Patterns of Irrigation Organization in Nepal

A Comparative Study of 21 Farmer-Managed Irrigation Systems

PRACHANDA PRADHAN

INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

Pradhan, P. 1989. Patterns of irrigation organization in Nepal: A comparative study of 21 farmer-managed irrigation systems. Colombo, Sri Lanka: 140pp.

/ irrigation systems / water allocation / water distribution / resources management / organizations / irrigated farming / irrigation management / farmer-managed irrigation systems / comparative studies / Nepal /

DDC :631.7

ISBN : 92-9090-109-8

Summary: This comparative study was conducted to identify and describe the organizations that have evolved over a period of time to meet the farmers' needs; to attempt to identify the factors that stimulate farmers to become organized for irrigation activities; and to examine key issues relevant to government policy for intervention and formulation of development strategy. The tremendous variations in environmental conditions that exist in Nepal have contributed to the development of a wide range of irrigation organization patterns. Twenty-nine different irrigation management tasks are also identified. The valuable experiences of farmer-managed systems suggest that certain management principles could be applied to government-managed systems for improved performance.

Please direct inquiries and comments to:

Information Office
International Irrigation Management Institute
P.O. Box 2075
Colombo
Sri Lanka.

Or

International Irrigation Management Institute (Nepal)
P.O. Box 3975
Kathmandu
Nepal

© IIMI 1989
Responsibility for the contents of this publications rests with the author.
All rights reserved.

Cover photograph by David Groenfeldt

Table of Contents

List of Tables		xi
List of Figures		xiii
Preface		xv
CHAPTER 1.	**Overview of the Irrigation Situation**	1
	INTRODUCTION	1
	OBJECTIVES OF THE STUDY	6
	STUDY METHOD	7
CHAPTER 2.	**Irrigation Systems by Physical Characteristics**	9
	PHYSICAL CHARACTERISTICS OF HILL IRRIGATION SYSTEMS	9
	Intake	9
	Canal	10
	Cross Drainage	10
	Farm Types	10
	Size of the Command Area	11

Availability of Water 11
Method of Water Delivery 11

PHYSICAL CHARACTERISTICS OF RIVER VALLEY IRRIGATION SYSTEMS 12

Intake 12
Canal 13
Cross Drainage 13
Farm Types 13
Size of the Command Area 13
Method of Water Delivery 14

PHYSICAL CHARACTERISTICS OF *TARAI* IRRIGATION SYSTEMS 14

Intake 14
Canals 14
Cross Drainage 15
Farm Types 15
Size of the Command Area 15
Availability of Water 15
Method of Water Delivery 15

ALTERNATIVE TECHNOLOGIES 16

CHAPTER 3. **Incentives for Organization** 17

FACTORS THAT STIMULATE WATER USERS TO BECOME ORGANIZED 17

Water as Community Property: An Organization Force in Irrigation Systems 18
Protection of Water "Rights" as an Organizing Force 20
Achieving Water Distribution in Proportion to Water Share as an Organizing Force 20

Organization Designed for Equitable Water Distribution and Minimizing Conflict 21
Organization to Acquire Water and Fertile Humus 22
Mobilization of Manpower as an Organizing Force 23

CHAPTER 4. **Characteristics of Irrigation Organizations** 25

TIERS OF ORGANIZATION 25

One-Tier Irrigation Organizations 25
Two-Tier Organizations 26
Three- and Four-Tier Organizations 27

MEMBERSHIP PATTERNS IN THESE IRRIGATION ORGANIZATIONS 31

Committees 31
Composition of the Committees 31
Number of Members on the Committees 33
Selection of Members 33
Types of Chairmen 35
Terms of Office 37
Accountability of the Committees 37
Political Neutrality of the Committees 37
Provisions for Remuneration to Committee Members 38

THE DIFFERENT FUNCTIONS OF IRRIGATION ORGANIZATIONS 39

Maintenance of Water Rights 40
Managing Water Distribution in Water-stressed Systems 42
Trapping Water and Fertile Humus 43
Safeguarding Water Rights within the Command Area 43

COMPENSATING FOR WEAK PHYSICAL STRUCTURE BY HAVING A STRONG, DISCIPLINED ORGANIZATION 44

SEASONAL ACTIVITY OF IRRIGATION ORGANIZATIONS 44

THE EVOLUTION OF FARMER-MANAGED IRRIGATION ORGANIZATIONS 45

CHAPTER 5. **Water Allocation and Distribution** 49

WATER ALLOCATION 50

Free flow in the Canal 50
Water Allocation on a Share Basis 50
Water Allocation Based on Type of Land 52
Water Allocation on Demand 52

DISTRIBUTION OF WATER 52

CHAPTER 6. **Resource Mobilization and Management** 55

BASIS OF RESOURCE MOBILIZATION 56

Basis for Labor Mobilization 57
Cash Contributions from Beneficiaries 60
Resource Mobilization for Emergency Situations 61

EXTERNAL RESOURCE MOBILIZATION 62

USE OF CASH INCOME 64

Developing Physical Infrastructure by Strengthening Weak Points of the System 64
Investment of Money for Interest Earning 64
Payment for Services Rendered to the System 65
Contributions to the Local School 65
Expenses in Buying Equipment and Materials 65

		LANDHOLDING RECORDS AND ACCOUNT MAINTENANCE	66
		Method of Collection of Fines	66
		OPERATION AND MAINTENANCE COSTS FOR MAINTENANCE OF THE SYSTEM	67
CHAPTER 7.		**Summary**	69
		CONCLUSIONS	69
		CHARACTERISTICS OF FARMER-MANAGED IRRIGATORS' ORGANIZATIONS	71
		ISSUES REQUIRING FURTHER RESEARCH	73
		IMPLICATIONS AND ISSUES FOR THE GOVERNMENT TO CONSIDER	73
References			75
Appendix	I.	Glossary of Nepali Terms	77
Appendix	II.	Functions of Irrigation Organizations	81
Appendix	III.	Profiles of Irrigation Systems	83

List of Tables

1. Irrigation systems by management type (in hectares) 2

2. Irrigation systems studied 4

3. Characteristics of irrigation organizations including the number of tiers 30

4. Composition of the members in the main committees 32

5. Water distribution method in relation to the number of members on the irrigation committees 34

6. Chairmanship pattern in irrigation committees 36

7. Examples of remuneration to committee members 38

8. Performance of irrigation activities by systems 41

9. Cost of operation and maintenance per hectare 68

List of Figures

1. Nepal: locations of systems studied 5
2. Matrix of irrigation management 6
3. Tiers of organization and their responsibilities in irrigation systems of Nepal 29
4. Matrix of the kinds and sources of resource mobilization 56
5. Argeli land use and irrigation systems 105
6. Thulo Kulo and Tallo Kulo, Chherlung, land use and irrigation systems 106
7. Upallo Kulo, Damka, and Sota Kulo irrigation systems 107
8. Satrasaya Phant irrigation system 108
9. Baraha Kulo of Yampa Phant irrigation system 109
10. Sange Patiyani irrigation system. 110
11. Phalibas Tallo Kulo irrigation systems, Devisthan Village, Parabat District, West Nepal 111
12. Charhajar irrigation system 112
13. Bhanu Baraha Kulo irrigation system 113
14. Charsaya Phant irrigation system 114
15. Phewa irrigation system 115
16. Badkapath irrigation system - Dang 116
17. Rani, Gorkhe and Kwadi Kulos 117
18. Chhattis Mauja irrigation system: main and branch canals 118
19. Pithuwa irrigation system 119
20. Panch Kanya irrigation system 120
21. Lothar irrigation system 121

Preface

A FARMER ONCE told me that the physical structure for irrigation made of cement and concrete can be washed away or eroded by landslides and floods but a strong irrigation organization can withstand these forces. To have a strong irrigation system, it takes more than cement and physical structures; a strong organization is also necessary to assure that the system can remain functional.

Nepalese farmers have recognized the importance of water resources for centuries and there exists a valuable resource in the experiences of the farmer-managed irrigation systems that are scattered all over the country. These farmers have evolved mechanisms over many years which take into account the soil, climate, topography, and social structure of the community to form dynamic organizations that enable them to carry out irrigated agriculture. Recognizing this, a case study of 21 farmer-managed irrigation systems in Nepal was conducted with the objective of identifying and describing the variety of organizations that have evolved over time to meet the farmers' irrigation needs. This includes some systems which were once either government-built and are now managed by the farmers, or farmer-built and later extended with government resources. The tremendous variation in environmental conditions which exist in Nepal has contributed to the development of a wide range of irrigation organizational patterns. The location of an irrigation system in either the hills, river valleys, or lowland plains *(Tarai)* also influences the organizational pattern of the system.

This case study attempts to identify and describe the types of irrigation organizations that can be found in farmer-managed systems, and to identify the factors that stimulate farmers to become organized for irrigation activities. Twenty-one different irrigation management tasks are also identified. The valuable experiences of farmer-managed systems also suggest that certain management principles could be applied to government-managed systems for improved performance. These aspects and key issues relevant to government policy for intervention and the formulation of development strategy are examined in this study.

Robert Yoder and Ed Martin encouraged me to write on the issues of irrigation organization related to farmer-managed irrigation systems. Their assistance during the preparation of the manuscript was invaluable. Doug Merrey, Ed Vander Velde, and Ujjawal Pradhan provided valuable comments, and Norman Uphoff provided the conceptual framework as well as editorial assistance in bringing this publication into its final form. Last but not least, I appreciate the efforts of Juanita Thurston whose professional editorial touch helped to make this publication readable.

The financial support of the Ford Foundation and the International Fund for Agricultural Development is gratefully acknowledged.

CHAPTER 1

Overview of the Irrigation Situation

INTRODUCTION

NEPALESE FARMERS HAVE recognized the importance of water resources for centuries and have been constructing irrigation systems at their own initiative to intensify their agricultural production. Irrigation development in the country remained in the hands of the people for many years. This tradition gave birth to the farmer-managed irrigation systems (FMIS) scattered all over the country. Historically, irrigation development has fallen under the domain of either a religious trust, individual initiatives, or community effort. The legal tradition and local administrative structures over a period of time have permitted farmer-managed irrigation systems to operate without interference from an irrigation agency or other administrative units. However, they have been assisted by the government from time to time when natural calamities required resources beyond the capacity of the farmers.

Promotion of irrigated agriculture has been a prime concern of the government. Even traditional village heads were punished if an irrigable field was not planted to rice because of a failure of the irrigation system. However, the 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 which there were only a few *Raj Kulos* (Royal Canals) which had state patronage. In the 17th century, an edict of King Ram Saha stated that irrigation and its management were the responsibility of the community (Riccardi, 1977). This attitude has contributed to a strong tradition of community-directed irrigation development and management.

Even though the bureaucracy for irrigation development was established only in 1952, its thinking has dominated irrigation development since that

time. The First Five-Year Plan (1956-1960) did not even recognize the existence or contribution of farmer-managed irrigation systems. Though the role of FMIS is extremely important in Nepal's agricultural economy, it was only in 1981 that the government acknowledged this and began to consider ways to enhance and expand FMIS (Water and Energy Commission Secretariat, 1981). The Irrigation Sector Policy for the Fulfillment of Basic Needs clearly spelled out the distinction and made it clear that FMIS will be managed by the farmers themselves but that appropriate assistance both for physical and management improvement will be provided by the government through the newly-established District Irrigation Offices (Department of Irrigation, 1988).

Irrigation systems can be broadly categorized into two groups according to where the responsibility for their management lies: those that are agency managed and farmer-managed systems. In the farmer-managed systems, farmers are responsible for all management activities encompassing water acquisition from the source to delivery to the plant in the field. In agency-managed systems, public servants are assigned many of the management tasks with varying levels of farmer participation. In practice, the latter are usually joint systems.

Table 1. Irrigation systems by management type (in hectares [ha]).

Land Area (estimated)		Management types	
Cultivable area	Irrigable area	FMIS[a]	Agency[b]
3,100,000	1,900,000	714,000	350,000

[a]The Water and Energy Commission Reports on Water Resources Inventory of *Tarai* Districts indicate the existence of 458,000 ha under farmer management in the *Tarai*. It is estimated that the hills of Nepal have more than 150,000 ha of FMIS. The Agriculture Development Bank of Nepal (ADB/N)-developed systems are basically beneficiary/farmer-managed systems, so the 106,000 ha developed by it are included in the farmer-managed category. FMIS.

[b]Economic Survey of 1987/88. Kathmandu, Nepal: Ministry of Finance.

Out of an estimated potential of 1,900,000 ha irrigable area in Nepal, 1,064,000 ha are presently being irrigated under either farmer or agency management.

Table 1 indicates that 11 percent of the cultivable area or 18 percent of irrigable area is served by agency-managed systems whereas FMIS serve 23 percent of the cultivable area, or 37 percent of the irrigable area. Thirty-three percent of the total irrigable area in the country is presently under agency management and 67 percent under farmer-management. It is estimated that there are about 1,700 farmer-managed irrigation units in the *Tarai* and over 15,000 systems in the hills of Nepal. All these systems are managed by the farmers themselves. FMIS are not necessarily small systems. They include command areas ranging from less than 10 ha to 15,000 ha. There are many FMIS systems ranging from 3,000 to 5,000 ha in Nepal. Despite the pressures of changes in the environment, landslides, and deforestation, many systems have made incremental improvements and only a few have fallen into disuse.

