irrigation Master Plan and Irrigation Management Project. Both these projects aim at strengthening the capacity of DOI to respond to the new challenges mandated by the new government policy.

The Irrigation Management Project (IMP) is based on the premise that better management of already-developed systems will produce faster benefits than will the development of new, larger schemes. This suggests that improved management of already-developed medium and small systems will help develop irrigated agriculture in Nepal.

"To maximize gain in overall agricultural production, top priority should be given to improving operation and maintenance in irrigation systems which are government operated. This means working both with irrigation department managers and with groups of farmers who manage water at the tertiary levels of the government systems" (Svendsen, et al. 1984:vi).

Under an agreement between HMGN and the USA, the Irrigation Management Project came into existence. It created two important elements for better management of the irrigation systems: the System Management Division (SMD) and the Irrigation Management Center. The System Management Division's mandate is to devise and monitor improved O&M methods. For the first time, a division has been created under the DOI that is responsible for issues related to irrigation system management. The Irrigation Management Center has the mandate to train irrigation personnel and undertake applied studies in order to improve the quality of training and provide input in decision-making.

Sirsia-Dudhaura at Parwanipur was selected as the pilot site for the application of the irrigation management system. A water users association and water user groups were formed among the beneficiaries and farmers were regularly consulted in structural improvement activities. Both physical and non-physical improvements took place in the system. Many useful lessons have been learned from this exercise at the Sirsia and Dudhaura systems.

The Sirsia-Dudhaura farmers organized themselves to clean about 32 km of field channels within the command area. After many years of neglect, the increased volume of water available from the clean canal helped to decrease water-related conflicts, improve the reliability of water, and allow a greater area of wheat to be irrigated than in the previous year. Better communications were also established between the farmers and agency personnel.

This project suggests that non-physical aspects such as organizing the farmers in an association and including them in the management of their system are very important. The project sent association organizers (AOs) to the field to promote the formation of WUAs. The AOs work as facilitators, catalysts, and links between the agency and the farmers. After formation of a WUA, the association organizers are moved out of the system. The Sirsia-Dudhaura system is going through the process of being jointly managed.

In addition to this joint-management exercise, IMP is experimenting with the turnover of the system at Hadetar from agency management to management by the beneficiaries.

There are systems of 100-200 ha which are being managed by the agency that can be handed over to the farmers for management. The farmers have proven on many occasions that they are capable of managing even larger FMIS. In order to activate this program, legal provisions and procedures need to be established to identify the candidate systems and work out the process of handing over the system.

The DOI has to work in two fronts at present in order to achieve the objective of fulfilling basic needs. It is true that only addition of new hectarage under irrigation is not going to increase agricultural productivity. Programs need to be worked out to improve the management of the existing systems as well. Examples from many countries have proven that non-physical improvements in irrigation systems have contributed to increased agricultural production. This raises the question of how the DOI can establish a responsive management system in the already-developed area. Farmer participation must be instituted in order to achieve better management, cost sharing, and resource mobilization. The approach of the DOI must balance construction activity and non-physical improvements.

RESEARCH EFFORTS

There has been little research on physical, hydrological, or social science aspects of irrigation systems in Nepal. Interaction between national research institutes and the irrigation agency needs to be established and a strong relationship encouraged so that research findings can be transferred and applied. Research activities of the Institute of Engineering (IOE), Institute of Agriculture and Animal Sciences (IAAS), Centre for Economic Development and Administration (CEDA), and Agriculture Projects Services Centre (APROSC) should be coordinated with the needs of the irrigation sector of Nepal. At present there is no dialogue between these research agencies and implementing agencies.

The International Irrigation Management Institute (IIMI) is undertaking research activities in collaboration with the Water and Energy Commission Secretariat (WECS). One of their research activities is to identify appropriate procedures for assisting farmer-managed irrigation systems in the country. This action research has relevance in the Nepal context because over 60 percent of the irrigation systems are farmer managed and many could benefit from some government assistance. An inappropriate assistance procedure might make them dependent on the government, hence, care must be taken to learn how these systems might be best assisted without hindering their capacity, organization, and work procedures. HMGN must encourage the research institutes to participate in important research activities relating to irrigation.

PROMOTING FARMER PARTICIPATION IN AGENCY-MANAGED IRRIGATION SYSTEMS IN NEPAL

At the policy level, there has been frequent reiteration that farmer participation is to be encouraged in the management of irrigation systems. Directives issued by His Majesty the King Birendra also emphasize beneficiary participation in irrigation system management. However, there are many intrinsic factors that inhibit the promotion of the farmers' participation.

The number of farmer-managed systems in Nepal that have informally organized water users groups runs in the thousands. There is a long tradition of these informal groups performing the important functions for irrigation on their own. Government has to be careful to safeguard the potential and resources of the people and provide the legal support that will make it possible for them to continue to function, perhaps more effectively. In order to promote WUA and farmer participation in management, the following concerns should be carefully considered and action taken to promote a positive environment that will capitalize on the farmers as a resource:

1) Institutional and technical development must relate to each other. Engineers have to help develop the institutional strength of the farmers. This requires reorientation of engineers to accept the farmers' organization as a resource for better management of the irrigation system. Lessons learned from Sirsia-Dudhaura and the WECS/Ford project in Sindhupalchok provide methods for encouraging farmer input during survey, design, construction, and monitoring of progress.

2) The present accounting procedure and contract provisions enforced whenever government aids a project discourage the active and organized participation of the farmers. The farmers are allowed to work as individuals but not as an organized group during irrigation construction activities. If the farmers are encouraged to organize for structural improvement activities they would learn valuable lessons which would help prepare them to manage the responsibility of O&M. The deployment of association organizers to organize the farmers into water users associatioins is not sufficient for achievement of effective participation of the farmers in system management. Changes in accounting and contracting procedures also need to be made, and an innovative approach is necessary.

3) There is no legal recognition of the WUAs so they are not allowed to participate actively. This is the case both in FMIS and agency-managed systems.

4) Dialogues are initiated between the agency and organized groups of farmers but there is no way to implement or enforce any agreements reached between them.

5) Frequent employment of outside contractors for the essential structural improvements weakens the farmers' interest in participation. Outside contracting does not provide them opportunity to learn management skills as a group of farmers or as association members. Hence, essential

structural improvement should be part of the process for promoting participation.

RECOMMENDATIONS

Two sets of recommendations regarding agency-managed systems and farmer-managed systems are given below. They are the recommendations prepared by IIMI staff and presented at the Irrigation Sector Coordination Meeting of February 1988. They are valid recommendations worth considering for long-term planning for irrigation development in Nepal. (Only the outline of the recommendations is presented here.)

RECOMMENDATIONS FOR ORGANIZATION AND MANAGEMENT OF GOVERNMENT SYSTEMS

Options for Agency-Managed Systems

1. Increase the level of farmer participation in joint management of large systems, and insure that agency staff and farmers each have specifically defined O&M tasks.

2. Turn over ownership and management of small systems to farmer organizations.

3. Shift from an administrative to a management mode in large systems.

Recommendations for O&M in Jointly-Managed Systems

4. Routine maintenance should be considered a part of operation and separate from emergency or catastrophe maintenance.

5. A mobile team and a centrally-funded budget should be established to respond to catastrophes.

6. Farmers should be given the major responsibility for O&M.

7. Effective farmer organizations need to be formed including federation of field channel groups at the sub-system and system levels.

8. Define water allocation and monitor the water distribution system as a management tool as well as a basis for mobilizing resources from farmers.

Recommendations for Resource Mobilization in Jointly-Managed Systems

9. The cost of O&M should be borne by the beneficiaries.

10. All irrigation service fees paid by farmers should be locally retained for use in the system in which they are collected.

11. Farmers should have the option of paying fees in cash or kind.

12. All accounts and transactions should be open for inspection by farmers and agency staff.

RECOMMENDATIONS FOR FARMER-MANAGED IRRIGATION SYSTEMS

Since irrigation systems constructed, operated, and maintained by farmers account for the major portion of irrigated agriculture in Nepal, and conservative estimates indicate that production from FMIS is feeding over 30 percent of Nepal's population, the farmer-managed irrigation sector deserves due consideration. The contribution of FMIS to the basic needs of the country is already high but it can be increased further if carefully conceived and implemented government assistance would be provided to strengthen the infrastructure and farmers' management. In both the hills and Tarai farmers are facing increasing difficulty in operating their systems due to deforestation and government policies protecting forests. Furthermore, as the nation seeks to bring increasing areas of new lands under irrigation, government resources will be insufficient to cover operation and maintenance costs. To compensate, the DOI needs to integrate the participation of the farmers at appropriate levels in the management of irrigation systems. Investment in strengthening FMIS to increase their productivity can be achieved at a cost lower than that of agency management. The following are recommendations concerning farmer-managed irrigation systems. (Refer to Appendix 1 for a detailed description of FMIS. Appendix 3 provides the rationale for each of the recommendations outlined below.)

Recommendations to Give Appropriate Recognition to FMIS

1. Provide legislation that establishes the legal identity and rights of the beneficiary groups operating irrigation systems.

2. Identify existing FMIS in the area of each new agency project and incorporate their physical and organizational structure into the system with minimum disruption.

Recommendations for Providing Assistance to FMIS

3. Establish uniform assistance policies for each geographical region of the country.

4. Systematically identify all FMIS in the country on a watershed basis by making an inventory that establishes a database giving pertinent details about each system.

5. Establish criteria for selecting systems for assistance.

6. Enable beneficiaries to improve the effectiveness of operation and maintenance activities in their system and to fully participate in any physical improvements that are made by providing assistance in strengthening their organizational and management capacity.

7. Beneficiaries should be encouraged to take responsibility in assisting with selection of the design and in implementation of physical improvements that are to be made to their system.

8. The design process for improvements to FMIS should be simple and

field based.

Recommendations for Administrative Reorientation

9. Assistance to FMIS should be in the form of loans (subsidized to the extent necessary) instead of grants.

10. A division should be established in the Department of Irrigation responsible for assistance to FMIS.

11. All levels of DOI staff dealing with FMIS need orientation and training to be able to implement a participatory approach to assisting these systems.

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APPENDIX 1

NATURE AND CHARACTERISTICS OF FARMER-MANAGED IRRIGATION SYSTEMS IN NEPAL

The limited functions of the government and the tradition of non-intervention in irrigation water management at the community level for hundreds of years led to the development of farmer-managed irrigation systems in Nepal. Over 60 percent of irrigated agriculture in Nepal is covered by farmer-managed irrigation systems. By and large, these systems are autonomous, self-governing entities.

The role and functions of farmer-managed irrigation organizations differ according to the type of system: hill irrigation systems, river valley irrigation systems, and tarai systems. The physical characteristics influence the intensity of a particular task to be performed by the irrigation organization.

Size of FMIS. Farmer-managed irrigation systems are not restricted to small units. Systems as small as 10 ha to as large as 15,000 ha have been identified in the country.

Irrigation tasks performed by FMIS. By and large, irrigation organizations perform water acquisition, water allocation and distribution, resource mobilization, system maintenance, and conflict resolution tasks. These are interrelated irrigation tasks. However, the level of organizational sophistication differs in accordance with the type of task to be performed by the organization.

Organizing forces. The force to keep the organization functioning does not necessarily depend on the performance of all tasks. The organization might be forced to come into existence and continue its existence only for the performance of one or two tasks. For some systems, water distribution alone might be the cementing factor for organization and in others, it might be only resource mobilization, while yet in other systems, the preservation and safeguarding of water rights at the source might be the compelling force. However, irrigation tasks might be performed through contractual arrangements employing other people. Hence, the cementing factor for organization in each system differs.

An irrigation organization comes into existence to perform certain tasks for making the system work. However, the organization may also degenerate and disorganize or change its role when change takes place in the resource endowment within the environment of the system. In one system, seepage water from another irrigation system built in the upper reach supplemented water to the main canal; this extra resource--water in the system--made resource mobilization of labor or cash unnecessary. Previously, the irrigators' organization had to organize for water acquisition and when this was no longer a major task the organization gradually degenerated.

In another system, access to a road and movement of the young people in search of opportunities elsewhere prompted distribution of water and maintenance tasks to be carried out through contractual arrangements. Cash contributions instead of labor contributions were required to obtain the contractual services. This has changed the whole complex task of labor mobilization for maintenance.

Irrigation systems in Nepal are geared for paddy cultivation and management of irrigation is intense for this season. Most of the committees are active from July to August. After paddy harvest, many of the irrigation organizations become inactive. During the winter season the farmers act individually or in small groups to divert water to their fields as needed with little involvement of the system's irrigation organization.

Flexibility to respond to changes and needs. The intensity of the task that an irrigation organization has to perform is sensitive to the environment. Change in one environmental factor, whether physical or socio-economic, influences how that task is performed by the organization. Farmer-managed organizations are flexible, tailoring their methods for water acquisition, labor mobilization, and water allocation and distribution to the needs of the farmers.

Farmer irrigation organizations can be the result of deliberate government efforts to establish such organizations. There are also examples where farmer irrigation organizations came into existence because of government neglect of the system: In Pithuwa water used to be delivered by government employees. Since the government was in charge of the water resource the individual farmers believed there was no harm in extracting more resources from the government. This situation created anarchy in the system. Some enlightened farmers thought of organizing themselves to achieve an equitable distribution of water. As the farmers organized they came to regard the irrigation resource as community property. This transformation in the concept of property helped to form the farmers' irrigation organization in Pithuwa. Government did not play any role in this process.

Characteristics of Farmer-Managed Irrigators' Organizations

Annual meeting. Decisions regarding irrigation water management are made by the irrigators as a whole at their annual meeting. At the annual meeting the farmers decide on the plan and program for different irrigation tasks, review the performance of the previous year, audit and settle accounts, and elect officeholders. The decision is made in the general body.

Management committee. The irrigation management committee carries out the decisions of the general body of irrigators. The performance of the officeholders is reviewed each year. Officeholders are accountable to the farmers as a whole.

The number of members in the committee is determined by the size, intensity of the water distribution tasks, and the amount of labor to be mobilized. Where water distribution or labor mobilization is not a problem, systems may even be managed by one person assigned by the community. However, in a small system with only a 17 ha command area (Tallo Kulo), a ten-member committee manages the system. Here the intensity of task performance in water acquisition, distribution, labor mobilization, and

APPENDIX 2

RESOURCE MOBILIZATION IN FARMER-MANAGED IRRIGATION SYSTEMS IN NEPAL

Resource mobilization, the degree of organization required for operation and maintenance of a system, and water allocation and distribution are interrelated aspects of the operation and management of farmer-managed irrigation systems. A better understanding of resource mobilization in FMIS can help develop an appropriate strategy for assisting these systems and examples of the practices in these systems can also help government to develop policies for resource mobilization in the irrigation sector as a whole.

The types and kinds of resource mobilization are categorized on the basis of case studies of 21 farmer-managed irrigation systems in Nepal. Information gathered from the 21 systems indicate that resource mobilization can broadly be grouped into internal and external resource mobilization. Resources mobilized from within the system itself are categorized as internal resources. These may encompass local labor, cash, materials, natural resources, animal power, and enterprises operated by the system. External resource mobilization is the use of resources from outside the community for rehabilitation or operation of the systems. These may include cash, materials, and technical expertise.

Types of Internal Resource Mobilization

Labor mobilization. The primary resource that almost all farmer-managed systems must mobilize is labor for operation and maintenance. The basis for labor mobilization is different among the systems of Nepal. The size of landholding within the irrigated area, number of households in the irrigation community, or water share may be the basis upon which labor mobilization is assessed. In some systems committee officeholders are exempted from labor contributions as compensation for performing their official duties. Labor contributions are not voluntary; the right to use irrigation water is obtained by contributing labor for O&M of the system. If the user fails to contribute the labor assigned to him, he is fined or deprived of irrigation water.

Cash mobilization. In lieu of labor, some systems collect money to hire laborers from outside of the system. This cash mobilization is assessed on the basis of crop yield from the irrigated land or in proportion to size of the area irrigated. Some systems collect cash for the construction of physical infrastructure, to pay fees to the forest department for the right to cut forest products used for river diversion work, or to pay salaries to their irrigation officials. Cash is also accumulated from the fines imposed upon the members of the irrigation system who had not fulfilled their irrigation obligations.

Mobilization of forest products. FMIS usually have temporary structures made out of stones, boulders, tree branches, logs, and bamboo. These materials are used for river training, diversion dams, and intake and check dams for raising the water level. These materials are heavily relied upon in large-scale farmer managed irrigation systems in the Tarai.

Mobilization of bullock carts. In some places, forest and rivers for collecting forest products, stones, and boulders are located at some distance from the temporary dam site. Hence, bullock carts are also necessary for transporting these materials. The FMIS at Tedhi Gurgi, Kulariya and Jamara, and Babai mobilize bullock carts for transportation of materials.

Irrigation enterprises. The Chherlung Thulo Kulo system is an example of a FMIS establishing a system-owned water mill. This hill system requires frequent maintenance during monsoon. Profits generated from the operation of the mill are applied toward the operation and maintenance costs of the irrigation system so that the labor contributions of the beneficiaries can be reduced.

Similarly, one of the irrigation systems of Majuwa has permitted a private party to use irrigation water for running a water mill. In exchange, the mill owner is required to maintain the canal from the intake up to the mill site, reducing the labor contributions required from the other water users. Similarly, two traditional water mill (ghatta) owners in the Kodku irrigation system helped to maintain a portion of the canal. With the introduction of electric-powered mills, the ghattas went out of business and the irrigators have since taken over the responsibility for maintenance of the system.

Sale of water. When the volume of water available is in excess of the system's needs, the excess water can be sold and the funds used for improvement or maintenance of the system. This has been done in Chherlung. The Argali Raj Kulo has also sold water to raise funds for improvement of the local school.

Water share transaction also occurs among individual shareholders. The additional beneficiaries must also contribute to labor for system O&M, thereby increasing the system's labor resource.

Mobilization of local expertise. The knowledge of local leaders and elders gained from years of experience with system operation and maintenance is a valuable resource existing within many systems. For example, the expertise of tunnel makers has been utilized in some hill irrigation systems. Also, farmers in one irrigation system may have useful knowledge about O&M practices in another system and they have helped to disseminate and transfer knowledge from one system to another.

Types of External Resource Mobilization

Cash mobilization. Funds received from either the national, district, or village panchayat government, from voluntary organizations, or from international agencies come under external resource mobilization. These funds have been used for the improvement of an irrigation system and sometimes for regular maintenance costs.

The Chherlung system in Palpa District received a cash grant from the District Panchayat for the improvement of the system. The Satamohane irrigation organization near Pokhara has lobbied the Kaski District Panchayat for money for regular system maintenance.

Development Research and Communication Group, a voluntary organization, given money to the Gharaphant irrigation system for tunnel repair. Bread the World and the German Voluntary Organization are other examples of untary organizations providing funds to FMIS.

In the government-funded FIWUD program the agency provides 70 percent of the cash needed for irrigation rehabilitation or construction and the farmers must provide the rest of the resources, usually contributed as 5 percent cash and 25 percent labor.

Material mobilization. Materials such as gabion wire, cement, pipes, or food for work have been provided by government and various international agencies for system improvements.

Technical expertise. Government engineers, surveyors, and association organizers are some of the external technical resources utilized by FMIS. This resource is usually provided by the technical agencies of the government. Farmer-to-farmer training programs and farmer consultancies have also been recent programs providing opportunities for farmers from one irrigation system to learn about improved irrigation practices from farmers in other systems. There have also been examples of individuals in the irrigation field providing their personal expertise to an irrigation community. Dr. Robert Yoder has provided assistance to the Chherlung community regarding the operation of a water mill.

Technical people may also supervise work performed by the local people.

Machinery mobilization. Bull dozers or excavators may be brought into the system at the time of desilting or canal repair. This occurs in Pithuwa for regular desilting of the canal after each flood and in Chhattis Mauja for desilting during annual canal maintenance. A bulldozer provided through the Tikapur Development Board was brought in to desilt the East Kailali irrigation system in 1987.

Credit mobilization. FMIS have received different types of credit from agencies outside their community for irrigation development. The ADB/N provides credit for shallow tube well system development. The ADB/Small Farmers Development Program and the ADB/CARE Nepal Program have provided credit to irrigators. Under the ADB/CARE program, CARE provides a grant to cover 50 percent of the costs and the farmers must provide the rest. This might be in the form of labor contributions plus credit from the bank. The ADB/N provides loans to farmers for irrigation development.

POLICY IMPLICATIONS

The political strength of an irrigation organization and its capacity to mobilize external resources are closely related and need to be considered in the government's total political and economic policy. Is the government prepared to take over all of the farmer-managed systems or will it provide assistance as and when it will be necessary? In the absence of a policy for assistance, non-irrigators are being incorporated into irrigation organizations in order to pressure the government for more resources.

A strategy of government assistance needs to be formulated which will take into account the irrigation systems' existing capacity and ability to mobilize resources. In many cases, the strength of the existing irrigation organization is closely tied to the nature and extent of the resources that the system must mobilize. Therefore, in the plan to strengthen water users organizations, resource mobilization must be considered, and any plan for government intervention must take this relationship into account.

The resource mobilization perspective can be used as a tool for understanding how FMIS function and at the same time it can identify areas in need of assistance.

APPENDIX 3

THE IMPORTANCE OF ASSISTING FARMER-MANAGED IRRIGATION SYSTEMS[3]

In the past ten years awareness of the scope of FMIS in Nepal and the contribution these systems make to the national economy has been increasing. These systems are spread over all districts of the country and range in size from less than one hectare to the federation of systems, managed by a central committee, covering more than 15,000 ha.

The total number of systems is unknown. Extrapolated information from a detailed inventory of one river basin in a hill district and land resource maps indicates there are likely over 17,000 FMIS in the hills. Inventories of all the tarai districts identified over 1,700 farmer-managed systems in that region providing some level of irrigation to at least 450,000 ha.

These systems and the farmer organizations which operate and maintain them are a unique national resource which must be preserved and improved. By a conservative estimate, the production from farmer-managed irrigation systems is feeding over 30 percent of Nepal's population.

Farmer-managed irrigation systems in Nepal present a wide variation in the type of organization and management style, methods for both internal and external (to the system) resource mobilization, maintenance practices, and water allocation and water distribution methods. Each FMIS has a distinct character which is determined by adaptation to the environment and needs of the people it serves. In most systems the low quality of physical structures is compensated by careful management of the available human resource.

While some of these systems are well managed and achieve a high level of agricultural production, many systems could benefit from assistance from the Department of Irrigation (DOI). In both the hills and Tarai farmers are facing increasing difficulty in operating their systems due to deforestation and government policies protecting forests that have traditionally provided the materials necessary for maintenance.

The contribution of FMIS to the basic needs of the rural population is already high but can be increased further. The unique resource of human organization and extremely diverse physical infrastructure represented by FMIS should be preserved and assisted in developing further. In determining ways to improve the functioning of FMIS and to devise appropriate ways to assist them, the following recommendations should be considered under the master plan.

RECOMMENDATIONS TO GIVE APPROPRIATE RECOGNITION TO FMIS

1. <u>Provide legislation that establishes the legal identity and rights</u>

[3]Paper presented at the Irrigation Sector Coordination meeting by staff from the International Irrigation Management Institute in Kathmandu, Nepal 22 February 1988.

of the beneficiary groups operating irrigation systems. At present, the farmer organizations managing irrigation systems have no clear legal status. This makes it difficult for them to mobilize resources external to their organization. For example, it is difficult for banks to give loans to a group of farmers to make improvements in their system. Frequently hundreds, even thousands of families are members of the association, with their own "formal" rules and regulations for operation and maintenance of a system. However, these associations of farmer irrigators are informal in terms of legal rights. They should be able to register their association and receive rights over the water which they are using and be able to deal as a formal enterprise with banks and government agencies.

2. Identify existing FMIS in the area of each new agency project and incorporate their physical and organizational structure into the new system with minimum disruption. Whenever a new irrigation project is proposed, one of the first steps should be to identify all of the existing FMIS in the projected command area. To insure this, the terms of reference (TOR) of the consultants or agency staff that does the preliminary investigation should require an inventory of the existing FMIS in the project area. For each system, they should report the name, location, water source, estimated area irrigated, cropping pattern, water rights among systems, number of farm households in the association, and method of water allocation among users for each crop.

For a subsequent feasibility study the TOR should call for detailed information about the existing management, operation and maintenance procedures, and production of each system. A requirement for approval to proceed to a design study for a new system should be a clear indication that irrigation services will actually improve in the areas already served by FMIS and that incremental increase in agricultural production of the improved service and expanded area will justify the cost of the project. This requires that careful consideration be given to the water rights of existing systems and discussion with present and potential beneficiaries to determine the level of cooperation there will be in expanding irrigation services.

The TOR for the design study should request details on how the existing systems and their organization will be incorporated into the new design. To the extent possible with the given topography, the farmers' distribution systems should be kept intact to cause the least disruption to the association's organization and management capacity. One way of doing this is to augment the supply at the headworks of the existing system, and continue to use the existing distribution network. It may be necessary to make improvements to the headworks and within the distribution system, but this should be done in the spirit of assisting a farmer-managed system instead of overlaying it with a completely new design.

If the existing farmer organizations are effective, they should not be forced to adapt to some rigid standard format but should be allowed to retain their own organizational form and management procedures. Weaker organizations should be strengthened as a part of the assistance effort. This effort should start with the experience and capacity the farmers already have and build on their existing rules and methods rather than introducing a standard water users association format which may be inconsistent with local conditions.

3. Establish uniform assistance policies for each geographical region of the country. Previously four agencies were involved in providing assistance to farmer-managed irrigation systems. Each used different policies and strategies for implementing their programs ranging from 100 percent subsidy and little participation to significant contribution and participation by the beneficiaries.

Since all irrigation development activities have come under one umbrella, a uniform policy, at least on a regional basis, will need to be applied. This policy should be formulated only after a careful study of the experience of all of the agencies in the past has been completed. The study should include field investigation to determine the impact the different levels of beneficiary input under various programs have had on the operation and maintenance of systems and ultimately on agricultural production. The study should also examine the strategy each program used and recommend the most cost effective and viable implementation procedures.

4. Systematically identify all FMIS in the country on a watershed basis by making an inventory that establishes a database giving pertinent details about each system. Comprehensive planning for improving the performance of FMIS cannot be done without detailed information about the status of individual irrigation systems. An inventory should be prepared by systematically investigating each watershed in a district to generate the first level of this information. Using the watershed as the basis of investigation allows clustering of systems that are related to each other with respect to water rights.

The inventory should identify all systems in the watershed with information such as: a) the name of the system and source; b) location; c) irrigated area; d) number of households using the system; e) extent of land and water resources utilization (How much cultivated land is unirrigated under the command of a each canal? Is there water in the source that is not utilized?); and f) problems of operating the system identified by the beneficiaries. Preparation of the inventory work should include establishment of a database for easy retrieval of information and modification and updating as assistance is given to specific systems.

5. Establish criteria for selecting systems for assistance. The inventory information should be used to identify systems where assistance is most needed and will be most beneficial. The criteria for selecting systems for further investigation and ultimately to assist should include: a) potential for expanding the irrigated area; b) opportunity to intensify the cropping pattern by better water delivery; c) willingness of the beneficiaries to invest a specified proportion of the improvement cost and to add new members to their association in return for their assistance in making improvements and in operation and maintenance; and d) opportunity to reduce the maintenance cost of the system.

6. Enable beneficiaries to improve the effectiveness of operation and maintenance activities in their system and to fully participate in any

physical improvements that are made by providing assistance in strengthening their organizational and management capacity. After a system is selected for assistance, there should be an in-depth investigation to determine the existing management capacity of the beneficiaries. This should include the rules, roles, methods of conflict management, and records that they keep as well as the extent and method of resource mobilization for routine and emergency maintenance. Where improvement in their management capacity is necessary, existing practices should form the foundation for expanding their expertise.

The use of association organizers, farmer consultants with experience from well-managed irrigation systems, and training programs that include field visits to other systems where different practices are used would be several methods that could be used to strengthen management capacity.

7. Beneficiaries should be encouraged to take responsibility in assisting with selection of the design and in implementation of physical improvements that are to be made to their system. The farmers themselves are the best source of information about crop preferences, soil conditions and variation over the area, stream flows, and stability of land forms, and can provide this input to the planning and design process. Where cadastral surveys have been completed farmers can assist in compiling accurate area estimates of the existing and potentially irrigated area to be used in designing the canal. The beneficiaries can quickly point out difficulties and bottlenecks in the system and priorities for necessary improvements in a "walk-through" of the system. The management capacity of the beneficiaries will be reinforced if they are encouraged and assisted to share responsibility for the planning, design, and implementation of physical improvements.

8. The design process for improvements to FMIS should be simple and field based. Where assistance is being given to upgrade existing structures that typically carry a discharge of less than 100 liters/second (liters/s) and seldom more than 300 liters/s the lengthy process of topographic field survey office design, and carefully inked drawings greatly delays the implementation process and is not cost effective. Procedures need to be developed (and where possible adapted from the past experience of the various agencies that had been assisting FMIS) to simplify the design process to make it prompt and less costly.

Where rock cutting is required or simple structures are to be improved, accurate sketches in a fieldbook and analysis of costs should be prepared on-the-spot. If the beneficiaries are to be responsible to contribute to the cost of the improvements and operate and maintain them in the future they should help select among alternative designs and set the priorities for making improvements.

RECOMMENDATIONS FOR ADMINISTRATIVE REORIENTATION

9. Assistance to FMIS should be in the form of loans (subsidized to the extent necessary) instead of grants. Assistance to farmer-managed systems should be in the form of loans, not grants. The loans could be subsidized by the government, but the principle that the farmer organization

pay for a significant proportion of the investment is important. If this is the case, the organization will set priorities according to what will really benefit them in terms of improved performance and/or reduced maintenance cost. The organization should decide how much of the cost of the project it wants to pay for with its labor and how much in materials and cash. There should be a means by which the organization as a whole can take a loan for the cash investment if necessary.

10. <u>A division should be established in the DOI responsible for assistance to FMIS</u>. The approach and necessary manpower for assisting existing FMIS is sufficiently different from the design and construction of new systems that a separate division is warranted. It should be the responsibility of this division to formulate policies and procedures and to provide overall guidance in assisting FMIS. The division should consider the importance of both physical and "non-physical" assistance to FMIS and employ personnel qualified, trained, and interested in working with farmer groups.

11. <u>All levels of DOI staff dealing with FMIS need orientation and training to be able to implement a participatory approach to assisting these systems</u>. Assistance to FMIS is a shift from considering primarily design and construction issues in which DOI staff have considerable expertise. If the approach is to be predominantly participatory, the staff will need a new orientation that will require a substantial training effort. The training will require exposure to the farmer's point of view of the cropping pattern, water rights, and water requirements, and emphasize methods for organizing water users into effective management units.

APPENDIX 4

PROPOSED DEFINITIONS OF PROJECT SIZE

The following is a summary of the definitions of project size and cost sharing responsibilities of the government and beneficiaries as proposed in the Sectoral Lending Strategy Issue Paper (DOI 1988:6-8).

Small Schemes

To reduce the financial burden to HMGN, investment in construction of irrigation facilities and in the promotion of farmer participation and sense of beneficiary ownership, HMGN shall contribute 75 percent of the construction cost in the form of a grant and the farmers shall contribute five percent cash and 20 percent in either labor contributions or as cash obtained through loans from the ADB/N if: 1) the project is feasible, 2) there is a formal water users association, and 3) the estimated cost of the project is not more than Rs three million.

For schemes with an estimated cost above Rs three million, the DOI shall be responsible for the construction of headworks and the main and branch canals. The beneficiaries shall provide land for canal construction, pay the cost for tertiary channels and farm ditches, as well as be responsible for O&M of the scheme.

Large and Medium Irrigation Schemes

HMGN should undertake the construction of large- and medium-size irrigation projects. The water user association will be responsible for the construction of field channels covering a block of ten ha, and operate and maintain the irrigation facilities for a block of 50 ha. Government will subsidize the capital cost recovery of the project.

Farmer-Managed Systems

The beneficiaries of farmer-managed systems will contribute 25 percent of the cost for improvements in cash and voluntary labor. Seventy-five percent of the total cost will be granted by the government. The users group will be responsible for system maintenance and operation.

Groundwater Development

Shallow tube wells. For the construction of shallow tube wells, 75 percent of the capital cost of the project should be borne by the farmers and 25 percent will be made available as a grant. Loans from the ADB/N to the farmers will be facilitated. Should individual farmers want to construct shallow wells at their own expense, they can also apply for the 25 percent government grant. The same cost-sharing formula will be followed for construction of ponds and wells for irrigation purposes.

Deep tube wells. For deep tube well systems, the DOI shall be responsible for construction up to the tertiary canals. The users group will be responsible for the construction of the distribution system for a block of ten ha. They should take the responsibility for operation and maintenance.

After the project is completed, the beneficiaries should contribute to help pay the capital cost. In the case where an individual farmer or farmer group seeks to construct a tube well using their own financial resources, 25 percent of the total cost will be provided as a grant from HMGN.

Collection of Water Charges

The principles that will be adopted for the collection of water charges according to category are:

Category I. In case of the schemes constructed and completed by the government without beneficiary contributions, water charges will be collected by the government as per the set rules and regulations.

Category II. In those schemes where the beneficiaries contribute to part of the construction costs and the whole of the maintenance and operation costs, no water charges will be collected by the government.

Category III. In those schemes where the main and the trunk systems are constructed and maintained by government and the beneficiaries contribute only to the construction and maintenance of the distribution systems limited within the block area, some concession in water charges will be made. The amount of the concession will depend on the size of the block.

These categories have been proposed in an effort to collect water charges in order to meet operation and maintenance costs. Past experience in water charge collection has influenced this proposal, however adjustments may have to be made in the context of changes in the overall sector policy.

APPENDIX 4

PRODUCTIVITY OF IRRIGATION SYSTEMS IN NEPAL

Name of the Systems	Total Value (Rs/Ha)	Yield MT/Ha/Yr.	Cropping Intensity %	Type of Management	Location	Area (ha)	Predominant crops in order	Existence of Users' Organization
Phewa	22557	5.84	155	Agency	Hill/Valley	280	Paddy, Maize, Wheat Mustard	No
Nyanja	8730	3.0	130	Agency	Hill/Valley	300	Paddy, Maize, Wheat, Potato, Millet	Yes
Sangey Patiyani	13557	3.5	200	Agency	Hill	208	Late/Early Paddy, Wheat, Mustard, Maize	Yes
Char Hazar	9453	3.3	120	FMIS	Hill/Valley	200	Paddy, Wheat	Yes
Bhanu Bhairah	19004	6.25	187	FMIS	Hill/Valley	120	Late/Early Paddy, Wheat, Lentil, Potato, Mustard	Yes
Char Saaya Phant	22539	7.0	250	FMIS	Hill	50	L/E Paddy, Wheat	Yes
Satra Saya Phant	30458	7.0	272	FMIS	Hill	40	L/E Paddy, Wheat, Maize, Peas Lentil, Potato, Vegetable	Yes
Taapa Phant	28019	7.75	275	FMIS	Hill	40	L/E Paddy, Wheat, Maize, Lentil	Yes
Pancha Kanya	18738	6.7	179	Agency	Tarai	600	Paddy, Mustard, E.Paddy, Wheat, Maize	Yes
Pithwa	22547	4.12	235	FMIS/Agen.	Tarai	1300	Paddy, Mustard, Maize, Potato	Yes
Kamala	16546	4.27	200	Agency	Tarai	12500	Paddy, Wheat, Mung, Tobacco, Potato	No
Kankai	17572	3.61	185	Agency	Tarai	4000	Paddy, Wheat, Jute, Oil, Pulse, Early Paddy	Yes
Lothar	22822	7.63	203	FMIS	Tarai	1000	Paddy, Wheat, Maize, Mustard, Pulse	Yes
Surtan	22396	7.93	187	FMIS	Tarai	273	L/E Paddy, Wheat, Mustard, Maize,	Yes
Auraha	24556	6.23	197	FMIS	Tarai	260	L/E Paddy, Wheat, Hybrid maize	Yes
Kerbari	43337	8.94	280	FMIS	Tarai	200	Paddy, Wheat, Jute, Mustard, Maize	Yes
Budhabare	33245	7.03	225	FMIS	Tarai	125	L/E Paddy, Wheat, Jute, Maize	Yes
Argali	29672	7.5	300	FMIS	Hill	85	Paddy, Wheat, Maize	Yes
Chherlung	33101	8.4	300	FMIS	Hill	52	Paddy, Wheat, Maize	Yes
Argali (Irrigated Bari)	27254	6.8	200	FMIS	Hill	50	Maize, Wheat	Yes
Majuwa	34165	8.0	300	FMIS	Hill	73	L/E Paddy, Wheat, Maize	Yes

[illegible]	Total Value (Rs/Ha)	Yield MT/Ha/Yr.	Cropping Intensity %	Type of Management	Location	Area (ha)	Predominant crops in order	Existence of Users' Organization
...besi	13492	3.44	116	FMIS	Hill	30	Paddy, Wheat, E Paddy	Yes
...erdia	11159	2.53	165	FMIS	Tarai	800	Wheat,Maize,Mustard,Blackgram	Yes
...armawati	26186	6.55	195	FMIS	Hill/valley	364	Paddy, Wheat	Yes
...andra Nahar	11944	2.72	162	Agency	Tarai	10500	Paddy,Wheat,Linseed,Mustard, Maize, Pulse, Jute	
...ndetar	13586	3.42	131	Agency	Hill	165	Paddy, Wheat, Maize	No
...diyar	14057	2.44	190	FMIS	Tarai	87	Paddy,Wheat,Lentil,Mustard,Flax	Yes
...aina Sat Tale	15169	3.8	190	FMIS	Tarai	147	Paddy, Wheat	Yes
...orbang	35180	6.73	200	FMIS	Hill	30	Paddy, Wheat, Potato	Yes
...argabang	24569	5.5	200	FMIS	Hill	5	Paddy, Wheat, Potato	Yes
...armakot	16185	4.09	200	FMIS	Hill	34	Paddy, Wheat	Yes
...aurjahari	24026	6.04	200	FMIS	Hill	30	Paddy, Wheat	Yes
...anauri	10753	2.5	197	FMIS	Tarai	27	Paddy, Wheat, Lentil,Chickpea	Yes
...oth Khola	23273	5.14	187	FMIS	Hill	20	Paddy, Wheat, Lentil	Yes
...edi-Gurgi	12420	2.48	195	FMIS	Tarai	5500	Paddy, Lentil, Linseed, Wheat,	Yes

...ote

1. Total value (in Rs)of crop yield (ton/ha/year) is as per the average national retail price of 1986/87.
Price Data Source: Department of Food and Agriculture Marketing Service, Nepal,1988

2. Data Source:a) Phewa to Budhabare system - Laitos,R. et.al. 1986. Appraisal of Nepal Irrigation Systtems. Forth Collins,Colorado: Water Management Synthesis Report 43.

b) Argali to Thambesi - Martin,Ed. 1986. Resource Mobilization, Water Allocation, And Farmer Organization in Hill Irrigation in Nepal ,Ph. D. dissertation, Ithaca, NY: Cornell University.

c) Goberdia to Dharmawati - Development Research Group, 1986. Rapti rural area development project medium irrigation appraisal study. Lalitpur: Nepal.

d) Chandra Nahar System - Water & Energy Commission Secretariat, 1988. Rapid appraisal of Chandra canal irrigation project, Report No 4/1/021187/1/1 Seq. 274. Kathmandu, Nepal.

e) Handetar System - Water & Energy Commission Secretariat, 1988. Rapid appraisal report of Handetar irrigation project, Report No. 4/1/270488/5/1 Seq 286. Kathmandu, Nepal.

f) Sodiyar to Goth Khola - Development Research Group, 1986. Rapti rural area development project minor irrigation appraisal study report. Lalitpur, Nepal.

g) Tedi-Gurgi System - Yoder, R. et.al. 1987. Rapid appraisal report of he Tedi/Gurgi farmer managed irrigation system of Kailali District. Unpublished memo. Kathmandu, Nepal: International Irrigation Management Institute.

Annex 3.

BHUTAN10

IRRIGATION DEVELOPMENT IN BHUTAN

Prachanda Pradhan

August 1988

TABLES OF CONTENTS

APPENDIXES:

LIST OF TABLES

LIST OF FIGURES

PREFACE

My effort in this report is to present the development of the irrigation sector in Bhutan. The present status of the sector, agency organization, investment trends, and donor agency involvement are highlighted within the context of a long tradition of beneficiary-managed irrigation systems and subsequent developments in government policy on irrigation development and management.

This report is prepared on the basis of my visit to Bhutan 18-25 June 1988, when I had the opportunity to interview people directly involved in irrigation development and management in the country. This report draws on information obtained from key informants, publications of the Royal Government of Bhutan, and other documents and literature on Bhutan. A review of literature on the country and its irrigation and agricultural sectors was conducted prior to my visit.

Since 1961 the Government of Bhutan has made substantial investments in the agricultural and irrigation sectors through planned development exercises. As new developments have evolved, government has changed its policy in the irrigation sector to respond to the changes. This report hopes to present the evolving trend in irrigation development in Bhutan.

I would like to thank the Department of Agriculture, Royal Government of Bhutan for inviting me to observe some of the irrigation systems in the country. My sincere thanks to Dasho Khundu Wangchuck, Director General, Agriculture Department. My visit was made more fruitful because of special care and help provided by Mr. Tsering Dorje, Superintendent Engineer; Mr. John Scott, EEC Advisor; and Mr. L.B. Rai, Deputy Executive Engineer of the Irrigation Division of the Agriculture Department.

Mr. Keylzang Tsering, Assistant Engineer, who accompanied me on my field trip to Punakha, Thimpu, and Wangdipodrang, deserves special thanks. His role as interpreter was vital to my ability to communicate with the Bhutanese farmers.

Last but not least, I would like to thank the farmers of those systems that I visited during my field trip. They were very kind to take time off from their busy agricultural schedules to provide information on their systems.

PART I
BACKGROUND ON BHUTAN

[INTR]ODUCTION

Bhutan is a mountainous kingdom comprising 18,000 square miles. The [...]of Gaylegphug has the only flat terrain. Ninety-five percent of the population is dependent on agriculture. Half of the gross domestic product and one-fourth of the country's total export earning is derived from this sector. However, Bhutan's population density is 25 per square kilometer and the population growth rate is 2 percent annually. In fact, the small population size and resultant labor shortage constrain the development effort of the country.[1]

Maize is cultivated throughout the country. It is the first major crop for many people in Bhutan. Paddy occupies the second largest area and is grown in many regions. Other crops are buckwheat, millet, wheat, and barley. Only six percent of the total land is cultivated, with only approximately 15,000 hectares (ha) estimated to have irrigation facilities. See Table 1 for land under agriculture.

Table 1. Land under agriculture in hectares.

Region	Wet land	Dry land	Shifting Cultivation	Kitchen Gardens	Orchards
Western	7300	6567	887	197	1773
Central	1662	5173	1751	84	1722
South/ Central	3691	10341	293	115	3900
Southern	12063	27229	5295	515	11401
Eastern	4990	16296	3597	366	210
Total	29708	65611	11825	1280	18006
	(23%)	(52%)	(9.35%)	(1.01%)	(14.24%)

Source: Statistical Handbook of Bhutan. 1986. Bhutan: Central Statistical Office, Planning Commission.

According to the Statistical Handbook of 1986, 1.6 percent of the valleys are cultivated and 4.4 percent of the land is under terraced cultivation. Combined, these areas represent the total of the land under cultivation.

IRRIGATION DIVISION

The Irrigation Division is part of the Agriculture Department in Bhutan.

[1]Karan, Pradyumna P. 1987. Development issues in Sikkim and Bhutan. Mountain Research and Development. United Nations University, August. (3):275.

the Fifth Five-Year Plan (1981/2-1986/7) of Bhutan, the Irrigation sision was mandated to 1) construct new irrigation systems; 2) to renovate gting irrigation systems; 3) to protect river banks from slides and sions; and 4) to construct feeder roads in order to open rural farm areas for input supply.

Under the current Sixth Five-Year Plan, the objectives of the Irrigation Division have been modified to emphasize new construction and renovation of existing irrigation systems.

The approach of the Irrigation Division in relation to assistance to farmer-managed irrigation systems has changed after the introduction of a decentralization policy beginning in 1981. This policy has emphasized strengthening local institutions, including farmer irrigation organizations. Until 1981, the Royal Government of Bhutan was subsidizing the irrigation systems. Each system received Ngultrum (Nu)[2] 10,000 to 20,000 per year. Since 1981, as part of the policy to have the beneficiaries operate and maintain the irrigation systems themselves, government has not allocated funds for an operation and maintenance (O&M) subsidy to beneficiary-managed irrigation systems.

Organization of the Irrigation Division

The Irrigation Division came into existence in 1967 under the Agriculture Department. Planned development in agriculture and irrigation was initiated during the Second Five-Year Plan. The outlay in this sector increased ten times more than in the First Five-Year Plan. During this period, Bhutan was divided into eight irrigation zones for administrative purposes[3]. In 1979, the Irrigation Department was separated from Agriculture, but once again merged with Agriculture in 1981. Bhutan is no longer divided into irrigation zones.

In 1988, the Irrigation Division was renamed the Land Use and Irrigation Division. It encompasses three sections plus centrally administered projects such as the Takalai and Gaylegphug Lift Irrigation Systems.

In the districts, public works, agriculture, education, basic health, and irrigation units administrate government funds. The dzongdha, appointed by the Ministry of Home Affairs, is the head of district administration.

Dzongs, or forts, were constructed for defense purposes in ancient times. They contained monasteries and served as the administrative center for the region. In those days, persons who resided in the dzongs were considered the authorities. Instead of creating a new governmental unit in the districts, effort was made to modernize the traditional institutions in Bhutan. In 1960, dzongs were converted into district administrative headquarters because people were accustomed to seeking and obtaining assistance there. Today, the district administration is known as dzongkhag.

The dzongkhag is again subdivided in to gewogs, or blocks. Each block is headed by a gup, mongup, or mandal (village headman) who is elected by the people but paid by the government. The term gup is used in northern Bhutan

[2]A unit of Bhutanese paper currency is called the Ngultrum (Nu). The value of Indian currency and Bhutanese Nu is kept at par. US$ 1.00 = Nu 1.70. Indian currency is accepted in Bhutanese markets.

[3] Nagendra Singh. 1985. Bhutan: A kingdom in the Himalayas. New Delhi, India: S. Chand and Company (Pvt) Ltd. 177-78.

mandal in the southern part. The gup or mandal functions as the link between government and community. He collects land revenues for the government and government communicates with the community through him.

Each dzongkhag has an irrigation unit to supervise assistance to beneficiary-managed irrigation systems. Each dzongkhag irrigation unit has an assistant engineer, 1-5 section officers, a draftsman, and construction supervisors. The section officers are overseers appointed by the government, assigned to the irrigation unit of a particular district. Administratively, these officials fall under the jurisdiction of the dzongkhag, but functionally they are under the technical direction and supervision of the Irrigation Division. (See the organization chart of the Irrigation Division of the Agriculture Department of Bhutan.)

(Organization chart of irrigation division in the next page)

Manpower in the Irrigation Sector

According to 1985 statistics, 330 persons were employed in agriculture and irrigation. Out of this 304 were male and 26 were female.

In June 1988, it is estimated that there are 102 technical persons working in the Irrigation Division of the Agriculture Department. Many United Nations volunteers and other volunteers are also working in the irrigation sector. A majority of the 102 employees are overseers, draftsmen, and construction supervisors.

Attempts are being made to upgrade manpower skills through training programs. A new institute, the National Agriculture Training Institute (NATI), will come into existence only in 1992. Meanwhile, the Institute of Resource Management will start training manpower in agriculture and forestry immediately. This institute started to function at Paro in July 1988.

Besides technical manpower, the Irrigation Division is making efforts to organize the beneficiaries so they will be capable of undertaking O&M responsibilities. New personnel are being trained in this field of organization and extension activities.

INVESTMENT IN AGRICULTURE AND IRRIGATION

The resource allocation to agriculture and irrigation from the First Five-Year Plan period (1961-66) to the Fifth Five-Year Plan period (1981/2-8/7) is shown in Table 2.

Table 2. Resource allocation to agriculture and irrigation from Bhutan's Five-Year Plans.

	Outlay (Nu in millions)	Percent of Total Investment
First Plan (1961-66)	1.9	1.8
Second Plan (1966-71)	21.6	10.7
Third Plan (1971-76)	58.3	12.3
Fourth Plan (1976-81)	259.0	23.4
Fifth Plan (1981/82-86/87)	419.42	5.93

A breakdown of expenditures for agriculture and irrigation is not lable. However, investment in agriculture and irrigation has increased endously over time. In the Fifth Plan period, it is estimated that 42 ent of the investment in the agriculture sector is for irrigation elopment. United Nations Capital Development Fund (UNCDF), Indian projects, International Fund for Agricultural Development (IFAD), and Asian Development Bank (ADB) projects were the major investments.

Financing of Irrigation

Major irrigation components are funded from external resources such as the Gaylegphug Lift Irrigation by Indian Aid, Takalai Irrigation Project by UNCDF, Small Farmer Development and Irrigation Rehabilitation Project by IFAD, and Chirang Hill Irrigation Development Project by ADB. In the Fifth Five-Year Plan, 80 percent of the resources for development activities were mobilized from external sources.

The Irrigation Division provides assistance to the beneficiary-managed systems through the dzongkhags. In 1979/80, an effort was made to collect an irrigation water charge at the rate of Nu 5 per acre per year. Later on, the water charge collection effort was dropped. The decentralization policy was introduced and effort was made to strengthen the beneficiary organization to be responsible for O&M of the system.

Bhutan Development Financing Corporation has provisions for providing loans for irrigation development but the people have not yet taken out loans for irrigation development.

Funding Agencies Involved in Irrigation Development

India, IFAD, UNCDF, ADB, United Nations Development Programme (UNDP), and the European Economic Community (EEC) are involved in Bhutan's irrigation development. Bhutan has adopted an area development approach with multiple activities. Irrigation is only one of the complementary components in the area development program. The multiple activities involve agriculture, horticulture, livestock, roads, and marketing. The EEC is basically involved in institutional and manpower development.

ROCESS OF IRRIGATION DEVELOPMENT AND IMPROVEMENT IN BHUTAN

Most of the irrigation systems were developed by the beneficiaries hemselves. After the introduction of planned development in Bhutan, the neficiary-managed systems also got support from the government. After 967, the Irrigation Division of the Agriculture Department gave specialized ttention to the improvement of irrigation systems. No reliable figure is ailable regarding the number of beneficiary-managed irrigation systems in utan. However, an IFAD study identified about 129 systems in a sampling of blocks in the Punakha, Wangdipodrang, and Thimpu districts.

Charles G. Reed, in analyzing water management of the four existing hemes in Mongor-Tashigang Districts,[1] has reported the existence of neficiary organizations with officials, rules, and regulations for rigation management. The chu nagerpa (water officer) or rilarm gothkang e the irrigation officials elected by the villagers. Rules approved by the llagers regarding irrigation water management are enforced by these water

[1] Charles G. Reed. Interim report on water management for existing hemes. Australia: Hassel & Associates PTY LTD. (No date available.)

officers.

While appraising the Chirang Hill Irrigation system, the ADB report says "the construction, operation and the maintenance of traditional irrigation schemes is invariably a cooperative venture involving some form of organization, generally at the hamlet or village level; the irrigators elect one of their peers to supervise operation of their particular system, to achieve equitable distribution of water and to organize routine maintenance work."[5] Hence, the ADB project proposes to assist small schemes. The project proposes to remodel 1,310 ha and provide permanent structures at important points in the systems.

From the 129 irrigation schemes identified in the IFAD report on the Punakha, Wangdipodrang, and Thimpu districts, 30 were selected to receive assistance. Previously, some of the systems were managed by the monasteries. With the cautious introduction of a land redistribution program in the 1970s, much of the redistributed land has been taken from the monastic establishments in some of the districts.[6] The beneficiary of the land took care of the management of the irrigation systems.

The Royal Government of Bhutan provides assistance for physical improvement to existing beneficiary-managed irrigation systems and assistance in strengthening the water users association or beneficiary organization for O&M responsibility. Larger systems are to be centrally administered. Some have more technical difficulties and need central management support.

With the introduction of the decentralization policy in 1981, a new approach was adopted by the Irrigation Division of the Agriculture Department. The Division policy sought to strengthen the system by providing capital development funds for irrigation improvements.

The prospective system for improvement is selected by the dzongkhag development committee. This committee consists of district level administrators, national representatives, and village leaders. This committee is responsible for the development of the whole district. Beneficiaries seeking to be considered for assistance by the dzongkhag development committee forward their request through the village leader. Once the irrigation system is selected for renovation and improvement, the Irrigation Division provides assistance to design the system. Since the dzongkhag irrigation units do not have sufficient technical skill and manpower, central support is provided in survey and design of the system. Once the design is approved, it is the responsibility of the district irrigation unit to supervise the construction work. Construction proceeds on a forced account basis. Contracts are not given out for the work. Government provides the materials and technical skill. The beneficiaries are required to provide the labor for the construction work, thereby ensuring their participation. Although labor mobilization is often a problem due to the low population density, this condition is uniformly enforced.

Once the systems have been renovated and improved, they are managed by the beneficiaries (with the exception of centrally administered projects). The Royal Government of Bhutan is enacting legislation giving the responsibilities for O&M to the beneficiaries.

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[5] Agricultural Development Bank. August 1985. Appraisal of the Chirang hill irrigation project in Bhutan, Appendix 2. Manila, Phillipines.

[6] International Fund for Agricultural Development (IFAD). Feb 1988. Valley development project, appraisal report. Rome: IFAD.

The Irrigation Division is in the process of strengthening the district irrigation unit to supervise the beneficiary organization and O&M activities. The district irrigation unit makes periodic checks of the beneficiary organization and if it finds that the system is not properly maintained, the beneficiary organization could be punished. In order to implement these provisions, the Irrigation Division is in the process of preparing an O&M manual for the beneficiaries.

The O&M responsibility will belong to the beneficiaries. No grant or subsidy will be given by the government for annual O&M activity. However, there are provisions to provide assistance in the event of damage from natural calamities. A request for such assistance would originate in the dzongkhag development committee.

MANAGEMENT TYPES

Irrigation systems can be classified by three management types: agency-managed, joint-managed and farmer-managed. Large irrigation systems such as the Takalai and Gaylegphug Lift Irrigation Systems are agency-managed systems.

The Bajo irrigation system in Wangdiphodrang is an example of a system where farmer and agency share in the management and maintenance.

The majority of the irrigation systems in Bhutan are farmer-managed systems. Now that these systems no longer receive an annual O&M subsidy from government new legislation has been proposed to form water users associations which will be responsible for the O&M. These systems would receive assistance for physical infrastructure improvement. The beneficiaries are required to contribute voluntary labor and the agency provides technical assistance and materials such as cement and gabion wire. Once the system is rehabilitated it would assume management responsibilities. The district irrigation unit would provide supervision and advise but the beneficiaries would have to mobilize resources from within their system.

File Name: IRRI

Irigation schemes completed by April 1985, by dzongkhag.

	New Construction				Renovation				Bank Protection		Feeder Road	
		Command Area				Command Area						
...zkhag	No. of Schemes (Nos)	Existing (ha)	Expansion (ha)	Length of Channel (Kms)	No.of Schemes (Nos)	Existing (ha.)	Expansion (ha)	Length of Channel (Kms)	No.of Schemes (Nos)	Length of Channel (Kms)	No.of Schemes (Nos)	Length of Road (Kms)
...ng	3	–	48	4.36	–	–	–	–	4	1.50	1	15.00
...ng	6	298	285	29.30	5	114	91	13.40	2	1.00	5	12.50
...a	2	182	129	7.21	2	161	10	12.64	–	–	–	–
	2	50	–	2.23	3	43	–	3.23	–	–	–	–
...gphug	9	1157	383	31.45	8	870	–	20.47	12	12.25	5	14.00
	5	22	22	3.79	4	36	–	5.75	3	0.50	–	–
...shi	8	220	163	39.49	12	593	–	42.52	–	–	2	11.00
...r	3	200	506	15.14	3	69	2	5.60	–	–	7	18.00
	2	48	32	3.50	13	708	–	19.88	27	3.60	2	7.00
...el	3	25	85	4.44	–	–	–	–	–	–	1	5.00
...ha	1	105	–	5.00	15	713	–	30.40	2	20.30	–	27.50
...i	8	540	190	22.10	13	1346	–	40.12	12	5.63	3	12.00
...khar	8	1212	–	20.11	4	485	–	–	3	5.27	2	7.00
...ang	1	–	91	3.35	3	42	33	12.77	1	1.00	1	2.50
...gang	11	1245	–	27.57	9	1561	–	36.42	3	2.00	2	10.00
...hu	6	152	318	9.49	7	194	–	11.10	2	2.00	–	–
...n	9	137	331	24.39	135	131	3	–	–	–	3	10.06
...i-ang	–	–	–	–	4	496	–	19.50	–	–	3	12.70
	87	5599	2589	252.92	240	7569	140	276.80	71	55.03	37	164.26

...: Royal Government of Bhutan, Statistical Handbook of Bhutan, 1986, Thimpu.

PART-~~II~~

OBSERVATIONS ON THE MANAGEMENT OF THE IRRIGATION SYSTEMS IN BHUTAN

[ODU]CTION

Bhutan has a long tradition of beneficiary-constructed and -managed irrigation [syst]ems. The farmers have developed management systems suitable to the terrain, [clima]tic conditions, and social needs. Travelers and missions who visited the country [in th]e 19th and 20th centuries noted the agricultural practices. Narendra Singh [descr]ibes the irrigated agriculture thus: "British travelers to Bhutan in the 19th [centu]ry as well as visitors and experts who now visit the Himalayan Kingdom have not [faile]d to observe the presence of Bhutanese skill in manipulating irrigation channels [despi]te the natural obstacles. Both Pemberto and Rennie, the renowned British [obser]vers of the Bhutanese scene during the 19th century noted: 'The fields of both [sides] of the rivers were neatly fenced and water was conducted by an indigenous system [of sm]all channels.' Sir Claude White, the British Political Officer in Bhutan in the [first] decade of the present century wrote in his memoirs: 'I have particularly noticed [durin]g my travels in the country, how remarkably skilful the Bhutanese are in laying [out c]anal and irrigation channels, and the clever way in which they overcome what to [ordin]ary people would seem insurmountable difficulties in leading water over steep, [diffi]cult places on bridges or masonry aqueducts, often built up at a great height.' [This] is further corroborated by Nari Rustomji, a discerning and learned observer who [visit]ed Bhutan in the '60s. He said, 'It was a delight to see such well terraced and [caref]ully irrigated fields in so many areas I visited. I do not think the Bhutanese [have m]uch to learn in the matter of agricultural irrigation'."[7]

[OBSER]VATIONS ON PRESENT IRRIGATION SYSTEMS

[Chara]cteristics of the Systems Observed

[I] visited five irrigation systems to gain insight into the dynamics of the [manag]ement of the systems. Information was collected from the beneficiaries. [Thou]gh more extensive documentation on Bhutan's irrigation systems is needed, these [obser]vations indicate a trend in the development and management of irrigation systems [in th]e country. The following systems were observed: 1) Simtokha, Thimpu district; 2) [...]a, Punakha district; 3) Bajo, Wangdipodrang district; 4) Lapchaka, Punakha [distri]ct; and 5) Yuwawon (Lobesa), Thimpu district. Table 3 gives the specific [chara]cteristics of each system.

[Table] 4. Characteristics of the irrigation systems observed during my visit.

[Name o]f [Syst]em	System	Length of Canal (km)	Area Irrigated (ha)	No. of Beneficiaries	Management Style

[7] Narendra Singh, op.cit. 177.

imthoka	10.0	23	24	farmer-managed
avana	6.7	6	8	farmer-managed
ajo	13.2	140	20[a]	joint-managed
pchaka	22.0	627	a few households[b]	agency-managed
awon	8.0	600	123[c]	farmer-managed

he beneficiaries include CARD, the town of Wandipodrang, and the Army barracks who ceive drinking water from the canal.

ifty ex-Army personnel have been given land in Lapchaka. Most of them have not yet settled here.

hey hold land in this place as well as in Thimpu valley. Yuwawon has many absentee ndlords.

urce: Field study, June 1988.

Irrigation water serves several villages along the canal. Hence, water location, distribution, labor mobilization, and water right practices must take into count the various villages served by each system.

pe of Management

The systems visited are managed either by the farmers, by the government agency, by both farmers and agency.

Farmer-managed systems. The Simtokha and Chavana systems are among the many stems in Bhutan that are farmer-managed. Simtokha and Chavana received assistance m the government for renovation and improvement but management is the ponsibility of the beneficiaries. Once a system has been identified for ovation, the irrigation agency (dzongkhag irrigation unit) negotiates with the eficiaries regarding their labor contribution. Prevalent practice in Bhutan is for ernment to provide the technical supervision and materials and the farmers to vide the labor.

Joint-managed systems. Among the systems observed, Bajo falls under joint-agement, where agency and beneficiaries work together. Not all of the eficiaries in this system are farmers and the water is used for various purposes. viously, irrigation water was used only for agricultural purposes. With the ablishment of a Center for Agriculture Research and Development, water is also vided to this agriculture farm. Over time, the township of Wangdipodrang was eloped and an Army barrack was established, creating more demand for water. A nking water project was constructed about 20 years ago, using the water from the e canal. Because of the numerous beneficiaries and multiple uses of the water, the ernment has provided support to strengthen the canal at its weak points. The nspeople and farmers work together to maintain the canal and have received support the Army as well. The district administration has also given attention to the ntenance of the system. Hence, the system is jointly managed.

Agency-managed systems. The Lapchaka system seems to be dependent on agency ntenance and operation. One section officer is assigned to this system and he is charge of repair, maintenance, and operation. Government has allocated Nu 100,000 maintenance. The person in charge of irrigation management, elected by the ficiaries, is known as the yopen. The responsibility of yopen rotates among the ficiaries and is usually an unpaid office. The canal is divided into 13 sections a yopen is placed in charge of each section. All 13 yopens in Lapchaka meet twice nth. Any problems that the yopens cannot resolve are referred to the section cer, who passes the matter to the district administration for resolution.

flicts are sometimes referred to the courts.

Fines are collected from those persons who fail to report during maintenance work. The fine is fixed at Nu 25 per day during the paddy planting season, and Nu 35 per day out of the season. In the past there have been abuses of the rules and regulations governing water distribution so that punishment and fines are imposed against transgressors.

In June 1988, the section officer stationed in Lapchaka reported that a separate account was opened with the district administration. The beneficiaries have deposited Nu 97,000. The interest from this account will be used for the maintenance of the system, subject to the approval of the dzongkhag.

The district administration is considering accumulating sufficient funds in the Lapchaka account to enable the beneficiaries of the irrigation system to use the interest from the account for the O&M of the system, in lieu of a subsidy from the government.

The prominent role of the section officer and the support of the dzongkhag to this system give the impression that this is an agency-managed system. However, Mr. Tsering Dorje, Superintendent Engineer in the Irrigation Division, suggested that this is not an agency-managed system in a true sense. He asserted that the beneficiaries are active in maintenance and operation. The section officer assigned to Lapchaka assists the beneficiaries with the ultimate goal of having the system managed by the beneficiaries.

Annual Maintenance of the Systems

In all the systems observed, annual desilting and maintenance of the canals are done by the farmers.

In the large systems, either the mandal, gup, or yopen lead the annual maintenance of the system. The mandal or gup is the head of the village elected by the people for a period of three years. The mandal or gup is assisted by the febe. The febe is responsible for transmitting messages from the mandal or gup to the villagers. The yopen is in charge of the maintenanace of the system. In small systems, the farmers decide when and how to undertake the annual maintenance of the canal.

Simtokha. In the Simtokha system, according to the informant, the mandal fixes the date and mobilizes the beneficiaries for the desilting and repair of the canal. This system serves five villages plus the government agriculture farm. The five villages are Simtokha, Olakha, Jalu, Luthe, and Zigithana. Labor mobilization is based on the number of households in each village. The command area and the number of households in each village are different. All the beneficiaries from all of the villages contribute labor at the time of desilting and repair, starting at the intake, working toward the tail. Each village contributes labor from the intake up to the village. The Simtokha people help to desilt the canal only from the intake to Simtokha. The Zigithana village, at the tailend, contributes labor to clean the entire length of the canal. Should breaches in the canal occur, repair is done by the village in the area of the breach.

Chavana. In Chavana, annual maintenance is done by the farmers. They have only eight beneficiaries and all of them participate in the maintenance work.

Bajo. Because various groups use the water for different purposes, contributions to desilting and maintenance of the Bajo system are more complicated. The dzongkhag requires the townspeople to contribute to the maintenance of the system up to the water tank. The Army provides manpower for maintenence up to the water tank. The Center for Agriculture Research and Development (CARD), established in 1982, is located in Wangdipodrang. Before the establishment of this center, it was a government agriculture farm. At present, the Center is engaged in collaborative research in paddy cultivation with the International Rice Research Institute (IRRI-CARD). Since CARD uses water from the Bajo irrigation system it contributes machinery and cash for the maintenance of the system from intake to water tank.

Until the present, the farmers have had to provide labor for maintenance work from the intake to their farms, which are situated beyond the water tank. Because so many people use the water from the canal, the farmers have petitioned that the Army, CARD, and townspeople be responsible for O&M of the canal from the intake to the water tank. The farmers would then take responsibility for O&M from the water tank to their farms. To this date, no decision has been made regarding their petition.

Lapchaka. Lapchaka has a long canal. Annual maintenance is the responsibility of the beneficiaries, who are usually supervised by the section officer assigned to the system. The yopens of each section make sure that their sections are desilted.

The Yuwawon system (Lobesa village) is a large system with a large number of beneficiaries. Landowners are required to contribute five man-days per acre to the annual maintenance work.

Each system appears to have developed a management method to accomplish annual maintenance. Yopens perform important roles in mobilizing people, maintaining the system, supervising water distribution, and resolving conflicts regarding irrigation management. Labor mobilization is compulsory in many places except in Lapchaka where cash fines are collected from persons who are absent from the annual maintenance work.

Water Distribution

Water allocation and distribution are two important elements in farmer-managed systems which shape the nature and strength of the irrigation system. Water distribution methods varied among the systems that were observed, each having distinctive characteristics.

Water distribution in Simtokha. In the Simtokha system water is allocated to the participant villages. Hence, each village has to contribute labor for the maintenance of the system. This labor contribution ensures the village's water right.

Water distribution practices are related to the principle of water allocation. After desilting the canal, the total volume of water in the canal is used by the first village until planting is complete. When that village has completed planting, the total volume of water is diverted to the second village. Each village receives the entire amount of available water for plantation in turn.

Once the whole command area has completed plantation, the principle of water distribution changes so that water flows continuously in the canal and all of the villages receive a share.

Each village has its own method of water distribution. During the time of plantation, each village decides the rotation system for water distribution. The informant said that the basis of rotation within the village during plantation and after is on the basis of the number of households. The mandal supervises the rotation.

The villages have practiced field-to-field irrigation and there are not many field channels and control devices in the command area of the Simtokha irrigation system.

Water distribution in Chavana. Chavana, with only eight beneficiaries and a small command area, has some interesting features regarding water allocation and distribution. Water is distributed using different methods depending on its availability.