Farmers have developed their own irrigation systems taking account of geographical impediments and limited services from the government in the past. They have managed their systems by adjusting the operation to the soils, climates, topography, and social structure of the particular location over a period of many years. These environmental conditions, which vary tremendously throughout Nepal, have contributed to different patterns of irrigation organization. In addition to distinctively different organizational patterns for the well-defined tasks of water acquisition, allocation, and distribution, methods of system operation and maintenance, and organizational activities regarding conflict management, communication, resource mobilization, and decision making vary. The various patterns of organization are also related to the physical type of irrigation system: hill, river valley, or *Tarai* systems.

In order to understand the various socio-cultural and physical types of farmer-managed irrigation organizations, 21 systems are included in this comparative study. Some systems are as old as 400 years, while others are 100 years old and many of them are as recent as 30 years old.

The organization of farmer-managed systems listed in Table 2 is indigenous, having evolved over time in response to physical conditions and the requirements of the irrigation tasks.

Table 2. Irrigation systems studied.

Hill irrigation systems	River valley systems	*Tarai* irrigation systems
Kulo Argeli, Palpa	Charhajar, Tanahu	Chhattis Mauja, Rupendehi
Thulo Kulo, Chherlung Palpa	Bhanu Baraha, Tanahu	Pithuwa, Chitwan[c]
Tallo Kulo, Chherlung Palpa	Charsaya Phant, Tanahu	Pancha Kanya, Chitwan[d]
Upallo Kulo, Damka, Gulmi	Phewa, Kaski[b]	Lothar, Chitwan
Sota Kulo, Damka, Gulmi	Badkapath, Dang	
Satrasaya Phant, Tanahu	Rani Kulo, Pyuthan	
Baraha Kulo, Yampa, Tanahu	Gorkhe Kulo, Pyuthan	
Sange Patiyani[a], Tanahu	Kwadi Kulo, Pyuthan	
Phalebas, Parbat		

[a]The farmer-managed Sange Patiyani system was extended by the government. The farmer organization evolved through the farmers' initiative to supervise the maintenance work undertaken by the agency.
[b]Farmers organized to press demands on the agency for more water. Previously this was a farmer-managed system. After the dam construction, the agency took over the management of the system.
[c]This system was gradually taken over by the farmers. The agency provides a certain amount of operation and maintenance (O&M) money to the system. The rest of the work is undertaken by the irrigators' organization.
[d]A farmers' organization developed only to distribute water. The farmer-managed system was expanded later by increasing the command area and the number of beneficiaries.

Irrigation management activities can be categorized as: 1) activities related to water use, 2) activities related to the physical system, or control structure activities, and 3) organizational activities. Water use activities relate to the application of water for agricultural purposes. Acquisition, allocation, distribution, and drainage considerations are involved. Drainage, for example, may not be significant as an activity in all systems, depending on soils and topography. It is more important in the *Tarai* than in the hills. Control structure activities include the design, construction, and operation and maintenance of the system for the conveyance of water. Organizational activities encompass decision making, resource mobilization, communication, and conflict management (Uphoff, 1986). The following matrix depicts the socio-technical process which combines human and material elements to achieve the goal of increased agricultural production.

Figure 1. Nepal: locations of systems studied.

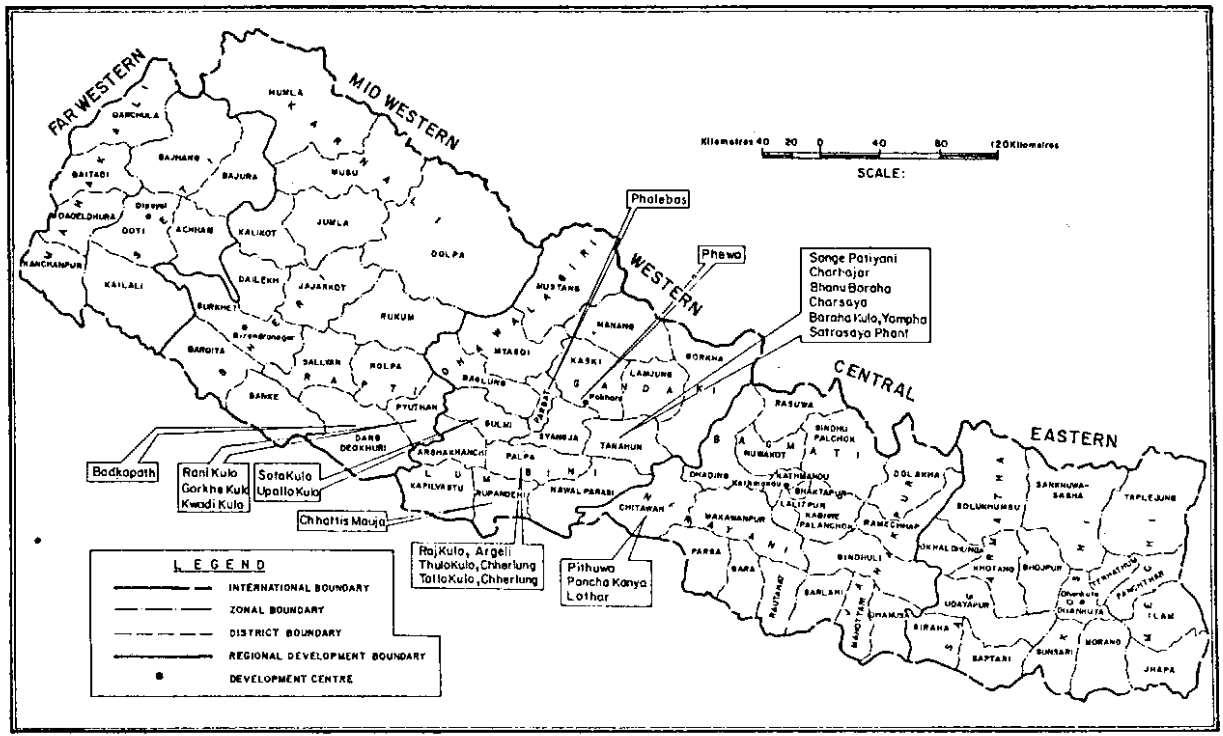
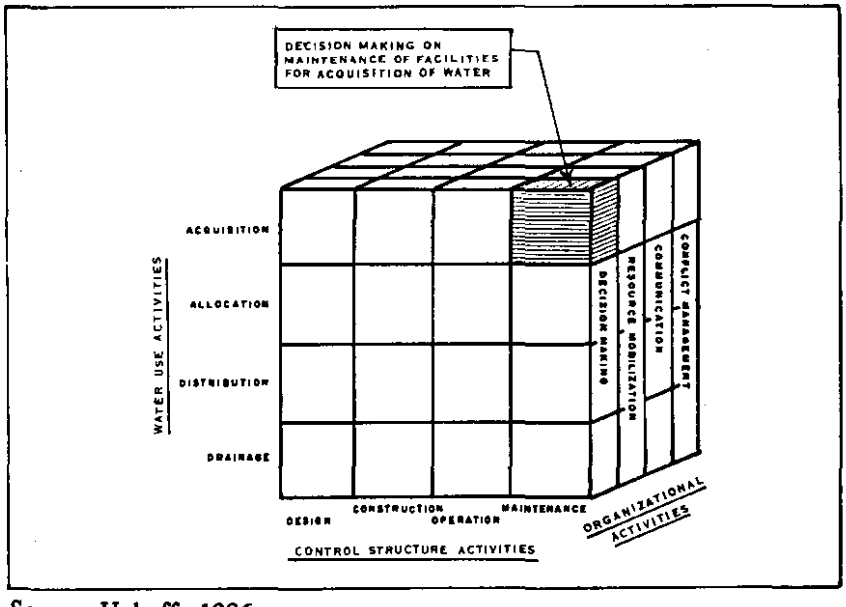


Figure 2. Matrix of irrigation management.



Source: Uphoff. 1986.

OBJECTIVES OF THE STUDY

The objectives of this comparative study of 21 farmer-managed irrigation systems are to identify and describe:

- the range of variations in farmer-managed systems;
- factors that stimulate irrigators to organize;
- application of management principles in FMIS to government-managed irrigation systems; and
- key issues important to government policy for intervention and the formulation of development strategy.

STUDY METHOD

The author has collected data on these systems over the past six years through interviews with farmers and irrigation officials during repeated visits to the field. The author also observed and participated in annual irrigators' meetings, and in the resource mobilization activities for desilting and repair work of the systems. Information was collected following a detailed checklist (Pradhan, P. et al., 1988).

In order to understand the variation in patterns of organization, three features are taken for comparison. These are: 1) ecological features, 2) technologies employed, and 3) important cultural features.

Ecological features are concerned with physical conditions including terrain, location, temperature, and rainfall. These features affect the need for irrigation and they influence the kind of agriculture and irrigation technology that is employed. These factors provide both opportunities and limits for the modes of irrigation exploitation.

The technology (for example, gradients, tunnels and cross-drainage, wooden proportioning weirs) employed in an irrigation system is examined in relation to the environmental factors and the organizational requirements which facilitate its effective use.

Key cultural features are discussed because they establish parameters for the rules and roles for cooperation, organization, and operation of an irrigators' organization.

Irrigation management activities identified by Norman Uphoff (1986) and rules, roles, and tasks identified by Walter Coward (1980) are used for further comparison of irrigation activities.

In subsequent sections, organizational characteristics and the varied patterns arising from different physical and social conditions are analyzed. Each irrigation system has its own particular characteristics.

Chapter 2 identifies the environment and technological features of hill, valley, and *Tarai* irrigation systems. Chapter 3 discusses the incentives for organization in FMIS. Chapter 4 describes the levels and degrees of sophistication of irrigation organizations under different physical and management conditions along with membership patterns and functions of irrigation organizations. Chapter 5 presents the different ways in which water is allocated and distributed. Chapter 6 discusses modes and methods of resource mobilization for operation

and maintenance along with the resource management practices in different systems. This is one of the important tasks required to sustain a system. Chapter 7 is a summary followed by implications for government intervention.

CHAPTER 2

Irrigation Systems by Physical Characteristics

IN NEPAL, THE varied topography has caused people to adopt different organizational patterns to utilize resources in their environment. Due to its mountainous and hilly topography, only 22 percent of the total 141,000 square kilometers of Nepal's surface area is cultivable. Although the hill and mountain regions account for over 75 percent of the surface area, they represent less than 50 percent of the cultivated area, whereas the *Tarai* (the lowland plains along the southern part of the country) with approximately 25 percent of the surface area, accounts for over 50 percent of the cultivated area (ADB, 1982). Farmer-managed irrigation systems in Nepal can be grouped into three types according to their physical characteristics. Broadly, they are: 1) hill irrigation systems, 2) river valley irrigation systems, and 3) *Tarai* irrigation systems.

PHYSICAL CHARACTERISTICS OF HILL IRRIGATION SYSTEMS

Intake

The intake of a hill irrigation system is located in a spring or in one of the streams or rivers running down hills. Several intakes might be located along

one stream or river. The oldest system will usually have its intake located at the higher elevation. If new intakes are to be constructed, they can be constructed only below an existing intake, not higher. The intake is a diversion dam made of boulders, stones, and tree branches. The intake requires annual repair before irrigating during the rice season. When it is washed away during the monsoon, the farmers within the command area have to mobilize to restore it.

Canal

The canal is usually three to four kilometers (km) long before it reaches the command area. Some are even longer. The canal passes through rocky stretches and landslide zones along mountain sides and often along steep slopes. Frequently, all the hill irrigation systems have some stretch of tunnel along the steep rocky portion. These tunnels are constructed by local technicians with traditional technology and form an integral part of the canal in most of the hill irrigation systems in Nepal (Ghimire and Onta, 1980). The gradient is usually high so that the cross section can be small. This improves slope stability and seepage losses.

Cross Drainage

Along the canal, there will be minor and major instances of cross drainage. This cross drainage will disturb the flow of water in the canal unless taken into account. In some places, farmers will install a log aqueduct or will construct pass-overs to drain the water above the canal. These are fragile parts of the canal which require frequent maintenance during the rice cultivation season.

Farm Types

Most of the land under rice cultivation in hill irrigation systems is in terraced farms. Such terraces are made only where water is available. It can take five

to ten years to complete the terracing for rice cultivation in an irrigation system. Such terracing is accomplished gradually by the farmers using their own resources.

Size of the Command Area

The command area of hill irrigation systems ranges from a few hectares to over a hundred hectares.

Availability of Water

In Nepal, most of the irrigation systems are intended for rice cultivation. Activities to capture water for this purpose are usually intensive. The flow of water varies tremendously because of the monsoon climate. Some rivers/ streams have a perennial water flow depending on the condition of the watershed, whereas other systems depend solely on monsoon flow. The quantity and availability of water in the system determine the agricultural irrigation calendars of the system.

Method of Water Delivery

In hill irrigation systems, branch canals, field channels, and farm channels are constructed to convey water through gravity flow.

PHYSICAL CHARACTERISTICS OF RIVER VALLEY IRRIGATION SYSTEMS

Intake

Annually, a river diversion dam constituting of boulders, stones, and branches is constructed by the farmers. The nature of the intake and the timing of its construction are determined by the type and size of the river. In a continuous flow river like the Rapti of Deukhuri, there is sufficient water in the river for irrigation so that farmers construct the diversion dam before the monsoon starts. During the monsoon period, the level of water becomes so high that irrigation activity in the river becomes difficult so that farmers abandon all irrigation-related activities, and rely on rainfall instead. The intake is constructed in such a way that it can trap water as well as fertile humus which is carried by the first flood in the river.