This system received government assistance for canal improvement. Since water is scarce during the early part of the season, the farmers decided to install wooden proportioning weirs, called gahs in the local language, across the canal at two points. The water share appears to be based on number of beneficiaries, not on size of landholdings. Water is allocated according to the number of original beneficiaries (seven) in this system, so there are seven notches of equal size in the first weir to allow for an equal flow of water to each household. The water flowing through one of the notches is again divided below the weir to supply the eighth beneficiary without disturbing the share of the other six original beneficiaries.

First Location of
Proportioning Weir

Second Location of
Proportioning Weir

The second wooden proportioning weir is installed at a point in the canal where nly five beneficiaries receive water, hence there are five notches of equal size cut n the second weir. However, the amount of water flowing through any one notch is not lways sufficient for agricultural purposes. Therefore, the farmers receiving water hrough the notches in the second weir have established a rotation system whereby all he water is diverted through three notches for a specified time, then the other two otches receive all of the water for a specified time. This system has been in ractice for two years.

The Chavana system adopted the use of the wooden proportioning weir after earning about its functions from one of the beneficiaries who had seen a roportioning weir in the village of Dhawakha where he was formerly a resident. ccording to the farmer, a High Court judge, Mr. J. Dorje, initiated this scheme to esolve water-related conflicts in the Dhawakha system.

An interesting concept related to ownership of water share was observed in this stem. It seems that water share is not attached to the land but considered property the individual beneficiary. One farmer in the Chavana system brought his share of ter from the neighboring Dhawakha system to his fields in Chavana by digging a annel from the Dhawakha canal to the Chavana canal. He runs the water from Dhawakha his fields in Chavana whenever the Chavana system is not running water in its nal. Hence, this beneficiary can use his share of water in whichever system he shes as long as he can get his share of the water from the other canal to his elds.

Bajo system's method for distributing water. Because various groups use the ter from the Bajo system, formal agreements regarding water allocation and tribution are enforced. Water from the Bajo canal is used by the townspeople, y, CARD, and the farmers. However, the farmers are the primary users of the stem.

A proportioning weir divides the water flow between the irrigation canal and nking water tank. The dzongkhag and the farmers have an agreement regarding this ocation. However, as the town of Wangdipodrang has developed, its need for water increased.

The farmers also have a written agreement, registered in the dzongkhag, with the iculture farm and CARD that specifies that the agriculture farm receive 3x3 inches water day and night, irrespective of season. Despite being a government farm, it not entitled to receive more than this amount. The Bajo system serves two lages, Bajo Wangukha and Thango. The two villages rotate the flow of water. One lage will receive water for 12 hours in one night; that village will take water for ours during the day in the next rotation.

Within the village, water is distributed according to the size of landholding, but no control devices to measure the water are used. The yopen and the villagers observe the fields and determine the amount of water to apply.

Lapchaka system. The Lapchaka system is evolving a method for water allocation and distribution through trial and error. The management of a 22-kilometer canal along a mountainside is a big challenge to the farmers and administrators.

The yopens get together twice a month to determine the water distribution and repair schedules. Observation of the canal reveals many places where damage has occurred because attempts have been made to divert all of the water through one outlet. Other damage to the canal indicates that farmers have attempted to open unauthorized outlets.

Yuwawan system. Yuwawan is a large system serving seven villages. Water scarcity is a characteristic of this system. Water is distributed on the basis of village. Each village is entitled to get water for a day and night, usually 24 hours. When it rains, there is plenty of water. But when water is scarce the people guard their water against water stealing attempts day and night. The rotation schedule is fixed and each village receives water during its turn. Within a village, water is distributed according to landholding size. No devices are used to control the flow of water at the farm level.

Water allocation and distribution are implemented in different ways in the systems that were observed. However, in each system the farmers have worked out methods to assure that water is available to the paddy crop when it is required.

Resource Mobilization for the Operation and Maintenance of the System

Two categories of resources may be mobilized by an irrigation system: internal and external. Internal resource mobilization means that the beneficiaries utilize resources from within the system. These could be labor or monetary resources. External resources refer to resources obtained from outside the system. External resources such as construction materials and technical expertise are sometimes provided by government. Construction is directly under the supervision of a technical expert. This assistance is usually aimed at improving the physical condition of the system.

Internal resource mobilization. In the five systems that were observed, labor is the primary resource that exists within a system. Labor contributions may be assessed in one of two ways: according to size of landholding, or according to the number of households. However, to be more equitable, the farmers have agreed that labor contributions should be based on size of landholdings.

The Simtokha, Chavana, Bajo, Lapchaka, and Yuwawon systems mobilize labor for operation and maintenance of their irrigation canals. Because of the short supply of manpower, many systems do not accept money in lieu of labor. If one household cannot supply the required manpower it is held responsible for finding a laborer from somewhere to do the work. If a beneficiary fails to appear for work on a specified day, he is required to present himself on another day. Peer pressure is important in obtaining compliance with the labor requirement. In some cases, the absent beneficiary is denied water for the season. This occurs in Simtokha, Yuwawon, and Bajo.

In Lapchaka, farmers who are absent during maintenance and repair work are fined. The fine is collected by the section officer and deposited in the dzongkhag. This is the only system with a bank account.

In the Bajo system, materials, tractors, and cash are mobilized from CARD for maintenance of the system. The townspeople and Army also contribute manpower for the maintenance effort.

External resource mobilization. All of the five systems observed had assistance from the government for the renovation of physical structures.

Any system can be a candidate for such improvement. The farmers, through the gup, file a petition with the irrigation unit of the dzongkhag. The district administrator puts the proposal before the dzongkhag development committee. Once approved by the dzongkhag development committee, the petition is sent for approval from the Irrigation Division, which checks the technical feasibility of the system. Approval is sent to the irrigation unit of the dzongkhag. Once approved, the dzongkhag unit is in charge of the renovation work. In all improvement projects the farmers provide the labor for the construction work.

Conflict Resolution

Although very few conflicts are reported in Bhutan, mechanisms exist for the resolution of conflicts should they arise.

When conflict arises within the village regarding irrigation water, it is settled by either the yopen, the gup, or the dum, who is the caretaker of royal lands.

When the case involves a bigger dimension, it will be referred to the dzongkhag, as occurs in Lapchaka. Sometimes the case is referred to the judiciary court in order to establish the water rights.

Irrigation-Related Officials

Some form of irrigation organization exists in the beneficiary-managed irrigation systems. Yopens are elected by the beneficiaries to carry out certain functions. In some cases, they are paid, but this is unusual. Each of the beneficiaries takes a turn at holding the office of yopen. The gup or mandal is the village head. He is paid by the government but elected by the villagers. The gup especially plays an important role during the time of renovation and selection of the system for renovation. He keeps the record of landholdings and organizes the farmers for desilting and maintenance of the canal.

The dum is the caretaker of the royal lands. Since he is close to the royal families, he is influential in resolving irrigation-related conflicts within a village.

AGRICULTURAL PRACTICES

The systems observed are in the valleys and terraces close to the valleys.

Irrigation activities are primarily geared toward paddy cultivation. At higher altitudes, red rice is grown, and in lower altitudes white rice is cultivated. Around the valleys, chili, mustard, and wheat are grown as second crops. Wheat is not yet a very important crop. Wheat straw is used as animal fodder.

As part of a program to increase paddy production, experiments are going on for the cultivation of early paddy. Depending on the availability of water in an area, the Agriculture Department will designate areas where two paddy crops may be grown. All irrigation systems will not be allowed to have two paddy crops because this may cause water conflicts.

CARD is introducing row plantation with the objective of introducing roter weeders as part of an extension program that includes farmers in the Bajo system. Inputs are subsidized, and insecticides are free in the Thimpu, Wangdipodrang, and Punakha districts.

In order to increase the area under paddy, government has encouraged people to convert hill slopes into terraces and is providing Nu 300 per acre for such terrace making.

SUMMARY

1. Some form of irrigation organization exists in all systems that were

ved. The irrigation organizations perform the tasks of water acquisition, water ation and distribution, and resource mobilization, especially labor mobilization the maintenance of the irrigation systems.

2. Annual maintenance is the responsibility of the beneficiaries of the system. ther the yopen or gup decides when desilting and repair of the canal is necessary. Irrigation management officials are found in the villages.

3. The Royal Government of Bhutan provides material and technical support to the irrigation systems designated for assistance. Usually the government provides onstruction materials and technical manpower but the beneficiaries contribute the labor for the construction activities. Labor mobilization has become a difficult task in many of the farmer-managed systems because canals are long and manpower is scarce. The construction works are performed under the supervision of the irrigation ersonnel. Contracts for construction are not allowed when the government assists a farmer-managed irrigation system.

4. The irrigation organizations that were visited do not keep written records of their activities apparently because the number of beneficiaries is small in many systems.

5. Except in one system, monetary transaction in the irrigation organization oes not exist. Labor has a higher value than money since Bhutan is a country with a anpower shortage. Foreigners are not allowed to work as agricultural laborers.

6. Irrigation organizations are not legal entities.

PLICATIONS AND ISSUES FOR FUTURE DEVELOPMENT AND GOVERNMENT INTERVENTION

1. Because of labor shortages, government should consider the canal length and mber of beneficiaries in a system when determining which systems should receive overnment subsidies.

2. The irrigation systems observed in Thimpu, Wangdipodrang, and Punakha have dopted flexible systems adapted to the local topography and terrain. Hence, overnment regulations pertaining to the beneficiary organizations should be flexible. igid rules applied to all systems might render the irrigation organizations neffective.

3. Issues on tenancy rights create problems for management of the systems. In e of the villages of the Bajo system, tenancy changes each year, requiring water llocation and labor mobilization quotas to be readjusted according to the number of nants/beneficiaries using water that year.

In the Lobesa system absentee landlords are predominant. The tenants on these nds have no assurance from one year to the next whether they will remain on the same nd. Where there is no sense of security, the tenants have little incentive to intain or improve the irrigation system beyond immediate necessity.

4. Bhutan has a variety of irrigation systems with diverse arrangements for termining water share, water allocation and distribution, and labor contributions. rigation organizations are a strategic resource enabling better management of rigation systems. The irrigation organizations which are presently in operation in utan need to be properly understood before water users associations are introduced ross the country.

5. In many systems, the roles of the yopen, gup, and dzongdha are spelled out early. These leaders presently play important roles in making the irrigation stems functional. The government plans to create water users associations to nage the O&M of the irrigation systems. Any irrigation organization which is eated needs to capitalize upon existing local expertise and integrate the already sting leaders and management practices into the new organization.

6. Over time, the demand for water for other purposes such as new settlements, ns, industrial use, and for government agriculture farms will increase. Hence,

oyal Government of Bhutan needs to set up regulations regarding the use of water rrigation.

7. Government projects are taking water from the existing irrigation systems and agriculture farms have plans to take water from existing systems. Norms need to developed when new projects use water from the existing systems. Such use of water ould not result in the scarcity of water to users with prior appropriation rights.

APPENDIX 1
AREAS OF WET AND DRY CULTIVATION

Areas	Wet cultivation (ha)	Dry cultivation (ha)
Paro valley	3237	1214
Thimphu Valley	2428	809
Wangdiphodrang Valley	3237	2023
Punakha Valley	4856	2023
Ha Valley	1618	404
Sambe Valley	809	404
Gasa Valley	1214	404
Lungshi Valley	809	404
Samchi Zone	1618	2428
Phuntsholing	809	1618
Chacha	1618	404
Chirang Valley	2428	3237
Dagana Valley	1214	809
Khen Valley	1214	1618
Sarbhang Zone	2023	2832
Bumthang Valley	2428	809
Tongsa Valley	1214	809
Lunatshi Valley	1618	1214
Songar Valley (Mongar)	2428	1618
Tashi-Yangtsi Valley	1214	1618
Tashigang Valley (including base area)	5665	3237
TOTAL	43707	29947

Source:

urce: Narendra Singh, op.cit. 181.

The figures given in the table indicate the availability of cultivable land under ferent conditions. Wet land does not necessarily mean irrigated land. The total igated land in Bhutan is still very small.

APPENDIX 2

TWENTY-FIVE YEARS OF DEVELOPMENT IN BHUTAN[8]

D.N.S. Dhakal

[IN]TRODUCTION

The Kingdom of Bhutan is a small, rather isolated state, with a total area of [4]6,500 square kilometers and a total population of 1.165 million, situated between the [T]ibetan Plateau and Himalayan crestline to the north and the Brahmaputra plain to the [so]uth.

Before 1961 most Bhutanese knew little about the outside world. They had no [ro]ads for vehicular traffic, lived on subsistence farming, and had a homogeneous [so]ciety, devoid of today's educated, business, and farming groups. Most were [co]ntented with what they had.

[DA]WN OF DEVELOPMENT

In 1961 Bhutan launched a planned process of economic development. The First [Fi]ve-Year Plan (1961-66) primarily concentrated on development of infrastructures. Of [al]l the government departmental outlay, the construction of roads topped the priority [li]st accounting for 66 percent of the total $10.7 million budget. Some of the [co]ntract funds for the construction projects went to local contractors who made rapid [pr]ofits and formed the core of today's affluent group.

Another major thrust of both the First and the Second Five-Year Plans was on [ed]ucation. In this way the government established a number of primary and secondary [sc]hools, and also provided scholarships for brighter children to study abroad. This [su]pplied the government, both at home and abroad, with educated school graduates who [in] the early 1970s were able to shoulder government responsibilities. Thereafter, the [wh]ite-collar sector found public popularity and created momentum to form today's [ed]ucated elites.

Thus, the dawn of development broke the kingdom's traditional homogeneous society [in]to classes and ushered the people into a new era--an era of business opportunities, [fr]ee education, free medical care, and job prospects outside the traditional sphere.

["PE]RPETUAL AID SYNDROME"

The total outlay of the Second Plan (US$ 20.2 million) was 90 percent larger than [th]e First, and the Third (US$ 47.5 million) was 139 percent larger than the Second. [The] three Five-Year plans were developed entirely by foreign expertise; and, in fact, [th]e total outlay of the First and the Second plans came as grants from the Government [of] India. As a result the people knew little about what these early development [inv]estments would mean to them in the future. Furthermore, the continual aid [ass]urance of the Government of India, the availability of the United Nations (UN) [dev]elopment assistance when Bhutan joined the UN in 1971, and the kind gestures of [oth]er friendly nations (such as Switzerland, Japan, and Australia) to participate in [dev]elopment work escalated the confidence of the people in external aid.

Assured of the bilateral and international aid, the Government continued to add [dev]elopment projects, rehabilitate settlements, reduce taxes, and subsidize prices on [esse]ntial commodities, fertilizers, agricultural implements, and cement. This made

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[8]Dhakal, D.N.S. 1987. Twenty-five years of development in Bhutan. In Mountain [Rese]arch and Development, United Nations University and International Mountain [Soci]ety, Boulder, Colorado. 7(3)August.

general public heavily dependent on the Government: dependent on jobs, education, health care. From the dawn of development to the Third Five-Year Plan the "Perpetual Aid Syndrome" preoccupied most Bhutanese.

TRANSITION PHASE

The Transition Phase began once the newly ordained Planning Commission took responsibility for preparation of the Fourth Five-Year Plan 1976-81). Until then, no single responsible government body had existed to co-ordinate development plans for review and planning; most tasks had been undertaken on an ad hoc basis. The Planning Commission established statistical units, channelized information from audit and central account units to generate at least the basic data deemed necessary for checking on progress towards its goals. Having routed most information through its administrative units, the Planning Commission launched a $101.6 million fourth Five-Year Plan in 1976.

Although the format of the Fourth Plan differed little from that of earlier plans, emphasis this time shifted to agriculture, which was allocated 29 percent of the total budget. The Government hoped to boost agricultural yields, and thereby reduce the already staggering dependence of the people on the Government. Simultaneously, large investments, outside the plan outlay, were made in a 336 megawatt hydroelectric project, various industries, and major irrigation works, in order to establish the revenue generating base of increasing the internal contribution to the Fifth Plan outlay. The capital investment came from the Government of India both in grants and loans.

But upon evaluating the feedback from the Fourth Plan in 1982, the Government noted a record food deficit of 25,000 metric tons, unbalanced regional development, and a huge overhead cost due to the burgeoning bureaucracy which consumed most of the revenue from capital investment. This convinced the Government that there was a basic flaw in the system, and it was decided thereafter to slowly lead the people away from the "Perpetual Aid Syndrome" towards "self-reliance".

CHANGE TO SELF-RELIANCE

The self-reliance policy of the Fifth Plan (1981-87) required a structural change in the bureaucracy. As the first step, the Government decentralized the development administration into districts (dzongkhags). In the dzongkhags, Dzongdhas (district commissioners) were entrusted to constitute district planning committees (Dzongkhag Yargye Tshokchungs) to decide upon the nature and quantity of aid required by the people in each district.

Every development proposal was to be submitted through the people. The Government officials would help the people to understand the feasibility and cost of specific projects. Also, it was made mandatory for the public to contribute either labor, cash, or materials. Only upon meeting these conditions can the Dzongdha forward plan proposals to the National Planning Commission for final approval.

Another obligation requires that the district plan must conform with the general guidelines stipulated in the National Plan document. Also, once the plan has been initiated no interim alteration is permitted without the prior approval of an appropriate authority. In addition, the progress of the plan would be periodically monitored and evaluated by an expert team deputed by the National Planning Commission. The Dzongdha is accountable for mismanagement or slow progress.

This work format was intended to streamline responsibility and bring general awareness to the people of the amount of money the Government had been committing to each dzongkhag. Also, the villagers would become cost conscious and be encouraged to use the free development support facilities in agriculture, animal husbandry, education, and health. In addition, the dzongkhag's elites would become familiar with the recurring expenditures from the development infrastructure, and would comprehend necessity that someday the people should be left alone to manage their own affairs.

Other reforms in the Fifth Plan were concerned with reorganizing the bureaucracy, cutting down unnecessary staff, and commercialization of public enterprises. These reforms helped the Government reduce overhead expenditure and increase working efficiency, and they produced significant annual revenues. It is expected that the revenue generating sources, such as tourism, industry, power, and forestry will continue to improve in efficiency and will provide a significant internal contribution to the budget of the Sixth Five-Year Plan (1987-92). The Government estimates total revenue at
...4.2 million during the Fifth Plan period.

...OBLEMS TO OVERCOME

It seems that everything that could be accomplished by the bureaucrats has been done. But there are remaining tasks of a scientific nature if Bhutan is to pursue a sustained, holistic approach to complex mountain development. Of the many important issues, the following require immediate attention:

- To investigate scientifically whether or not a subsistence community with an average of about one hectare of land per family can become self-sufficient within a certain time period.
- To suggest an alternative approach to tackling the household problems of self-sufficiency if the present milieu inhibits the society from moving towards this goal.
- To determine the present status of soil erosion, and integrate a new village-wide soil management system based on agro-climatic data.
- To assess the present status of environmental degradation from road cuttings, commercial logging, industrial development, hydroelectric dams, and mining, and then establish a regular monitoring body to record the environmental changes within a certain time period.
- To create facilities for recording time-series data on rainfall, temperature, and wind and also on stream-flow and sediment transfer. This information is important for deciding whether or not a cycle of catastrophic events would effect developmental capital projects in the specified time period.

...NCLUSION

The development process, which invariably creates disturbance in a self-contained, subsistence farming community, is difficult to reconcile with native values and goals. As more developmental programmes are initiated, they create disturbances that require more attention. Whether a developing country such as Bhutan can someday succeed in bridging these gaps or not, it is still necessary to make an honest effort. effort.

Map of Bhutan

RECONNAISSANCE/INVENTORY STUDY OF IRRIGATION SYSTEMS IN THE INDRAWATI BASIN OF NEPAL

Robert Yoder and S.B. Upadhyay[1]

INTRODUCTION

The first official recognition and estimate of the extent of farmer-managed irrigation systems (FMIS) in Nepal was made by the Water and Energy Commission Secretariat (WECS) in 1981. The size of systems ranges from a single farmer's plot consisting of a fraction of a hectare (ha) to the federation of several organizations and diversions into a system which irrigates as much as 15,000 ha. However, it is the sheer number of systems rather than their size that makes the greatest impact on irrigated agriculture. Farmers in Nepal have been active for many generations in pushing the technology available to them to its limit. They have tapped all easily accessible water and land resources to develop irrigated agriculture.

Excluding the systems in the tarai, simple extrapolation of the results shown in this paper along with information from the Land Resource Mapping Project (1986), indicates that there may be well over 17,000 farmer-managed systems in the hills of Nepal. The impact of FMIS in terms of subsistence living and hence the national economy has not been carefully studied. Martin (1986) and Yoder (1986) present data from several communities with perennial irrigation at elevations below 1,000 meters (m) which produce three crops per year. The net annual increase in cereal production with irrigation over that of nearby unirrigated land was found to be well over 6,000 kilograms per hectare (kg/ha). As a conservative estimate one can assume an average increase in production of at least 2,000 kg/ha through FMIS. Using this estimate of yield increase and the WECS estimate that roughly 390,000 ha are irrigated by such systems in all of Nepal, one can show that the incremental increase in production due to FMIS is providing the total subsistence level cereal production for at least 30 percent of Nepal's population. This calculation is based on the average cereal consumption of 164 kg/person/yr (Khadka and Gautam 1981). WECS is presently conducting a water-use inventory in the tarai districts which will give a better estimate of irrigated land area. Preliminary analysis indicates that the area irrigated by FMIS may be as much as double the earlier estimates. In this case the dependency upon FMIS for food production may be much higher than the above analysis indicates.

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The appearance of most FMIS belies their potential performance. Brush/stone diversions and earth-lined canals leak and require frequent maintenance. This has led development agencies, and engineers in particular, to assume that structural improvements in the water acquisition and delivery system will improve the system efficiency. Further, that efficient operation will allow for more reliable, intensive irrigation of the existing command area, and expansion of the irrigated area where land is available.

Past efforts of intervention in FMIS to improve their agricultural performance have not been highly successful. This is partially due to misdiagnosing the cause of the shortcomings. FMIS are generally built with local materials that decay quickly when not in use. Inspection of systems by technicians responsible for intervention usually takes place in the winter and dry season. At that time many systems do not have water available in their source and farmers do not waste effort in trying to maintain a system that cannot be used for a season. Technicians often declare such systems to be in total disrepair without the understanding that they will be transformed into viable systems by the beneficiaries as soon as water is available. In some cases farmers are willing to invest as much as 50 person-days/ha/year in maintaining their systems (Yoder 1986).

Physical improvements in a system may be a necessary condition for better performance but making structural improvements alone seldom brings the desired results. The strength of an irrigation system with scarce resources that performs well, is its management. Improving the management capability of poorly performing systems may be equally important to making improvements to its physical system. In some cases assistance from outside the community has eroded local management and resource mobilization capability.

The magnitude and impact of resource mobilization by the beneficiaries is not well known or understood. The high performance of some FMIS is attributed to the capability to mobilize tremendous labor and cash resources for operation and maintenance (Yoder 1986). One system in Gulmi, two in Palpa and one in the Nawalparasi hills were intensively monitored for 18 months in 1982-83. In systems where the water source was adequate, all were producing three irrigated crops each year. Using crop cuts to estimate the yield, the system with least water--producing two crops--had a total annual production of 5,200 kg/ha and those with three crops per year ranged from 7,500 to 9,000 kg/ha. Such examples of intensive agriculture production in FMIS are not isolated cases (Pradhan 1986).

However, some FMIS are operating far below the production level that they could potentially achieve with the available water and land resources (Pant 1985; Tiwari 1986). In many cases farmers have good cause for requesting and actively campaigning to attract outside assistance for structural improvements. In addition to more reliable and extensive irrigation, farmers are interested in reducing the effort--labor and in some cases, cash--that they need to invest in maintenance of their systems.

With increasing interest among agencies to target poorly performing systems for intervention, several practical questions emerge. It is clear that FMIS have been successful in increasing agriculture production. Some systems perform well and are close to achieving their potential. Others perform far below their potential. How does one distinguish between systems? What procedure can be used to quickly collect and analyze information for anking systems in priority for assistance? How does one analyze the symptoms in order to diagnose the causes of low performance? How does one intervene to improve the performance?

WECS has engaged in an action-research project to attempt to answer some of these questions.

THE WECS ACTION-RESEARCH PROJECT

The underlying rationale for the WECS action-research project is the hypothesis that farmers in the hills of Nepal have already, to some extent, developed most of the sites with potential land and water resources for irrigated agriculture. Few new systems will be built where there is not at least some existing irrigation activity. Where irrigated agriculture already exists, farmers have some irrigation management experience. They also have knowledge about the stream discharge, diversion and canal maintenance problems, soils, irrigated agriculture practices, and benefits of irrigated agriculture. It is expected that food production gains can best be made by examining the existing (running) systems to identify, and to the extent possible, release the constraints that farmers face in increasing agricultural production through intensification or expansion of their irrigation system.

The aim of the WECS project is to examine the physical, hydrologic, agronomic, economic, and social/organizational aspects of existing irrigation systems to first identify if there are water and land resources in a community that are not fully utilized, and then attempt to uncover the reason for less than full exploitation of the irrigation potential. Another aim is to develop and test processes to overcome the problems. Emphasis is placed on developing the necessary methods and tools for collecting useful information as quickly and cheaply as possible. After evaluating the alternatives, recommendations for upgrading and improving individual system operation will be made and carried out as a part of the project.

The intent is to carry out all activities in such a way as to enable the beneficiaries to continue to take full responsibility for the operation and maintenance of their irrigation system. This implies maximum participation of the farmers in the identification of the constraints, examination of alternatives, choice of the appropriate action, and implementation of the action. The action-research mode of carrying out the work allows specific problems to be addressed as they are identified. Recommended actions can be implemented immediately, offering an opportunity to further study the impact of these activities and to make additional recommendations and carry them out as necessary.

Objectives of the Project

The primary objective of this action-research project is to examine ways to assist farmer-managed systems that will allow them to overcome the constraints limiting intensification and expansion of irrigated agriculture. This includes testing lower-cost techniques and technologies and maximizing participation and resource mobilization of the beneficiaries. It also includes developing and testing low-cost processes, procedures, methods, and methodology for developing under-utilized human and physical resources. The aim is to do this without shifting the responsibility for operation and maintenance to the government.

The WECS action-research project proposes to assist irrigation systems in the project area. However, success of the project will not be measured by the intensification or expansion of irrigated area, but by the degree to which the objectives of developing processes and procedures are accomplished.

The implementation of the project is being carried out in two phases. The first phase consists of information gathering, analysis, and recommendations of steps for initiating the second phase. The second phase will involve intervention in irrigation systems selected as a part of the first-phase activity. Monitoring and evaluating the intervention will be an integral part of the activity.

The chronological steps taken to carry out the first phase include:

1. Project site selection.

2. Development of the terms of reference for a reconnaissance/inventory and rapid appraisal study of the project area.

3. Selection of a local consulting firm to carry out the first phase field studies.

4. Development of a procedure for the reconnaissance/inventory study and carrying out the field work and report writing associated with it.

5. Selection of micro areas for further investigation by rapid appraisal techniques based on the reconnaissance/inventory study report.

6. Development of a procedure for the rapid appraisal study and carrying out the field work and report writing associated with it.

7. Development of a work plan for the second phase based on the reconnaissance/inventory and rapid appraisal reports by the consultants, and additional field reconnaissance by WECS staff.

With the exception of developing a work plan in the last step, the first phase is complete. The remainder of this paper will examine and analyze the procedure and results of the reconnaissance/inventory step of this activity.

Methodology and Field Procedures

The project site was envisioned to encompass a large river basin and include all of its numerous minor tributaries. The criteria for selecting the site were: accessibility from Kathmandu for supervision and representativeness of the hill areas of Nepal. The Indrawati River basin in Sindhupalchok fit these criteria. To further define the boundaries of the project, only the area above Sipa Ghat, extending four kilometers (km) on each side of the Indrawati River, was included. This excluded the Melaunche River, a major tributary, but included almost all of the remaining irrigated area in the basin.

The consultants were given background materials, including check-lists and write-up guides developed in different parts of the world, and available materials from Nepal. From this material they developed their own lists and guides for both the reconnaissance/inventory and rapid appraisal study.

To carry out the field work the consultants were to use an interdisciplinary team consisting of at least an engineer, a social scientist, and an agriculturalist. However, the nature of consulting firms does not lend itself to fielding such a team. Few persons can be employed full time by consulting firms, therefore individuals who can take leave from their regular jobs are recruited. Frequently the best-qualified persons on the roster are not available and others must be substituted. This allows little flexibility in selecting disciplines.

The reconnaissance/inventory field work was carried out by a civil engineer, an agriculture specialist, one junior hydrologist and two helpers. Some assistance was provided for part of the time in the field by an IIMI social scientist.

The reconnaissance/inventory team visited each irrigation system in the basin. The most important activity was to walk along the length of the canal from the intake to the command area. One or a group of farmers was invited to accompany the team. While walking along the canal the farmers were questioned about the operation and maintenance of the system and the organization that was in place to carry out the various irrigation activities. Problems with the diversion and along the canal were discussed while making this inspection.

Water in the source was estimated while inspecting the intake. Farmers were also asked to estimate the discharge in the stream and relate the observed discharge to that in each irrigation season. In addition to the consultant's estimate of discharge by visual inspection, he asked the farmers to make their own estimate by asking them how they measure water. Usually the response was in <u>ghatta</u> of water (discharge required to drive a locally-built water-powered flour mill assumed to average about 28 liters per second [lps]) or <u>gagri</u> (water pot used for carrying domestic water holding about 20 liters) or <u>samaha</u> (water basin 5-10 liters). Water for driving a ghatta was further differentiated by asking if the water was sufficient for grinding all types of grain. If at some periods of the year it could only grind millet, the discharge was clearly lower than at other times. Half or one-fourth ghatta of water were also typical responses for discharge estimates. For lower discharges, farmers were asked how long it would take to fill a gagri or samaha. Since time is not generally measured in minutes and seconds by the farmers, they were asked how many times the gagri would fill in the time that it took to smoke a cigarette, which was estimated to be about four minutes.

The error in this type of estimate is high. A mill can grind grain with 0.25 - 1 kilowatt (kw) of power and power is a function of both the discharge and head (height the water is dropped) as well as the efficiency of the particular ghatta. However, it does give an idea of the relative discharge and of the variation over the year. Coupled with information from the farmers about the adequacy of the water supply for irrigating different crops and whether there was sufficient water to expand the area irrigated, the discharge information provided insight into the extent that the water resource had potential for further utilization.

To the extent possible the command area was also inspected. This was a difficult task among the many ridges and valleys and not always possible in the time available. The farmers were asked to estimate the area in the hydraulic command of the canal, how much of that area was actually irrigated, how much was cultivated but not irrigated, and the extent of the waste area.

While examining the command area, farmers were also asked about their agricultural practices.

Estimates of land area were more difficult for farmers to make than estimates of water discharge. The cadastral survey of this area is complete and individuals have knowledge about their own holdings but not of the aggregate in the system. The most common measure of land area used by the farmers in this area is the volume of seed required to plant the area. A rough estimate for conversion is 20 patti of seed/ha (91 liters of seed/ha). Unlike most systems studied in western Nepal, few of these systems had quantified the resource mobilization or water allocation of the system on the basis of land area. Therefore, farmers have not needed to compute the total land area or seed required for a system and found it difficult to do so. The accuracy of the land area information could be improved with good quality air photos.

Since maps of a suitable scale are not available, the consultants were asked to make a sketch map of the area showing the irrigation water source, rough alignment of the canal, and layout of the command area. The map included the names and relative locations of the intake, canal, and command area of each system from that particular water source.

RESULTS AND ANALYSIS OF THE RECONNAISSANCE/INVENTORY WORK

The project area covers about 200 square kilometers (km^2). The Indrawati River cannot be used extensively for irrigation because it is deeply incised, and is large, with violent floods. Almost all of the irrigated fields in the project area receive their water from the 25 tributary streams. Most of these streams are steep-sloped having highly destructive, short-duration floods during the rainy season and very little water in the dry season.

The reconnaissance/inventory study identified 119 irrigation systems in the project area with canals longer than 0.5 km. These systems irrigate about 2,100 ha of land and were found to benefit approximately 10,100 households. In addition there are many systems with shorter canals and small command areas in the valley bottoms which have easy access to the available water. These were not included in the inventory because they have little potential for intensification or expansion.

The longest canal was found to be 5.5 km from the source to the command area. On the average the canals are 1.9 km long and serve 100 households. Several systems irrigate over 100 ha. Up to 800 households own portions of land in the larger systems. The average land area served by the systems in the study area is 18 ha. However, the median area covered by a system is about 10 ha.

Of the approximately 3,800 ha within the boundaries that can be irrigated by gravity (hydraulic or gross command area) from the canals, 30 percent is too steep or rocky for cultivation. Of the gross area, 56 percent is irrigated and about 14 percent is cultivated but not irrigated because of insufficient water in the source or inability to deliver the water to the land.

The area irrigated represents about 11 percent of the total 200 km^2 project area. Although the project area is small and no claim can be made that it is average for the hills, this is possibly the best data presently available for estimating the area irrigated by FMIS in the hills and for estimating the total number of such systems. Extrapolation of the number of systems and percentage of area covered by FMIS in the project, to all of the hills and mountains of Nepal, yields an estimate of at least 17,000 systems covering 300,000 ha. The basis for land area in this calculation is taken from the Land Resource Mapping Project (1986) and only Class I, II, and III land (land classified as supporting cultivation) from the siwaliks, mid-mountains, and high mountains was included.

Out of the 119 systems identified, 25 have received some form of outside assistance in the past 20 years. For some the assistance was a certain tonnage of grain for working on the improvement or rehabilitation of an existing canal. In such cases the beneficiaries did most or all of the work themselves. Eleven systems in the study area have been built (about half are still under construction) by the Department of Irrigation, Hydrology, and Meteorology.

A major accomplishment of the reconnaissance/inventory work is a detailed listing of the potential for either intensifying the cropping pattern or expanding the area irrigated by each system. Out of the 25 basins of the minor streams tapped for irrigation in the study area, only 11 basins with 21 different irrigation systems were identified by the consultant as having land and water resources with potential for expansion of the irrigated area. A more reliable water supply would allow more intensive cropping in many systems beyond these 21 and improvements in both the management and physical system would assist in making this possible. However, assisting the 21 systems identified by the reconnaissance/inventory study is likely to lead to the largest gain in food production.

In addition to the physical resources, the study examined operation and maintenance (O&M) activities of the irrigation systems and agricultural practices. Even by spending very little extra time in each system the team collected valuable information about the historical development of the system, the current organization for O&M, and the capability for resource mobilization. This information was considered along with information about the physical system in determining the potential for expanding water and land resource utilization.

A summary of the effort that went into carrying out the reconnaissance/inventory work is presented in Table 1. Here it is seen that the report writing was more time consuming than the field work. Attention should be given to making the report writing simpler without compromising content and also to making it more readable than the present two volumes totaling 500 pages.

By making a comparison of river basins it is estimated that the same level of intensive field work to cover the entire Sindhupalchok District would require one team to spend about 18 weeks in the field.

DISCUSSION AND CONCLUSIONS

Although the estimates of water discharge and land area are not accurate in absolute terms, the reconnaissance/inventory work is extremely valuable in determining the irrigation development potential in a relative sense. The study has successfully identified the existing irrigated land resource. It has also successfully captured farmer input in identifying under-utilized resources. Finally, it has allowed the identification of systems with obvious potential for intensification or expansion from among those with little or no potential. Through systematic examination, attention is focussed on 21 of the 119 systems. The study provides a combination of information on the agriculture system, management practices, and physical system, giving an insight into the constraints that must be overcome to make the systems more productive.

If this type of study were to be carried out on a district-wide basis it would allow planners and policy makers to set priorities that would maximize returns on investment in development. The cost for completing the reconnaissance/inventory study in Sindhupalchok would be approximately six times what has been invested in studying the Indrawati basin.

Two limitations of the present study should be addressed in future work. The land area estimates need to be improved and potential areas where farmers have not been able to develop irrigation should also be examined. Both of these could best be addressed by using good quality, large-scale air photos in the field. The possibility of using existing air photos by enlarging relevant areas should be examined. By tracing the boundaries of the irrigated area on the air photo, more accurate estimates of area could be calculated. Some effort would need to go into determining the scale of each photo segment by making measurements on the ground or using the cadastral map, if identifiable features can be found on both the photo and map.

Table 1. Resources expended in carrying out the reconnaissance/inventory work (person-days).

Activity	Office	Field
Preparatory Work[1]	12	2
Field Work	-	50[2]
Report Writing	73	-

[1]This included map collection and study, preparation of question-guide and write-up format, pretesting, etc.

[2]Twenty-one calendar days were spent in the field by the team.

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Annex 5

GUIDELINES FOR RAPID APPRAISAL OF IRRIGATION SYSTEMS EXPERIENCE FROM NEPAL

Prachanda Pradhan, Robert Yoder, and Ujjwal Pradhan[1]

THE UTILITY OF RAPID APPRAISAL

Given constraints of time, money, and manpower, rapid appraisal is a useful tool for assessing existing irrigation systems. It can be used to identify key issues and problem areas and to give direction for further investigation. The effort of rapid appraisal should lead to a wide variety of options and possible alternative arrangements for irrigation management.

The "quick and dirty image" often associated with rapid appraisals can be overcome with a well-developed framework and a team that is integrated in its effort. Intensive interaction of the team while in the field leads to cross-checking of information and an opportunity for follow-up questions.

One must recognize that rapid appraisal has limitations. Not all questions can be answered by it. Complex issues cannot be unraveled in a short time. Some results and conclusions will inevitably be wrong. Increased skill in cross-checking can reduce this problem but there is always danger that the investigator will be misled by one or a few informants. It is important to examine rapid appraisal results within the context of its limitations.

This guideline for rapid appraisal of irrigation systems was largely prepared on the basis of experience with farmer-managed irrigation systems in Nepal. With some modification it could be used to investigate agency-managed systems as well.

INTRODUCTION TO RAPID APPRAISAL

Agrarian change and agricultural development are quite intimately associated with the status of irrigation in Nepal. Irrigation systems are complex socio-technical units, and development activities have directly and indirectly affected the status of these systems. Due to resource constraints of a developing country, a detailed and in-depth study of each irrigation system under consideration is not possible. This is certainly not possible in Nepal where it is estimated that there are over 20,000 irrigation systems.

Effective rapid appraisal studies cannot be conducted by simply putting together a comprehensive question guide and taking it to the field for systematic investigation. Before a team goes to the field it is important that each member understand "what" the nature of a rapid appraisal study is, "why" rapid appraisal methods have been selected, "how" it will be applied, and what the nature of the "product" of the study will be.

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What Is Rapid Appraisal?

Rapid appraisal is a methodology for collecting information quickly. Appraisal is used in the general sense to mean investigation and analysis, and primary attention is given to practical investigation. Since the time-frame for field investigation is shortened, there is an attempt to compensate by intensive preparation and carefully planned procedures in the field. It is particularly well-suited for studies of irrigation systems since there is usually more than one system to examine, and time, funds, and skilled manpower are often a constraint to conventional studies. The output of rapid appraisal studies is generally a report for a specific purpose. The purpose for the study must be well defined in advance. The study is usually carried out by an interdisciplinary team.

Why Use Rapid Appraisal?

A rapid appraisal study can be used for various purposes. In some cases it can be used as a way to identify and describe systems for which there is no written documentation. It can be used to assess the physical system and problems associated with it such as identifying the need for rehabilitation. It can be used to assess the organizational strength and weaknesses of a system. A study can be used to lay out the socio-technical processes involved in the operation of a system and this information used to solicit participation in organizational activities or collaborative resource mobilization for improving the system. The utility of rapid appraisal methods will vary depending on the type and depth of information that is needed and how the results are to be used.

A series of rapid appraisal studies can be used to provide a comparative picture of irrigation operation across systems. By identifying pertinent variables such as maintenance labor mobilized per hectare, sanctions for water theft, leadership roles, etc., it is possible to make cross system comparisons and in some cases rank the strengths and weakness of each system.

A general picture of a single system or a comparative understanding of a series of systems helps decision makers focus on key issues. It might point toward the need for more in-depth research or identify the physical areas or social interactions that require further study. It may thus be a tool for identifying further research needs.

How to Undertake Rapid Appraisal?

Since irrigation is multidimensional with interacting physical, biological, and social environments, an interdisciplinary team has a definite advantage. This assumes, however, that the team will work together and interact; it is an ideal that cannot be taken for granted. A balance is needed among the team members to insure that the necessary multitude of perspectives are properly integrated and incorporated into the report.

There should be a conscious effort to cover the range of disciplines needed to understand the complex interaction of the biological, social, and physical environments. A valuable contribution that should not be overlooked is the opportunity for cross-fertilization of research methods among the different disciplines represented on the team.

Unstructured, small-group interviews and careful observation are powerful tools for collecting accurate information and should be used as much as possible. Interviews should be conducted with a checklist to ensure that the important points are not missed. Open-ended discussion should be encouraged by avoiding formal questionnaires. Since time is a factor in rapid appraisal, choose a guide who knows the people and is familiar with the part of the system to be visited. This will assist in moving about and meeting key informants, allowing for rapid investigation. Use maps or aerial photos to select locations and pick out key categories of information to determine which people to visit. Key informants to interview should be selected for their specialized knowledge: irrigators (head, middle, and tail), women, agriculture workers, and project staff. When different versions of issues are given by different informants, they must be interpreted from the perspective of the different interests within the community. On sensitive issues one must be careful to remain neutral.

For many irrigation systems in Nepal, what one sees in the field visit will be dependent upon the time of the year. Some systems are not operating in the dry season. Most systems have been built for irrigating monsoon rice. It would be desirable to visit them during the monsoon even though that is the time when travel is most difficult. If a system is visited while it is not operating one must look for clues to how the system might function. For example, the cropping pattern and the extent and location of fallow land would lead to questions about water adequacy and the management of distribution. The logic for type and location of physical structures like aqueducts, siphons, and gates, or lack of structures, are easier to understand if the system is seen in operation but can also be visualized by imaginative questioning.

Preparatory steps before a rapid appraisal study. Gathering all available information such as maps, previous reports and air photos, is the logical way to begin any study. To become familiar with the study area, there is no substitute for desk work. If a large area or large number of systems are assigned for study, it may be necessary to do a reconnaissance. It is not necessary that all team members participate in this step. One or two persons can do the reconnaissance. The purpose of the reconnaissance is to help in selecting, or limiting, the type and number of systems for further study. It should give an overview of the situation and the reconnaissance report should provide valuable background material for briefing the team.

Formation of the team. For irrigation studies it is useful to have at least a mix of four disciplinary skills on the team--organizational, cultural/social, technical, and agronomic. However, even more important than the disciplinary mix is mutual respect and an attitude and desire to learn from each other's point of view. Three to six members on a team allow easy interaction and discussion. If a portable computer is available, an experienced typist with the team in the field would help reduce the drudgery of writing and speed up the report writing.

Rapid appraisal activities. There should be an organizational meeting where information is shared and roles for the study are established. A team leader should be selected to assign tasks: logistics, public relations, scheduling. All of the background material available should be shared among all of the team members. There should be discussion about the purpose of the study and the format of the report. The checklist or question guide should be discussed and amended by consensus. It is useful if this checklist can be arranged in the desired outline for the field notes. This facilitates merging each individual team member's notes into one complete set of comprehensive field notes containing all observations and data collected. Such a set of notes can be more easily checked for consistency than each member's separate complete set of notes. A sample checklist that doubles as an outline for merging the field notes is included in Appendix 1.

A useful exercise for the team in the first meeting would be to discuss the interaction of the various irrigation activities. This would help to underscore the need for different perspectives to establish a comprehensive understanding of the irrigation system and how it operates. A matrix showing the interrelationship of organizational, physical and water use activities is given in Appendix 2. This matrix could be used to facilitate discussion.

If at all possible the team should be resident in the command area while in the field. There should be as much interaction as possible with farmers on an informal basis. The team must be disciplined in not displaying authoritative behavior. They should answer questions asked by farmers about the reason for the study as soon as they are raised with as much detail as necessary but without giving false assurances about assistance. Sensitivity about intruding upon the farmer's time is important. Food and services should be paid for.

The team should travel through the system together the first time (walking, if possible) to share observations and jointly conduct farmer interviews. Then the group should break into smaller units of two or three for subsequent visits. Useful suggestions from Chambers and Carruthers (1986) for offsetting frequent appraisal biases while carrying out field work are given in Table 1.

In addition to writing notes in the field (while observing the system and discussing with informants), the team members should spend time alone each day rewriting the notes according to the agreed upon outline and making certain the notes are complete. If a typist is part of the field team the team members should have these rewritten field notes entered into the word processor. The emphasis should be on simple statements and phrases rather than polished sentences and paragraphs in order to record the raw data quickly and make it available for discussion with the rest of the team.

The most important group activity is to have frequent meetings to share and discuss what has been measured, observed, and heard. Different and contradictory points of view need to be aired and hypotheses formulated for testing in order to identify gaps in understanding and interpretation. This intensive discussion will help the team to comprehend the relationship among the physical, social, and agronomic environments. The group discussion sessions will generate new questions to be taken back to the field on the next visit.

Before leaving a system it is essential that each team member's notes be compiled into a master note file according to the agreed-upon outline. This can be done by each team member or one individual and is greatly facilitated by having a typist and computer in the field. Even though doing it by hand is time consuming and difficult when a computer and typist are not available, it improves accuracy and ease in report preparation later. The master note file assures that discussion of each point has taken place and discrepancies resolved before leaving the opportunity to ask a few final questions or make additional observations in the field. Analysis of the information while compiling the master note file allows weeding out of misleading information.

It also assures that all of the information of one system has been processed before moving on to another system with the possibility of getting the two systems mixed and confused.

Table 1. Offsetting appraisal biases.

Source Bias	What to do
Visiting only head reaches and traveling canal roads by car.	Go to the tails and off the roads: walk around.
Examining the distribution system.	Look at the drains.
Visiting only during working hours and in daylight.	Go before and after working hours, and at night.
Making only one visit, or visiting at the same time each season. seasons.	Inquire about the situation at other times, and in other
Observing only physical works such as headworks, canals, cross regulators, and gates.	Find out about process--distribution, communication--and meet people.
Visiting only demonstration trials or special projects.	Visit farmers lower down the same channel who may get less water because of a trial or project.
Meeting only the elite: staff, better-off farmers, influential people, and men.	Make an effort to meet poorer farmers, laborers, and women.
Blaming farmers for misusing the system.	Find out why farmers do what they do.
Telling people what they should do.	Listen to people and learn from them.
Visiting people hurriedly.	Plan to spend more time and be patient with people.

Source: Chambers, Robert and Ian Carruthers. 1986. Rapid appraisal to improve canal irrigation performance: experience and options. IIMI Research Paper No. 3, IIMI, Digana Village, Sri Lanka.

THE PRODUCT OF RAPID APPRAISAL

The product of rapid appraisal is a report which reflects a well-integrated team effort. The integration begins with the organizational meeting when tasks and roles are assigned and continues in the field as notes of discussions are compiled. The effectiveness of rapid appraisal is due to the team effort and utilization of input from all team members on all issues.

The style of the report should reflect the purpose for which the information is intended to be used. If the primary purpose is identification and description of systems, the report will be mostly narration. However, if comparison of systems is planned, the variables to be compared should be identified before the report is written so that the material to be compared in different reports is presented in an identical format and is easily found in each report.

The structure of the final report should be decided by the group and does not need to follow the organization of the question guide. To ensure continuity in style and content it is best if one person writes the first draft of the report. The report should contain appropriate maps and sketches of important features. If possible, photos should be included to assist in communicating the information that has been collected.

Under constraints of time, finances, and manpower, rapid appraisal is a useful tool for compiling information that can only be acquired through field studies. Experience and skill in cross-checking are necessary to reduce the errors often associated with rapid appraisals. This requires a well developed framework and an integrated team effort.

APPENDIX 1

RAPID APPRAISAL CHECKLIST

I. INTRODUCTION

A. Area overview

-Location: zone, district, village panchayat, ward.
-Access to the system.
-Access to support services and markets.
-Physical information of the surrounding area.
-Food sufficiency.
-Labor availability in each season: daily wage, contract.

B. Settlement pattern of surrounding area

-History of settlement.
-Population.
-Milestones in agricultural development (establishment of support services, introduction of new crops, etc.).
-In- and out-migration patterns.
-Ethnic composition.

C. History of the surrounding area's irrigation development

-Map or sketch including the following for each system: relative location, water source, diversion point, command area, name.
-For each system: type (hill, river valley,or tarai), management (agency, farmers, or joint).

II.HISTORY OF THE SYSTEM

A. Original construction

-When?
-Who initiated and directed?
-Amount and source of resources invested: cash, labor, materials.
-Basis for internal resource mobilization: household, landholding.
-External resources.

B. Improvements/rehabilitation

-Other than routine maintenance, when have major inputs and improvements been made?
-Who initiated? When? What was done?
-Internal or external resources.
-Basis for internal resource mobilization.
-Are there regular external resources given?

C. System expansion

-How have boundaries of system changed over time?
-Have new settlers (authorized or unauthorized) been allowed to join?
-Have segments of the system left?
-Has there been amalgamation, incorporation of systems?

III. DESCRIPTION OF THE SYSTEM

A. The physical system

1. Hydrology

- -Source(s) of water.
- -Catchment area.
- -Rights to water in source: upstream and downstream systems.
- -Seasonal variation of water supply at extraction point.
- -Discharge in canal at extraction: maximum and minimum for each crop.
- -Flood frequency.
- -Drought frequency.
- -Water quality: salt, lime, etc.
- -Other uses of water: power, fire protection, animals, etc.
- -Water constraints to expansion/intensification of irrigation.

2. Canals: main and branch

- -Type of construction, materials, quality, and condition.
- -Seasonal and long-term changes.
- -Sketch or map of layout.
- -Distance from source to first fields.
- -Length of main canal in command area.
- -Design capacity of main and branch canals.
- -Density: including field canals (m/ha).
- -Condition of rock and soil along aligment.
- -Condition (specify in which season).

3. Structures

- -Type of construction, materials, quality. and condition.
- -Seasonal and long-term changes.
- -Intake/diversion.
- -Regulators: gates, fixed.
- -Cross drains.
- -Aqueducts, siphons, drop structures.
- -Measuring devices.
- -Main turnouts: type, number.

4. Boundaries of the irrigated area

- -Irrigated area for each crop.
- -Changes in system over time: amalgamation, expansion, or loss.
- -Limitation of expansion for each crop: physical, water rights.

5. Drainage

- -In command area.
- -Escapes from canals.

6. Soils.

- -Type: head, middle, tail.
- -Fertility and suitability for irrigated agriculture.

IV. OPERATION AND MAINTENANCE

A. Activity/problems

-Related to water acquisition: water rights, paucity of supply, damage from floods, etc.
-Related to water delivery: canal cleaning, landslide repair, flood damage, crabs, animals, seepage.
-Related to water distribution and drainage.
-Priority tasks in O&M: maintenance of diversion and canal or water distribution.

B. Water distribution tasks (Frequency and magnitude of effort)

-Method of water distribution for each crop and variation during each crop: rotation (who and how initiated, frequency of turn); continuous flow; contract; turns (head to tail).
-Distribution during water-short period: rotation among outlets, among field neighbors within outlet.
-Match between water distribution and allocation: method of matching, proportioning weir, timed rotation.
-Relationship of water distribution to physical infrastructure.
-Who is responsible for water distribution activities?

C. Routine maintenance

-What work is done.
-Frequency.
-Purpose: improve performance, preventive.
-How long does it take?
-Who initiates and directs work?

D. Emergency maintenance

-Reasons.
-Frequency.
-How long does it take?
-Who determines it is an emergency?
-Who organizes and leads the work?

E. Extent of agency involvement in system

-What agency is involved?
-Management input of agency.
-Agency organization for water delivery and O&M.

V. INSTITUTIONS AND SOCIAL ENVIRONMENT

A. Social structure

-Landholding pattern.
-Nature of tenancy (criteria: owner, tenant, sharecropper).
-Ethnic composition in the command.
-Villages.
-Settlement pattern and irrigation labor availability.
-Power structure (related to land and panchayat affiliations).

-Religion.
-Kinship pattern.
-Leadership: formal, informal.
-Migrants: where from, previous irrigation experience.
-Non-agriculture employment.
-Seasonal migration for employment.

B. Organization for irrigation operation and maintenance

1. Membership

-Criteria: land, water share, crop, tenancy, official panchayat position, contractual, ethnic (exclusions), gender, age, labor, investment input.
-Membership in other systems.
-Absentee members.

2. Roles and positions

-For each position include: method of nomination, appointment, tenure, remuneration (cash, in kind, labor exemption).

-Appointed functionaries.
    Chairman.
    Vice-chairman.
    Secretary.
    Treasurer, etc.
    Water supply and/or system damage monitor.
    Crier.
    External communications.
    Moderator of meetings.
    Tool keeper.

-Committees: regular and ex officio.
-Informal leaders.
-Relationship of panchayat and political leadership to system.

3. Tiers of organization

-Federation/unitary.
-Central.
-Regional/distributory.
-Village/farm channel (mauja).

4. Meetings

-Regular: time, place, who calls.
-Extra.
-Purpose: resource mobilization, accounts, maintenance, conflict.
-Attendance: landlords, tenants, women.
-Penalty for not attending.
-Leadership: moderator, minute keeper, how selected.
-How are resolutions passed? vote, consensus.
-Records of meeting.

Conflict and conflict management

-Cause, nature, frequency of conflict.
-Specific to cropping season?
-Internal or external to the system.
-Among systems.
-Non-water issues.
-To whom is first appeal for conflict resolution and what is the step-by-step procedure for difficult cases?
-What is handled within the organization and what is taken outside?
-Police cases.
-Court cases.
-Panchayat involvement.
-Rules and sanctions.
-Records of conflict resolution.

Water rights at system level

-Sharing with other system.
-Permit, rent, prior appropriation, riparian.
-Customary rights.
-Evidence of conflict among systems.

Water allocation (water rights of members within system)

-Bases for allocation principle: land area, soil, investment, purchased, traded.
-How does water allocation change with crop, level of water supply.
-Outside influence due to assistance.
-Dominance of one social group.

Internal resource mobilization

-Purposes for resource mobilization.
-Basis: same as water allocation, household.
-Type of resource: cash, labor, in kind (remuneration, etc.), animal, bullock cart, local knowledge.
-Organization to manage.
-Accounts of resources due and contributed.
-Annual quantity of each type of resource.
-Sanctions for not contributing.
-Annual amount realized from fines, how collected and used?
-What is consequence of not paying fine?
-Where are funds and in-kind resources held? Is there intermediate (short-term loans) use?
-Discrimination against contribution: caste, sex, age.
-What if family does not have male member?
-Contractual arrangements for maintenance: method, reason.
-Resource generating activity: mill.

External resources

-Purpose.
-Source: connections, contacts.
-Who (person) initiated contact with outside agency, incumbent or previous experience in government position.
-Frequency.
-Type: cash, food-for-work, cement, gabion wire, technical advice.
-Equipment: bulldozer, jackhammer.

6. Organizational development.

- Changes over time in: rules, roles, resource mobilization, processes for electing functionaries, etc.
- Changes in decision-making process.
- Process of allowing new outlet from main canal.
- Terms and conditions of external agency for providing aid and resolving conflict.
- Change in involvement of panchayat or district offices.
- Changes in relationships with other systems: water sharing when temporary damage in canal, sharing resources for maintenance.

DESCRIPTION OF THE AGRICULTURAL SYSTEM AND SERVICES

A. Agricultural system

1. General

- Main crops.
- General condition of crops.
- Cropping pattern (provide a rough sketch map indicating the crops grown in different locations).
- Crop calendar.
- Cropping intensity.
- Estimated yield.
- Change in agricultural practices in past 25 years: new crops, varieties, technology.
- Mechanization vs. labor-intensive system.

Production inputs

- Use of improved of seed.
- Use of fertilizer.
- Extension services (types, training, production campaign).
- Price of inputs.

Agricultural practices

- Land preparation methods.
- Use of manure, fertilizer.
- Broadcasting or transplantation.
- Yield per crop.
- Total yield per year.
- Prices and marketing.

SYSTEM STRENGTH AND WEAKNESS

Strengths.
Weaknesses.

APPENDIX 2

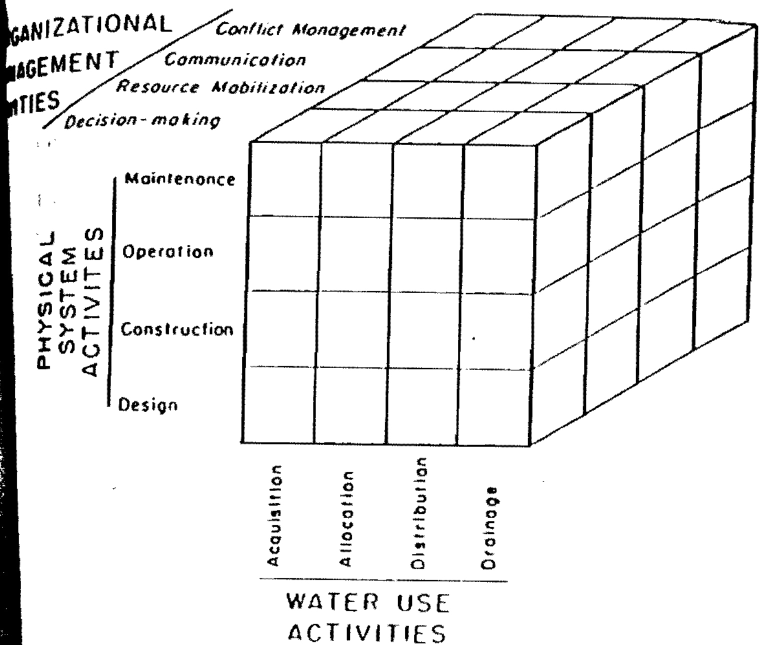
IRRIGATION SYSTEM ACTIVITIES MATRIX

All irrigation systems require that certain essential tasks be accomplished if the system is to function productively. One set of management activities focuses directly on the water. Water must be acquired, allocated, distributed, and, if there is excess, drained. A second set of management activities deals with the physical structures for controlling the water. A final set of activities focusses on organization which manages the water and structures and includes decision making, resource mobilization, communication, and conflict management.

There is interaction among the activities of the three sets; for example, the organization must decide how to operate the structures to distribute the water. The matrix shown in the figure illustrates these interactions. Not all activities are equally important in each environment, and the farmers' irrigation management institutions will reflect the relative importance of activities in a particular location.

For a rapid appraisal study it is instructive to use the matrix to formulate questions about the management of the system. Each of the 64 boxes is a potentially important interaction. For example, one might ask what decisions need to be made about the operation of the system as it relates to water allocation, Often whole blocks of interactions "boxes" are not relevant for a particular system. This matrix is useful for examining the activities internal to the irrigation system.

IRRIGATION SYSTEM ACTIVITIES MATRIX



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INSTITUTIONAL DEVELOPMENT OF WATER USERS ASSOCIATIONS

Annex 6

Prachanda P. Pradhan

The Irrigation Management Project (IMP) is a joint HMG/USAID endeavour to assist the Department of Irrigation (DOI) to improve Irrigation Management in Nepal. The DOI is being assisted with technical assistance from both foreign as well as local professional staff. In this respect efforts were initiated in essential structural improvement (ESI), training of technical personnel, and formation of water user associations (WUAs) as a vehicle to promote farmers' participation in irrigation management. The following comments deal with the process of water user association formation in the IMP field sites.

The project organization established a Systems Management Division (SMD) consisting of three sections. One is responsible for WUA activities. This section with the assistance of the TA team and the counterpart of DOI/IMP staff is undertaking activities for the formation and strengthening of WUAs in the Sirsiya-Dudhaura irrigation system in Parwanipur and then Handetar, Lamjung. The experiences of Sirsiya-Dudhaura have been valuable for making essential structural improvements, mobilizing resources for maintenance of field level channels, understanding the dynamics of forming WUAs, and training farmers.

PROCESS OF ESTABLISHMENT OF WATER USERS ASSOCIATIONS (WUA's)

The project document proposes the strategy of employing Association Organizers (AOs) as catalysts for facilitating the formation of WUAs. At the initial stage of the project, there was serious debate about who would be the appropriate persons to act as AOs for the promotion of WUA's.

As part of the experimentation in WUA formation, the project approved recruitment of 15 AOs by the technical assistance contractor for IMP. They were given training and fielded in Sirsiya-Dudhaura. In the absence of hydrological maps and knowledge of exact boundaries of the system, the AOs were fielded on the basis of panchayat ward boundaries, with the assumption that their assigned areas would be changed after hydrological maps had been prepared.

The AOs initiated the field assignments by collecting social, cultural and agricultural information. This activity established communication between farmers and the AOs. Following this initial activity, a "sensitization workshop" was organized in order to disseminate information on the purpose of the project, the role of AOs, role of local DOI/IMP staff and the role expected for farmers through formation of WUAs. Farmer-leaders identified by the AOs, project officials and staff participated in the workshop.

In the first year, there were difficulties in enlisting farmers' input in determining ESI in the absence of an organization who could speak on their behalf. After three months in the field, AOs were able to form groups, known as tolis on a ward basis following existing panchayat administrative boundaries. There was no experience in the farmer community for such an nization and they had never participated in irrigation management on a basis. Keeping the groups together and institutionalizing their ities required a continuous and concentrated effort both from the AOs in field and from IMP staff.

The provision of farmer-to-farmer training of Sirsiya-Dudhaura farmers Pithuwa brought a turning point in the activities of the tolis. The Pithuwa irrigation system is now largely operated and maintained by farmers. They were assisted by IMP in preparing a training program for the visiting Sirsiya-Dudhaura farmers. This program helped them in three ways. First, it forced them to ask themselves, if the farmers of Pithuwa can do this, why cannot we also assume more operation and maintenance responsibility? Second, it helped them to broaden their knowledge base about how to carry out organization activities. Third, they had the opportunity to learn skills for resource mobilization, keeping records, for water allocation and distribution, etc.

Farmers in Sirsiya-Dudhaura engaged in numerous channel cleaning activities for the winter crop. The number of people involved and the amount of desilting of field channels was substantial. Along with this, there was a formulation of rules and regulation by the tolis for desilting the field channels. This represented an important step forward in the institutionalization of WUAs.

The physical impact of this activity was an increase in the extent of wheat planted in Sirsiya-Dudhaura during the 1987 winter season. This was partly due to a greater water availability in that season but farmers also attribute it to the organized efforts of the toils in desilting field channels. They allowed an easy flow of water to fields, thus water scarcity was minimized. Also because of the tolis, farmers had more confidence that water would be shared fairly. Farmers are expecting to increase the extent of wheat coverage even more in the next winter season (1988).

In the second year of ESI activities, it became relatively easy to get farmers' input in deciding on essential improvements. Negotiations took place on the basis of groups along branch canals. As pat of the involvement of farmers in the rehabilitation process and in preparation for their taking more responsibility for O&M, petty contracts for construction were awarded to tolis. Through this means they are undertaking a large portion of the ESI works. The experience gained from working with tolis in construction activities will be a guide for planning this year's ESI activities in Sirsiya-Dudhaura and in other IMP projects.

The farmers are starting to feel a sense of responsibility and ownership of the channels. Regulations were enacted by the tolis prohibiting damage to the canal bunds or outlets. Reenforcement of this sense of ownership by farmers is important in order to promote their participation in irrigation management.

An inter-group association (Sangh) has been formed from representatives of each toli. This association will work to establish inter-group coordination, to make inputs to decisions at the main canal level, and to make suggestions for water delivery and distribution. The conduct of monthly meeting, keeping records, and making inputs to the decisions of the system gineer-in-charge are some of the things indicating progress in formalizing institutionalizing this organization. This regular interaction with the agement of the system and articulation of farmers' needs to the thorities on behalf of the groups have helped to schedule distribution of ater more satisfactorily. Previously, it was difficult to cater to dividual water needs, which became a source of intense conflict.

The WUAs' role in water management is gradually becoming recognized by both the farmers and the agency in charge of S-D irrigation systems. Once a decision is made by the WUA in consultation with the agency, the latter attempts to follow the schedule. Any conflict or confrontation resulting from this will be taken care of by the associations. Requests for water delivery will be made on behalf of the WUA and group interests. Group input and group interaction are increasingly shaping the water management activities in S-D systems.

When WUAs were started initially there was a confrontational relationship with the agency. Unmet needs and demands were frequently discussed by farmers. Once their inputs were taken into account, however, the confrontational situation gradually changed into a cooperative one between the farmers and agency. The following episode is an example of the organizational maturity of the WUAs and the agency. In the second year of ESI, it was decided by the WUA that the main canal would be closed for rehabilitation work during March. This decision conflicted with the practice of Tajpur farmers of cultivating early paddy. These farmers went to the agency to press their demand for water release in the main canal. They were referred to the inter-group WUA concerning any decision to release water. The WUA stood by its initial decision. This broke the tradition of water being monopolized by a few head-end farmers and gave the agency time to undertake main canal repair work.

The IMP is continuing its fieldwork with WUAs in Sirsiya-Dudhaura in order to strengthen organizational capacities to contribute to operational improvements in those systems. An unresolved issue is when and how to withdraw, or reduce, AOs without adversely affecting the performance and maintenance of WUAs.

WUA ACTIVITIES IN HADETAR IRRIGATION SYSTEM

At the end of the second year of irrigation Management Project (IMP) implementation, a second field site was selected in the hills, Handetar Irrigation Project in Lamjung District. This site who selected to understand process of handing over the system for management by the beneficiaries. This system already had a WUA formed by the Lamjung District Panchayat which had been active in mobilizing resources from the government for repair, however, if water users are to play a fuller role in system O&M.

Four AOs were fielded in Handetar to collect basic information on socio-economic, agricultural and community activities as well as on the physical system itself. After information is available on the water users at the outlet level, AOs arel helping farmers to form outlet-level groups.

PROSPECTS FOR INSTITUTIONALIZING WUAS

The government is working on making legal provisions for the establishment of WUAs in all agency-managed irrigation systems. The purpose of such legislation or regulating is to provide legal recognition and status to WUAs so they can receive funds and mobilize and manage resources within the system. WUA formation is now accepted as one of the responsibilities of the DOI in order to promote effective and sustained farmers'participation in water management.

WUA formation is now accepted as one of the responsibilities of the DOI in order to promote effective and sustained farmer's participation in water management.Consequently the Department of Irrigation is in the process of recruiting AOs to initiate WUA activities in other projects

WUA activity is accepted as an integral part of the Mahakali Irrigation Project supported by the World Bank, in the line of credit program of the World Bank and the sectoral lending program of the asian Development Bank use of WUAs will be one of the prime activities to be promoted in other to ensure farmers' participation in water management.

Can the WUA experience gained by the IMP be shared with other projects? This was the original expectation when the IMP was planned. With two-and-a-half years of accumulated experience the answer is yes. The knowledge gained and lesser learned can be shared with others, so they do not have to repeat the same experimentation as IMP has in this initial phase.