The quantity of water in the river depends on the size and condition of the watershed as well as on the quantity of rainfall. For example, there are small river systems like the Sange river of Tanahu or the Chudi Khola of the same district, which do not have a high discharge of water regularly. In such systems, diversion dams and intakes are constructed to divert flood water to the farms. Such dams and intakes are washed away after high flood or the dams are broken by the farmers themselves to avoid unnecessary flood water in their farms. When the river flow stabilizes, the diversion dam and intake are reconstructed. In small river systems, the diversion dam and intakes must be frequently repaired during rice cultivation. There are examples where the farmers have mobilized 5-15 occasions for repair of the diversion dam and intake during rice cultivation.

In big river systems, sufficient water for irrigation is available during the pre-monsoon period. When the river gets turbulent, irrigation-related activities are abandoned, whereas in other small stream or river systems, irrigation activities start with the beginning of the monsoon when enough water is available for farming.

Canal

Earthen canals carry water to the farms. Since the canals run through level plain areas in the river valley systems, they do not present much problems in conveyance and not much attention to maintenance is required. Once every five or six years when the canal becomes dysfunctional because of too much leakage caused by burrowing crabs, the alignment of a certain portion of the canal may be changed.

Cross Drainage

Cross drainage has both advantages and disadvantages for the farmers in river valley irrigation systems. Before the monsoon starts or when only a mild monsoon prevails, the flow of water from cross drainage is used to supplement water in the canal. During heavy rains, the cross drainage presents a big problem. Sometimes, a portion of the canal gets washed away. Often, getting water across the cross drainage is difficult. Farmers expend considerable effort in the construction of cross drains (natural drains) to direct the water to other parts of the command area.

Farm Types

Farms in the *Tarai* are flat with some slopes.

Size of the Command Area

The size of the command areas ranges from 15-20 ha to thousands of hectares.

Method of Water Delivery

Water is delivered to the farms through gravity flow. When water distribution is the prime objective based upon water share, the main canal and field and farm channels are necessary to assure that each beneficiary gets his share. In Charsaya Phant of Chundi, there is an elaborate canal system despite it being a river valley system. The elaborate channels were created in order to avoid possible conflicts over water share. But when trapping humus carried by the water is more important, as in Dharmabati of Pyuthan and Badkapath of the Deukhuri valley, field and farm channels are not as important and field-to-field irrigation is practiced.

PHYSICAL CHARACTERISTICS OF *TARAI* IRRIGATION SYSTEMS

Intake

The diversion dam and intake are made of boulders, stones, and tree branches. Intake reconstruction is a required annual task. The type of intake depends on the type of river and the location of the command area. If the command area is higher than the river bed, the farmers dam the river to raise the level of water upstream and divert water to the canal. In other systems, diversion dams are sufficient. Whatever type of intake is used, it requires quite a few people to construct and repair it regularly.

Canals

Main canals without lining are constructed and water is delivered through them. Secondary canals are also constructed to deliver water to individual villagers who have participated in the repair and maintenance of the intake. Water conveyance is not a difficult task for the irrigation organization.

Cross Drainage

Cross drainage often poses a problem to conveyance of water, but drainage itself can be a bigger problem since *Tarai* means flat land and there is the possibility of waterlogging in parts of the command area. Drainage is an important physical factor to consider in the *Tarai* irrigation systems.

Farm Types

Farms in the *Tarai* are flat with some slopes.

Size of the Command Area

The command area in *Tarai* irrigation systems is large, ranging from 100 to thousands of hectares.

Availability of Water

Some of the systems have a perennial water supply, and other systems dry up. Agricultural activity emphasizes rice cultivation and acquiring of water for rice cultivation. However, farmers may try to divert water from the river system for winter wheat cultivation.

Method of Water Delivery

For the purpose of this study, only gravity flow irrigation systems are studied. In the *Tarai*, different irrigation systems such as deep tube wells, shallow tube wells, and hand-pump systems are available. Gravity flow systems through main, secondary, and independent outlets are focused in this study in relation to irrigation tasks and the role of irrigation organizations.

ALTERNATIVE TECHNOLOGIES

Topographical conditions have led farmers to adopt different technologies and materials for the delivery of water to the farms.

Hill systems with long canals excavated through landslide zones have utilized tunnels for certain stretches along with high gradient and narrow canal cross sections for slope stability. The weak physical condition of the system is often compensated for by effective management of the resources contributed by the beneficiaries for regular maintenance.

River valley systems are influenced by the nature of the rivers. The farmers of irrigation systems fed by big rivers plan their activities before the monsoon starts because these rivers are unmanageable during monsoon. The irrigation systems fed by small rivers and streams schedule their agricultural activities when the monsoon starts. The materials used for temporary intake and diversion construction are stones, brush, and wood.

Tarai systems are generally large. Intake construction is a crucial task because these systems usually tap into large, powerful rivers. It requires large amounts of wood, brush, and stone which are transported long distances. The frequency of floods in the river determines the number of times the intake must be repaired. Hence, an elaborate mechanism for human and material resource mobilization is required.

CHAPTER 3

Incentives for Organization

AN IRRIGATION ORGANIZATION has to perform a variety of functions ranging from water acquisition, allocation and distribution, conflict resolution, and resource mobilization to daily operation. The types of irrigation tasks to be performed by each organization differ from system to system.

In all cases, one or more identifiable common problems keep the organization intact. These problems remind the irrigators of the need to work together and force them to make collective decisions. The participation of all beneficiaries is important at annual general assemblies where decisions are made. The management committees implement the decisions made by the general assembly of farmers. The accounts of the organization are presented to the beneficiaries for auditing and inspection. This collective decision-making process at annual meetings has helped farmer-managed irrigation systems to be effective and flexible so that the needs of individual places and soils can be accommodated.

FACTORS THAT STIMULATE WATER USERS TO BECOME ORGANIZED

No single factor or element brings water users together in an irrigation organization. Different systems have different elements which surface as the prominent feature. Water rights issues, resource mobilization, water distribution,

sense of belonging to the community, preservation of an individual's water share, and acquisition of water and humus before the monsoon, are different unifying factors. However, it is not necessary to have all these features present for an irrigation organization to function.

Water as Community Property: An Organizing Force in Irrigation Systems

Valuing water as "community property" can become the organizing and unifying force for farmers in a given system. The effectiveness of an irrigators' organization can be placed on a continuum ranging from anarchic to well-organized, depending on the degree of collective interest in irrigation water. Non-compliance with rules for water acquisition, allocation and distribution, and resource mobilization results in "anarchic" application of irrigation water, where individual interest prevails over collective interest. In a well-organized system, irrigation-related tasks are performed collectively by the beneficiaries or group agreements are carried out by all individuals.

Anarchy in an irrigation system results where group norms and values are not observed. Water is considered as a resource to be extracted for individual benefit on the basis of "might is right." In an anarchic situation, water acquisition, allocation, distribution, and conflict resolution depend on individuals settling problems with other individuals. Generally, the more powerful and influential individuals are able to extract a larger share than others.

In a well-organized system, the acquisition of irrigation water and its application for agricultural use are based on community decisions. Committee members are elected to manage the system on behalf of the community and are accountable to it. Management and decisions related to irrigation are based on the premise that water is "community property."

Water acquisition is usually a collective effort, i.e. the community pools its resources to do this either in the form of cash or kind or labor. The allocation principle is also decided collectively by the irrigator community. The distribution of water according to the criteria prescribed by the irrigator community is an effort to distribute the community resource for individual use. Limits are placed on the extent to which individuals are allowed to use these resources.

If someone violates the norms of allocation or distribution by "stealing" water or depriving others of the share of water assigned to them by the community, he is subject to punishment. A penalty is imposed depending on the gravity of the offense and according to norms and values of the system. The terms of the penalty are determined by the irrigator community. This is intended to prevent an individual from extracting more resources than allocated by the community.

The individual's view of how irrigation water should be utilized is influenced by his sense of ownership of the water. In agency-managed systems, the agency employs *dhalpas* (gatekeepers) to distribute water to individual farmers. There is no collective decision-making process involving the farmers, and water is treated by officials as belonging to them, giving them the right to distribute it according to their criteria.

The Pithuwa irrigation system which was constructed in 1972 illustrates the transition from anarchic to organized irrigators for water management. This system was constructed and operated by the government for some time. Management by the agency resulted in disregard for other farmers' equitable water share, and water stealing was common. In an effort to receive water more equitably and reliably, the farmers of Branch 14 decided to "communalize the water" at their outlet. They determined conditions for water allocation and distribution and penalties for misuse. This concept led to a change in the management system whereby individuals were required to conform to the values and norms stipulated by the group. Previously, the water in the canal was considered as a government resource, and the farmers believed that they would be better off by extracting as much of this resource as possible from the government. The effort to communalize the water resource in the Pithuwa system according to community decisions helped the formation of an irrigation organization to direct water acquisition, allocation, distribution, and conflict resolution. In Pithuwa, the irrigation organization is currently operating at a system level and at branch level. This example demonstrates the importance of the perception and values of the beneficiaries regarding water as a community resource requiring collective management.

The concept of community property has become the basis for organization in other sectors as well. "Forest" or "pasture land" in many communities can be community property. Once the resource becomes community property, the group must organize to preserve it and distribute benefits to the members of the community. This requires a viable community-based organization as has emerged in most farmer-managed irrigation systems.

Protection of Water "Rights" as an Organizing Force

In the course of analyzing the 21 irrigation organizations, it was observed that each system has one or more prominent features which keep its irrigators together. The Satrasaya Phant irrigation system is an example of the need to protect water "rights" as the main factor which caused the irrigators to work as a group.

In Satrasaya Phant there had been conflict at the system's water source for many years. The Satrasaya Phant farmers wanted to establish rights over the water of the Adhi Khola, the source of the system. They claim that all the water belongs to Satrasaya Phant farmers. These irrigators needed a way to insure that neighboring systems sharing the same source (a spring) would not steal water from the source. Below the intake of this system, there are four other irrigation systems. Farmers from the other systems would often break the Satrasaya Phant system's dam to obtain a greater flow of water for their systems. The farmers of Satrasaya Phant had even filed a case in the courts to establish their water "rights", but the court declares simply that the water is to be used as it had been in the past, which did not help the Satrasaya Phant irrigators' concern. As a result, the farmers of Satrasaya Phant organized to protect "their" water share. Six members from the irrigators group guard the source at night on a rotational basis. Of the 21 systems studied, this is the only system that must do this. In comparison with the intensity of effort Satrasaya Phant farmers must expend to safeguard their water "rights," other irrigation tasks have less importance. Annual maintenance of the system and water distribution are not performed by the beneficiaries but instead by hired workers through contractual arrangement under the supervision of one of the members of the committee.

Achieving Water Distribution in Proportion to Water Share as an Organizing Force

Irrigation organizations have been effective in the Chherlung Thulo Kulo and Tallo Kulo systems and in Phalebas, where water shares are distributed among the members on the basis of investment made during the time of construction

of the system. In the Raj Kulo of Argeli, water shares are distributed in proportion to the area irrigated. If the source of water decreases, the volume of the water share going to all shareholders also decreases. Hence, the shareholders have to make a regular effort to assure that the volume of water from the source does not decrease. For this, they patrol the canal and intake daily and have a group of people ready to undertake emergency repair work in the event of a landslide or break in the canal. Because of the need to increase the volume of water to shareholders and distribute water according to entitlement, these irrigation organizations are well organized and effective.

Organization Designed for Equitable Water Distribution and Minimizing Conflict

The Pithuwa and Pancha Kanya irrigation systems were built and managed by the government. Water distribution by agency managers became a problem causing many conflicts in the communities. This gave an impetus to the formation of a users' organization.

The Pithuwa system has 16 branch canals. Water distribution was a difficult task causing much conflict and quarrelling. The farmers of Branch 14 were organized by one of the farmers of this branch who had grown up in a large farmer-managed system in Rupendehi district and who had also received formal training in community development activities. He convinced the other farmers that if they would all agree to distribute water on a time basis, the length of time each farmer receiving water to be proportionate to his landholding, the water distribution problem could be solved. Convinced by this farmer leader, a water management committee was formed in Branch 14. Within a year, the situation for water distribution improved tremendously and conflict was reduced. Influenced by the change in Branch 14, the farmers in other branches started forming branch-level water management committees. Over time, all the branches created water distribution and maintenance committees. Finally, a second level of organization came into existence. There is now a system-level committee for water acquisition at the main canal and other committees for the respective branch canals. The formation of irrigation organizations in this system was influenced by the need for equitable water

distribution. At present, the system is managed by the farmers' organization. The Department of Irrigation has provided a bulldozer for desilting at the intake and an annual grant of Rs 30,000-40,000 (US$1,250-1,650).

In nearby Pancha Kanya (a previously farmer-managed system expanded by the irrigation agency), there were many problems involving water distribution. The farmers of the command area decided on their own that they needed to do something about water distribution. At the initial stage, the agency was not cooperative with the water distribution committee. The village *panchayat* of this area wrote to the Department of Irrigation stating that the water distribution group was a legitimate one so the responsibility for water distribution should be entrusted to it. This was finally agreed to by the field office of the Department of Irrigation at Chitwan. The water distribution committee of Pancha Kanya formulated criteria for water distribution with the farmers' concurrence. Land within the command area was classified into two categories: tar (higher land) which was given priority for irrigation water and ghol (lowland) which does not receive irrigation water because it gets spring water and seepage water. Furthermore, priority was given to small farmers holding less than 0.6 ha.