Annex 7

IMPROVING IRRIGATION SYSTEM MANAGEMENT: KNOWLEDGE TRANSFER THROUGH FARMER TO FARMER TRAINING EXAMPLES FROM NEPAL

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SUMMARY

Evidence that physical improvements alone do not solve all of the problems causing poor performance of irrigation systems has resulted in emphasis on increasing farmer participation in irrigation management activities. However, it has been difficult to find ways to encourage farmer participation. Research in Nepal in farmer-managed irrigation systems has shown that some have highly developed irrigation management practices while others are very weak in their ability to manage. They have arrived at these practices through the experience gained in a long process of trial and error. They have a valuable resource of knowledge about the process in arriving at their practices and the reasons for them.

However, farmers in many systems have not been as successful in arriving at viable management practices and have not been able to exploit the full potential of their resource base. Hence, they face problems in acquiring water, in mobilizing resources to maintain their canal, in allocating and distributing water equitably, and in resolving conflicts. This results in less area being irrigated with a lower cropping intensity than the available land and irrigation water would support.

In Nepal, as elsewhere, irrigation development by various agencies has been a construction oriented process. The view has been that if the hardware of the physical system is correct the system will function. As more systems are constructed and operational deficiencies noted, emphasis is shifting to development of more appropriate management or the software dimension. With increasing recognition of the socio-technical nature of irrigation, attempts are being made to increase farmer participation in

irrigation activities. An important step in farmer participation is the formation of knowledge and the ability to select among the alternatives and options available for the multitude of activities that must be preformed to carry out effective irrigation. Suitable communication and extension methods are needed for this.

However, finding suitable means to transfer management technique and innovations learned in one systems to another has not been highly successful. However, finding an effective means to transfer techniques and innovations learned in one system to another remains a problem. The usual method for researchers is to write reports to the irrigation agency and let it up to the agency staff to implement the findings. This has not been effective. Giving reports directly to farmers is usually not an option since most reports are not in the language of farmer and those that are generally too difficult to comprehend for farmers with little reading experience. **Farmer-to-farmer exchange visits or peer training is being tested as a method of transferring the experience gained by farmers in a well-managed system to those where management improvements are needed.**

The idea of farmer-to-farmer extension training in Nepal came about when researchers investigating FMIS found that management techniques and organizing principles of well managed systems can be adopted by other FMIS and farmers organizations in AMIS. To test this it was decided to give an opportunity for farmers from poorly performing systems to see and hear about other management options, including the detailed practices and effort required to make them successful, and then try to observe if changes in management practices and system performance took place.

Several experiments carried out for transferring this information to poorly performing irrigation systems. The purpose was to improve the ability of the irrigators being trained to manage the O&M of their system. The method used a horizontal approach where farmers became trainers of other farmers. It tested the hypotheses that communication between peer groups is effective when conducted in the setting of the trainers system with the guidance of persons knowing the details of both the trainers and trainees systems.

Some of the management practices that can be transferred are operating [illegible]es, functionary, roles and reduce and manage conflicts. Farmer to farmer [illegible]aining assumes that the knowledge being communicated will have a higher [illegible]obability of being accepted when there is on site observation at the time [illegible]nagement procedures are being explained. Finally, the opportunity to visit [illegible]everal well-managed systems in one tour allows comparison of practices in [illegible]ifferent systems. They then need to process and adapt this information [illegible]quired to their own needs.

This paper describes the process that has been used in Nepal for [illegible]armer-to-farmer training. A series of examples of training visits is given. [illegible]y visiting a number of systems on a tour, the trainees have an array of options to choose from that stimulates their thinking and provokes discussion among them. Preliminary analysis of the impact of peer training shows that management innovations have been adopted as a result of the training and that it is a lowcost method of motivating farmer groups to change their habits and practices.

Irrigation Systems Along Indrawati River Basin, Sindhupalchowk

The Water and Energy Commission Secretariat (WECS) is presently carrying out an action research project in a 200 sq km area of the Indrawati river basin. The project has identified 21 irrigation systems that have underutilized water and land resources. The purpose of the project is to develop methods for assisting these systems achieve higher food production in the existing irrigated area and to expand irrigation facilities to areas not presently irrigated. These systems have some physical problems but it was concluded that the major problem is lack of an organized effort by the beneficiaries to improve their systems. A series of farmer training visits was initiated to overcome these difficulties.

Two hill irrigation communities Chherlung and Argali were selected as a training centre because of the similarity of the physical environment of these systems. Trainees were selected by the users themselves. Not all of the members of a poorly managed system can be taken on a training tour. Trainee selection is very crucial and the degree of success of the training largely depends upon the ability to identify the right people to participate. Participant trainee farmers should possess leadership ability and their peers must have faith in them.

A facilitator is required who is well acquainted with the farmers that will conduct the training and who is familiar with the intricacies and evolution of the rules, roles, and practices involved in the O&M of their systems. The facilitator must also be well acquainted with the weakness and strengths of the systems from which the trainees have come so that he can direct the discussions to cover pertinent topics.

They were given an orientation about the basic characteristics of the systems to be observed.

In visiting the trainer's system it is useful for the trainers to first be given a tour of their physical system--the canal, distribution system, and the command area. This visual aid gives insight to the trainees about similarities and differences to their own system. They should also observe the agricultural system, areas where maintenance must frequently be done requiring resource mobilization, water distributing devices, and all types of records that are kept. If a regular meeting is planned in the trainers system, it has at time been possible to plan the tour to coincide so that the trainees could observe the meeting. Such an opportunity to observe an organization in operation is valuable.

The tour of the physical system often stimulates the most discussion and it is useful not to hurry this interaction. While moving about the system the group is usually spread out and it is impossible for the facilitator to provide much direction. It is, therefore, important to also have a more formal meeting where the trainers and trainees can sit in a circle for discussion.

The trainer farmers usually start with a description of the history of their system. They are very good at describing improvements, expansion, and the difficulties that they face in operating and maintaining the system.

In Chherlung they were able to observe routine maintenance work being carried. An important lesson was taught in how to set priorities on work to be done to best utilize external assistance. After explaining the rules for operation and maintenance, the roles various functionaries play in managing the system, and how conflicts are managed, the trainer farmers suggested that the visiting farmers must make their own rules and regulation that are suitable to their own environment. They also emphasized the need for the managing committed to work hard to gain the respect and confidence of all the beneficiaries so that directions would be carried out.

In Argali one group observed the annual meeting of one of the irrigation systems. They were able to see first hand:

- the procedures for the meeting,
- how the past years activities were evaluated,
- an election of irrigation officials,
- settleing of accounts for the past year,
- establishment of new operating rules, and
- the procedures for planning irrigation activities.

After the training visits, the attitude of the trainees changed and they identified many weakness in their own systems. Most became confident that many of the principles they had learned were suitable for their system and that they could adopt them. When they returned home they organized management committee meetings and conducted assemblies where all beneficiaries were requested to attend in order to convince those who were not able to go on the tour of the value of building a stronger management structure and organization.

In one case a trainee farmer assisted three other systems to set up management committee and to begin the process of formulating rules for operating the systems.

Table 2 presents some preliminary indicators of the management changes after training. These indicators show that new activities are being adopted. The direct cost for operating the training program was about Rs 500 (US$ 22) per person.

Preliminary indicators of management changes after the training program.

...ities	Irrigation Systems												
	Dhap canal	Majh canal	Siran canal	Chatta Muhan	Majh canal	Siran canal	Tallo Chapleti	Chap Bot canal	Chhahare canal	Jhakri Khet canal	Chhollang Khet canal	Naya Dhara canal	Besi canal
...erating ...ests	1	1	1	1	1	1	1	1	1	1	1	1	1
...ed canal ...intenance	1	1	1	1	1	1	1	1	1	1	1	NA	NA
...ings & minutes	1	1	1	1	1	1	1	1	1	1	1	NA	NA
Written records	1	1	1	1	1	1	1	1	1	1	1	NA	NA
...lar meeting place	0	1	1	0	1	1	1	1	1	1	1	NA	NA
Planned water allocation	1	2	2	1	2	2	2	1	2	2	2	2	2
Planned resource mobilization	0	2	2	2	2	2	2	1	1	1	1	2	2
Installation of proportioning structure	1	2	2	0	2	2	2	2	2	2	2	2	2
Establishing water powered mill	2	0	0	0	0	2	0	0	2	2	0	0	0

Note: 1 = Irrigation management activities executed and will continue.
2 = Plan has been made for execution.
0 = Either the activity does not exist, or past has been followed.

CONCLUSION

The preliminary results of the training program clearly demonstrate the effectiveness and wide applicability of of such a process. The cost of such study tours is minimal compared to tours taken oversees by agency officials to learn about irrigation management. However, a systematic indepth study needs to be conducted to evaluate the benefits related to the costs of carrying out a large scale program of this nature. If such a program were desirable, it raises a question of how to institutionalize it and still keep it effective.

One possibility that could be explored would be to make several of the sites that have already been frequently utilized into training centers. The trainers already have a great deal of experience in explaining their irrigation management practices and have only been paid on an ad hoc basis for the many days of effort they have put into extending their experience to others. By assisting them to develop a curriculum, giving them training in how to best use the recourse of their system to communicate the knowledge they have gained through experience, and developing guidelines for logistic and administrative detail they could run a very effective training courses at a minimal cost. If this training enterprise were taken on by the irrigation organization it would be another way for them to mobilize resources to upgrade their systems.

An added benefit of expanding such a program would be to stimulate the search for other well managed systems. The process of such a search and subsequent investigation into the details of their management practices would give further insight into what it takes for effective irrigation management. It would provide a valuable opportunity for agency staff to understand farmers interests and ability in irrigation management as they carry out the program of detailed field investigation to expand the number of sites that are used for training visits.

Annex 8.

2. PITHUWA IRRIGATION PROJECT

INTRODUCTION

The Pituwa irrigation system is extremely interesting, as it is a unique combination of a DIHM and farmer-managed system. It was constructed by DIHM but is operated by a farmer's committee. Pithuwa irrigates all the wards of Pithuwa Village Panchayat except Ward 6. Pithuwa irrigation system lies in the Chitwan District about 18 km east of Bharatpur and 2 km north of Tadi on the Bharatpur-Hetauda highway (Figure 11). Pithuwa Irrigation Project was constructed in 1972 and started operating in 1973.

The designed command area of the system is about 600 ha, but the farmers have built field channels and branch canals to feed about 1300 ha. Since the canal's capacity does not allow enough water flow to supply all 1300 ha, the farmers rotate the paddy biannually. With the present capacity of the main canal, the farmers can irrigate about 05 ha of late paddy. The water available in the river can supply one irrigation for the winter crop.

Pithuwa Irrigation Project lies mostly on the Kaier River floodplain, which makes the head of the system vulnerable to flooding during the monsoon season.

CHARACTERISTICS AND PERFORMANCE OF THE PHYSICAL SYSTEM

1. Hydrology

The water source for Pithuwa Irrigation Project is the Kaier River, which flows seasonally. The river discharges about 200 l/s at the intake from June to December. After December the river has a very small flow which is difficult to tap because the river is about 200 m wide.

There are three farmer-managed irrigation systems upstream of the Pithuwa intake, and intakes for two other farmer-managed systems lie close to the intake of Pithuwa. One intake is for Budi Kulo, which was dug by the Tharu ethnic group long ago, and the other intake is for Chainpur Kulo. All five of these systems are older than Pithuwa.

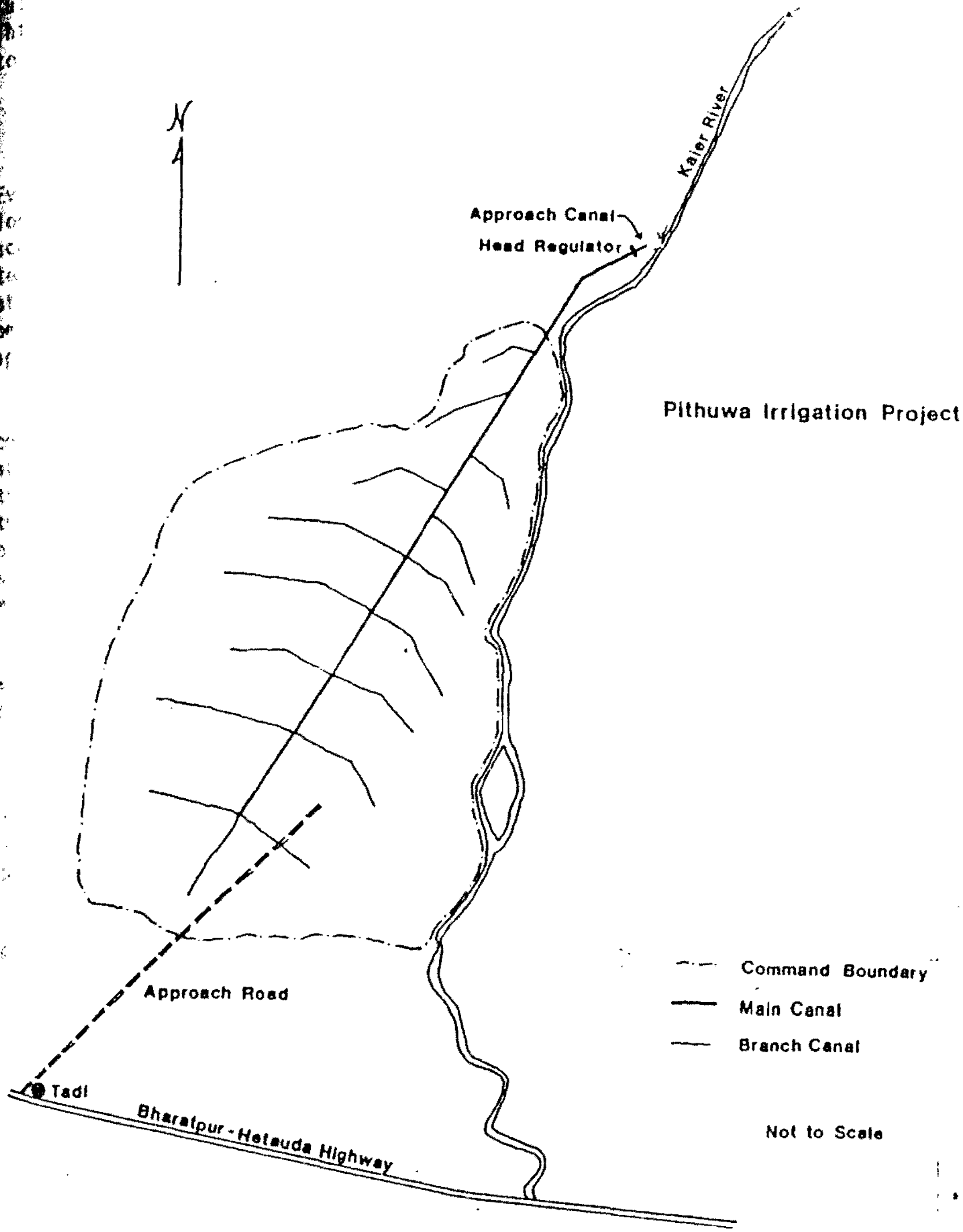


Figure 11. Pithuwa Irrigation Project

During periods of water stress, water stealing among the systems takes place. Although Pithuwa has an agreement with Chainpur Kulo to share water every 12 hours, the agreement is seldom followed. This water sharing problem has forced the Pithuwa irrigation committee to be strong and effective.

2. Canals and Structures

No permanent intake structure exists at the Kaier River. Every year water is diverted by an approach canal which is about 75 m long from river to head regulator and by a boulder and sand weir across the river. After every flood, the approach canal and the temporary weir are washed out. It takes two to three days to construct a new approach canal and weir. One earth mover (bulldozer) has been provided to Pithuwa by Chitwan Irrigation Project to repair the approach canal during the rainy season.

One head regulator exists at the intake of the main canal to control the water flowing into the main canal. The main canal is about 7.5 km long. A service road runs along most of the length of the main canal. The main canal is about 3.0 m wide at the intake and the maximum depth of water in the canal is about 1.0 m. The capacity of the main canal at the head reach is about 1000 l/s, but because of silt deposits (at an average depth of 40 cm) the canal may not draw more than 750 l/s.

There are 19 falls in the main canal of about 1.5 m each. The main canal does not have any cross drainage. The main canal and the branch canals are earthen.

There are 16 branch canals that divert water from the main canal. The main canal runs north to south and the branch canals east or west. The average length of the branch canals is about 2.0 km. Most of the branch canals irrigate about 30 ha, except for branch canals 1 (10 ha), 2 (100 ha), and 14 (20 ha).

There are no regulating structures at the intakes of the branch canals. All of the branch canals receive water from the main canal through hume pipes averaging 300 mm in diameter.

Because of the large amount of silt deposited in the canal bed, the capacity of the main canal is reduced. To get the required water, the farmers try to bring more water in without leaving any space for free board. In several places, water spills over the banks. Operating the canal this way has created a greater fall depth at the drop structures than the structures were designed for, which is causing erosion of the downstream canal banks and the launching apron (downstream canal bed) of the fall structure. In most places, the downstream bank has been reconstructed of dry boulder masonry to its original shape and size, but some of the drop structures need immediate maintenance.

3. Soils

The recent alluvial soils of the area range in texture from light to medium and show little profile development. Soils of deep sandy loam (high in humus) were observed, and soil fertility is good.

The command area of this system slopes from north to south an average of about .2 percent, and the watertable lies about 70 ft below the surface.

C. CHARACTERISTICS AND PERFORMANCE OF THE SOCIAL/INSTITUTIONAL SYSTEM

1. Social Structure

The Pithuwa irrigation system is a relatively prosperous and progressive settlement area. Fields are rectangular and well attended. Rather than living in distinct villages, farmers dwell in houses scattered throughout the command area. The houses are well kept, and a few are made of brick. During the study of Pithuwa Irrigation Project, at least two women were observed with more modern, urban hairstyles. Another woman in the command area wore stylish glasses, obviously purchased outside of Pithuwa. These proxy indicators led us to believe that the farmers at Pithuwa are more urban-oriented and economically advantaged than farmers in some other areas in the Terai.

Land

Most farmers in Pithuwa appear to own 1.2 to 1.8 ha of land. There were, however, differences in landholding size between the head and tail. The largest landholders at the head owned from 3.0 to 3.6 ha. At the tail, one landowner was said to hold 60 ha; and three or four other farmers apparently each own about 14 ha of land. Larger landholdings at the tail might be related to the tail farmers' proximity to the Bharatpur-Hetauda highway.

Approximately 20 percent of the farmers at Pithuwa are sharecroppers, 10 percent are owners-cum-sharecroppers and 10 percent are landless farmers. The sharecropping arrangement is usually done 50:50, with the owner and sharecropper equally sharing the cost of all inputs (fertilizer, seeds) and also the agricultural output. In many other systems we saw in Nepal, the owners did not share the cost of the inputs.

Sharecropped land was scattered throughout most of the command area except for the head, where there was more sharecropped land on the east side of the main canal than on the west. The land on the east is closer to the river and more susceptible to flooding. Landowners may prefer to rent out this less valuable land to others than to rent out other landholdings.

There are many absentee landlords at Pithuwa; some of them reside as far away as Kathmandu. Very large landowners often rent their land on contract, sometimes on a three-tiered arrangement. For instance, one landowner at Pithuwa leases his land to another farmer for Rs. 1,500/bigha (1 bigha = 0.66 ha) and Rs. 30,000/20 bighas. The contracting farmer then does what he wishes with the land. In this case, the contracting farmer divides the 20 bighas into smaller parcels and sharecrops the land with several other farmers. As with other sharecropping arrangements, the cost of all inputs, and the yield, are divided 50:50.

Castes and Ethnic Groups

Several different castes and ethnic groups farm in the Pithuwa Irrigation Project -- Brahmins, Chettris, Magars, Gurungs, and Newars. The castes and groups seem equally scattered throughout the command area, though some people estimated that 75 percent of the tail farmers were Brahmins or Chettris. At the head, Brahmins, Chettris, Magars and Gurungs were encountered along branch canals 2 and 4.

There appears to be a great deal of interaction and cooperation among the different castes and ethnic groups. At the head of the system, Chettris and Gurungs were observed socializing together, and Brahmins and Magars were freely entering each others' houses to discuss irrigation.

A female Brahmin farmer whose husband works in Kathmandu stated that she felt no discrimination in water distribution, even though she lived only with her children. She did say, however, that she would not go out alone at night to irrigate her crops, and she was reluctant to ask her neighbor to help her with night irrigations. She said that her crops suffered as a result.

Power

As in other locations in Nepal, large landholdings were identified as a primary source of power. Farmers at Pithuwa stressed, however, that education and being "convincing" also added to an individual's power. One Chettri farmer declared that power at Pithuwa could be gained through community involvement and honesty and applied these terms to an important irrigation committee member.

At another household, two farmers stated that the three most powerful people at Pithuwa were the largest landholder in the area, the pradhan panch, and a women who is the Chitwan District representative to the Nepal Women's Organization. The inclusion of a woman on this list was unexpected and an interesting feature of the Pithuwa irrigation system.

History of Development Around Pithuwa

Except for the small village at Khairate, the rest of the command area was forested until 25 years ago. The forest land was distributed to the hill people under the Rapti Zone Development Project. These settlers from the hills of Nepal had to clear the forest. Most of the settlers in this area are from the hill districts of Dhading, Gorkha and Lamjung.

Khirate village was on the route to Thori from Kuringhat of Gorkha. In those days, the people of Gorkha and Dhading took this route to Thori to buy salt for domestic consumption. At that time, the Chitwan district headquarters was located at Upaidang Gadi, which was on the route between Gorkha and Thori. The district headquarters of Chitwan was shifted in 1961 to Bharatpur, which was a newly deforested area with few physical facilities.

The early settlers in Pithuwa had difficulty getting drinking water. At that time, the only irrigation system was farmer-managed and was known as Khairate irrigation system. It commanded about 40 ha outside Khairate village. The water supply for this system was used for drinking water until recently. Comparing the accounts of the early settlers and the observations of the current agriculture and growth of the villages around Pithuwa irrigation system, one witnesses a large transformation that occurred within only the last 25 years.

2. Irrigation Organization

Prior to 1973, the lack of water within the current command area of Pithuwa allowed farmers to grow only maize. In 1970, farmers were given Rs. 15,000 under the Minor Irrigation Development Program to construct an irrigation system in Pithuwa. Using voluntary labor and this fund, the main canal was dug. However, the canal did not function properly and the people again approached the government. Finally, DIHM undertook the construction of Pithuwa Irrigation Project in 1973.

After DIHM completed the main canal, irrigation water was released. At first, water distribution was *laissez-faire*. "Might is right" prevailed in the system resulting in conflicts and feuds over water share.

Then, one prominent farmer took the initiative to organize the other farmers on Branch 14 into a committee, which formulated rules for water allocation and distribution along Branch 14. With farmer participation in committee activities, conflicts over water sharing along the branch canal decreased in a short time. Other branches started to follow the example set by the farmers of Branch 14. Eventually, all the branch farmers created branch committees for water allocation and distribution; some as recently as four years ago. Once the branch canal committees were working satisfactorily, a federation of the branch canal committees created a general assembly of farmers and a main canal committee.

General Assembly

All the farmers in the Pithuwa irrigation system are members of the general assembly. The farmers meet once a year in June at a central location to discuss the following issues:

a) general principles for managing water in the system

b) electing the secretary of the main committee

c) approving or disapproving the accounts of the system presented by the secretary

d) deciding the outcome of outstanding conflicts within the system

e) reviewing whether the decisions made during the previous assembly meeting were duly undertaken or not.

Main Committee

The main committee has 18 members. Originally, the chairman was elected from among the assembly members; today, the pradhan panch of Pithuwa village panchayat is the ex-officio chairman of the committee. The secretary of the main committee is still elected by the assembly during the annual meeting. The other sixteen members are the chairmen of the branch committees.

From late June until late October the committee is active and holds at least one meeting each month, depending on the issues that have to be decided. The major functions of the committee are to implement the decisions of the assembly and supervise the overall operation of the main canal. The specific responsibilities of the main canal committee are:

a) to supervise and maintain the main canal.

b) to allocate approximately Rs. 18,000 for the fuel and operation costs of the bulldozer that is used for maintenance.

c) to communicate the decisions of the main committee to the branch canal and determine the water allocation for the branch canals.

d) to contract with and establish relations with external agencies (e.g., the government or other irrigation systems upstream of the intake).

e) to allocate the area in the main canal that must be desilted by the branch canal farmers and to mobilize labor as needed to otherwise clean the main canal.

f) to keep proper accounts of income and expenditures.

g) to resolve conflicts over water allocation among the branch canals.

<u>Branch Canal Committee and Farmers' Assembly</u>

Initially, there were 15 branch canals, but one more was added later to expand the irrigation command area at the tail of the system. The rapid appraisal team interviewed the secretaries of branch canals 1, 2, 3, and 16. All of these branch committees have written rules, account books, and minutes of the meetings.

There are two organizational units in each branch: the branch canal farmers' assembly and the branch canal committee.

<u>Branch Canal Farmers' Assembly</u>: Once a year, usually in June or July, all the farmers along a branch meet to discuss:

a) the election of the branch chairman and the branch secretary;

b) the method of water allocation;

c) the registration for the paddy transplantation schedule;

d) the time allocation for water use based on landholding;

e) setting the priority for water allocation;

f) settling the annual account of the branch; and

g) the water allocation for winter crops.

<u>Branch Committee</u>: The branch committee consists of a chairman, a secretary and representative members from the branch. These members are elected for one year during the branch farmers' assembly. Once a member is elected, he can continue in that position

for several years as long as he receives annual approval from the assembly each year. The number of members on the committee varies from branch to branch, but averages five or six members per branch.

The branch chairman presides at the assembly meeting and the branch committee meetings, represents the branch committee, and communicates the decisions of the main committee to the branch committee and the farmers of the branch.

The secretary keeps records and implements the decisions of the branch committee. The secretary supervises the water rotation schedule and is expected to prevent damage to the branch canal bunds during rotations. The secretary of the branch canal seems to be the most wanted person from late June to late October. He has to be present in the system day and night to monitor the rotation and prevent conflict. One secretary's wife complained that his office has taken so much of his time that his own farming operations have suffered. The secretary receives no renumeration for the job he performs for the community. In the four branch canals we looked at closely, the secretaries have six to seven years of work experience and the farmers want them to continue as secretaries.

Fine Imposition

The farmer who breaks the rotation schedule is fined Rs. 25 the first time. If he disobeys the rules a second time, he is fined Rs. 50 and his turn for water is cancelled. For a third offense, he is not allocated any water at all. These rules are strictly followed, and few problems in water distribution and water allocation are reported.

In general, committee system seems quite effective in Pithuwa. With the introduction of individual branch committees, the system is more flexible for meeting farmers needs. Also, effective rules are formulated and enforced.

D. CHARACTERISTICS AND PERFORMANCE OF SYSTEM OPERATION, MAINTENANCE, AND WATER DELIVERY

1. Water Allocation and Distribution

The Department of Irrigation, Hydrology, and Meteorology built the approach and main canals at Pithuwa Irrigation Project. After the water passes the headworks, the farmers are responsible for allocation. Local DIHM officials compared the allocation and distribution system at Pithuwa with nearby Panch Kanya, and all officials stated that the Pithuwa system has a better source and there are fewer conflicts with farmers.

During both the paddy and the winter seasons, water flows in the main canal continuously. The 16 branch canals remain open the entire year. If there is a severe water shortage, the committee arranges a rotation system. They then allocate water to the tail outlets first for a set number of days, and then to the head outlets. Farmers also plant their crops on different dates, which means that irrigation water is required at different times. A kind of rotation system is instituted to take advantage of varying planting dates. Farmers register for water for paddy transplantation during the general assembly. At this time, water is allocated according to the registration list -- no consideration is given for the location (head or tail) of the fields in the system.

Along the branch canals, water is allocated to farm outlets by the branch canal committee. Farmers request water from the branch canal secretary, and they are given a token that guarantees them a water turn. The token is returned to the secretary when the irrigation is complete.

Time allocations differ from branch to branch. In branches 1 and 2, four hours of water per _bigha_ (0.66 ha) are allocated, whereas in branches 3 and 16, two hours per _bigha_ are allocated. The time for allocation is based on the nature of the soil, the size of the fields, the volume of water available, and the frequency of watering required for the crop. On some branches, daytime water is allocated for transplantation, and nighttime water is allocated for fields that are transplanted. Each committee has adopted rules that suit their soil, crops, and the availability of water in the branch canal.

Pipe outlets and wooden gates are used to distribute water along the branch canals. Representatives of the branch canal committee, as well as the irrigators themselves, make sure that the time allocated for an irrigation turn is not exceeded.

On field channels, which are shared by several farmers, the farmers collectively distribute water. Then, individuals distribute it to their own farm channels. All farmers reported that there is no priority system, and all water is delivered by rotation.

2. Maintenance

Until 1983, the main canal maintenance was done by Chitwan Irrigation Project. Maintenance money was made available to the Chitwan Project by the Irrigation Department, and Chitwan Irrigation Project contracted the maintenance work. Last year, the maintenance money allocated for Pithuwa was made available to the main committee itself.

A few years ago the funds were as high as 1 _lakh_ of rupees (Rs. 100,000). Lately, however, the budget has steadily declined, and this year, the project will receive only Rs. 31,000. The committee is required to keep books showing how these funds are spent. DIHM officials are allowed to examine these books whenever they wish.

Every year the committee must set aside at least Rs. 15,000 to pay for diesel fuel for a bulldozer. The bulldozer is used to repair the diversion structure on the Kaler River, because every year the intake is damaged by floods. The funds left over must take care of all other maintenance tasks. This year the money available will come to about Rs. 31,000. This is a relatively small sum for a 600-hectare irrigation system which delivers some water to over 1,000 ha. Local farmers, however, contend that they can perform 1 lakh rupees worth of work for only Rs. 25,000.

DIHM officials stated that their biggest problems in helping farmers maintain the main system are delayed maintenance due to lack of funds, and repairing the approach canal every year. Repairing or replacing structures along the branch canals is almost impossible due to the shortage of money. Farmers stated that if no money for repair was forthcoming, they would attempt to repair the structures as best they could using their own resources and skills. The fuel cost for running the bulldozer is also a continuing problem for DIHM. Currently, DIHM does not charge the committee to use the bulldozer. According to DIHM, the recurring costs of fuel and machine operation are problems that need to be solved.

Once a year, just before the paddy season, the main canal is partially cleaned under the supervision of the irrigation committee. Sometimes the committee simply contracts with a group of farmers or laborers to perform the cleaning and repair work.

The branch canals are also cleaned at least once a year, supervised by the branch canal committee. There are two methods for maintaining the branch canals. Branches 2 and 16 contract the maintenance to a third party. Interested contractors submit a bid, and the lowest bidder is awarded the contract. The funds for the estimated bid are raised based on the size of the farmers' holdings. A sub-committee of area members supervises the job. On branches 1 and 3, the farmers desilt and maintain the branch canals themselves. Here farmers working independently may clean the branch canal as many as three or four times a year depending on their individual needs. Voluntary labor is contributed.

All farmers consider the cleaning of farm channels to be a routine accomplished from once in a season to once in a year. Farmers on the channel initiate the work, and nonparticipation is fined Rs. 15 to 25/day of work missed. All farmers interviewed reported that the fine is enforced and collected.

3. Conflict Management

Conflict is reported by all farmers to occur over water distribution and is reported to be started by farmers whose crops are in need. The committee members of the branch canal mediate disputes, and differences among individuals are settled by discussion during meetings called for that purpose.

4. Water Adequacy, Reliability, and Equity

Five of twenty head farmers interviewed reported water inadequacy and untimeliness in the monsoon paddy season. Very few head farmers reported water inadequacy and untimeliness in the winter season.

Eleven of twenty tail farmers contacted reported water inadequacy and untimeliness during the monsoon paddy season. Five of the twenty tail farmers reported inadequate and untimely water supply for the winter crop.

Many farmers also report that the temporary Pithuwa diversion structure makes the water supply unreliable. Head farmers on the east side of the main canal name monsoon flooding as a major problem for cropping, particularly during harvest. Some tail farmers reported the need for a drain to remove water.

E. CHARACTERISTICS AND PERFORMANCE OF AGRICULTURAL SERVICES AND THE PRODUCTION SYSTEM

1. Agriculture

By providing a supplementary irrigation source, the Pithuwa irrigation system appears to have had a profound influence on agricultural activities. Multiple cropping, the development of a more reliable cropping pattern, and the gradual adoptation of improved technologies has resulted not only in higher yield/unit of land, but also higher total yields annually. In the winter, farmers grow mustard on more than 90 percent of the command area and grow wheat on more than 5 percent of the command area.

Intensive cultivation practices have allowed little time between crops for land preparation and sowing. As a result, farmers use tractors, especially for mustard cultivation, and draft animals for maize and paddy cultivation. Most farmers broadcast mustard and corn seeds. Pulverised or wet seed beds are used for paddy, and early varieties are preferred. Mixed cropping and green manure practices have been introduced recently. Buffalo are invariably raised by every household for additional income.

A wide range of crops and vegetables can be grown in the command area. However, the main crops are paddy, mustard, corn, potatos and wheat.

The general condition of the paddy, mustard, and potato crops appeared quite satisfactory. Mustard usually receives one irrigation and this makes a good stand. Additionally, as the watertable is low (70 ft below the surface), root germination and development are profuse, resulting in more yield. Corn and wheat more or less depend on rainwater late in their growing stage. The cropping patterns the farmers use and the area under different patterns follow.

Cropping Patterns and Area for Pithuwa Irrigation Project

Cropping Pattern	Area (ha)
Maize - mustard	730
Maize - potato - wheat/(mixed cropping)	100
Maize - paddy - mustard	200
Fallow - paddy - mustard	240
Fallow - paddy - wheat	33

At the head of the system, some farmers reported reduced cropping in the spring, and they all reported some maize production instead of early paddy. Water supply limited cropping to 61 percent of the area of the farms studied. Tail farmers also reported spring maize production instead of early paddy. The cropped area was 67 percent of the 20 farms studied.

In the monsoon paddy season, cropping was reported on 81 percent of the 20 head farms studied. At the tail, all 20 farmers contacted grew summer monsoon paddy, with 67 percent of the area cropped.

In the winter season, most head farmers produced wheat and mustard. The cropped area in winter was 79 percent of the total area for the 20 farms studied. All tail farmers reported growing mustard, but very little wheat. The winter cropping area at the tail was 94 percent of the farm studied.

Large landholders rotate maize and paddy biannually due to water shortages. The total cropping intensity of the area exceeds 235 percent, compared to 176 percent in the nearby DIHM operated Panch Kanya irrigation system. All farmers reported that they determined cropping times by the calendar month, synchronizing dates with their neighbors.

2. Production Inputs

More than 90 percent of the total cropped area (except for that in mustard) grows improved varieties. Farmers prefer early maturing varieties to fit the cropping patterns. Fine paddy is liked as it commands a good price.

Farmers use fertilizers on most crops, except for maize, in the following ratio:

Crop	N P K (kg/ha)
Paddy	40-20-0
Mustard	20-20-0
Wheat	60-30-0

Farmers are gradually using more pesticides in potatos, mustard, paddy, and maize. The following table summarizes land use under different crops and fertilizers.

Summary of Land Use Under Different Crops and Fertilizers

	Crops						
	Paddy		Mustard		Wheat	Maize	Potatos
	I*	NI	I	NI	I	NI	NI
Area (ha)	472	-	265	830	30	933	100
Fertilizer (kg/ha)	75	-	75	-	75	-	150
	(urea)		(urea)		(urea)	(Manure)	(combination)

* I = irrigated, NI = not irrigated

The services of a junior technical assistant and cropping pattern personnel stationed at the town of Tadi are available, and the farmers themselves appear to be agriculturally advanced. Farmers get inputs through the Tadi cooperative and private dealers. The service provided by the local cooperative is poor.

Production credit is available from the Tadi market and the bank. The cooperative in the command area is non-functional because loans were not repaid satisfactorily.

3. Yields

The average yield as reported by the farmers is presented in the following table.

Yield Variation and Average Yield for Crops Grown in Pithuwa Irrigation System

Crop	Yield Variation (mt/ha)	Average Yield (mt/ha)
Paddy	2.5 - 4.0	2.9
Wheat	2.0 - 3.5	2.2
Maize	1.5 - 2.5	1.6
Mustard	0.6 - 1.2	0.8*
Potato	10 - 16	11.2*

*True average yield figures for mustard and potato may be higher than these figures reported by farmers.

Farmers said that marketing through middlemen and low prices for produce are growing problems.

F. STRENGTHS AND WEAKNESSES

1. Strengths

a) Pithuwa irrigation system has a strong, disciplined farmer organization which the farmers consider their own. The rules and regulations of the organization are effective, and farmers' participation seems quite high.

b) The farmers' organization has effective control and distribution of water and, if necessary, enforces water rationing and budgeting. The overall management of the system is very effective.

c) There is little conflict among the different castes and ethnic groups, or between head and tail farmers. Most of the farmers have harmonious relationships with other farmers in the system.

d) Though the system was designed to serve 600 ha and it is officially referred to as a 600-hectare system, farmers have designed management procedures and channels to increase the command area to over 1,000 ha. We estimate that 1,300 ha receives some irrigation water.

e) The main canal and field channels seem to be functioning quite well.

f) Most of the command area has a high cropping intensity, sometimes as high as 250 percent.

g) The cropping pattern is well adapted to the water supply. Water is usually available throughout the system.

2. Weaknesses

a) Because of the temporary diversion on the river there is not an ensured supply of water, particularly during floods in the rainy season when the diversion is damaged. Silt from floods blocks the intake, and a bulldozer must be used to clear the intake.

b) The soils at the head of the system are sandy and not ideally suited for irrigated agriculture.

c) There are no drainage outlets at the tail.

d) The main canal below the drop structures is badly eroded.

e) As there are irrigation systems upstream from the Pithuwa irrigation system, conflict exists between the upstream farmers and the Pithuwa farmers.

f) Large, absentee landlords control much of the land in the system, particularly at the tail.

g) Farmers depend on a shrinking maintenance budget from DIHM. Much of this budget must be used for bulldozer operation.

h) There is no clear responsibility between DIHM and the farmers concerning the maintenance of the main canal and the structures.

3. Summary and Conclusions

Pithuwa Irrigation Project was constructed by DIHM, but is operated by a farmer's committee. The 9.5 km main canal has 16 branch canals and irrigates about 475 ha of paddy and supplies one irrigation for the winter crop. Farmers have developed enough branch and field canals to supply about 1300 ha. However, the current canal capacity cannot provide water for more than about 475 ha for late paddy. The area under paddy could be increased by improving the canal sections and structures.

A serious problem on Pithuwa is not having a permanent intake structure. During monsoon the system may suffer having its temporary diversion washed away by flood at any time.

Since there is no silt control at the intake, frequent silt removal from the canal bed is needed. Silt deposits reduce the capacity of the main canal.

Pithuwa irrigation system is functioning well, and many things can be learned from it. The volume of water at the intake has forced Pithuwa to operate effectively to make agriculture profitable. Pithuwa is a hybrid system, neither completely DIHM-operated nor completely farmer-managed, although farmers have taken more responsibility for operating the system. Pithuwa irrigation system could be a model for many medium-sized DIHM-operated irrigation systems.

Additionally, despite the disparity in landholding size, farmers of all castes and ethnic groups seem to cooperate on irrigation tasks. Few serious conflicts were noted, and most features of the social system indicated that it was relatively egalitarian and harmonious.

The agricultural undertakings of the Pithuwa irrigation system appear to be satisfactory. When compared with the nearby DIHM-operated Panch Kanya irrigation system, Pithuwa has a more reliable water supply, more effective farmer participation, better adoption and intensification of improved agriculture practices and land use patterns.

Examples from the Hills of Nepal

Annex 9.

Edward D. Martin and Robert Yoder[1]

...DUCTION: IRRIGATION INSTITUTIONS

...is a growing literature which examines farmer-managed irrigation systems[2] in a number of countries and a ... ecological environments. Studies from the Philippines (Lewis, 1971; Siy, 1982), Indonesia (Geertz, 1980), ... (Tan-kim-yong, 1983), Sri Lanka (Leach, 1961), and Peru (Mitchell, 1976) have described a variety of ... systems which are managed by farmer groups. This article describes and analyzes the institutions ...ed by farmers for the management of gravity irrigation systems in the hill region of western Nepal.

...ter, as one of the essential resources in agricultural production, has several unique characteristics, especially in ...vironments.[3] Individual farmers, acting alone, can seldom acquire water for irrigation. Construction and ...enance of the structures to divert, convey, and distribute water usually require investments beyond the capac... ...a single farmer. Surface water cannot be easily stored, certainly not by the individual farmer, in the way that ...tilizer can be. It must be used when it is available or it is lost. Farmers generally cannot transport water ...omically over great distances, and the locations to which it can be conveyed are limited by the topography. ...e implication of these characteristics is that institutions are needed for the development and operation of irriga... ...n systems. The form and function of these institutions vary depending on the physical, social, and economic ...vironments.

...stitutions have been defined as "complexes of norms and behaviors that persist over time by serving collectively ...ued purposes (Uphoff, 1984)." Institutions regulate individuals' actions and consist of significant practices and ...ationships within a society. In some cases, institutions may be formalized in organizations like cooperatives, local ...vernments, or banks. Examples of institutions which are not organizations are land tenure systems and customary ...bor exchange relationships.

...stitutions of both kinds contribute to production and development processes in several ways. They facilitate the ...gregation of resources beyond an individual's capacity and the application of resources to the solution of problems ...r the benefit of many. They reduce uncertainty by the predictability of behavior that they encourage and enforce ...n various spheres including the distribution of benefits from collective investments.

In this paper we examine institutions that have evolved to enable the collective management of water for agricul... ...ral production. One institution is the farmer organization itself, an organization which has been vested with ...gitimacy by the local community.[4] Another important institution is the convention of property rights in water.

...gricultural economist and agricultural engineer, the International Irrigation Management Institute, Digana Village, Sri Lanka.
...e research was conducted from 1981 to 1983 under the auspices of the Research Division and the Research Centre for Applied Science and ...chnology, Tribhuvan University, Kathmandu, Nepal. Financial support was provided by the Ford Foundation, Appropriate Technology ...ernational, and Cornell University's Program in International Agriculture.
...e authors gratefully acknowledge the contribution of Prachandra Pradhan to the development of this paper. He visited the system frequently and the ...ervations and concepts presented here were discussed with him on many occasions. They are also grateful for the useful critical comments of Douglas ...ey and Mark Svendsen. Both Authors with to express their appreciation to the editorial and production staff of IIMI.

...rmer-managed irrigation systems are operated and maintained collectively by groups of farmers. Management of the whole system from ...e of water to the fields where it is used is the responsibility of the farmers. Irrigation systems of this type are often referred to as ..."community-managed" systems (Coward, 1980). The term "farmer-managed" is used to avoid the ambiguities inherent in the term "community."

...me of these characteristics do not apply to the case of irrigation from ground water sources, but ground water is not an important source of ...igation in hill environments.

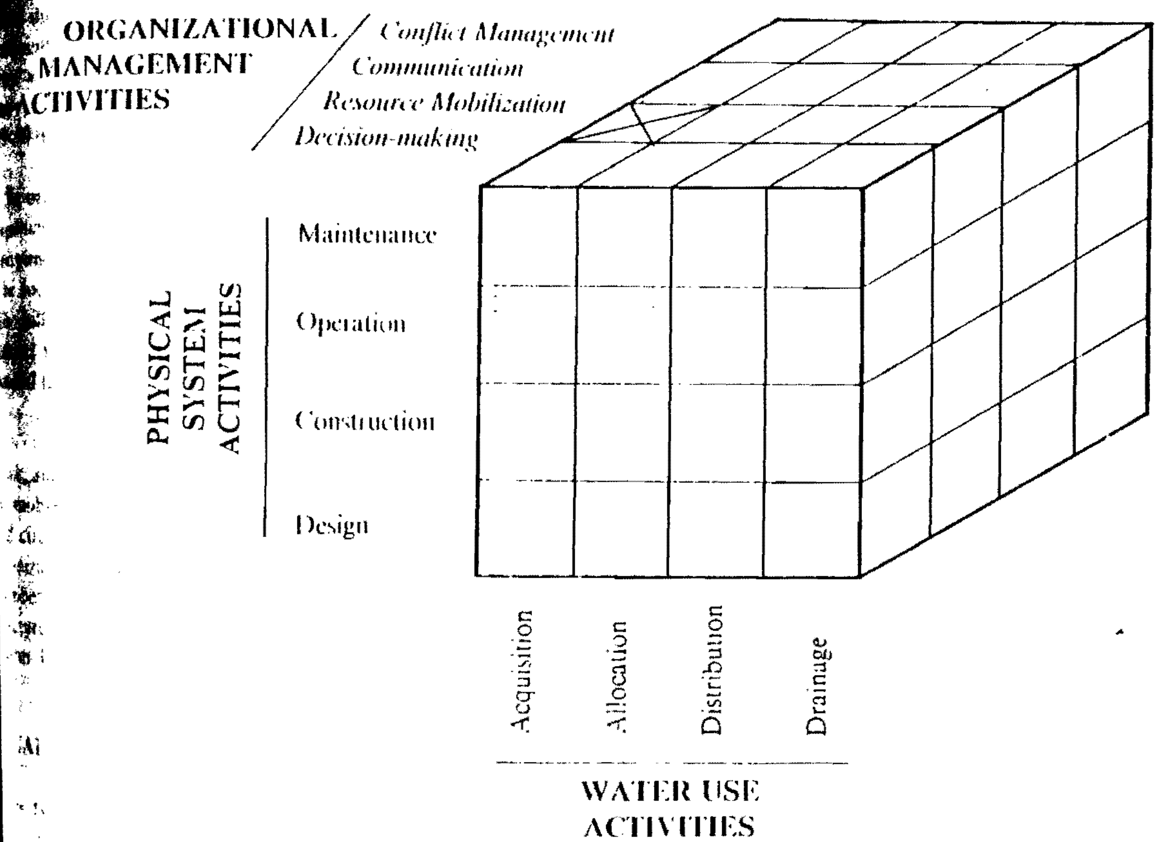
...e degree of formal legitimation by civil authorities varies among countries.

...rty rights include both the principle by which water is allocated among farmers and the responsibilities that ...duals have for maintenance of the system. Both institutions, the organization and the convention of property ...ts, are crucial to the effective management of irrigation systems.

...gation Management Activities

...armer-managed irrigation systems are found in diverse environments and employ a wide range of technologies ...xploit different types of water sources for production of a variety of crops. All these irrigation systems, however, ...uire that certain essential tasks be accomplished if the system is to function productively. One set of management ...ivities focuses directly on the *water*. Water must be *acquired, allocated, distributed,* and, if there is excess, ...*ained*.[5] A second set of management activities deals with the *physical structures* for controlling the water. These ...uctures must be *operated* and *maintained*.[6] A final set of activities focuses on the *organization* which manages the ...ter and structures and includes *decision making, resource mobilization, communication,* and *conflict management* (Uphoff, 1986). Figure 1 depicts these three sets of irrigation management activities as a three-dimensional matrix.

...gure 1. Irrigation systems activities matrix (adapted from Uphoff *et al.*, 1985).



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[5] Water "allocation" and "distribution" are often used interchangeably in the irrigation literature to describe the delivery of water. However, they ...times refer to different activities. Water allocation is the assignment of entitlement to water from a system, both identifying the fields and ...mers with access to water from the system and the amount and timing of the water to be delivered to each. Water distribution refers to the physical delivery of water to the fields and may or may not conform to the water allocation.

[6] The structures must also be designed and constructed, but these are not usually considered to be management activities. The design and ...struction of the physicl structures certainly have implications for the management of a system, however. Not all types of management ...actices are possible with every design, and both the design and quality of the construction may limit the effective management of a system.

re is interaction among the activities of the three sets; for example, the organization must *decide* how to e the structures to *distribute* the water. Not all activities are equally important in each environment, and the ers' irrigation management institutions will reflect the relative importance of activities in a particular location. e context of the hills of Nepal, *resource mobilization* to *maintain* the system for *water acquisition* is the primary ity which influences the structure of many of the farmer irrigation organizations. In addition, the institutions of erty rights in water and the principle by which water is *allocated* have important implications for the efficiency quity of the farmer-managed irrigation systems studied in Nepal.

the following discussion, we will describe and analyze two farmer-managed irrigation systems located in the ern hills of Nepal which were studied for 20 months in 1982-83. The discussion will focus on the management utions for operating the systems, i.e., 1) the organization and the way it accomplishes irrigation activities, icularly resource mobilization, and 2) the principle of water allocation.

I. IRRIGATION IN NEPAL

Irrigation to grow flooded rice in the valleys of the hill region of Nepal has been practiced for many centuries. Groups of farmers with adjacent landholdings have worked together to construct brush and stone diversions. They have dug canals to convey water to fields that they have leveled and bunded for growing irrigated rice. The canals frequently must pass along steep slopes and through rock outcrops. Tunnels a few meters underground are used to pass vertical cliffs and rocks. Landslides along the canal and floods which destroy the diversions demand high maintenance inputs to keep the systems operating. In some systems each farmer receiving water must contribute -30 days of labor each year for maintenance.

In order for a group of farmers to accomplish the various irrigation management activities, their behavior must be organized. All but one of the 25 systems investigated had explicit organizations with designated rules and roles for carrying out these activities. The degree of formality of the organizations varied considerably among the systems.[7] The focus of an organization and its structure are determined, in part, by the activities which are most important. The hill environment requires long canals traversing steep, landslide-prone hillsides to bring water from streams subject to flooding during the monsoon season. As a result organizations are structured to mobilize the resources needed to maintain the intake and canal for acquiring the water.

In organizations that must mobilize a large amount of resources, written attendance records, sanctions for missing work, and audited accounts were found. The rules and minutes of meetings tended to focus on issues surrounding the mobilization of resources, e.g., how much labor and cash members must contribute, the fines for missing work, and circumstances under which one is excused from work. The main functions of the elected officers of the organizations were to organize and supervise the maintenance work on the system, keep accurate records of members' contributions, and enforce sanctions for failure to contribute as required. The formality of organizational structure was found to be, to a large degree, a function of how much labor must be mobilized to maintain the system. If little labor is required, the organization tends to be less formal and vice versa.[8]

GALI AND CHHERLUNG IRRIGATION SYSTEMS

The two systems to be discussed are both on river terraces (*tars*) 100-200 meters above the Kali Gandaki River an elevation of about 650 meters. Argali is in Argali Village Panchayat and Chherlung is in Baugha Gumha llage Panchayat,[9] both located in Palpa District between Ridi Bazaar and Ranighat (see Map in Figure 2.) Argali d Chherlung are about two hours' walking distance from each other.

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cators of the degree of formalization of organizational structure were the number of designated roles, regular meetings, established sanctions the extent of written records such as minutes of meetings, work attendance records, accounts, rules, and listing of members' water allocation.

conclusion is examined and supported by statistical analysis in Martin (1986).

al is divided into several levels of political and administrative units. The village Panchayat, which consists of nine wards, is the lowest level. are more than 3,000 village panchayats in Nepal. These aggregated into 75 district panchayats. The national panchayat is the equivalent of onal Parliament. Members of the Panchayats are elected by the adult constituency which they represent.

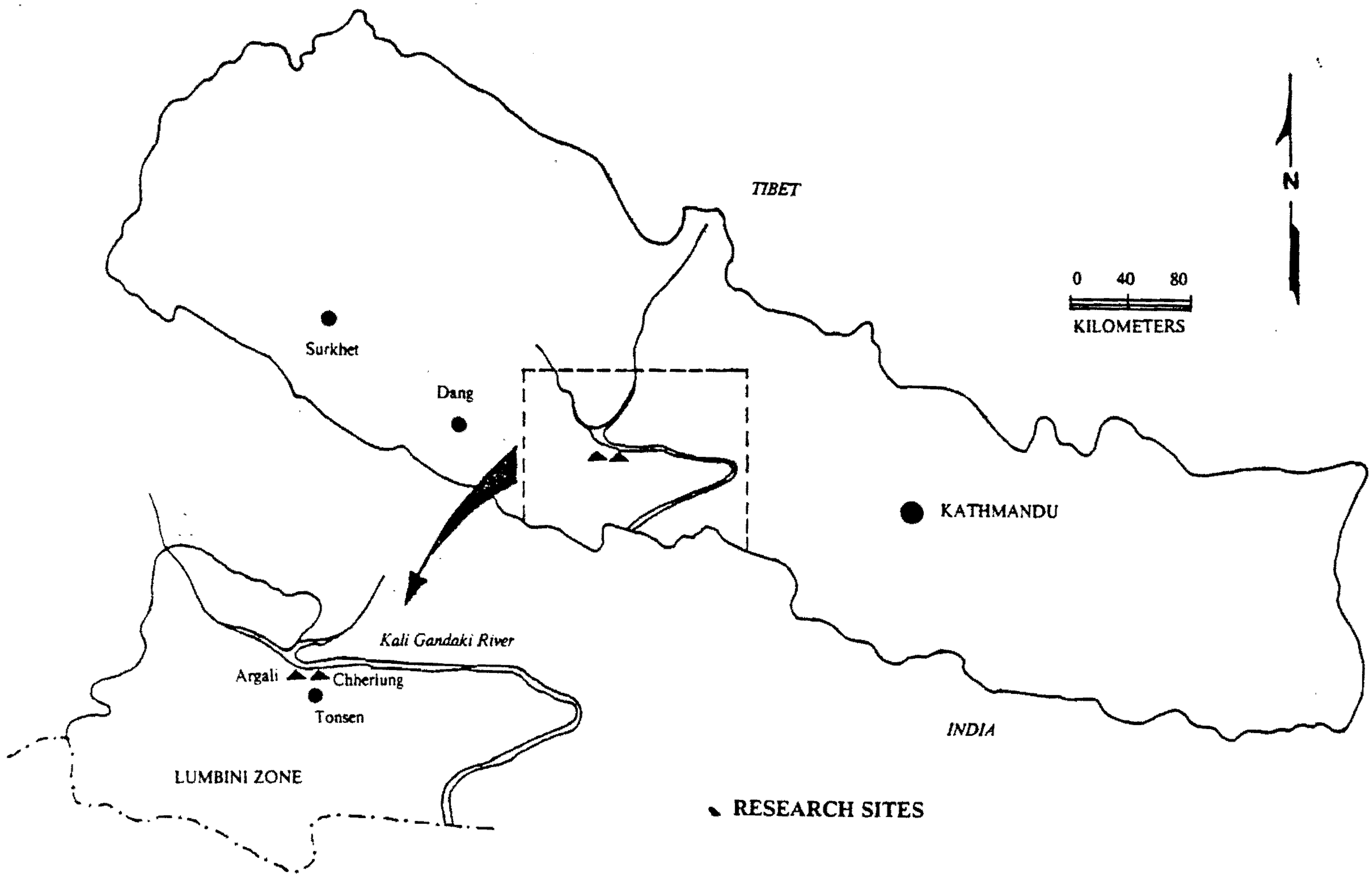

Figure 2. Location of Argali and Chherlung.

In Argali there are four irrigation systems, each consisting of an intake on the Kurung Khola (stream) and a canal which conveys water to a command area on the Argali river terrace. The four systems range in area irrigated during the monsoon season from about 11 to 47 hectares and in membership from 28 to 159 households. Since there is little difference in the four organizations, we will limit the discussion to the largest system, the Raj Kulo (Royal Canal).

Three systems irrigate the land in Chherlung. The smallest system serves less than 10 hectares and is supplied with water by a spring near the command area. Little labor is required to operate this system, and it has an informal organization.

The other two systems have intakes on the Brangdhi Khola. They are called the Thulo Kulo (large canal) and Tallo Kulo (lower canal) systems and irrigate 35 and 17 hectares of rice, respectively, in Chherlung. The Thulo Kulo has 105 members and the Tallo Kulo, 60 members. They employ a principle of water allocation which is distinctively different from that used in Argali. Because the Thulo and Tallo Kulo organizations and their historical development are similar, we will focus on the Thulo Kulo system and compare it with the Raj Kulo of Argali.

In both sites the soils are well-drained with high percolation rates. Measurement of the rate of water subsidence in selected rice paddies yielded estimates of the seepage and percolation (S&P) rate which increased over the season from about 10 to 80 millimeters/day in fields which were continuously saturated and from 10 to 160 millimeters/day in fields which cracked due to drying during rotational water distribution (Yoder, 1986).[10] Consequently, water application rates for rice cultivation are extremely high. The average over the monsoon season when rice was cultivated ranged from 4 to 7 liters/second/hectare depending upon the water supply available and the water distribution method.[11] While the top soil layer has a relatively high clay content, it is not deep. The depth of the puddled layer is controlled by the depth of plowing which averages only 75 millimeters. The sub-soil layer is porous, and the water table on the river terraces is far below the surface. The shallow puddled layer, nature of the subsoil, and deep water table contribute to the high percolation rate.

Farm sizes are small in both villages. The average size of irrigated landholding (*khet*)[12] per household in both systems is about 0.3 hectares. Agriculture is extremely intensive in both locations, which is made possible by effective irrigation systems. Farmers in both systems have developed the same cropping pattern on their irrigated fields. Most farmers grow three crops: monsoon rice, winter wheat, and pre-monsoon maize. Several farmers in Argali planted rice on some of their land in the pre-monsoon season. In Chherlung, however, the water supply is so limited in the pre-monsoon season that if rice were grown, only one-third of the area could be cultivated, leaving the remainder fallow. In order to provide equitable irrigation benefits among the members in Chherlung, water is allocated on a priority basis for maize. Since maize is a less water-intensive crop than rice, all of the hydraulic command area can grow irrigated maize. Total grain production per year from a hectare of land in each system averaged approximately 8 tons. Table 1 presents the results of crop cuts that were taken in the two systems.

Figure 3 shows the crop calendar that was observed in Argali in 1982/83. The calendar for Chherlung was virtually identical to that of Argali. Whereas during the monsoon season all of the khet is used for growing rice, in the winter season some farmers grow potatoes, cabbage, or other vegetables in place of wheat on some of the area. In the pre-monsoon season maize is grown on most of the khet with a lentil crop, usually cowpeas, intercropped with the maize as a vegetable, fodder, or green manure.[13] A few farmers with larger holdings leave part of their khet fallow in the winter and plant a longer-season, higher-yielding maize variety before the time of wheat harvest.

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[10] The measured increases in S&P over the season are thought to be a result of the shallow depth of plowing which allows easy root penetration and cracking of the puddled layer.

[11] In contrast, systems in the lowlands of India, the Philippines, Indonesia, and Thailand usually require 1 to 1.5 liters/sec/ha.

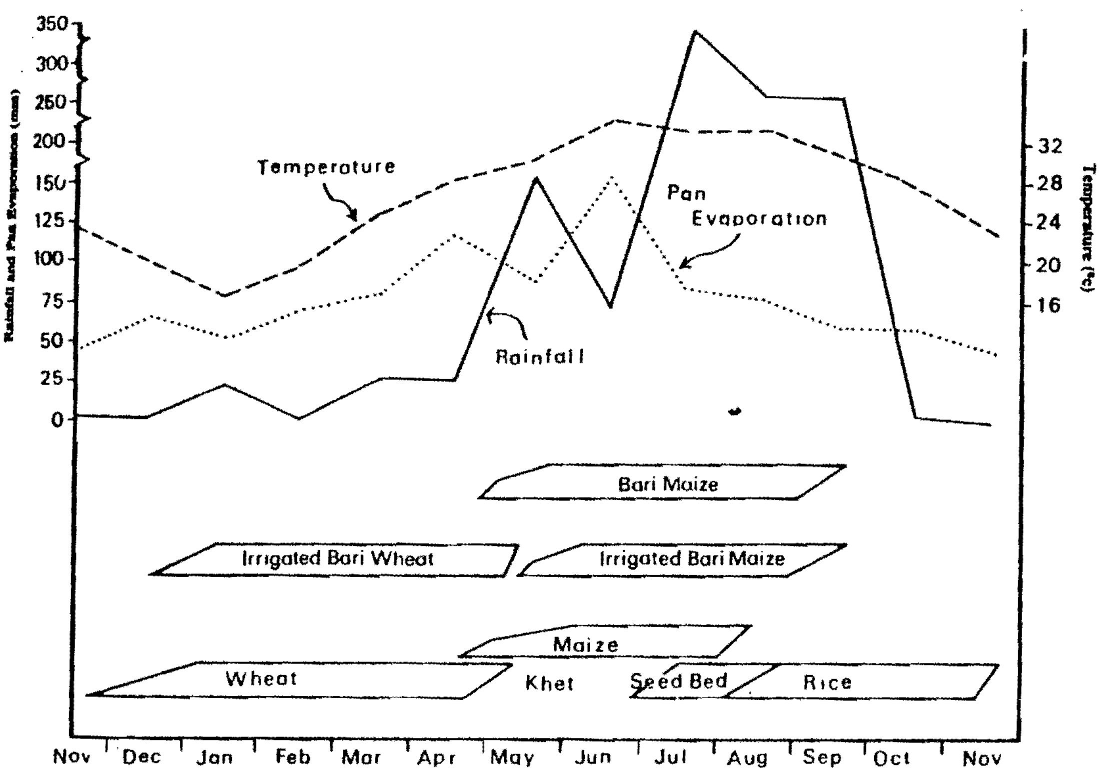
[12] *Khet* is the Nepali term for fields which have been leveled and bunded into terraces for the cultivation of flooded rice. *Bari* is the term for upland fields which have not been leveled and bunded for flood irrigation.

Table 1. Grain yields estimated from sample crop cuts in 1982-83 (tons/hectare).

	Argali	Chherlung
Khet (leveled & bunded)		
Rice	3.3 (89)[a]	3.5 (121)
Wheat	2.5 (83)	2.5 (95)
Maize	1.7 (92)	2.4 (95)
Total	7.5	8.4
Irrigated *bari* (sloping upland)		
Wheat	2.9 (14)	*
Maize	3.9 (14)	*
Total	6.8	

[a] Number of crop cut samples used to compute the mean yield. * No crop cuts taken.

Figure 3. The Argali 1982/83 crop calendar.



[13] As the yields reported in Table 1 indicate, maize suffers in the three crop pattern on the khet and produces less than half the yield of maize grown on irrigated bari. Khet maize was harvested before maturity so that rice, the priority crop, could be planted soon after the onset of monsoon rains. It was in the field less than 95 days on average compared to 115 days for bari maize.

In both villages traditional varieties of rice are grown in the monsoon season. However, management-responsive varieties of wheat and maize have been adopted by most of the farmers. The farmers in Argali who cultivated pre-monsoon rice planted a management-responsive variety.

Many of the farmers also have some upland fields (bari). These may or may not be irrigated during the wheat and maize seasons depending on their location relative to the canal. If the bari is irrigated, farmers usually plant winter wheat followed by a long-season maize variety which is not harvested until near the end of the monsoon in September. Most households plant potatoes and vegetables for household consumption on part of their irrigated bari during the winter wheat season. A legume is intercropped with the maize and harvested for household consumption and animal fodder. After the maize is harvested, mustard may be planted, but this is not irrigated. A long-season variety of maize is the common crop planted on unirrigated bari in both villages.

Historical Development

Oral tradition in Argali states that the Raj Kulo was initiated by Mani Makunda Sen, the first Sen rajah of Palpa. This would make it over 300 years old. It was originally constructed to irrigate land to support a temple which he had built on the bank of the Kali Gandaki River at Ridi. Part of the production from a small section of the present command area is still given to the temple. Since the original construction took place so long ago, nothing is known of how resources were mobilized and work carried out.

Much more is known about the history of the Thulo Kulo in Chherlung because construction began in 1928. Men who worked on it in their youth are still farming land which it irrigates and remember some of the details of the original construction. Two individuals, a Brahmin and a Chhetri[14], are credited with initiating and organizing the construction and contributing the bulk of the initial resources needed to dig the canal. An additional 25 households provided some support, but other families in the community doubted the feasibility of delivering water from an intake more than six kilometers away by means of a canal which had to be cut through dense jungle, hard rock, and along the face of sheer cliffs.

To build the canal a contract of Rs. 5,000 and ten *maato muri* (about 0.12 hectares) of potential khet land was given to four Agris from the village of Damuk Khanee in Gulmi District[15]. These four skilled canal builders hired laborers, including people from Chherlung, and each supervised 25-30 workers. Construction was begun in 1928 and continued for 10 months each year. The work was interrupted when people from Tansen, the District Center, arrested several workers on the charge that they were taking wood from the jungle without authorization and burning it to heat and break rocks. Tansen residents were also concerned that the canal would leak and ruin the road to Ranighat, the place where they traditionally cremated their dead. A settlement was reached when the Chherlung farmers agreed to repair any damage to the road, received permission to cut firewood, and were granted the right-of-way for the canal. Water first flowed through the Thulo Kulo to the Chherlung command area in 1932.

Farmers in Argali and in Chherlung have continued developing the irrigation potential of their respective water and land resources. In Argali they have built three more canals parallel to and below the Raj Kulo. These three, known as *Maili* (second daughter), *Saili* (third daughter), and *Khanchi* (youngest daughter) irrigate an additional 42 hectares of khet.

After construction of the Thulo Kulo in Chherlung had demonstrated the feasibility of irrigation from the Biangdhi Khola, two Magars[16] organized the construction of the Tallo Kulo parallel to the Thulo Kulo. The local

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[14] Brahmins and Chhetris are high caste Hindus.

[15] Persons who spent time working in the once flourishing mining industry of western Nepal became known as *agris*. Numerous ethnic groups and castes were involved in this work. Man Bahadur Kami, one of the four who took the Chherlung contract, is credited with constructing a number of irrigation canals in Palpa and Gulmi Districts.

[16] Magars are a Tibeto-Burman ethnic group native to the hills of western Nepal.

ion regarding water rights required this second canal's intake to be below that of the Thulo Kulo even its command area was higher. Thus the two canals cross just before they reach the command area. The same skilled canal builders who had constructed the Thulo Kulo were given a contract to build the Tallo Kulo.