Both these cases illustrate how irrigation organizations can come into existence primarily to perform the task of water distribution.

Organization to Acquire Water and Fertile Humus

Water acquisition is in some ways the primary task of an irrigation organization. However, the *timing* of water acquisition is the important organizing incentive for some irrigation organizations. This task is influenced by the nature of the river. The Badkapath, Rani Kulo, Gorkhe Kulo, and Kwadi Kulo irrigation systems have a perennial river as their water source. Before the river becomes unmanageable in the monsoon, the farmers attempt to obtain water as well as fertile silt from the first flood of the river.

The irrigation calendar of these systems begins in February-March. Rice planting starts at the end of April. In other irrigation systems, irrigation-related activities start with the beginning of the monsoon in mid-June. But these river valley irrigation systems with a perennial river as their water source start their irrigation activities before the monsoon begins. During the monsoon, the farms

remain fallow. Water discharge during the peak period is 100 times greater than during the lean period. According to the farmers of these systems, they cannot manage the turbulent river with only temporary diversion dams so they abandon agricultural activities during the peak monsoon period.

A prime objective of these farmers is to trap the fertile humus from the first flood of the river. The farmers usually do not put fertilizer on their rice cultivation. According to the farmers of the Rani, Gorkhe, and Kwadi irrigation systems, the rice yield decreases by 25 to 50 percent if silt cannot be trapped for rice.

Mobilization of Manpower as an Organizing Force

The need to mobilize labor to operate and maintain the system is a task which all irrigation organizations have in common. In some systems, such as Chhattis Mauja, this need is the overriding factor for which the farmers organize.

In order to make water available to the 3,000 ha within the Chhattis Mauja irrigation system, large-scale labor mobilization from within the system is necessary. An elaborate mechanism has been developed so that about 60,000 labor-days can be mobilized for desilting the main canal and repairing the intake and diversion weir in the Tinau river. The organization has strict rules to ensure that those who come to work really work. They do not even allow people to bring an umbrella since it is not possible to work while holding an umbrella. The three-tier elaborate structure has maintained a disciplined organization that is able to work on its own and mobilize required resources internally.

The organization has different categories of labor mobilization. The main canal cleaning is the responsibility of the main committee. It designates the number of laborers to be mobilized from each village based on the amount of land each village irrigates. The number of laborers required depends upon whether the task involves regular repair or emergency repair requiring twice the work force.

Another example of an organization functioning primarily to mobilize labor in the *Tarai* is the Lothar system. Some of the hill irrigation systems constructed on fragile terrain have focused more of their efforts on mobilizing resources for keeping the system operational during the rice season. Raj Kulo

of Argeli, and Tallo Kulo and Thulo Kulo of Chherlung are examples of systems which have to be united for resource mobilization on short notice.

CHAPTER 4

Characteristics of Irrigation Organizations

AN ORGANIZATION MAY be defined as a group of people who seek to achieve a defined purpose through unified action. Different mechanisms evolve within the organization depending on the purpose for which the group has come together.

TIERS OF ORGANIZATION

Some organizations have developed various tiers, each having certain functions. Factors that influence the number of tiers of organization that may exist in a single irrigation system might include: 1) size of the command area, 2) topography of the command area, 3) availability of water in the system, 4) amount of labor to be mobilized for maintenance of the system, and 5) sharing of water from the source and sharing of laborers among the systems.

One-Tier Irrigation Organizations

Small irrigation systems and those with a homogeneous topography usually have only one level of organization. Charhajar (200 ha), Bhanu Baraha (120

ha), Charsaya (50 ha), Rani Kulo (75 ha), Gorkhe Kulo (180 ha), Raj Kulo (48 ha), Thulo Kulo (40 ha), Tallo Kulo (17 ha), Upallo Kulo (40 ha) and Soto Kulo (25 ha) have single-level irrigation organizations. The size of these systems ranges from 17 ha to 200 ha. In terms of the type of system, some are hill irrigation systems and others are river valley irrigation systems. The command area of hill irrigation systems under study ranges from 17 ha to 50 ha. Since hill systems are situated in difficult terrain, the size of the command is comparatively small. The command area of river valley irrigation systems ranges from 50 ha to 200 ha. However, the terrain is easy and the command area is usually served by one main canal.

The volume of water available in the source does not have much influence on the tiers of organization. In the systems referred to above, some have abundant water and others have little water. The Argeli Raj Kulo suffered from water scarcity before parts of the main canal were rehabilitated in 1982. The Chherlung Thulo Kulo and Tallo Kulo are water-stressed systems which need much supervision for water management. The single-tier systems studied are water-abundant systems, and the irrigation organizations do not need to provide for uniform water distribution. Labor mobilization in these systems is less compared to other systems. Attention is primarily focused on maintaining the intake after heavy floods in the river.

Two-Tier Organizations

Some medium-sized systems with several distribution canals branching off the main canal such as Pithuwa (900 ha), Pancha Kanya (600 ha), Lothar (800 ha), and Phalebas (134 ha) have two levels of organization. The primary level of organization is at the village or distributory level with jurisdiction for irrigation activities over the individual fields within the village or canal command (first tier), and a central committee with jurisdiction over irrigation activities of the whole command area (second tier).

Pithuwa, Pancha Kanya, and Phalebas have developed two levels of irrigation organization to deal with water distribution. Distribution in Phalebas is based on water shares determined on the basis of investment made during construction of the physical structures. Pithuwa and Pancha Kanya have to deal with water scarcity problems. Hence, the lower level of organization was

set up along the distributary canals to deal with water distribution taking into consideration water availability, the water requirements of each crop, and scheduling of water distribution, rotation, and rationing of water. Such detailed work for water distribution can be done only at the lower level. The higher level takes care of assigning and supervising resource mobilization for maintenance of the intake and main canal.

Phalebas, though small in size compared to other systems, has a complicated rotation procedure for water distribution which requires frequent adjustment in allocation and distribution. Village representatives meeting on a system-level committee can best handle this and avoid possible conflicts caused by limited water shares. The lower level takes care of water distribution at the farm level and sends representatives to the central committee meetings. The number of water shares apportioned to each of the villages in the system varies so the lower unit has the responsibility of mobilizing the human and cash resources for maintenance of the main canal according to its water share (Pradhan, U., 1988:39-43).

The size of the system, water scarcity, and the intensity of water management necessary at each level are determining factors for decentralizing authority and creating a level close to the group of farmers served by the branch or outlet. In these situations, the primary tier develops a detailed water distribution scheme to suit the farmers' needs.

Three- and Four-Tier Organizations

Large-scale irrigation systems may have three or four levels of organization. The Badkapath system (800 ha) has three levels and the Chhattis Mauja system (3,000 ha) has four levels.

The nature of the source of water for the system, the need for labor mobilization from within and outside the system, and requirements for water sharing at the source with neighboring irrigation systems are factors that influence the need for three or four levels of organization.

Chhattis Mauja has 54 village groups, 9 area committees, and 1 central committee, plus an inter-system committee to supervise the sharing of water from the Tinau river between the Chhattis and Sorah Mauja systems (Pradhan, 1984).

The village level (first tier) is responsible for overseeing irrigation activities within the village. The next tier consists of a committee made up of representatives of half a dozen villages that oversees the O&M of its portion of the larger system. Then there is a central committee for the whole Chhattis Mauja system. Where several systems have to share an intake from a large river, a joint, inter-system irrigation committee is responsible for coordination of water acquired and distributed among the systems and for mobilization of resources in proportion to the command area of each system.

The Badkapath system has a village *(mauja)* committee headed by a *katkandar* in each village. A system-level committee looks after the main canal and is headed by the *paani pradhan* (water headman). Then a joint committee supervises the sharing of water from the Rapti river among the six systems in the Deukhuri valley. It also provides help to any of the systems when the members of one alone are not able to repair the intake and labor from other systems is requested. At this time, the joint committee of paani pradhans representing each system (third tier) decides the number of the laborers needed from each system. In addition, the joint, inter-system committee allocates the share of water for each of the systems fed by the Rapti River. The majority of the beneficiaries in Badkapath are of the Tharu ethnic group, and are known for their collective work (DRG, 1986).

Figure 3 depicts the various tiers that may exist in an irrigation organization and identifies the areas of jurisdiction of each tier while Table 3 summarizes the characteristics of the 21 irrigation system studied.

In summary, farmer-managed irrigation systems are not necessarily small, with simple one-tier organizational structures. They may be large irrigation systems with elaborate organizational structures having specialized functions and responsibilities at each level.

Figure 3. Tiers of organization and their responsibilities in irrigation systems of Nepal.

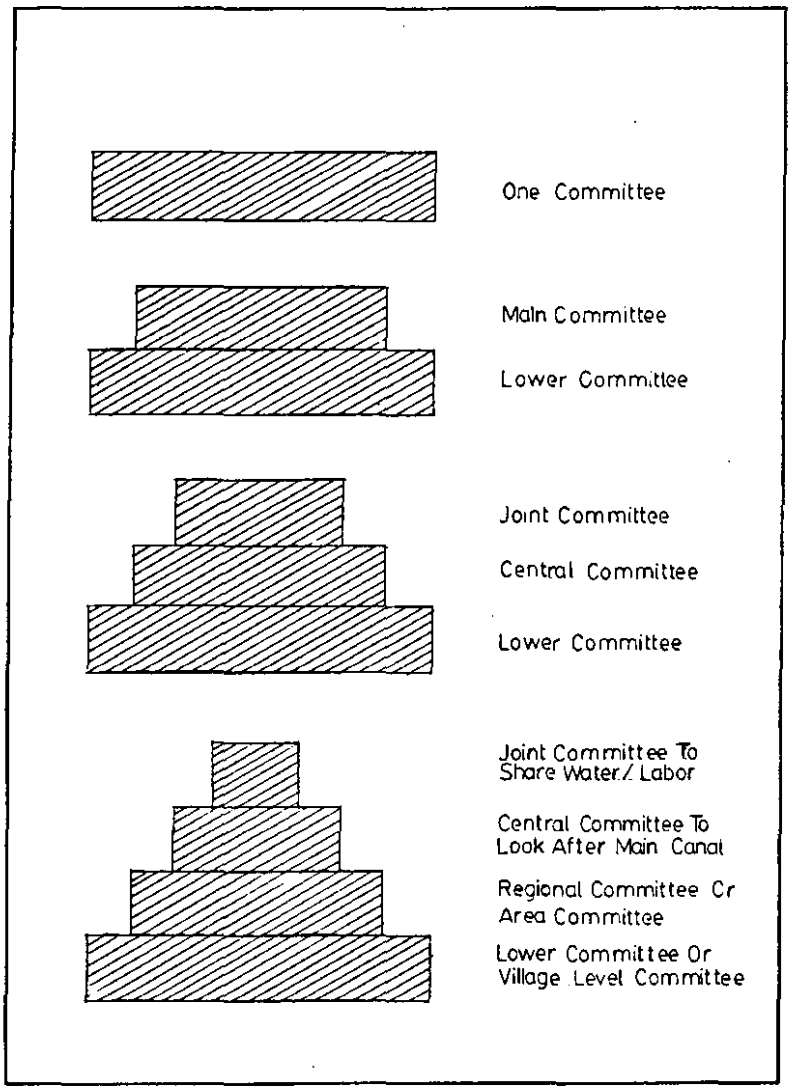


Table 3. Characteristics of irrigation organizations including the number of tiers.

System	A	B	C	D	E	F	G	H
Raj Kulo	48	155	Hl	N	N	Ro	Hh	1
Thulo Kulo	40	108	Hl	N	N	Ro	Hh	1
Tallo Kulo	46	134	Hl	N	N	Ro	Hh	1
Upallo Kulo	40	113	Hl	N	N	Co	L	1
Sota Kulo	25	95	Hl	N	N	Co	L	1
Satrasaya Phant	40	45	Hl	Y	N	Ro	L	1
Baraha Kulo	15	40	Hl	Y	N	Ro	L	1
Sange Patiyani	208	--	Hl	N	N	Ro	L	1
Phalebas	134	366	Hl	Y	N	Ro	Hh	2
Charhajar	200	215	R	N	N	Co	L	1
Bhanu Baraha	120	92	R	N	N	Co	L	1
Charsaya Phant	50	65	R	N	N	Co	L	1
Phewa	280	300	R	N	N	Ro	L	1
Badkapath	800	800	R	Y	Y	Co	M	3
Rani Kulo	75	75	R	N	N	Co	L	1
Gorkhe Kulo	180	180	R	N	N	Co	L	1
Kwadi Kulo	55	55	R	N	N	Co	L	1
Chhattis Mauja	3000	4000	T	Y	Y	Ro	M	4
Pithuwa	900	1000	T	Y	N	Ro	L	2
Pancha Kanya	600	500	T	N	N	Ro	L	2
Lothar	800	300	T	N	N	Co	Hh	1

Notes:

A - Command area in hectares
B - Number of beneficiaries
C - Geographical location (Hill [Hl], River valley [R], *Tarai* [T])
D - Water at the source is shared with other systems (Yes/No)
E - Labor is shared with other systems (Yes/No)
F - Water distribution (Continuous flow [Co]/Rotation [Ro])
G - Resource Mobilization: Cash and labor requirements for O&M
High [Hh] = over Rs 500/ha
Medium [M] = Rs 100 - Rs 499/ha
Low [L]= less than Rs 100/ha
H - Number of tiers of organization

MEMBERSHIP PATTERNS IN THESE IRRIGATION ORGANIZATIONS

The irrigation organization at the central level usually comprises a general assembly of beneficiaries and a committee consisting of members elected to carry out the decisions made by the general body.