Chherlung the contractors were retained for an additional four years to maintain and improve the Thulo Kulo. did this during the monsoon months and worked to construct the Tallo Kulo the rest of the year. The bers paid for all of the contract work and in addition contributed labor. Since that time the members have nued to mobilize labor and cash to make improvements. Gradually the canal has been enlarged to deliver a er discharge, and the intake structure has been improved. In 1967, cement was used in the system for the first and since then short sections of the canal have been lined. The district panchayat made small grants to the ization in 1967, 1975, 1981, and 1983. These were used primarily to purchase cement.

was reported that in the first years only a trickle of irrigation water could be delivered through the Thulo Kulo. in water discharge over the years has allowed the area irrigated to gradually expand, and in parts of the m, farmers can now irrigate their rice by continuous flow. In the early years of the system, it was necessary to bute water by rotation to all fields throughout the entire system.

uch of the improvement in the Argali Raj Kulo has taken place in the past 25 years. Prior to that, most of the had been farmed by tenants who were reluctant to invest in improvements to the system because of the urity of their tenancy. Those who farmed irrigated rice land, whether owners or tenants, were members of the ation organization and were responsible for operating the system. The organization fined persons who were t from work and who were caught stealing water. At the end of the year, the money collected in fines was for a feast for the members rather than used to improve the system.

e tenant operators became land owners after passage of the Land Reform Acts in 1957 and 1964, and the ice of spending the fine money on a feast was discontinued. Since then, this money has been invested in ovements in the system. The canal has been widened, areas with high seepage have been lined, and skilled has been hired to cut tunnels through some areas where landslides often damaged the canal.

idence of the increased water discharge of the canal lies in the report by many of the farmers in Argali that 10-15 years ago they needed to guard the water to their fields carefully both day and night. This required that family member sleep by the canal turnout to their field at night. Observation of the water distribution in 1982 y showed that in an average rainfall year the water supply was now adequate for continuous-flow water bution to all of the fields in the Raj Kulo system for the entire season. It was no longer necessary for Raj Kulo bers to guard their water carefully.

r Allocation

ce is the preferred staple food in Argali and Chherlung and is the crop for which irrigation has been developed. echnology and organization, i.e., the techniques, rules and conventions, developed by the farmers are primarily ce cultivation. Membership in the irrigation organization is limited to those who have the right to water for ing rice in the monsoon season, even though other farmers have access to water from the system in other ns for other crops. According to local tradition and Nepali law, the first farmer or group of farmers to develop er source can claim the right, at the point of the diversion from the stream, to all of the water that they need ltivation (Muluki Ain, 1964).

mbers of both the Raj Kulo and the Thulo Kulo have a strong feeling of ownership of their irrigation systems. s a result of their personal investment and the physical danger they faced in developing and operating the ms. Accounts of accidents claiming lives while constructing or maintaining systems form a part of the history of irrigation organizations in western Nepal.

rmers carefully protect their right to a limited resource. Although drainage water from the Raj Kulo is used for ating several additional hectares of rice, the owners of these fields are not considered members of the system. do not need to contribute to the maintenance of the system nor can they exercise authority by demanding water or influencing the timing of water delivery. When the members in systems like the Raj Kulo were questioned about allowing those using drainage water to become members, the answer was universal that since they had not invested in the system they could not become members. Even acquiring access to the canal water for a nonconsumptive use, such as a water-powered mill, was sometimes not possible (Scheuer et al., 1980). A frequently expressed fear was that if irrigation access or other uses were allowed, rights would be established to the water. If rights were established, then in the event of a drought the crops of the original members would be stressed and they would not be able to deny water to the new users.

Additional irrigation development from the same stream can usually only take place by other farmer groups constructing their own diversion and canal downstream of the existing intake. The only exception is if the new canal does not diminish the discharge in an existing canal with an intake below it. Many communities have three or four canals conveying water from the same stream into a command area. Frequently the canals can be seen running parallel along a hillside, separated by only a few meters of elevation but serving distinct areas within the command. The construction of multiple intakes and canals is often a result of the allocation of rights of access to water by prior appropriation. This principle was enunciated in the Law on Reclamation of Wasteland in the traditional legal code of Nepal, the *Muluki Ain*, as follows, "Water shall not be available for others until the requirements of the person who constructed the irrigation channel at his own expense or with his own physical labor are first met" (Regmi, 1978:244).

Water allocation, i.e., the distribution of entitlements to water from an irrigation system, consists of two dimensions. The first dimension, discussed above, distinguishes the farmers or fields which have access to the system's water from those which do not. The second dimension is a quantitative allocation of the water in the system among the farmers or fields which have been granted access to it, i.e., the designation of the quantity and timing of water to which each farmer or field is entitled.

The Argali Raj Kulo and Chherlung Thulo Kulo organizations have clearly defined both aspects of water allocation. In Argali during the monsoon rice season, only certain designated fields are allocated water. Fields which have no water allocation, but on which irrigation is hydraulically feasible, have no claim on the water resource from the time seedbeds are established for the monsoon rice-crop until the rice is harvested. The amount of water to which each field with an allocation is entitled is defined in terms of its area relative to the total irrigated area. Formerly the unit of area measurement was a *maato muri* (about 1/80 of a hectare), and each field's allocation is still referred to as "so many *muri* of water." Only those households farming land that has a water allocation for monsoon rice are members of the Raj Kulo organization.

The allocation during the winter wheat season and for maize planting is much less strictly defined and limited. Any farmer whose fields are located where they can receive water from the Raj Kulo is entitled to water in exchange for working on the system one day for each water application. The area that is irrigated during the dry season for wheat and maize is nearly double that which is irrigated during the monsoon rice season.

Access to water for growing rice in the Chherlung Thulo Kulo system and membership in the organization is limited to households that own at least a fraction of a share in the system. At the completion of the Thulo Kulo construction, the Rs. 5,000 construction contract was divided into 50 shares of Rs. 100 each. Shares in the system were distributed among the 27 contributing households according to the investment each had made and became the basis of the water allocation.

Ownership of one share entitled a member to 1/50 of the discharge in the system. Several households had contributed enough to receive more shares than they needed to irrigate their fields, while other households received less than needed. In addition, many people who had been unwilling to risk investing in the initial construction now wanted access to irrigation. This led to the initiation of buying and selling shares. The ownership of transferable shares was thus established and continues as the method of water allocation in the Chherlung Thulo Kulo.

Now there are 105 member households, and the range of share holdings is from one-eighth to four shares. On the average in 1983, a share of water irrigated one-half hectare of rice. The price of a share has increased over the years with transactions taking place in 1985 at the rate of Rs. 10,000 (US$575) per share.[17] In the same year the price of

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[17] This is the cost of a one-time purchase of a share, not an annual or seasonal rental charge.

prime irrigated land was Rs. 40-45,000 (US$2,300-2,600) per *ropani*.[18] In 1985 the cost of water for irrigating rice was about 2 percent of the cost of the best rice land in Chherlung.

The price of shares is set by the organization's managing committee and is said to somewhat reflect the total investment in the system. Even though the price of a share has increased tremendously, shares are still denominated according to the original price like the par value of stock, i.e., one share is referred to as Rs. 100 of water even though its current price is Rs. 10,000.

Over the years, improvements have been made to the main canal, significantly increasing the total flow in the system.[19] Since a share is a fixed proportion of the flow and not a specific volume, increasing the discharge in the canal increases the amount of water in a share. A member who initially needed two shares to adequately irrigate his land may at a later time require only one share. The member is therefore allowed to sell all or part of a share to another farmer who has no water or less than he wants for irrigating his land. When a sale takes place, the transaction is recorded by the secretary and the water distribution changed to meet the new allocation pattern. This involves changing the size of a notch in a saacho[20] if the water is transferred between secondary canals and recalculating the time intervals for rotational distribution. The Thulo Kulo farmers are adept at readjusting the water distribution to match a new allocation of shares.

On one occasion (in 1978) a group of farmers in Chherlung with land in an unirrigated area wanted to purchase shares, but no individual was prepared to sell the number of shares they wanted. The Thulo Kulo organization decided that improvements to the diversion weir and canal were necessary before enough water could be delivered to serve an expanded command area. A decision was made by the organization to sell ten additional shares at the rate of Rs. 2,800 (US$233) per share, thereby increasing the total number of shares in the system from 50 to 60. The Rs. 28,000 received by the organization from the sale was then invested in improvements in the diversion and main canal to successfully expand the irrigated area by more than 25 percent in one year.

Organization for Irrigation Management

Membership in the irrigation organizations in both Argali and Chherlung is hydraulically determined. Even though in both locations there is more than one canal from the same source serving a contiguous command area, each canal has a separate organization for its operation. In Argali, the membership of the Raj Kulo irrigation organization consists only of those farmers operating land that receives a water allocation from the Raj Kulo for monsoon rice. All farmers in Chherlung owning shares or a fraction of a share in the Thulo Kulo system are members of the organization.

Both organizations have a *mukhiya* (leader) and a secretary who are elected by the members. The current officers have served for a number of years but could be replaced if members were dissatisfied with their performance. The mukhiya is responsible for organizing and supervising work done on the system, and the secretary keeps the accounts, a record of members' water allocation and attendance at work, and minutes of the organization's meetings. As remuneration the number of workers these officers must supply for maintenance work, based on their water allocation, is reduced. If the number of workers that they would have to provide is less than the remuneration they are due, the balance is paid to the in cash at the local daily wage rate.

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[18] One hectare is about 20 ropani. At 1985 prices (Rs. 17.4/US$), land sold for more than US$45,000/ha.

[19] Improvements in the canal have been made on an almost annual basis. This has resulted in increased discharge from a mere tricklet in 1932 when the canal irrigated only a few small plots, to a maximum discharge of 180 liters/second in 1982. The average discharge, measured in the main canal on a twice daily basis over the 1982 rice season, was 160 liters/second (Yoder, 1986).

[20] A *saacho* is a proportioning weir used to divide water from one canal into two or more smaller canals. It is described more fully on the following page.

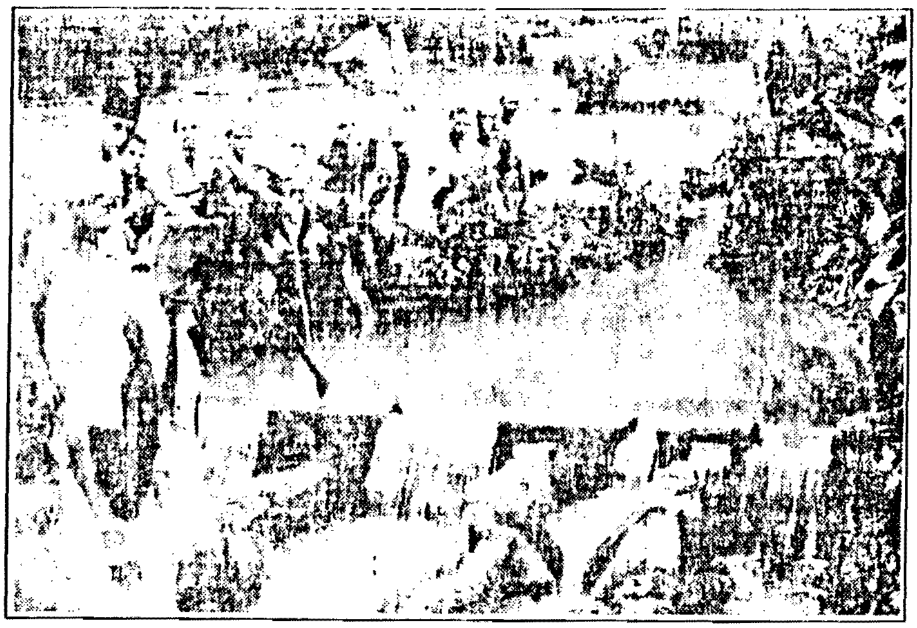
Both organizations have a meeting of the members in mid-May. At this meeting plans are made for the major annual maintenance which begins shortly thereafter, new officers are elected if necessary, and the operating rules for the coming monsoon season are reviewed and amended as needed. In Argali the accounts are presented for review at this meeting, whereas in Chherlung this is done at a meeting after rice harvest in the fall. Other meetings may be held throughout the year if decisions about system operation need to be made.

Water Distribution

Unless an irrigation system has an abundant supply of water allowing all fields to be adequately irrigated without concern for insuring that distribution of water is consistent with the allocation, some method of rationing the water according to each farmer's allocation is required. In Argali and Chherlung this is accomplished through the use of saachos and rotational distribution. Farmers in Argali and Chherlung irrigate rice by continuous-flow distribution whenever the supply is sufficient. Water flows continuously in all channels of the system, and farmers apply water to their fields at any time they want. With the exception of the days when they weed the field and apply fertilizer, farmers prefer standing water in their fields until near the end of the season when they dry the fields for harvest.

Saachos are used to distribute water by continuous flow in accordance with the pattern of water allocation. A saacho is a weir that the farmers install in the canal with two or more rectangular openings for the water to flow through. By having the bottom of each opening at the same elevation, the flow in the canal can be divided into parts that equal the ratio of the width of each opening to the total width of all the openings. Because of its notched shape, the proportioning weir is called a saacho (key) in the Argali and Chherlung systems. Figure 4 shows a saacho dividing the flow of one of the main canals in Argali into four secondary canals.[21]

Figure 4. A *saacho* installed to distribute the flow from a main canal into four secondary canals according to the water allocation of each



[21]This same type of device for proportioning water distribution is found in many of the irrigation systems studied in western Nepal. In some communities they were called *pani dhara* (water spout) or *khat bunda* (wooden closure). Similar devices are also found in other countries. In Indonesia they are referred to as *penaro* (Coward, 1985), in Sri Lanka *Torahunkota* (Leach, 1961), and in Thailand, *tae wai* or *mai wai* (Tan-kim-yong, 1983).

In Chherlung, saachos are used only to distribute water from the main canal into secondary canals. The group of farmers below the saacho is then responsible to apportion the water among their fields. When the discharge is adequate, the flow into each field is controlled by adjusting the size of the opening in the earth bund and by placing stones and mud in the canal to divert part of the water.

In much of Argali, saachos are used for distributing water from the main canal into secondary canals, from the secondaries into tertiary canals, and from tertiaries to the farmers' fields. They are installed to the field level when farmers are not able to satisfactorily distribute the water among themselves less formally. Installation of a saacho eliminates the conflicts that arise under informal distribution as farmers try to take more, or are thought by their neighbors to be taking more, than their share.

In both systems, when the supply is insufficient to provide continuous flow to the entire area at once, a timed rotation system of distribution is initiated. In the 1982 rice season, rotational distribution was not required in the Raj Kulo system in Argali. Halfway through the same season in Chherlung, however, the water supply had diminished to the extent that continuous-flow distribution to all of the fields was no longer possible. It was possible to maintain continuous flow through the saachos into all of the secondary canals, but farmers within each secondary formed rotational units and decided independently when they wanted to initiate rotational water distribution among the fields served by their secondary.

For water distribution within the secondary, the number of minutes per share was computed by dividing the total number of shares served by the secondary into the number of minutes in the rotation cycle. Each farmer would then receive water for the time period represented by the number of shares he had allocated to his field served by that secondary. A typical rotation cycle was 36 hours. By setting the length of the rotation cycle at 36 hours, the irrigation turn for each farmer alternated from day to night. Although irrigating at night has always been an accepted practice in Chherlung, it is both more difficult (disrupting sleep) and expensive (requiring the purchase of batteries for a torchlight).

Water distribution in Argali during the wheat and maize seasons is less precise and formal because the water supply is sufficient to irrigate more than the command area. Water is applied several days before land preparation to make it suitable for plowing and planting. Wheat is then irrigated two or three more times during the season. Maize may be irrigated only at planting for quick germination. At the most it is given only one or two additional irrigations, depending on the rainfall. Wheat and maize irrigation is done turn-by-turn with the farmers informally deciding upon the order. From long tradition, farmers wanting water on a particular day will meet at the main saacho at the head of the system at 10:00 a.m. to decide the order of irrigation and to do any minor repairs necessary to deliver the desired amount of water.

In Chherlung, the most demanding irrigation period each year is at maize planting time in mid-April. Most farmers are ready to plant maize at the same time, and they must irrigate to initiate germination. Discharge in the Aandhi Khola in April is very low, requiring that the total flow of the canal be rotated from one farmer's field to the next at the system rather than secondary canal level. Therefore, full authority for the allocation of water for maize planting--both in quantity and timing--is given to the mukhiya. All requests for water must be made to him, and as nearly as possible he assigns water delivery to each farmer's field in the order in which requests are received. A field usually consists of several terraces depending on the slope and size of the field. In order to allow equity in timely planting of every farmer's maize, the mukhiya decides, on the basis of requests for water each day, what portion of each farmer's field, i.e., how many terraces, will be irrigated in his turn. In this way water is allocated by turn to farmers, and a portion of their land, depending on the terrace size, is irrigated. The farmer must then wait for another one or more turns to complete his maize planting.

For an irrigation system to function well, the distribution of water must be done according to the allocation scheme. The precise definition of farmers' water allocation is only useful if the system can actually deliver to each farmer the share of the supply to which he is entitled. Measurement and comparison between the amount of water actually distributed and the amount allocated to different parts of an irrigation system provides an evaluation of the system's performance. The portion of the supply delivered to parts of the Thulo Kulo system was measured and compared with the amount allocated to those parts of the systems. The same measurements were made for the Kanchi Kulo system in Argali which distributes water in the same manner as the Raj Kulo. As Table 2 shows, the actual distribution closely matched the allocation, an indication of good system performance.

Table 2. Comparison of water distribution to water allocation in selected secondaries.

System	Location of Secondary	Water Allocation (percent of total water in system)[a]	Water Distribution[b] (percent of total water in system)[a]
Thulo Kulo, Chherlung	Head	9.5	10.2
	Middle	11.4	10.5
	Tail	21.8	20.6
Kanchi Kulo, Argali	Tail	16.6	16.9

[a] Since not all secondaries were measured, percentages do not sum to 100 percent.
[b] Discharge in the main canal and selected secondaries was measured twice daily for 97 days during the 1982 monsoon rice season. The figures refer to the percentage of the total volume of water supplied to the respective secondaries over the season.

Maintenance

A critical period for maintenance of most hill irrigation systems, including Argali and Chherlung, is prior to and during the monsoon. Major routine maintenance is done in late May and June to prepare the system for the monsoon season when efficient water delivery for rice cultivation is most important. At this time, the diversion and canal walls are repaired to reduce leakage, silt and weeds are cleaned from the entire length of canal, and sections of the canal are lined with clay to reduce seepage. This usually takes between two and three weeks.

In Chherlung, because of the low discharge in the stream in April, similar maintenance is also carried out prior to land preparation for maize. After the 1983 maintenance for maize, it was observed that the irrigators had used clay to seal the diversion in the stream. All of the surface water in the stream was captured, and measurements showed that for the short period during maize planting, over 80 percent of the water entering the canal reached the command area 6.5 kilometers away.

A large amount of maintenance is required throughout the monsoon season. The streams fluctuate tremendously with the monsoon rains, often damaging the diversion structures made of brush, stones, and mud. The heavy rainfall causes landslides on the steep, unstable hillsides along which the canals run, interrupting the flow of water until the canal is repaired. The intake and main canal are patrolled daily so that there is early detection of damage. The Chherlung organization pays two men to do this every day during the monsoon, while in Argali the members take turns patrolling in pairs.

The men patrolling the canal will do minor maintenance work such as repairing small leaks. In Argali if there is a need for more laborers, one of them will inform the mukhiya who then organizes members to do the repairs. In Chherlung the members are divided into seven groups, and each group is responsible for maintenance on a different day of the week. If laborers are needed, they will first be drawn from that day's group. Sometimes, due to the magnitude of the disaster, an emergency will be declared, and then each member household is required to send one man to work. Work will sometimes continue at night by the light of lanterns until the water is flowing again.

During the winter wheat and maize seasons, much less maintenance is required because there is very little rainfall. The farmers who want to irrigate on a given day may have to repair the intake to divert more water or plug small leaks in the canal to increase the flow, relatively minor efforts compared to the monsoon season maintenance.

Resource Mobilization

Resource mobilization is critical to the effectiveness of an irrigation system, and both the Raj Kulo and Thulo Kulo organizations successfully mobilize significant amounts of resources every year. Most of the labor and cash resources are contributed by the members, although small grants and some technical assistance have been given recently by the district panchayat and Department of Irrigation, Hydrology, and Meteorology (DIHM). Both organizations mobilize between 1500 and 2500 man-days of labor annually, depending on the severity of the monsoon rains and the attendant flooding and landslides. Both organizations have assessed cash contributions from members for the purchase of cement to line portions of the canals.

In both systems resources are generally mobilized in proportion to the benefits that members receive from the system, i.e., according to the water allocation. In Argali, where water is allocated in proportion to area irrigated, labor and cash are also contributed according to area served. Members must contribute labor for ordinary maintenance work at the rate of one man for each 40 *maato muri*[22] of khet each work day. A household with only 20 maato muri is required to provide one worker every other day.

Members in Chherlung contribute labor and cash according to the number of shares they own in the system. A household with one share is required to supply one man each day of ordinary maintenance, while one with two shares must provide two workers each day. Table 3 presents the number of man-days of labor mobilized by the two organizations.

Table 3. Labor mobilized for system maintenance (person-days).

Year	Routine Maintenance	Emergency Maintenance	Total
Raj Kulo, Argali			
1961	1120	681	1801
1966	1251	92	1343
1967	1120	690	1810
1968	1085	371	1456
1969	1120	825	1945
1970	1453	a	a
1971	1135	161	1296
1972	1003	159	1162
1973	1032	543	1575
1974	1287	205	1492
1975	1104	358	1462
1976	1203	294	1497
1979	1264	1378	2642[b]
1980	1087	638	1725
1981	1322	985	2307
1982	1179	822	2001
1983	1271	599	1870
1984	926	449	1375
Average	1165	544	1692
Thulo Kulo, Chherlung			
1981	c	c	1811
1983	c	c	3541[d]
1984	c	c	1362
1985	c	c	1740
Average			2114

...ing. [b]Construction of a road above the canal began in 1979, reselting in more than usual damage to the canal for several years.
...ine and emergency maintenance not separated in records of the organization. [d]Damage caused by a major landslide required much more ...the average amount of labor.
...e Raj Kulo and Thulo Kulo organizations' attendance records.

In 1982, members of the Thulo Kulo organization were assessed cash contributions at the rate of Rs. 250 (US$19) per share, raising a total of Rs. 15,000 (US$1,140) from 105 member households owning a total of 60 shares.[23] Rs. 34,800 (US$2,636) was raised by assessing the members at the rate of Rs. 580 (US$44) per share in 1983. Most of this was spent to build a masonry wall several meters high to support a section of lined canal following a severe landslide.

The one exception to the rule of proportionality in resource mobilization is when an emergency is declared. Each member household must then supply one man, irrespective of its water allocation. At the annual meeting in May 1983 in Argali, some members with small water allocations strongly protested that it was unfair for them to have to provide the same number of workers in an emergency as households with a much larger water allocation. After much discussion the decision was made to leave the rule unchanged but to be careful about when an emergency is called, i.e., only when there is a real emergency.

In order to mobilize the resources needed to maintain the system in effective working order, the organization must have sanctions which can be applied and enforced when members fail to contribute their share of labor and cash. Both systems levy cash fines against members who are absent from work. The fine for missing a day of ordinary maintenance is set near the local daily wage rate in Chherlung, Rs. 10 (US$.75) in 1982 and somewhat lower in Argali, Rs. 6 (US$.45). In Chherlung when a major emergency is declared, the fine rate is increased to encourage a higher rate of attendance. If a person is absent from the community when the emergency is declared or has another acceptable excuse such as illness, the fine is reduced to Rs. 6 per day, even for a major emergency.

Fines, when levied, are paid because as one farmer in Argali said, "If the fine is not paid, the organization can deny the offender water." Also, the community of members can exert social, as well as physical, pressure on members to pay fines. In Chherlung it was reported that in an early year of operation of the system, one man did not report for emergency maintenance for several days. When his fine was levied and he refused to pay, a group of members confiscated his cooking pots and threatened to sell them to pay his fine. Within a day or two, he paid the fine and recovered his cooking pots. Other members witnessed how serious the organization was about enforcing its rules and collecting fines, and payment has been 100 percent of all fines levied.

At a December 1982 meeting of the Raj Kulo organization, two members were appointed to collect the fines from the previous monsoon season and any that were outstanding from previous years. As remuneration for this work, they were entitled to keep 6 percent of the amount collected. In both organizations, the cash that is raised through fines is invested in maintenance and improvement of the system. Until it is spent, the money may be loaned to members who pay interest to the organization.

IMPLICATIONS OF THE PRINCIPLE OF WATER ALLOCATION

The principle of allocation has important implications for the efficiency of water use and the expansion of the irrigated area. Allocation of water in proportion to area irrigated provides no incentives for efficient water use nor a mechanism for expanding the area irrigated.[24] In Argali there have been significant improvements made in the canal, and the amount of water supplied to the command area has increased considerably in the past 25 years. However, there has been little increase in the area irrigated. DIHM invested approximately Rs. 400,000 (US$30,300) in the system in 1982 with no change in the irrigated area or cropping intensity. The main impact of the improvements made over the past 25 years, including those by DIHM, has been to reduce the water distribution

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[22] A *mauto muri* is a traditional measure of area. Forty *mauto muri* equal approximately half a hectare.

[23] The exchange rate at the time was Rs. 13.2 = US$ 1.

[24] An exception to this statement is the warabandi systems of Northwestern India. In these systems water is allocated in proportion to land area, but each farmer receives considerably less water than needed to irrigate his whole farm. Farmers, thus, have an incentive to use water efficiently and to expand their irrigated area.

costs.[25] Much less effort is now required to manage the system. Whereas the farmers once had to use a rotation system of distribution and go out to irrigate at night, sometimes sleeping in the field to guard their water, now the water flows continuously to all fields. It is recognized that there is plenty of water to irrigate additional land,[26] but members have no incentive to allocate water to fields owned by nonmembers. To maintain their yields, they would have to work harder to manage a smaller amount of water more efficiently, i.e., change to a rotation system of distribution, and would receive nothing in return.

On the other hand, allocation by purchased shares in Chherlung provides both the individual incentives for efficient water management and a mechanism for expanding the irrigated area. As the system improved, the amount of water delivered and, consequently, the amount of water per share increased considerably. Shareholders can decide whether to keep all their shares and reduce their management input or to sell part of the additional water. Because the individual can sell part of his water, he is aware of the opportunity cost of his use of water, and there is a financial incentive to manage his water efficiently. In addition, if an individual sells part of his allocation, the amount of labor that he must contribute to maintaining the system is reduced. Since the Thulo Kulo requires a large amount of labor each year for maintenance, this provides another incentive to reduce the number of shares one owns and to use the water more efficiently.

A comparison of the seasonal relative water supply for the two systems gives an indication of the efficiency of water use. The relative water supply is estimated by dividing the total water supply by the total demand for water over the season.[27] Seepage and percolation in both systems was measured to be approximately the same, with the daily average over the rice season being approximately 35 millimeters. Computation using data collected twice daily over the rice season gives a seasonal relative water supply of approximately 1.0 in the Chherlung Thulo Kulo system and 1.3 in the Argali Raj Kulo system. In neither system was there any indication of moisture stress, but the Thulo Kulo farmers had to practice rotational distribution while Raj Kulo farmers were able to distribute water continuously. The relative water supply calculation suggests that water was managed more efficiently in Chherlung than in Argali, lending support to the hypothesis that allocation of water by the sale of shares results in more efficient management of water than allocation in proportion to area irrigated.

The sale of shares, either by individuals or from the system at large, provides a mechanism for expanding the area irrigated. Water is not tied to a specific land area but is distributed to wherever, within the area commanded, those owning shares want it. In Chherlung the system has expanded through the sale of water shares to the point where it now irrigates 85 percent of the potentially irrigable area. The chairman of the Thulo Kulo organization estimated that the area that is irrigated during the monsoon season doubled between 1967 and 1982 as a result of continual improvements to the system and subsequent sales of shares. In comparison, only 45 percent of the Raj Kulo's potentially irrigable area receives irrigation for the monsoon season rice crop.

Interestingly, the Raj Kulo organization has recognized that the sale of water shares would be an effective means of expanding the area served. Most members accept that there is surplus water in the system, and that the work the Department of Irrigation, Hydrology and Meteorology did in 1982 has made the supply more reliable, i.e., less subject to major interruptions by landslides. In 1983, it appeared that the government was going to reduce by half its contribution to the local school's budget, precipitating a financial crisis for the school. A decision was made, after much debate within the Raj Kulo organization, that the Raj Kulo organization would sell 200 muri of water (about percent of the supply) and give the money to the school as a permanent endowment. Requests for the water

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The cost of maintenance was also reduced, but the data in Table 3 do not show this. Construction of a road above and parallel to the Raj is largely the cause of the higher maintenance labor between 1979 and 1983. Rocks and mud excavated by the contractor during construction were dumped down the hillside into the canal. Since the cut for the road was made, the hillside is less stable resulting in more slides. The Rs. 400,000 (US$ 30,300) invested by DIHM was used mainly to install hume pipe through this vulnerable area.

Several farmers reported that if they owned all of the potentially irrigable land, they would irrigate the entire area by rotational distribution, thus ...ing the area of irrigated rice land. While some members did not agree that all of the potential area could be irrigated, all accepted that some ...ual area could be served with the present supply without any reduction in yields

The elements of supply are irrigation and rainfall while demand consists of evapotranspiration and seepage and percolation.

were solicited, and 40 households applied to purchase nearly three times the amount offered for sale. The price was set at Rs. 2,000 (US$ 138) per muri; only two households were able to raise the necessary cash, indicating that the rate was probably set too high. Based on the flows in the Raj and Thulo Kulos in the monsoon of 1982, the price per unit of flow, i.e., liter per second, set in Argali was ten times higher than the rate in Chherlung at that time. Before the price or conditions of payment could be renegotiated, the government restored its contribution to the school's budget to the original amount, and members of the Raj Kulo organization lost interest in the sale of water.

The allocation principle also has equity implications. In Argali the only way that a person can irrigate rice is for the household to have inherited khet land with a water allocation or to buy some irrigated land. It is, thus, nearly impossible for the poor and low caste people to acquire access to irrigation for the important monsoon rice season. In the past, no low caste households had land with an allocation of water. One Damai[28] has been able to buy a small parcel of khet with earnings from work in India. He is the only low caste person in all of Argali with land that has a water allocation for monsoon rice. Irrigated land is extremely expensive (Rs. 400,000 (US$27,500) per hectare in 1983), and the poor have little possibility of buying any.

In Chherlung 20 percent of the members of the Thulo Kulo organization are low caste households, and gaining access to irrigation is much more feasible. A person with unirrigated land in the hydraulic command area has only to purchase a fraction of a share of water in the system and through hard work gradually convert his bari to khet and realize more production on it. He does not need to buy expensive, already irrigated land to acquire access to the benefits of irrigation as he would in Argali. Most of the low caste members' fields are in the area to which irrigation was first supplied after the number of shares in the system was increased by the sale of 10 additional shares in 1978.

CONCLUSION

In this paper we have described and analyzed the institutions utilized for irrigation management in a number of farmer-managed irrigation systems in the hills of Nepal. Farmer control of the entire irrigation system and the need for farmers to rely on themselves for the operation and maintenance has resulted in the development of sophisticated institutions for management of the water resource. These institutions have enabled effective use of irrigation, making extremely intensive agricultural production possible with three crops cultivated per year in many systems.

The institutions examined included both the organization which manages the irrigation systems and the traditional convention of property rights in water. Both types of institutions are essential for the effective operation of irrigation systems. Irrigation institutions are designed to enable the accomplishment of certain activities related to 1) the water, 2) the physical structures for control of the water, and 3) the organization of farmers which manage the irrigation system. In the hill environment of Nepal, the activity of *resource mobilization* for *maintenance* of the system for *acquisition* of water was found to be the most critical activity which influences the structure of an irrigation organization. The principle of water allocation was found to have extremely significant implications for the efficiency and equity of utilization of irrigation resources.

Two specific systems, the Raj Kulo of Argali and the Thulo Kulo of Chherlung, were described in detail. These two systems exhibit many of the institutional characteristics common to a number of irrigation systems which were observed in West Nepal during the 20-month period of field research in 1982-83. The structure of the farmer organization in both systems is similar. Membership is limited to those households with a right to use water during the monsoon rice season, officers are elected by the members, regular and special meetings of the members are convened, resources are mobilized according to members' water allocation, sanctions are applied for failing to provide the required amount of labor for maintenance, and written records of attendance at work, accounts, members' water allocation, and minutes of meetings are maintained by the secretary. Both systems require a large amount of labor to maintain intakes, which are often damaged by floods, and the main canal which must traverse steep, landslide-prone hillsides. Between 1,500 and 2,500 man-days of labor are mobilized annually in each system for routine and emergency maintenance.

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[28] The Damai are an untouchable caste who traditionally work as tailors.

The water allocation of each member is precisely defined in both systems. The Raj Kulo organization allocates water to each member for monsoon rice in proportion to the area of irrigated land owned. To acquire water rights for the monsoon season, households must buy land which already has water allocated to it. In Chherlung, the Thulo Kulo organization allocates water by the sale of shares, and property rights in water are, thus, separate from ownership of land. Most transactions of water shares take place between individuals, but on one occasion, the organization sold shares, increasing the total number of shares in the system.

A measure of the performance of an irrigation system is a comparison of how closely the actual distribution of water matches the water allocation. Measurement of water distribution to different parts of the command area showed that in both Chherlung and Argali water distribution very closely matched the pattern of water allocation. Thus by this measure both systems can be said to have performed well. Continuous flow through saachos (proportioning weirs) and timed rotation are the two methods used to distribute the water in accordance with the allocation.

The comparison of the Raj Kulo and Thulo Kulo systems demonstrates the importance of the principle of water allocation for efficient and equitable development of irrigation resources. If water is to be utilized efficiently and irrigated area increased, there must be incentives for efficient water management and mechanisms for expanding access to the water. Water allocation by purchased shares, as practiced in Chherlung, provides the individual incentive and an organizational mechanism which enable the efficient development of resources, while allocation in proportion to area irrigated does not. In contrast to the Raj Kulo system, the Thulo Kulo system has 1) expanded the area irrigated during the monsoon season to a greater extent, 2) achieved more efficient water utilization through more intensive management of the distribution, and 3) realized greater equity in access to the irrigation resource.

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Annex 10

REPORT ON

MAIN SYSTEM MANAGEMENT OF

PITHUWA IRRIGATION SYSTEM

PREPARED BY

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INTRODUCTION

Pithuwa irrigation canal is situated in Pithuwa panchayat in Chitwan district near Narayangarh. It is accessible through moterable road. The total length of main canal is 7.5 km. It serves 16 branch canals of command area of 1300 ha. The main source of canal is from Kaier River.

History

Pithuwa village was jungle before the settlement. People came to settle here about 28 years ago. After eight years of this settlement, Mr. Tilak Bahadur Thapa, one of the beneficiaries, initiated the canal for introducing water in his field from the river called Kaier Khola. However his attempt failed. So they have requested to the government for assistance. As per their request, Irrigation Department implemented Pithuwa system in 1967 with the grant budget of Rs.75,000. Later on, the public realized the importance of irrigation and they started the expansion of command area for their cultivation. In order to irrigate expanded area, they have enlarged the main canal and also extended it up to market area of Pithuwa. To improve the system, they constructed the head regulator, branch canals and field channels. With these improvements, the command area was increased from 600 ha to 1300. However, due to high flood level, their intake gets destroyed every year. So they have not constructed permanent structure at intake. They have to contribute labor for repairing the intake every year and also they get grant from government either in cash or kind (like bulldozer).