Committees

Twenty out of the 21 systems observed have explicit committees to manage the irrigation system. The committees are "formal" in the sense that the irrigators recognize them as having the authority to enforce the organization's decisions. However, these committees are not recognized by law or registered with the government agency. Committee members are usually chosen for one year at a time and are accountable to the general assembly.

Composition of the Committees

The number of members on a committee varies from system to system as discussed below. Committee size is usually influenced by the size of the system and the complexity of the water distribution methods. The number of members and composition of the main committee in each of the systems studied are shown in Table 4.

Each of the committees constitutes a chairman, secretary, and treasurer except where one individual performs all activities relating to irrigation management. Other members on the committee usually represent different areas of the system. Their functions are to help with water distribution and conflict resolution within their respective areas and to help mobilize resources for system maintenance and repair. They may also perform certain committee duties on a rotational basis.

Table 4. Composition of the members in the main committees.

System	Number of members	Positions
Raj Kulo	10	1 *Mukhiya*, 1 *Baidar*, 1 *Chaukidar*, 2 supervisors of two divisions 1 water inspector and 4 representatives
Thulo Kulo	11	1 *Mukhiya*, 2 *Jimmuwals*, 7 *Thari*, 1 Secretary
Tallo Kulo	10	1 *Mukhiya*, 7 *Thari* and 2 watchmen
Upallo Kulo, Damka	1	
Sota Kulo, Damka	1	
Satrasaya Phant	10	Chairman, Vice Chairman, Secretary, Treasurer and 6 members
Baraha Kulo, Yampa	3	1 Secretary (Other members on an ad hoc basis)
Sange Patiyani	22	*Pradhan Pancha* and members from tail end and head end.
Phalebas	12	Chairman, Vice Chairman, Secretary, Treasurer, and 8 village representatives (ex-officio)
Charhajar	2	2 *Jimmuwals*
Bhanu Baraha	7	Chairman, Secretary, 5 regional members
Charsaya Phant	5	Chairman and other members
Phewa	11	11 members nominated by the Agriculture office
Badkapath	15	1 *Paani Pradhan*, 12 *Katkandar*, 1 *Agheriya*, 1 *Pucheriya*
Rani Kulo	5	Chairman, Secretary, Treasurer and 2 members
Gorkhe Kulo	11	Chairman, Secretary, Treasurer and 8 members
Kwadi Kulo	9	Chairman, Secretary, Treasurer a 6 members

Chhattis Mauja	16	Chairman, Vice Chairman, Secretary, 9 regional members, 2 *Meth Muktiyar*, 2 messengers
Pithuwa	18	Chairman (*Pradhan Pancha* ex-officio) Secretary and 16 ex-officio members --chairmen of branch committees
Pancha Kanya	11	Chairman, 5 sub-com chairmen and 5 other members
Lothar	8	Chairman, Vice Chairman and 6 appointed by the Chairman

Number of Members on the Committees

The total number of members on the committee is influenced by the water distribution method employed as well as by size of command area.

Limited water supply requires distribution of water on a rotational basis. Observations of technology and management practices used for distribution of water show that more intensive efforts were employed when supply of water is relatively scarce. The ratio of supervisory and management personnel and size of the command area is given in Table 5. For the continuous flow method of water distribution, the ratio is one committee member for every 19 ha whereas for the rotation system, it is one member for every 12 ha on average. The range for continuous flow is 4 to 125 ha per committee member and 2 to 53 ha per committee member for rotational delivery.

Selection of Members

In ten of the systems studied, the chairman of the committee holds the job because of hereditary position in the community (that is, the position is passed on from father to son). Eleven of the systems have elected chairmen. Even a "hereditary" chairman must be re-elected each year at the annual meeting of the irrigators and must have several years of experience in the system; he must also be a socially influential person or the formal head of the village *(mukhiya or jimmuwal)* or a person from a family specialized in irrigation management

such as the *paani pradhan* of Badkapath. A hereditary head is always subject to approval by the assembly.

Table 5. Water distribution method in relation to the number of members on the irrigation committees.

Name	Size (ha)	Water distribution	Committee members	Ha/member
Raj Kulo	48	R	10	5
Thulo Kulo	34	R	11	3
Tallo Kulo	23	R	10	2
Upallo Kulo	27	C	1	27
Sota Kulo	25	C	1	25
Satrasaya Phant	40	R	10	4
Baraha Kulo	15	R	3	5
Sange Patiyani	208	C	22	9
Phalebas	134	C	33*	4
Charhajar	200	C	2	100
Bhanu Baraha	120	C	7	17
Charsaya Phant	50	C	5	10
Phewa	280	R	11	25
Badkapath	800	R	15*	53
Rani Kulo	75	C	5	15
Gorkhe Kulo	180	C	11	16
Kwadi Kulo	55	C	9	6
Chhattis Mauja	3000	R	236*	13
Pithuwa	900	R	96*	9
Pancha Kanya	500	C	29*	17
Lothar	1000	C	8	125

Notes: * Members of all tiers of organization are counted.

C = Distribution by continuous flow
R = Distribution by rotation

The freely elected chairman is usually a person who is recognized by the irrigator community as an impartial person, respected by the community, with the capacity to mobilize people for repair and maintenance when needed. The chairman is elected each year at the irrigators' general meeting.

Only three of the systems have the village panchayat chairman *(pradhan pancha)* as the chairman of the irrigation committee. In the Pithuwa system, the pradhan pancha was recently made the ex-officio chairman. In Rani Kulo, the present chairman holds the positions of pradhan pancha and jimmuwal. At Sange Patiyani, the pradhan pancha was selected to be the chairman to initiate dialogue with the irrigation agency. He does not cultivate land within the command area.

Types of Chairmen

Factors which could influence whether a system opts for a hereditary committee chairman or an elected one are: 1) the age of the system, 2) the number of beneficiaries, 3) the size of the system, 4) type of settlement -- new settlement area versus old settlement area, 5) access to a road, 6) introduction of a land reform program and abolition of old institutions, and 7) the number of levels in the irrigation organization.

The age of the system has some influence on the type of chairmanship as the average age of systems with hereditary chairmanship is 103 years, compared to an average of 81 years for other systems. The size of the system and number of beneficiaries do not necessarily influence whether an elected or hereditary chairman is selected, although systems with big command areas or many beneficiaries are more likely to have freely elected chairmen. Generally, an elected chairman is more common in systems that have been recently settled, that have multiple levels of organization, that have access to roads, or where legal provisions have been made to abolish certain hereditary positions. Among these factors, new settlements and multiple levels of organization are the most important influences. Chairmanship pattern in irrigation committees is given in Table 6.

Table 6. Chairmanship pattern in irrigation committees.

Hereditary Chairmanship			Elected Chairmanship		
System	Designation	Age of system	System	Designation	Age of system
Raj Kulo, Argeli	*Mukhiya*	100 yrs	Satrasaya Phant	Chairman	100 yrs
Thulo Kulo, Chherlung	*Mukhiya*	50 yrs	Baraha Kulo	Secretary	100 yrs
Tallo Kulo, Chherlung	*Mukhiya*	50 yrs	Sange Patiyani	*Pradhan Pancha*	10 yrs
Upallo Kulo, Damka	One person	50 yrs	Charhajar	*Jimmuwals*	100 yrs
Soto Kulo, Damka	One family	50 yrs	Bhanu Baraha	Chairman	200 yrs
Phalebas	Chairman	33 yrs	Charsaya Phant	Chairman	200 yrs
Badkapath	*Paani Pradhan*	100 yrs	Phewa	Chairman on ad hoc basis	5 yrs
Rani	Chairman	200 yrs	Chhattis Mauja	Chairman	150 yrs
Gorkhe	Chairman	200 yrs	Pithuwa	*Pradhan Pancha* ex-officio	12 yrs
Kwadi	Chairman	200 yrs	Pancha Kanya	Chairman	8 yrs
			Lothar	Chairman	15 yrs

Terms of Office

All committee members hold office for usually one year or sometimes two years. The members' performance is reviewed at the annual meeting of the irrigators. Members may be replaced or re-elected at the annual meeting.

Accountability of the Committee

The committee is accountable to the general body of irrigators. It is responsible for keeping accounts, distributing water in accordance with directives of the assembly, implementing decisions made during the general meeting, and resolving conflicts.

Political Neutrality of the Committees

In all the systems, the committee seeks to keep politics out of irrigation water management. The pradhan pancha, who is a local politician, is a member of the irrigators' assembly if he cultivates land within the system, but he usually does not have an active role on the committee because the irrigators want to avoid having factionalism between political parties enter into water management issues. However, in Sange Patiyani, the pradhan pancha was elected committee chairman because the farmers hope to use his political influence to facilitate relations with the Department of Irrigation.

In Raj Kulo, different political factions cooperate even in an election year to decide how to maintain and operate the system. The command area frequently crosses ward or village panchayat political boundaries. While wards or panchayats are politically demarcated boundaries, the hydrological boundaries of irrigation systems may extend beyond.

Provisions for Remuneration to Committee Members

The chairman or other members in some systems are remunerated in either cash or kind. In about two-thirds of the systems, however, service for irrigation management is not remunerated. In certain systems, if the committee members do not perform their job properly, they may be penalized. Examples of remuneration to committee members are given in Table 7.

Table 7. Examples of remuneration to committee members.

Cash		Kind	
System		System	
Chhattis Mauja	Cash remuneration to messengers, Meth muktiar and to the chairman and secretary	Bhanu Baraha	Up to 20 *maato muri*[a] (up to .25 ha) labor exemption to committee members
		Badkapath	*Paani Pradhan* gets 128 laborers at his service for a year
Charhajar	Rs 25 to *Jimmuwals*	Raj Kulo	5 *maato muri* extra water to *Mukhiya*, two laborers exemption
		Thulo Kulo	*Mukhiya* is exempted from labor contribution for his share of water
		Tallo Kulo	*Mukhiya* gets one labor exemption plus two inches extra water

Note: [a] 80 *maato muri* = 1 ha; 1 *maato muri* = .013 ha.

In Pithuwa, Pancha Kanya, Lothar, and Satrasaya Phant, the officeholders serve the community without remuneration. In the Phalebas, if any committee member is absent during maintenance work, he is fined twice the amount of the fine imposed on other members.

THE DIFFERENT FUNCTIONS OF IRRIGATION ORGANIZATIONS

The ongoing functions of irrigation organizations can be grouped into three common tasks: 1) water allocation and distribution, 2) maintenance of the system and resource mobilization, and 3) conflict resolution. Robert Chambers (1980), in analyzing community irrigation systems of Sri Lanka and Tamil Nadu of India, identifies the allocation and appropriation of water, enforcement and arbitration, and community resource mobilization as the most important functions. Coward suggests both institutional and organizational elements as the basis for identifying the functions of irrigation organizations. Key rules, important roles, and interaction with significant social groups, he suggests, are institutional and organizational elements for analyzing system activities such as water allocation, system maintenance, and conflict management.

Uphoff et al. have identified three sets of activities of irrigation system management: 1) water use activities including acquisition, allocation, distribution, and drainage; 2) tasks relating to the physical system including design, construction, operation, and maintenance of structures to acquire and control water; and 3) organizational tasks including decision making, resource mobilization, communication, and conflict management. All these tasks are interrelated with the goal of utilizing water efficiently for maximizing agricultural production.

In the analysis of the 21 FMIS in Nepal, water allocation and distribution, resource mobilization, and conflict management are the most common activities in all systems, irrespective of the size and type of system. However, the importance of a particular function differs from system to system. In hill systems, resource mobilization (both cash and labor) for water acquisition, allocation, and distribution, and conflict management involving allocation,

distribution, and resource mobilization are the primary activities in water-stressed systems. In water-abundant hill irrigation systems, regular resource mobilization for water acquisition is the major task, and water allocation and distribution, and conflict management are not as intense as in other systems. In river valley irrigation systems, allocation and distribution are not as important as labor mobilization for water acquisition for desilting and diversion dam construction. The importance of any of the activities depends on the availability of water in the system. However, specific functions might be the overriding concern in any particular system. In principle all of the activities interrelate, but in practice only some are relevant, for example, drainage activities are not needed in some systems because of topography and soils.

Table 8 gives an estimate of the intensity of management activities in irrigation organizations of the systems in three geographical locations. Up to 29 different types of irrigation activities may be performed by any one irrigation organization (see Appendix 2. Functions of irrigation organizations). The total number of irrigation activities that might be performed by the nine hill irrigation systems studied is 261. The number of activities that were observed as actually being performed in these systems is 114. Hence, 43 percent of the potential activities is performed on average. However, the case of each irrigation system is different. In river valley systems, only 31 percent of total activities is performed on average. In *Tarai* systems, the intensity of management activities is almost the same as that in hill irrigation systems. Among the three geographical locations, hill and *Tarai* irrigation systems have to perform more irrigation activities as compared to river valley irrigation systems. At a 90 percent level of significance, hill and river valley irrigation systems show a statistically significant difference in the management practices, i.e., the management functions of these systems are different.

Maintenance of Water Rights

Some systems are most concerned with the maintenance of water rights for the members of the command area or with the protection of rights against intrusions from outside the system. In the case of the Chherlung, Tallo Kulo and Thulo Kulo, and the Phalebas system, water is allocated to individuals from the system on the basis of investment made during construction of the system.

Therefore, there is no relation between the size of an individual's landholding and the number of water shares that he holds. Land and water are separate entities. One can sell one's share of water or buy water from a shareholder. Any transaction of shares must be registered with the irrigation organization. Hence, the responsibility of the irrigation organization is to protect the value of the water right of each member in the system, measured in terms of amount per share.

Table 8. Performance of irrigation activities by systems.[a]

Hill systems	activities	%	*River valley systems*	activities	%	*Tarai systems*	activities	%
Raj Kulo	19	65	Charhajar	6	20	Chhattis M.	18	62
Thulo Kulo	14	48	Bhanu Baraha	11	37	Pithuwa	17	58
Tallo Kulo	17	58	Charsaya	8	27	Pancha K.	6	20
Upallo Kulo	7	24	Phewa	6	20	Lothar	8	27
Sota Kulo	7	24	Badkapath	10	34			
Satrasaya	13	44	Rani	10	34			
Baraha	8	27	Gorkhe	10	34			
Sange Patiyani	11	37	Kwadi	11	37			
Phalebas	18	62						
Total activities	261			232			116	
Observed activities	114			72			49	
Percentage	43			31			42	

Note: [a]The total possible number of different irrigation, activities that an organization might perform was identified as 29 for each system. As each type of activity was performed in a system, it was recorded as an "observed activity." Then the ratio of actual activities observed in relation to the total possible number of different activities was calculated.

Water right preservation from outside the system is also an important function of an irrigation organization. In the case of Satrasaya Phant, the irrigation committee needs to take special care to preserve their water rights at the source. It sends members of the system on a rotational basis to guard the source at night during the time of rice cultivation.

The Phalebas system presents an interesting case where the irrigators refused government intervention, preferring to remain autonomous so as to maintain control over their water rights within the command area and at the source. When the government attempted to expand the Phalebas system under an Asian Development Bank loan, the members of the system vehemently opposed the scheme. They filed petitions against the proposal with the Department of Irrigation and with the King of Nepal, arguing against having their system incorporated in the proposed expansion program. The Department had to prepare a document to prove that the Phalebas system belonged to the government, based on government assistance provided (Rs 7,000, or US$300) during construction some 45 years before. The farmers argued that the canal dug with that money did not work and they abandoned that part of the system. A new canal using entirely village resources was dug in 1955. The farmers therefore asserted that the system belonged to them and not the government. District politicians were mobilized to argue against including Phalebas in the Department of Irrigation expansion program. Finally, the government abandoned the idea and designed and aligned a new canal separate from the old one. The Phalebas case demonstrates how an irrigation organization can act to preserve and maintain the water rights of the system.

Managing Water Distribution in Water-stressed Systems

In water-stressed systems such as Pancha Kanya, Pithuwa, Phalebas, Tallo Kulo, and Thulo Kulo, much of the organization's effort is focused on water distribution. The irrigators' organization in Pancha Kanya is organized for the purpose of water distribution only. Water acquisition and maintenance of the system are performed by the government. In the case of Pithuwa, the irrigators' organization came into existence to deal with inequitable water distribution. Water, as such, has been the unifying force in the system and proper water distribution in accordance with a schedule decided by the farmers themselves has been the distinctive function of the organization. It performs other functions of irrigation as well but the degree of intensity is less.

In the Tallo Kulo, Thulo Kulo, and Phalebas systems, distribution of water according to the individual's share in the command area is an important function along with maintenance activities and the mobilization of resources.

Trapping Water and Fertile Humus

Trapping water and humus through irrigation canals to the farms is an important function of some systems, particularly those river-valley irrigation systems with a water source in big rivers such as the Rapti of Deukhuri and Dharmabati of Pyuthan. Farmers trap the fertile humus carried by the first flood in the river to use as a substitute for chemical fertilizer. In Badkapath, the farmers broadcast rice on irrigated land and transplant rice seedlings where they do not have irrigation.

Safeguarding Water Rights within the Command Area

The command area, as well as the membership of an irrigation system is prescribed in many irrigation systems. Hence, safeguarding the right of the members within the defined area is one of the major functions of the irrigation organization. In both water-abundant and water-stressed systems, only the prescribed area is entitled to use irrigation water even though the command area has the potential to be expanded.

Raj Kulo of Argeli, Tallo Kulo of Chherlung, Phalebas, and Satrasaya Phant all have well-defined command areas. Farmers outside the command area are not allowed to use water and attempts to do so by such farmers are subject to penalties imposed by the irrigation committee. In the case of Chherlung, Tallo Kulo, and Phalebas, the irrigators' committee fought continuously to safeguard the right to water within the originally defined command area.

Irrigation organizations also act to preserve the catchment area as the source of irrigation water (Chiregad of Dang), to exchange labor for water from other systems (Tallo Kulo with Boge Gomba village), or to join a confederation of irrigation committees for emergency inter-system labor mobilization (as occurs in Badkapath).

COMPENSATING FOR WEAK PHYSICAL STRUCTURE BY HAVING A STRONG, DISCIPLINED ORGANIZATION

Many farmer-managed irrigation systems rely on temporary structures such as brush dams and unlined canals built in fragile and difficult terrain. Farmers have been cultivating rice with the help of such systems for generations. How can they make the system work? In these cases, weak physical structures are compensated for by the strong management provided by the irrigation organization which is able to mobilize resources for immediate repair and maintenance as needed. Maintenance of strict discipline among the irrigators is one of the major functions of these irrigation organizations. Raj Kulo of Argeli, Tallo Kulo and Thulo Kulo of Chherlung, Lothar, and Chhattis Mauja are examples of irrigation systems where fragile physical structures have been maintained because of the efforts of strong management and disciplined organization.

SEASONAL ACTIVITY OF IRRIGATION ORGANIZATIONS

The operation of all the irrigation systems under study is geared to rice cultivation and the onset of the monsoon. Activities are scheduled at the annual assembly of all the irrigators which is usually held in May. In systems where irrigation activities have to be undertaken before the monsoon (the river valley systems of Badkapath, Rani Kulo, Gorkhe Kulo, and Kwadi Kulo), the annual assembly is convened in January. The dates for desilting the canal, repair of the intake, and rules for labor or cash mobilization for maintenance are determined, and presentation and auditing of accounts are accomplished at this meeting. The performance of the committee members is also evaluated.

The irrigation organization's activities are most intense for four months, usually from the second week of June until October. The committee meets at least once a fortnight and reviews the situation. The members supervise water distribution if water is scarce. In other systems, regular maintenance is performed to increase the volume of water in the system. Prevention of water

stealing and punishment for violations of the organization's rules are major functions of the committee in these four months.

For wheat, mustard, maize, or for early rice, the committee or the general body of irrigators is usually not active. Those members who are interested in these crops cooperate among themselves to acquire and distribute water except in Pithuwa and Phalebas where the committee is concerned with water distribution for all crops.

There are systems where winter crop cultivation committees are formed. All the farmers are not necessarily members of this group because the command area for water utilization might decrease due to a shortage of water. However, Raj Kulo of Argeli expands its command area for winter crop cultivation. Those farmers who are not entitled to get water for rice cultivation are allowed to use irrigation water beyond the command area specified for rice cultivation. Separate canals are maintained for this purpose. Water acquisition and resource mobilization are performed only by those members who need water on a particular day. These examples illustrate the variations in organizational activity and irrigated area as related to crop seasons.

THE EVOLUTION OF FARMER-MANAGED IRRIGATION ORGANIZATIONS

Most of the farmer-managed irrigation organizations evolved over a long period of time. Some have over 100 years of experience while others have 10-50 years of experience. Hence, the norms, values, rules, and roles relating to irrigation water management have evolved gradually. Therefore, it is important to understand the irrigation organizations in the context of their evolution.

Farmers will usually play a very limited role in agency-managed irrigation systems. There are instances where farmers gradually took over total or partial management of the system from the agency. The Pithuwa irrigation system was once managed entirely by a government agency but because the farmers were unhappy with the water allocation and distribution practices, they organized themselves without government help and now the irrigation agency

hands over its government-allocated maintenance budget for the Pithuwa system to the farmer organization which operates and maintains the whole system. After the farmers assumed management for their system, they were able to expand the command area by imposing strict rules of water allocation and distribution.

There are other systems where farmer irrigation organizations are responsible for only water distribution and conflict resolution relating to water distribution. Maintenance, water acquisition, and construction are performed by the agency. Such joint-management of the system is practiced in Pancha Kanya. This farmers' organization evolved due to the dissatisfaction of the farmers with the water distribution performance of the agency.

While farmer-managed irrigation organizations have, on the one hand, emerged spontaneously in order to handle some of the tasks of irrigation management, on the other, there are examples where farmer irrigation organizations have gradually disintegrated or where modes of operation have changed.

The Charhajar system is an interesting case for identifying factors which cause the disintegration of an irrigation organization. Some time ago, according to the farmers, they had strong rules and organization for water acquisition, distribution, and maintenance of this river valley irrigation system. About 12 years ago, the Department of Irrigation built a hill irrigation system (Sange Patiyani) in the upper reaches parallel to the Charhajar system. Poor construction, coupled with the destruction of canal beds and banks by crabs led to seepage and breakage of the Sange Patiyani main canal. Seepage water from this canal goes into the Charhajar canal, thereby increasing the amount of water available to Charhajar. As a result, the Charhajar irrigators do not have to put as much effort into annual dam construction to acquire water. Except for regular desilting of the canal, there is no longer any strong common challenge organizing the members. Unexpected and unplanned increase of resources (the Sange Patiyani seepage water) into the system caused the organization to decline.

A high rate of absentee landholders and the absence of settlements in the command area may also decrease the effectiveness of an organization. As the nation's road systems have been improved and expanded, access to roads has opened up new economic opportunities for the young people in these communities who tend to move out of the command area in search of new jobs. As a result, internal labor resources dwindle but those who have jobs outside the area may

send cash home. Money obtained from outside the system creates a separate group of people to undertake the task of irrigation. Satrasaya Phant has an irrigation organization only to protect its water right at the source. Maintenance and water distribution tasks are performed by contractors who are appointed by the committee each year. Instead of farmers organizing themselves, specialized jobs were created in the system and paid for in cash.

Irrigation systems are like living organisms. They continually change in relation to the changing environment, resource endowments, and economic and social changes. Because the environment is not static, the irrigation organizations have to be dynamic to meet the challenges created by the socio-economic, physical, technological, political, and demographic conditions.

CHAPTER 5

Water Allocation and Distribution

IRRIGATION WATER ALLOCATION and distribution are distinctive and important functions for any irrigation system. Water allocation is the assignment of entitlement to water from an irrigation system and it has two dimensions. The first dimension distinguishes the farmers or fields having access to the system's irrigation from those not having such access. The second dimension is the quantitative allocation of water in the system among the farmers or the fields, i.e., the designation of the amount and the timing of water to which each farmer or field is entitled (Martin and Yoder, 1987). Distribution is the implementation of the allocation principle as agreed upon by the beneficiaries. Different methods of allocation and distribution are in practice. Allocation has implications for efficiency of water use and equity, and can be a mechanism for expanding the area irrigated. 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 (Martin and Yoder, 1987:12). There are different patterns of water allocation and distribution in Nepali farmer-managed systems.

WATER ALLOCATION

Free Flow in the Canal

When water allocation is according to free flow in the canal, water is not limited either in volume or in relation to the size of the land to be irrigated. Gross availability of water for farming is the objective. This occurs in systems where water is abundant as in Rani Kulo and Gorkhe Kulo of Pyuthan. There is no recognized denomination of water. All the irrigators have access to water when and where they want it and often there is more than one inlet to field-to-field channels.

Water Allocation on a Share Basis

For allocation on a share basis, water is denominated according to some principle, usually proportional to either investment or area irrigated within the command.

Allocation on the basis of original investment or purchased shares. The quantity of water in the canal is divided into a number of shares on the basis of prior investment made by the beneficiaries. Three systems were observed where farmers get a share of water in proportion to the investment made at the initial stage. These systems are Thulo Kulo and Tallo Kulo of Chherlung and the Phalebas system of Parbat District. In Thulo Kulo and Tallo Kulo, the systems were built by raising funds from among the villagers. When completed, the total amount invested in the construction of the system was, proportionately divided into the flow of water in the canal. In Thulo Kulo, Rs 5,000 (US$200) was invested with the water divided into 50 shares. It could be divided in any number of shares. Persons who had contributed Rs 100 (US$4) during the time of construction received one share, equivalent to one inch of water in the canal. The water is divided by a proportioning weir. In these systems, land and water are separate units. Water can be sold and purchased separately from the land.

Some farmers who did not contribute to the initial investment for construction of the canal have acquired a share of the water by buying it from the initial

investors, thereby expanding the command areas of the systems. The Chherlung Thulo Kulo and the Phalebas systems in particular have expanded their command areas this way. In Phalebas it is estimated that 2.2 liters/second/ hectare (liters/sec/ha) are needed to grow rice. The standard maintained by the Farm Irrigation and Water Utilization Division (FIWUD) of the Department of Agriculture when designing a system is three liters/sec/ha. Many hill irrigation systems require more than three liters/sec/ha for rice production. However, the Phalebas farmers have been managing to cultivate rice with less water. Although Phalebas is water-stressed, farmers have expanded the irrigated area and increased the number of beneficiaries. The additional beneficiaries are critical to obtaining enough labor to make possible the acquisition of sufficient water and the operation and maintenance of the system.