Water Allocation

This irrigation system is well functioning, and managed by the farmers. Water is distributed to all 16 branch canals in the amount that each branch canal is allocated. The method of distribution is based on hume pipe outlet. Hume pipe is installed at every outlet of the branch canal causing the flow to be divided into proportion. Then from the branch canal, it is distributed to the farmers field through field channels based on time rotation.

About 14 years ago, the Pithuwa system was constructed by the government After the completion of construction there was no committee existed, as it was fully financed by the government so farmers did not take initiative in any respects. As a result, canal improvement and expansion of wet land could not take place. The outlets provided was temporary structures where people can spoil it easily and hence equitable allocation of water was not there. Often or always farmers steal water or they have to use force in order to get water to their field. Owing to such situation, people lost their interest in the system and percentage of conflicts went up considerably.

Consequent of such lawlessness, the branch number '8' formed committee consisting of nine members. Then the committee, along with the beneficiaries, formed rules and regulation regarding the water distribution, mobilization of labor, mobilization of resource for maintenance and operation of the system.

They have decided that whatever amount of water flow in branch No.'8' will be distributed equally to every farmer according to land owned (acreage system). Sometimes, they also followed the time rotation system.

As a result of committee and regulations, conflict among the farmers was reduced and farmers could transplant their paddy in time. By seeing systematic distribution of water in branch No.8, the branch no.9 and 10 also started forming committees. In couple of years all 15 branch canals formed branch committee. After having formed all branch committees, they felt necessary to form central committee.

Main Committee. (Role and Composition)

The main committee has 18 members. Originally, the chairman was elected from among the assembly members. At present, the pradhan panch of Pithuwa village panchayat is the ex-office chairman of the committee. The secretary of the main committee is still elected by the assembly during annual meeting.

The other 16 members are the chairman of the branch committees.

They have general assembly meeting once in a year (during June). If necessary, they can hold second meeting also depending on the issues that have to be decided. The major functions of the committee are to implement the decisions of the assembly and supervise the overall operation of the main canal. The specific responsibilities of the main canal committee are:-

a) To supervise and maintain the work.
b) To keep proper record of income and expenditure incurred
c) To resolve conflicts over the water distribution in the branch canals.
d) To maintain link with the government and other agencies.
e) To keep touch with the branch canal over the equitable water distribution to every outlet.

Previously they have only 15 branch canals, but at present, they have added one more canal at the tail point which is branch no.16.

ranch Committee

Once in a calendar year (June or July) each branch canal committee olds meeting with their respective beneficiaries. They all meet once to iscuss the following:-

a) Election of branch chairman and branch secretary (if necessary)
b) Method of water allocation.
c) Setting the annual account of the branch canal.
d) Water allocation for winter crops.
e) Fixing the time for transplantation of paddy
f) The time allocation for water use based on landholding.

bers of Branch Committee:- The branch committee consists of a chairman, a cretary and representative members from the branch. The members are cted for one year during the branch farmers' assembly. Once a member is cted, he can continue for the position for many years as long as he receives annual approval from the assembly each year.

Functions:- The branch chairman presides at the assembly meeting and the branch committee chairman represents the branch committee at the main committee and communicates decision of the main committee to the branch committee.

Secretary:- He keeps records of annual account and labor contribution from the beneficiaries. He also calls meetings whenever necessary. He supervises the water rotation schedule.

Agricultural System and Services

Before the introduction of the irrigation in the area, they used to grow only maize, mustard and other crops which need less water for the growth. In only some portion of the land, they used to grow paddy by means of rain water. Now after the introduction of irrigation water, mode of cultivation system changed, paddy becomes the main crop. After the harvest of paddy, the farmers grow mustard in most of the land as the second a crop which is a major income, some also grow wheat as the second crop. Maize is the third crop of the area. Vegetables like potato, cabbage, cauliflower are also grown for home consumption. Since there is no water at the they don't grow early paddy during this season.

It is also understood after interviewing many farmers that early varieties of seeds are introduced by them for more production and early growth. People of the area started using chemical fertilizer like urea and also pesticides for the crops in order to reduce viruses and diseases insects. This indicates modern farming system. It is also understood that the farmers in this area grow crops by rotation, especially the dry season crops. The cropping intensity of this C.A. is about 300%.

Yields

The average yields as reported by the farmers is presented below:

Crop	Yield
Paddy	2.9 mt/ha
Wheat	2.2 mt/ha
Maize	1.6 mt/ha
Mustard	0.8 mt/ha
Potato	11.2 mt/ha

Operation and Maintenance

Usually they hold meetings twice or thrice in a year. All the beneficiaries and members of the groups, participate in the meeting. They discuss regarding maintenance of the main system and head works whether dozer has to be hired or contracts to be given for other party to remove the silt and debris. This sort of issues will be discussed in the general meeting and decision will be made at this level itself. Contributions for the O&M will be made by the beneficiaries with in the targeted period. In this way, required fund will be raised as per the rough estimation made by the system. Government makes some fund available to the programme. In addition to the money, the beneficiaries of the system make full contribution of labors till completion of the work. So far, no one has hesitated to work and conflicts has not come in existence when we asked about this with the committee members. If conflict arises, they themselves settle at their level. It is understood that everybody has been interested in maintaining the system. They have not faced much difficulties to raise the fund and labor contributions except for natural calamities at the intake point.

CONCLUSIONS

The water in this system is used very efficiently with an increased in command area and more resource mobilized for repairs and maintenance of the system. This system that we observed is well managed and proper functioning system. The agriculture output is high. Hence, this farmer managed irrigation system could be selected as a model of "farmer managed irrigation systems".

REPORT

ON

BRANCH CANAL NO.3 OF

PITHUWA IRRIGATION SYSTEM

PREPARED BY

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I. INTRODUCTION

Branch No.3 of Pithuwa Irrigation System is situated in Ward No. 1 & 2 of Pithuwa village panchayat, Chitwan district. This branch is near the intake of the main canal which is about 25 km north of Tadi on the Bharatpur-Hetauda highway. After the survey by the Irrigation Department of HMG/N, this branch - canal was constructed by the beneficiaries themselves, and at present it irrigates about 40 ha of land and provides benefit to about 45 landholders.

The population of the Pithuwa village panchayat as a whole is estimated to be 10,000 with a literacy percentage of about 40%. Most of the beneficiaries have enough food from their respective farms and they also use to sell the products in Tadi Bazar.

II. HISTORY OF BRANCH CANAL - 3

The Pithuwa Irrigation System was constructed in 1972 and was operating since 1973. The branch canal No.3 was constructed 2-3 years after the construction of main canal. The outlet of this branch canal (which consists of two hume pipes of 9" & 6" diameters) was constructed by the government and this branch canal and its sub-branches were constructed by the beneficiaries themselves. The resource mobilization was done on the basis of landholdings. In courses of time, the length of this branch canal was extended a few hundred meters to the tail reach of the command.

III. DESCRIPTION OF THE BRANCH - CANAL

For the system as a whole, the source of water of this branch canal is Kaier river which flows seasonally. This branch-canal has several sub-branches, running north to south. The canal length is about 1.5 km, width about 80 cm. The maximum depth of water is about 15-20 cm in summer, but at the time of our visit, we found it almost dry, except at intake area. The command area of the canal is about 40 ha, which covers whole cultivable land of ward No.1 & parts of ward No.2. The branch canal runs to the east from the main canal.

There is no regulator in this branch-canal and no siphons were used for its construction. There is no drop structure along the whole alignment.

IV. OPERATION AND MAINTENANCE MANAGEMENT

There is one branch-canal committee for the operation and maintenance. It consists of 7 members, including one chairman, one secretary and 5 members. During our field visit, we got chance to meet the chairman, the secretary and some beneficiaries of this branch-canal. The main problem of this canal is siltation. Every beneficiary has to contribute labor-for desilting which is on the basis of the size of landholdings and they also have to contribute labor for desilting of the main canal (parts of the main canal upstream of the inlet of branch-canal). There is no regular system of cash contribution.

At the time of water scarcity if some farmers steal the water, they will be penalized up to an amount of 50 rupees and this money will be used for the operation and maintenance of the canal. But there is no such cases for the last few years. Contribution from the beneficiaries will be made whenever necessary.

Beneficiaries get water two hours a day in a rotational order. The ater is enough for irrigation at the intake and middle portions of the anal. But the farmers at the tail never have enough water for cultivation. he production of the crops would have been increased by three times, if they t enough water. Near the tail, branch-canal No.9 comes to meet with 3. e beneficiaries at the tail said that there is a possibility of getting re water from it and they have already contacted respective people and quested for this. But nothing has changed yet. It is because, at the time surveying from the Irrigation Department, the alignment was fixed on that and it can not be changed simply (as told by the chairman of the Branch mittee). Irrespective of this, there has been no conflicts for many years re. Most of the beneficiaries are land owners themselves and they own d from 0.2 to 3.5 Bighas (1 Bigha = 0.66 ha).

V. DESCRIPTION OF AGRICULTURE SYSTEM

Main crops of the area are paddy, wheat and maize. At present 2/3 of the whole irrigated land is covered by maize and 1/3 by wheat. Besides these, some farmers have started to grow cash-crops like mustard and buck wheat. Growing these crops in that area seems quite logical since these crops need less water. Farmers usually market these crops.

Average crop production of the area is as follows:-

Paddy	-	35 quintals/bigha
Maize	-	15 ------ do ---
Wheat	-	20 ------ do ---
Mustard	-	5 ------ do ---

Each crop is grown once a year. The farmers use local as well as improved seeds and most of them use compost manure and chemical fertilizer. The quantity of manure used in an average is about 1 quintal per bigha.

Transplantation period for maize, rice and mustard are in March, June and October respectively. And after three months, these crops will be harvested.

One fish pond was constructed about 2 years ago near the tail of this branch canal. It covers an area of about 6 Kathas (1/3 bigha) of land. However there is a scarcity of water in that portion, every body seems to help in keeping the pond full of water, as it is the first kind of such fish cultures in Pithuwa village. The first year went by without any result and they have already sold about 1 quintal of fish this year . The maximum weight of fish is up to 70 gms. There was no water in the pond at the time of our visit.

The farmers sometimes use tractor for ploughing. The hiring charge for tractor is 150-200 rupees per hectare and cash-contribution done for this on the basis of landholdings.

CONCLUSIONS

The Pithuwa Irrigation System was constructed by government and operated by farmers' committee. This committee has been granted technical as well as material assistance from the government from time to time for the improvement and rehabilitation of the canal. Desilting is one of the big problems of the main canal & every branch committee (including No.3) has to send labors, depending upon the quantity of water they used. The system as a whole is a good example of farmer-managed systems where farmer's participation plays an important role in O&M of the canal.

The members are selected by the beneficiaries. Among members, a chairman and a secretary will be selected. Each branch committee has to perform 2-3 meetings annually. In these meetings, they will make detail operation programme of the year after various kinds of discussions.

REPORT

ON

CHANNEL 10

OF

PITHUWA IRRIGATION SYSTEM
CHITWAN, NEPAL

PREPARED BY:
Mr. L.N. Sharma,
Mr. Rinchhen Dorje and Mr. Tashi Dorji

Rapid Appraisal Report of Branch No.10 Pithuwa Irrigation

This group consists of four members. They are; Dr. Prachanda Pradhan, Mr. Rinchen Dorji, Mr. Tashi Dorji and Mr. L.N. Sharma. During visit to the branch channel No.10 and walking along the alignment, the following observations were made by the team. The channel at the separation from main canal is having permanent cemented brick wall connected by 18' long hume pipes with dia of 12". This serves the command area of 40 ha. with 74 beneficiaries . The channel is an indigenous one without having any permanent structures except in two points of road crossings which got a siphonic system of hume pipe connection and over it a vehicle road crossing culvert. It has over 67 outlets with in the length of 2.5 km. This branch channel is administered by the seven member committee out of which one is chairman, the other is a secretary and rest are the members elected by the beneficiaries. These people are doing the work on voluntary basis without any wages. They take responsibility of water management activities. Since the system has a large command area to serve and there is no alternative other than having proper water distribution schedule the above mention members take the responsibility of water distribution. Certain rules and regulation of the system are also made.

The requirement of water is maximum from April to the early part of November for paddy cultivation. Since they don't have water at the source itself, after paddy cultivation they cultivate maize in small portion of land for their own consumption . They sow mustard in large area as second crop. It requires only one time of irrigation during dry season for the growth. It brings high income to the farm family.

During paddy plantation, they have certain principles for allocation of water. They distribute water as per the land holding with 74 min/ha. The flow of water is blocked by the beneficiaries by means of planks supported by wooden ballis with a standard size and the sides are covered by mud bund. As such they don't have any mechanical measuring devices for distribution of water. Since they have to cultivate the land with the limited water and only 3-4 farmers get water on a day for plantation, Other farmers also come to help the farmers who have transplantation to do. The labor exchange system is prevalent in Pithuwa. We interviewed four farmers in the field. They reported that there has not been problem in the system. They have some system of penalty to the beneficiaries. Those who violate the rules and regulation framed by the organization, they will be punished. Some of the examples of rules and regulations are ;

(a) If some one utilizes the water in other's turn, he will be fined Rs.50 on the spot.

(b) If some one damages the bund of main branch canal for crossing of tractor or for some domestic purposes and does not repair during cultivation and does not respond the organization, in this case his membership will be discharged from the list and get no water for his land.

(c) If some one misses the turn and ask the organizer for other turns then he is not allowed to use water at this time but got to wait till next turn.

While moving along the alignment, the team observed the channel being silted by sands, gravel etc.

To overcome this, they use to contribute after the decision of the meeting chaired by the branch committee. The desilting work is give on contract basis to some other individuals who are expert in clearing the syphon which they find to be quite a typical job. For this, they don't have much problem in contributing especially for maintenance of canal purpose. Also they don't have system like advance contribution for repair and maintenance of the canal. When we ask the farmer in region 3 that his land has been silted and won't there be any effect for the crops ? His version was that his paddy is growing alright with good yield but yield of mustard is hampered as the water seepage takes place.

Although no one guides them in the managerial aspects from the department or by the outsider, it is quite interesting to note that in two outlets, i.e. in no 42, they have the system made by the farmer that wooden frame has been carved and fixed at the bottom with the wood of equal level in order to insert the planks turnwise with equal dimension. After the irrigation work is over, the plank is kept by the nearby farmers for the future use. Further, the farmers technique has a bit improved. In outlet no 49, two outlet gates have been constructed with cement and brick wall having a dimensions of 18"x18" costing Rs 300 for two gates. And this type of gate will be made in every outlet by all the beneficiaries in order to minimize the water stealing conflicts among the farmers although it has not been the problem so far. Once there was an incident that one beneficiary, Mr. Sarki violated the rules that he utilized others turn of water by putting big log as check dam along the channel. The secretary of the organization of the branch channel went to settle the case but he was nearly beaten by Sarki and the chairman happen to be there facing this problem. Somebody was sent to inform the central committee members about the incident. All the members of the central committee came to the spot of incident and settled the case giving punishment to the Sarki.

Only at the tail points, the system is not in a position to supply sufficient water for the field. A farmer stated that his land could be irrigated only half because of insufficient water flow in the system. Instead of paddy, he cultivates maize. Mustard and sesame are grown as second crop. Even then he has full satisfaction about the system management.

This proves that they have got a very strong unity among themselves. Seeing their managerial activities, it is interesting to know that without anybody guidance and this system has been run very smoothly and we were very much impressed by it.

REPORT

ON

BRANCH CHANNEL-16 OF

PITHUWA IRRIGATION SYSTEMS (FMIS)

PREPARED BY

MR. LHAPCHU,
MR. TEMPA GYELTSHEN AND
MR. SONAM CHOGYEL

On 23-2-1989, the personnel mentioned in the report visited the branch canal no.16 of Pithuwa irrigation system. The findings and observations are as follows:

Construction

The branch canal no.16 was constructed by the committee with the assistance from the government about 14 years ago. The total length of canal is about 2 km which covers the command area of 30 ha of the Pithuwa Panchayat ward no.5 and 3, consisting of 50 household.

Structures

There is no special structure constructed except two masonry culverts with the humepipe as an inlet of 30 cm. The rest length of the canal is earthen.

Organizations

In order to have good operation and maintenance, the beneficiaries of the canal formed association consisting of the following:

- Chairman - 1
- Secretary - 1
- Member - 5 members

Function and responsibilities of the association:-

Chairman

The chairman helps in framing of the policy for management and the mobilization of resources, and also decisions are made to resolve conflicts. Chairman represents the main canal committee.

Secretary

The functions of the secretary are; to conduct the meeting, keep the minutes of the meeting and also keep the records of resources, expenditure and other activities.

to schedule the Water Allocation and Distribution

- Members

They give support to the branch committee and to inform the beneficiaries for emergency work if need arises and water distribution.

- Field Channel

There are 15 field channels taking the water from the branch canal. As a rule, a household cannot take more than one outlet from the branch canal whatever the command area it has. To have an efficient and assured irrigations, the field channels are divided into many numbers. Each out-let is provided with gate and every irrigator is supposed to give right of way of to construct the field channel with out any compensation.

Operation and Maintenance:- The critical period for maintenance of this system is prior to and during the monsoon season. They hold meetings three times in a year, that is in the month of May, June and September. So, during May's meeting, all the beneficiaries have to attend in which they discuss the cleaning of the canal, water distribution system, mobilization of resources. Meeting conducted during June and September is only for the committee. It is not necessary for the beneficiaries to attend this meeting.

Regarding the desilting of the canal, the beneficiaries contribute labors. They do not contribute the cash. However, few years back, beneficiaries had contributed Rs.125/bigha for repairs of branch no. 8 canal.

Water Distribution:- Water is distributed to each farmer's field in the amount depending on the command area on the time rotation basis. Each farmer takes water from the canal for specified length of time. The length of each farmers turn is calculated to provide him the proportion of the flow which he is entitled for.

Agriculture:- (Cropping Pattern)

The main crops grown in the command area is as follows:-

(a)	Paddy	(Summer)
(b)	Mustard	
(c)	Potato and	(Winter crops)
(d)	Wheat	(,,)

Yields

The average yields as reported by farmers are as follows:-

Paddy	-	2	-	0.25 mt/bigha
Mustard	-	0.02	-	0.08 mt/bigha
Wheat	-	2	-	mt/bigha
Potato	-	11	-	mt/bigha

Observations and findings:- of the individual farmer interviewed.

Name:- Mr. Tilak Prasad Dhamal

Command area = 0.50 bigha

Family = 4 nos.

Pattern of cropping:-

(a)	Winter	-	Mustard	100%
(b)	Summer	-	Paddy	100%

				200% cropping intensity

Input to Agriculture Land:

- Urea in Paddy
- Compost in mustard and maize. As stated by him, he does not

have sufficient food grains from his own field. To solve this problem, he got leased 1.50 bighas from the land lord with the conditions of 50% share. So, the tenant is responsible for contributing the labor in the management of the canal. In case of the management of canal, if money is required landlord is responsible to contribute.

Social Composition:- In this association, any caste person can be a chairman or member and there is no restrictions on the basis of caste. At present, the association is run by Sharma.

Conflicts:- So far, there exists no conflicts among the farmers. In case of disputes within the branch canal, the branch committee is responsible to settle the matter. If branch committee fails to settle the case, the branch committee forwards the matter to the main committee for further action.

Conclusions:- In all respects, the system is found well managed and functioning well. It signifies that the beneficiaries and association have good cooperations and mutual understanding. With such systematic irrigation management, all the beneficiaries are satisfied with amount of share of water they get.

RAPID APPRAISAL

ON

TALJO KULO, CHHERLUNG

CONSTRUCTED AND MANAGED BY FARMERS

VISITED ON 25-2-89

PREPARED BY
MR. L.N. SHARMA, MR. LHAPCHU,
MR. JIVAN BAJRACHARYA, MR. RINCHEN DORJI,
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AND MR. TASHI DORJI

RAPID APPRAISAL ON TALLO CHHERLUNG KULO

Chherlung lies in the middle hill region of Western Nepal, under Lumbini zone, Palpa district. The irrigation is an indigenous system constructed in 1932. This system serves 110 households at present. It has command area of 65 ha. It has about 7 km of canal length from the source Brangdhi Tallo Kulo to the field.

Except for the small village of Chherlung under Boga Gumpa panchayat, the rest of the command area was forest until 60 years ago. At first, the settlers faced much difficulties even to manage drinking water for their survival. There was no imagination to have irrigation activities over the flat land at Chherlung. Mr. Pratap Singh and Hasta Singh Thapa took the initiations constructing channel by contributing Rs 5500 and 450 kg of paddy. There was no skilled people having knowledge of constructing the channel in the locality therefore they hired persons from Damak Khani. Till that time, other members of the community were not in a belief of getting water flown in the channel and did not participate in construction activities. The canal alignment was in rocky terrain. Only after the completion of the channel, other four or five families got awareness and would like to join the above two families, with a condition to contribute the amount of expenditure incurred in the channel construction.

At the initial stage, the discharge of the channel was small and that was divided into 55 units of water and this water was divided by 25 families. They use to have water transaction and they still buy and sell water in this system. At the early stage, one unit of water costs Rs 100 but now the cost escalated to Rs 10,000 per unit. At present Mr. Bir Bahadur Saru is taking initiative to maintain the canal for smooth functioning and is assisted by other eight members including his secretary.

Since no government assistance has been given to this channel, it is purely a indigenous type of earthen channel. Therefore, they have their own system of organization. They usually have twice or thrice meetings in a year depending upon the work load in the system. They have the general meeting in the month of April and May and in the last week of November for winter ops. They don't have practice of advance contribution for raising the fund or emergency repair of the canal but have contribution whenever requires. he water distribution is done by means of wooden proportioning weir for mmer crops. The contribution of labor is done by means of water share .e. 1" of water equal 1 person. For winter crops, they are utilizing water otation system as per their requirement. In addition to it, if somebody equires more water, chairman allocates the water, the beneficiaries cannot e the water without the knowledge of chairman. During channel cleaning ime if some one fails to attain the work, he has to pay Rs 15 as the nalty. The penalty death in the ranges from Rs 5 to Rs 50 depending upon he mistake made by the beneficiaries. In case of death in the beneficiary's mily during the time of channel maintenance, the concern individual is empted from work/fine. As per the record and several queries, it is derstood that the channel has been run very smoothly with proper management t present. The beneficiaries could grow 3 crops i.e. rice, wheat, maize. e cropping intensity is 300% Since chairman and the secretary got to devote ximum time for channel management, secretary is exempted to Rs 30 (thirty) rth of labor and the chairman is exempted the labor of Rs 100 worth. For ily channel patrolling one man is kept to look after Payment of his salary made by means of contribution by the beneficiaries. Rs 360/month is paid him from the month of June till the end of November .Children upto 14 ars of age and women are not allowed to work during maintenance of the stem.

Presently people of the area is growing old varieties of paddy, wheat, ize with the local name, Chherlung Dhan, Chherlung wheat, Chherlung maize. ese varieties are appropriate for this area. After getting irrigation ter, almost all the families of the area became self- sufficient in terms food grains. Only at the tail point, (Arthunga) the channel is not in a sition to supply sufficient water for the field, a farmer stated that his d could not be irrigated fully and does not have much satisfaction for coming the member of the channel and would like to withdraw from the mittee since his expenditure on contribution is more than the output from e field. Rest of the beneficiaries are having full satisfaction.

REPORT

ON

THULO KULO (UPPER)

IRRIGATION SYSTEM (FMIS)

PREPARED BY

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LHAPCHU, SONAM CHHOGYEL, RINCHEN DORJI,
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THULO KULO AT CHHERLUNG

[I]NTRODUCTION

The Chherlung canal is situated in Bogha Gumbha panchayat on the [so]uthern bank of the Kali Gandaki river in Palpa district under Lumbini zone. [Ac]cess is by foot that takes around three hours from Tansen,district [he]adquarters of Palpa. The total length of canal is 9 km serving 35 ha. of [t]otal command area. The total number of households benefitted by this system [a]re 119. Almost all canal length is unlined except in the landslide [a]rea/drops and silting tank .

[B]ackground of Thulo Kulo of Chherlung

From the historical point of view, water tapping in canal from [B]rangdhi stream to Chherlung was financed by 27 villagers under the [l]eadership of two villagers in 1928. The initial cost of construction was [R]s.5000 which was contributed by the villagers. They introduced wooden [p]roportioning weir for the distribution of water . The amount of water in [t]he canal is divided into 50 shares, each share costing Rs 100/-. Each [h]ousehold who contributed to the construction of the canal received his own [s]hare in proportion to the investment he had made. Those who had more water [c]ompared to the land they can sale water to other. Consequently, the number [o]f members in the system has increased up to 119 numbers. The committee also [s]old 14 units of water to the new area. Hence, by conservation of water use, [t]he command area could be expanded.

About 25 years back, they got grant of Rs.35000/- and technical [a]ssistance from the district panchayat for the improvement of intake. After [n]ine years of first grant, they got another grant of Rs 12000/- from the [d]istrict panchayat for maintenance work. Again a couple of years back, [v]illagers got assistance of Rs 18000/- from district panchayat. About 2 [y]ears back beneficiaries themselves mobilized about of Rs 60,000/- to repair [t]he slide area. After all these canal improvements, volume of water has [i]ncreased considerably, thereby increasing cropping intensity from 100% to [2]00% .

rganization

At present there are nine members including a chairman, a secretary and even other members. All the beneficiaries are divided into seven groups nder seven members supervision. Each group is responsible to work for one ay in rotation in a week. If major repair is to be carried out, all seven roups are called for the work.

- The chairman is responsible to preside meetings. He also keeps annual accounts.

- Secretary fixes the date for operation of water.

- He supervises work. He keeps labor contribution attendance and money contribution records.

The other seven members support the chairman and secretary in framing olicy and rules. These seven members are responsible to collect their abor requirement during their turn in a week. If emergency maintenance is equired on a particular day, then the particular member has to contribute abor.

ater Distribution

Water is distributed to each farmer's field with measuring devices of roportioning weir made out of wooden structure. The total quantity of water is divided into fifty thumb. (50") So the water distribution is not a roblem, as it is done on share basis. Buying and selling of water share is revailed in the system. Previously cost of 1" water is Rs 100 but the resent rate is Rs 10,000 per 1" water.

Operation and Maintenance

They have formed a committee consisting of nine members to look after the operation and maintenance of the irrigation system.

For operation and maintenance, the committee has to hold the meeting twice in a year. During the meeting, they discuss with beneficiaries about the cleaning of canal, repairing of canal, how to mobilize the resources, water distribution system and also the committee presents annual budget. When there is major repair work they have to ask government assistance. The committee assigns the beneficiaries to do the clearing and repair works. If the particular beneficiary has no manpower, he has to pay Rs 15 to the committee and committee will decide whether to hire manpower or use the money for procuring materials for the construction. Incase of deaths of any farmers family, the particular farmer is exempted from the work.

In this system, those 7 members are made to visit the canal every day on rotationwise and seven groups formed under each member.

Agricultural and Services

In this system, as there is good water management, every one gets the assured supply of water as a result the cropping intensity is 300% . The principal crops grown in the area are as follows:

Summer	Paddy	100%
Winter	Wheat	100%
Spring	Maize	100%
		300%

The crop grown in this area are mostly local variety. Improved varieties are on trials.

Penalty to defaulters

The committee had framed a rule with all the beneficiaries. If any defaulters are found, they are fined Rs 5.00 - 50.00 depending upon the gravity of the crime.

Crimes are as follows:

(1) Stealing of water
(2) Breaking bunds of the canal
(3) Not contributing labors
(4) Not following the schedule of time

The money collected from the defaulters are deposited by the committee. The committee appoints two water watchmen to look after the canal during summer and one water watch man in winter.

CONCLUSIONS

It was observed that this irrigation canal supplies water for industrial purpose which is also the main income for running that irrigation canal. For installation of this mill, they took the loan from Agricultural Development Bank, amounting a sum of Rs 80,000/-. They have already paid back the loan and 11% interest by running the mill by the beneficiaries. Now onward, income collected from this mill will be utilized for the maintenance of the canal. This mill belongs to the committee (beneficiaries) of this irrigation system as a common property. This indicates the beneficiaries have got good understanding and strong organization.

REPORT

ON

THE FIELD VISIT OF RAJ KULO, ARGALI, PALPA

PREPARED BY

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UGYEN, CHOPHEY DORJE, TEMPA GYELTSHEN,
TASHI DORJE, SONAM AND JIBAN BAJRACHARYA

INTRODUCTION

On 26 Feb.1989, the whole team visited Raj Kulo, which is situated in Argali, Palpa district. The site can be accessed by about 1.15 hours' drive on the dry season moterable road from Tansen. During our visit, we met the chairman, the secretary, members as well as some local farmers of the Raj Kulo farmers' committee. One of the members of the committee did the briefing of this canal to all the participants. The command area of this canal is about 103 ha.

HISTORY

Raj Kulo (also known as Jethi Kulo) was one of the oldest irrigation systems of Nepal. It was constructed by the King Mani Mukunda Sen of Palpa about 400 years ago in order to have trust funds for the temple of Rishi Keshav Bhaguvan. The intake was constructed at Jorte from the stream Kurung Khola.

At first, there was not much cultivable land, but in courses of time, the area of cultivated land was increased and many efforts were made by the beneficiaries themselves in order to get a larger quantity of water for irrigation.

About 42 years ago, the then Prime Minister visited that area and contributed some funds for the improvement of this canal. About 8 years ago, the government also gave some grants for major improvement of the canal. Now the system is operated by the farmers' committee.

DESCRIPTION OF THE SYSTEM

As described above,the source of this canal is Kurung Khola. Besides Raj Kulo, there are three other different canals (Mahili Kulo, Sahili Kulo and Kanchhi Kulo), which run almost parallel, but in different elevations, from the same Kurung Khola. The command area of the Raj Kulo is about 2000 Mato Muri (Mato Muri is the local unit used for determining the area of irrigated lands). Water distribution is done on the basis of landholdings with the help of proportioning weir. The length of the main canal is about 3 km with a width of about 1.5 m. The quantity of water in canal is enough for cultivation even during winter time.

There is one water mill owned by a farmer immediately after the main proportioning weir of the Raj Kulo . Before the distribution of water, it is used in the water mill . After that, the water is distributed to the respective fields. This water mill was permitted to run provided that it will not affect the irrigation system of the area. There are several branches and sub-branches of this canal. Near the water mill, there is about 5 meters vertical fall of water. There is no cross drainage in this canal.

OPERATION AND MANAGEMENT

There exists one farmers' committee for operation and maintenance of this canal. This committee consists of one chairman, one secretary and five members. The committee has its own rules and regulations. One labor is required for repairing and maintenance of every 40 Mato Muri of lands (about 0.5 ha).

Two general meetings will be held every year. Every beneficiary has to participate in these meetings. The meetings are held usually in the 1st week of May and January. In these meetings, the committee will give the whole account of the previous seasons as well as they will have various discussions with the farmers. Some rules and regulations of the committee, as given in their minute book are as follows:

- At the time of desilting works, women and children under 14 years of age are not allowed to work. All other beneficiaries have to work from 12.00 to 5 PM.

- In summer time, the committee can use one peon for communication with beneficiaries.

- There is a system of penalty if the beneficiaries do not perform assigned works under the leadership of chairman or secretary or members of the committee.

- During the working period, if there occurs death in a family of any beneficiary, the family members will be exempted from works for 13 days. Besides, one assistance will be provided for this family and this assistance will also be exempted from works.

- Secretary has to keep the records of all beneficiaries, records of income and expenditure. Secretary can keep up to 500 rupees for emergency cases.

- Secretary and chairman will be exempted two labors works (80 Mato Muri).

- One water-supervisor can also be employed by the committee to check the canal system (to make sure if there is continuous water flow on the canal, leakage, to see if the concerned people has gone to the intake for its daily maintenance and repair). Two watch men (one each for lower and upper ends of the canal) can be appointed during monsoon.

- At the time of water scarcity, if one steals the water, he will be penalized up to 100 rupees at first. And if the same beneficiary once again steals the water, he will be punished more (up to 500 rupees). In case of third time, he will be kicked out from the beneficiaries' organization. Such case has not happened yet in that system. At the time of water scarcity (usually in winter), one can use the water. For this he has to go to the main canal intake, repair it and then gain water.

- If the chairman and the secretary and even the members of the committee do not perform their duties properly, they can be dismissed from the committee at any time on the approval of 2/3 of the whole beneficiaries.

DESCRIPTION OF AGRICULTURE SYSTEM

Paddy, wheat and maize are the main crops of this area. They do not grow any kinds of cash crops. The cropping intensity of the area is almost 300%. All the farmers use local varieties of paddy, wheat and maize. Some of the farmers are found to have early paddy and late paddy.

About 45% of the whole cultivated area is irrigated under this system, with the total no. of beneficiaries 165. Most of the farmers use compost manure.

CONCLUSIONS

The farmers managed irrigation system in Argali is well functioning. Their committee seems strong, with quite effective rules and regulations. The farmers organization is a disciplined one. There is no conflict among each other and the management is quite effective, irrespective of different castes and amount of landholdings. The cropping intensity is very high in that area. The cropping pattern is well adopted to the water supply.

Near the water mill, there is a fall as high as about 5 meters, and due to this there may arise a problem of land erosion just below the drop structure. Actually this portion of the canal is well lined with cement and concrete. Any way precautions should be taken regarding this fall, as it may cause landslides in future.