Any transaction of water shares must be registered with the irrigation committee, and according to the size of the share, obligations to contribute to maintenance of the system are determined and assigned.

Water allocation based on time. In the Phalebas system, water is divided into shares. At the time of the construction of the system in 1955, different villages contributed cash for the construction of the system. The money mobilized from among the villagers was not in equal proportions, however. After completion of the system, water shares were divided first among the villages on the basis of their respective total investment. Each village in turn allocates its water on the basis of individual investments. Since this is a water-stressed system, the number of hours a farmer receives irrigation water is proportional to the amount of investment he has made.

Water allocation in proportion to size of landholding in the command area. Water allocation in proportion to the area irrigated is considered a general principle of water allocation. Raj Kulo of Argeli has adopted this principle. The land to be irrigated is served according to the availability of water and distributed by wooden proportioning weirs (called *saachos* in Nepali). The size of the notches in the proportioning weir serving each downstream area is fixed according to the area of land to be irrigated in each area.

Water allocation on the basis of labor contributions for maintenance In systems following this principle, water is allocated according to the number of laborers a village contributes toward maintenance. The size of the outlet in the main canal is measured in *lathi* (a three-foot-long stick). A village getting one *lathi* of water must contribute 16 laborers per day during canal and intake repair and construction. If a village is willing to contribute more laborers, that village

can obtain more lathi, and therefore a larger outlet from the main canal. A village that is unable to mobilize much labor receives less lathi. The size of the outlet from the main canal changes frequently. Badkapath and other irrigation systems in the Deukhuri valley base water allocation on *lathi*.

Water Allocation Based on Type of Land

In some systems, fields on slightly higher land are entitled to get water and lowlands are not given irrigation water. In Pancha Kanya of Chitwan district, land is classified into *tar* (higher land) and *ghol* (very low-lying land with access to water from natural sources); the *tar* area gets irrigation water.

Water Allocation on Demand

In Pithuwa, when a farmer needs water, he registers his name in the register book. Within the command area at the branch level, water is allocated according to the order in which names are registered. In this case, water supply is not the major constraint, but there is not enough water to serve all the beneficiaries at the same time, so scheduling is important in order to avoid conflict and disorder in water distribution.

DISTRIBUTION OF WATER

The distribution of water requires definite rules with specific roles for the irrigation organization to perform.

In those systems where water is to be distributed by share or by time rotation based on the proportion of land in the irrigated area, wooden proportioning weirs, or *saachos* (also called *gahak, paani dhara* or *khat bunda* in Western

Nepal [Martin and Yoder, 1987]) are fixed in the canals so that everyone knows how much water is flowing and where it is going.

In other places, when there is water stress, wooden weirs may be installed to distribute water. When water is abundant, wooden weirs are not used except in those systems where water is allocated according to shares. These weirs minimize conflict in water distribution.

In one village of Phalebas, a water share of Rs 100 entitles the shareholder to five hours of water (Rs 1 = 3 minutes' water). The allocation schedule is based on 7 or 14 turns. Each turn is 12 hours long. If the schedule consists of seven turns, an individual receives a second water application in 72 hours, or in a 14-turn schedule, he gets water after 144 hours. In a 14-turn schedule, water is released to a particular field for twice the amount of time as is allowed in the 7-turn schedule.

There are a few systems where the water distribution schedule is determined by lottery. All the landowners assemble before the agriculture season starts. The order for water delivery is fixed according to the number drawn in the lottery. A person who does not have land in the command area is hired to distribute water accordingly. With this method, a tail ender might receive water first or last. The sequence for distribution changes each year. Marpha and Jomsom of Mustang District use this method for scheduling water distribution.

Most conflicts revolve around the question of water distribution. In many systems, particular attention is given to water delivery activity. In many systems, officials are appointed to ensure that water delivery is in accordance with the designated allocation of each beneficiary.

Large *Tarai* irrigation systems allow outlets to the village canals from the main canal. These systems generally do not have secondary branch canals. The chairman and other members regulate the size of the outlet and the distribution of water to the village canals. The outlets are temporary structures needing regular supervision by the central committee officials to ensure that they are not tampered with and that distribution is in accordance with entitlement. The chairman of Chhattis Mauja and the paani pradhan of Badkapath are responsible for distribution of water at the outlet levels. The job of water distribution at the village level requires supervision of 24 hours a day. In many systems, an area representative is appointed to supervise water distribution. An area representative in Phalebas, the *tharis* in Thulo Kulo and

Tallo Kulo of Chherlung, and the muktiyar in Chhattis Mauja perform this duty. In Badkapath, a *paanihari* is responsible for water distribution among the farms at the village level. This system has specialized positions for irrigation activities such as *ketkandar, agheriya, puncheriya,* and *jharulu*. In the Pithuwa system, the secretaries of the branch committees are responsible for distributing water according to a rotation system.

In Satrasaya Phant, water distribution is performed by a contractor. Guidelines are specified by the management committee and the contractor is responsible for supplying water to the farms. He is fined if he fails to do his job in accordance with the guidelines.

Farmer-managed irrigation systems employ different water allocation methods depending on the requirements of the system. Distribution is adjusted according to the timing and needs of the land and crops. Distribution at the farm level often requires intense supervision by committee members. These farmer-managed systems have had to adapt to a variety of circumstances in order to obtain irrigation for agriculture.

CHAPTER 6

Resource Mobilization and Management

RESOURCE MOBILIZATION AND management are prominent tasks of all irrigation organizations (Martin, 1986; Pradhan, U., 1988; Pradhan et al., 1988). Three kinds of resources are mobilized in the 21 systems under study. First, *labor* contributions for repair and maintenance are the most common resource observed in all the systems. *Cash* contributions in lieu of labor are a second type. A third kind of resource mobilization is material contributions such as bullock carts to transport boulders and forest products or construction materials such as gabion wire. These resources are mobilized from among the beneficiaries of the system, i.e., internal to the system. The other source of resources is outside the system, or external resource mobilization. External resource mobilization might be a contribution from the government or other agencies including nongovernmental organizations in the form of a *monetary grant* for a specific purpose, a regular government contribution for O&M, or a *material contribution* by the government supplying gabion wire or cement for strengthening the physical system. Figure 4 presents a matrix showing the kinds and sources of resources that might be mobilized by a farmer-managed irrigation system.

Contributions from outside the system are also sought when repair of the system is beyond the capacity of the beneficiaries. The external source of resource mobilization can be sub-categorized as government, non-governmental organizations, and other FMIS. Most of the irrigation organizations have provisions for resource mobilization to meet emergency situations. Hence, the basis for resource mobilization differs from system to system but resource mobilization is one of the important tasks in all irrigation systems.

Figure 4. Matrix of the kinds and sources of resource mobilization.

Kinds Sources	Labor	Cash	Kind
Internal			
External			

All the systems in the study have up-to-date records of the water share each member is entitled to, and records of the contribution to be made by each member for system maintenance and operation, along with annual income and expenditure in the system.

At the farmers' meeting before desilting the canal and repairing the intake, resource mobilization is always at the top of the agenda. A report on the resources that were mobilized and individuals who contributed to the effort during the past year is prepared by the secretary of the organization and is reviewed at the general assembly each year. The farmers also discuss methods for the collection of dues from the beneficiaries.

BASIS OF RESOURCE MOBILIZATION

The resources that each beneficiary must contribute are usually related to the person's water allocation. The amount of labor or cash per unit of water is determined by the general assembly of irrigators at their annual meeting. Once the contribution rate is agreed upon and approved, the committee enforces it strictly. Exemptions are seldom allowed. Collection of dues as part of resource mobilization is strictly implemented.

Basis for Labor Mobilization

Contributions of labor by the farmer-members are the most common form of resource mobilization. However, the method in which the labor contribution requirement is calculated differs from system to system, usually figured in terms of how much labor a farmer (a household) must contribute on each day for the entire period when group maintenance or repair of channel structures is being done.

Proportional to landholding within the command area. Labor contributions calculated in proportion to the landholding within the command area seek to achieve equity between big and small landholders. Those with big holdings are required to contribute to group work more than small landholders.

A farmer with 20 *maato muri* (0.25 ha) in Raj Kulo of Argeli is required to contribute one laborer per day until the routine maintenance and repair are completed, irrespective of the number of days taken. A person holding only ten *maato muri* (0.12 ha) contributes one laborer on alternate days. Twenty *maato muri* is the landholding unit used to calculate the labor contribution for irrigation maintenance. Everyone using the irrigation facility must contribute labor and no exemption is given. The ratio of 20 *maato muri* to one laborer per day is also followed in Charsaya Kulo, whereas in Bhanu Baraha, beneficiaries must contribute one laborer per day per every five *maato muri* (0.6 ha) they irrigate.

In Rani Kulo, Gorkhe Kulo, and Kwadi Kulo, the irrigators have fixed a landholding category relating to the labor contribution required: up to 16 *maato muri* (0.2 ha), one laborer to be contributed; from 16 to 32 *maato muri* (0.2-0.4 ha) two laborers; and 32 to 40 *maato muri* (0.4-0.5 ha), three laborers to be contributed. Here, the category is the basis, not a proportion as observed in Raj Kulo of Argeli.

In the Charhajar system, the main canal is divided into three sections, Barahabot, Agrakhe, and Bahatar dam. Cleaning of the canal starts at the tail. All the beneficiaries start working here, but farmers having up to five *maato muri* (0.6 ha) are required to clean the main canal only up to Barahabot or pay 75 *paisa* (US$0.03) per *maato muri*. This section is only one-third the length of the main canal. Farmers having up to ten *maato muri* then continue cleaning the canal up to Agrakhe, and farmers having 15 *maato muri* clean up to Bahatar dam. Farmers irrigating more than 15 *maato muri* must work from the tail up

to the main intake. When it is time to construct the brush diversion dam, all the beneficiaries must provide additional contributions. Beneficiaries irrigating 5 to 10 *maato muri* must contribute two days of voluntary labor for repair of the diversion dam. Those with 10 to 15 *maato muri* contribute 3 to 4 days of labor, and those having between 15 to 30 *maato muri* can contribute either labor or cash. However, farmers with over 30 *maato muri* must contribute labor.

Proportional to investment by farmers. In Thulo Kulo and Tallo Kulo of Chherlung, a farmer owning one water share must contribute one laborer for system maintenance. An additional contribution is calculated in proportion to his water share and he must continue to provide this amount of labor for as long as the maintenance work lasts.

In Phalebas, anyone holding a water share worth one rupee or more is required to contribute one laborer during maintenance and repair work. Recently, the farmers are allowed cash payments calculated in proportion to crop yield in lieu of labor.

Labor contribution on the basis of outlet size. Labor contributions based on the size of the outlet serving a command area is seen either in big systems where many laborers have to be mobilized for desilting the main canal and repairing the intake and diversion dam such as Badkapath or Pithuwa, or in small systems such as Baraha Kulo of Yampa Phant. In small systems, fewer laborers are available; therefore, to ensure that sufficient labor is available to perform the repair work, the provision of labor contribution on the basis of outlet size is enforced.

In Badkapath, a village with an outlet of one lathi must contribute 16 laborers for main canal maintenance and repair. Within the village served by a particular outlet, labor mobilization is based on landholding size and it is designated as one laborer for every three hectares of land.

In the Pithuwa system, the central committee assigns the cleaning of certain sections of the main canal to specific branch committees whose members must then mobilize the farmers in their own branches. The central committee divides the main canal into 16 sections since there are 16 outlets, and assigns a section to each branch committee. The farmers can decide to desilt the main canal themselves or they can give a contract to a third party and pay the labor cost. At times, the central committee allocates a certain amount of money to each branch committee to subsidize the cost of cleaning the canal. This money may not cover the full cost of the job, so the branch committee must make up any difference in the cost.

Where there is a proportionally large requirement for labor, labor contributions may be assessed on the basis of the size of the outlet. This method assigns to the branch committee all responsibility for determining how much each individual must contribute.

Labor contribution according to the area cultivated in the village. Chhattis Mauja is a large farmer-managed irrigation system which mobilizes about 60,000 man-days each year for maintenance of the main canal, intake, and repair of the diversion dam. This system's command area includes 54 villages. Each village has its own outlet from the main canal. The amount of land irrigated by each outlet is used as the basis for calculating the labor contributions required in Chhattis Mauja. The term used for such mobilization is *maujane khetara*. One *maujane khetara* is equal to 20 laborers from one village. The number of *maujane khetara* varies in proportion to the irrigated land in the village. The *meth muktiyar* (technical supervisor) of the central committee assigns a length of the main canal to be desilted by each village. The measurement unit is known as *nath*, a stick seven-and-a-half feet long. The length and specifications for desilting are assigned to the village by the meth muktiyar who supervises the work. The villagers have to work until he is satisfied with their performance. The meth muktiyar can impose punishment on a village for poor work performance. Within the village, labor mobilization is based on the size of landholding, calculated according to one person per 1.25 ha.

Labor contribution on the basis of households in the command area. In some systems the labor requirement for canal maintenance and intake and diversion dam repair is very high. All households cultivating land in the command area have to contribute labor. The Lothar irrigation system in Chitwan District is an example where labor mobilization is based on the number of households in the command area, and not on the basis of landholding, as is more typical. This system has 300 landholders but they must sometimes mobilize more than 300 people in a day. In the early rice season, because of water shortage, the irrigation organization allows the cultivation of rice on only 25 percent of the land. Therefore, persons with large landholding lease out fallow land to landless people on a share-cropping basis. The sharecroppers often manage to get water to the leased land and to cultivate rice. Once they have used irrigation water for agriculture, they are obligated to contribute labor to the system whether they own the land or not. Leasing of land to landless

people in order to mobilize additional labor is an unusual system in Nepal. This type of labor mobilization contributes only a small proportion to the number of laborers the system requires.

Cash Contributions from Beneficiaries

Landholding as the basis for fixing the rate of contribution. There are systems where the maintenance responsibility is contracted out to a third party. These systems need cash to pay contractors. In the Upallo Kulo of Damka, Rs 160/ha is collected in cash for maintenance of the system. In Satrasaya Phant, farmers pay Rs 100/ha. In the government system of Sange Patiyani, farmers pay Rs 60/ha.

Yield as the basis for fixing the rate of contribution. In Sota Kulo of Damka, the contribution for maintenance is raised on the basis of the yield of the land. Rs 4.50 (US$0.18) is fixed for one *muri* (60 kg) of rice yield. Previously, farmers maintained the system themselves. One person per household irrespective of the size of holding was required to contribute labor but this method did not work well because most of the Sota Kulo farmers do not live within the command area. They also wanted a more equitable method for mobilizing labor. This led the farmers to find an alternative. They introduced the system of giving a contract for regular maintenance work. In order to raise money, they decided to collect resources on the basis of yield. According to the farmer leader of the system, collection of resources on the basis of yield protects the small and poor farmers. This also incorporates many other considerations such as quality of soil, availability of water, and locality (i.e., whether the land is situated at the head or tail of the system).

In some systems where cash is collected in lieu of labor contributions, as in Phalebas, the irrigation committee has worked out ranges for production. A farmer with 1-10 muri of rice production has to pay Rs 80; 10-20 muri of rice is assessed Rs 120; and, 20 and above, Rs 190.

Cash collection on the basis of assessment of work to be done. The amount of work to be done determines how much money is needed, so rather than follow a fixed formula, the amount needed may be apportioned among all users in some way. This practice is observed for desilting branch canals in Pithuwa, where the money expected from each farmer is in proportion to the area irrigated.

Collection of cash for penalties. In systems where labor contributions are required, strict rules are enforced. Except for the possible exemption of irrigation committee members, any persons who fail to provide the required labor contribution are fined. In some systems, the absentee is fined the equivalent of a day's wage. In systems where there is a shortage of labor or where alternative employment outside the system is easily available, the penalty for absence is set at *double* the wage rate of the area. These penalties are imposed to discourage people from being absent and to make maintenance a community effort.

Should the call for emergency maintenance be ignored, the penalty may be increased to two to four times the daily wage rate of the area. These penalties are enforced vigorously. Non-compliance can lead to collection of the fine by use of force, or depriving the violator of irrigation water, or to ostracism.

Resource Mobilization for Emergency Situations.

All systems have mechanisms for emergency management activities. Emergency activity can be classified as 1) ordinary repair which needs immediate attention requiring perhaps 10-15 people; 2) big damage which requires the mobilization of all members, but the system itself is not in grave danger; and 3) endangering damage which requires mobilization of all residents of the villages within the command area. If the necessary steps are not taken immediately, the whole crop might be lost or the physical system might sustain major damage.

The intensity of the emergency situation differs with the type of irrigation system. Hill irrigation systems and *Tarai* systems with intakes from big rivers usually have detailed procedures for emergency operations.

In Raj Kulo of Argeli, and Thulo Kulo and Tallo Kulo of Chherlung, different names are given for different types of labor mobilization. Ordinary mobilization is called *mamulate;* the large mobilization which needs immediate attention but is not so serious is called *jhara;* and emergency efforts which require not only the work of all members of the system but of the whole village is known as *mahajhara.*

Different terms are also used for the mobilization of labor in Chhattis Mauja. These are:
1) *Double:* When something happens and normal mobilization alone cannot cope with this situation, double the work force is mobilized.
2) *Jharulra:* This is a kind of emergency call; four times the usual work force is mobilized. This type of call is made when the diversion dam is washed away or breached by floods during the cultivation of rice.
3) *Site Jhara:* When some big crisis occurs in the irrigation system, people are mobilized by the sound of a whistle. All men above 14 years of age (those wearing a cap)[1] within the irrigation command area must respond to the call. People using water for utensil cleaning or for animals are also required to contribute labor during this type of mobilization.

In the Badkapath system, if the emergency situation cannot be handled by the farmers of the system alone, the paani pradhan asks the paani pradhans of other systems within the Deukhuri valley for help. The farmers of other systems cooperate to fix the system, knowing that they may have to request similar help at some time in the future. The systems in the Deukhuri valley all have intakes off the large, strong Rapti river, and emergency situations often arise requiring this type of inter-system cooperation.

Even in systems where maintenance is undertaken through contract, there are provisions for mobilization of farmers in case an emergency occurs in the system. In Satrasaya Phant, Upallo Kulo, and Sota Kulo of Damka, a provision is included in the contract that if a needed repair in the system cannot be completed by the contractors in three days' time, all the farmers of the system shall be mobilized to complete the job. In all systems, the provision for meeting emergency situations is spelled out by the irrigation organization.

EXTERNAL RESOURCE MOBILIZATION

Resource mobilization from outside the system includes cash and kind resources mobilized from the central or local government, or labor contributions from other systems in emergencies.

---

[1]In Nepal, usually all adult males wear a cap. They are expected to respond to this call for emergency work.

Farmer-managed systems look for outside resources, first, for augmenting, assuring, and minimizing the labor requirements for maintenance, and second, for increasing the volume of water flow in the system.

Raj Kulo of Argeli received help from the government to rehabilitate a large section of the main canal along the hill. This has helped them reduce their annual maintenance task and made the flow of water more reliable.

Thulo Kulo of Chherlung has been mobilizing resources from the village panchayat for canal improvement over the last several years. Weak points in the canal have been rebuilt with these external resources. Recently, they borrowed Rs 83,000 (US$3,450) from the ADB/Nepal to install a water turbine in the canal to mill grain. The money earned from milling will be the property of the Thulo Kulo irrigation organization and used for maintenance and repair of the system.

The Pithuwa irrigation system receives about Rs 40,000 (US$1,660) a year from the Department of Irrigation for O&M and a bulldozer for three months to clear the sand and boulders from the intake. Besides this government grant, the farmers mobilize about Rs 80,000 (US$3,350) on their own for maintenance and repair of the system.

Chhattis Mauja has mobilized some resources from the government: a bulldozer for desilting the canal and gabion wire for river training. Phalebas had a lump sum grant of Rs 7,000 (US$300) from the government about 45 years ago for construction of the system.

Besides cash and material mobilization from the government, there are instances when resources from outside the system were mobilized by selling water. Thulo Kulo of Chherlung expanded its command area by selling water for a new area, and the money thus collected was used for improving the system so that more water was available. This also added new members to the system.

In Raj Kulo of Argeli, after the rehabilitation of the main canal, maintenance was reduced and water delivery became more reliable. The irrigation committee decided to sell extra water to a new area and contribute the money thus raised to local school improvement. The objective of this scheme has not been realized as yet.

USE OF CASH INCOME

Cash income acquired by the organizations is used for many purposes.

Developing Physical Infrastructure by Strengthening Weak Points of the System

Many irrigation systems have made innovations and improvements over a period of time using the money raised either from within or from outside the system. When many irrigators were tenant farmers in Raj Kulo, they were not interested in improving the system, and the money collected from fines was spent on feasts at the end of the irrigation season. When the land reform program was introduced, absentee landlords were forced to sell their land to small farmers. When many of the tenants became landowners, a feeling of ownership over the irrigation system was developed among these farmers and efforts were made to invest money in physical improvements. This led to still more investment in the system as farmers saw improved irrigation facilities as being closely linked to agricultural productivity.

In Thulo Kulo and Tallo Kulo, after the initial investment for system construction was made, the farmers continued to strive to improve the system. As a result they have been able to bring more water into the command area. Again, a feeling of ownership of the system has encouraged farmers to continue to invest in the improvement of their systems.

In Upallo Kulo and Sota Kulo of Damka, the irrigators have invested money for tunnel improvement and canal widening on several occasions. This helped bring more water into the command area so that less emergency maintenance is required.

Investment of Money for Interest Earning

Rani Kulo and Bhanu Baraha Kulo have both used the cash collected from fees as capital for providing loans on interest. The interest earned from the loans

is eventually used for the improvement of physical infrastructure. During the time of this study, Rani Kulo had Rs 15,000 in savings and Bhanu Baraha Kulo had Rs 800.

Payment for Services Rendered to the System

Salaries to employees of the system need to be paid from the cash collected. The salaries of messengers, an honorarium for the committee chairman at Chhattis Mauja, and honorariums for the *chaukidars* of Tallo Kulo, Thulo Kulo, Phalebas, and the jimmuwal of Charhajar Kulo are paid out of these systems' cash incomes.

Contributions to the Local School

The Lothar irrigation system has a cash saving of Rs 15,000 which was deposited in the local bank. The community has designated some of these savings for operation of the local school.

Expenses in Buying Equipment and Materials

Some systems such as Chhattis Mauja use cash income to buy equipment used for maintenance of the system. Other systems have purchased bicycles for the organization's messengers.

Some systems do not want to maintain a cash balance. Rani Kulo, Charsaya Kulo, Badkapath, and Charhajar all spend any money remaining at the end of the year on feasting at the end of the irrigation season or for paying their irrigation officials.

LANDHOLDING RECORDS AND ACCOUNT MAINTENANCE

All of the irrigation systems maintain records of the landholding of the members of the irrigation organization which are updated each year. Landholding records are important for mobilization of the labor required for maintenance. Also, since the irrigation facility is available only for a certain defined command area, records are important in determining who is entitled to get a share of the irrigation water.

Another important reason for maintaining up-to-date records is to proportion the share of water among different outlets according to their respective entitlement.

Along with the landholding and water share records, there are usually well-kept records of attendance at maintenance and repair work. On the basis of this record, defaulters are required to pay fines for failing to contribute labor.

Method of Collection of Fines

Fines are imposed for failure to do maintenance work, for stealing water, for breaking the canal, and for other violations of the irrigation organization's regulations. Some fines are collected from individuals and some fines are collected from the villagers as a unit. If the outlet is tampered with or water is stolen among outlets, and if the villagers involved who are fined do not pay such fines, the whole area served by the violators' outlet is closed.

The irrigation organization takes responsibility for collecting the fines. If some member defies the collection of the fine, other members of the organization go to his house, confiscate utensils, and mortgage them in one of the village shops, realizing the amount of the fine. If the defaulter wishes to recover his utensils, he must pay the amount of the fine to the shopkeeper.

In some systems, the irrigators go to the defaulter's field and harvest rice equivalent to the amount of the fine. Before taking such action, the matter is discussed in a general meeting and such a course of action is determined by the general body. Recordkeeping for resource mobilization and strict collection of dues are two features which make farmer-managed irrigation systems function under even adverse physical conditions and with weak structures.

OPERATION AND MAINTENANCE COSTS FOR MAINTENANCE OF THE SYSTEM

The O&M cost per hectare in hill, river valley, and *Tarai* systems is different. Hill systems have to mobilize between Rs 400 - Rs 535/ha as compared to about Rs 100/ha for river valley systems while *Tarai* systems spend about Rs 270-360/ha.

In hill irrigation systems, conveying the water from the source to the command area is the aspect of operation and maintenance requiring the greatest effort by the users. The distance from the intake to the command area is usually long, passing through steep, rocky terrain prone to frequent landslides. This requires frequent repair and great amounts of labor each season.

Tarai irrigation systems usually have large command areas and use large rivers as their source of irrigation water. Floods in these big rivers wash away the intakes and require frequent repair to sustain a supply of irrigation water. Hence, in the *Tarai,* maintenance of the intake is the largest component of costs.

River valley systems have lower O&M costs because their command areas are close to the water source and no long conveyance structures are required. The terrain is not difficult and fewer repairs are necessary.

Table 9 provides details of the contributions required for operation and maintenance per hectare according to type of irrigation system.

Table 9. Cost of operation and maintenance per hectare.[a]

Tarai systems	Rs	Hill systems	Rs	River valley systems	Rs
Chhattis Mauja	270	Raj Kulo	300-400	Charhajar	37
Pithuwa	133	Thulo Kulo	500-700[b]	Bhanu Baraha	40
Pancha Kanya	NA	Tallo Kulo	500-700[b]	Charsaya Phant	35
Lothar	430-680	Upallo Kulo	160	Phewa	NA
		Sota Kulo	80	Badkapath	50
		Satrasaya Phant	80	Rani Kulo	180
		Baraha Kulo	100	Gorkhe Kulo	180
		Sange Patiyani	600	Kwadi Kulo	180
		Phalebas	860		
Average	277-361	Average	408-535	Average	100

Notes:

[a]Figures are computed on the basis of information given by the farmers plus the account mentioned in their record books.

[b] Martin, 1986.

CHAPTER 7

Summary

CONCLUSIONS

THE LIMITED FUNCTIONS of the government in Nepal and the tradition of non-intervention in irrigation water management at the community level for hundreds of years have led to the development of thousands of farmer-managed irrigation systems. Sixty-seven percent of irrigated agriculture in Nepal is farmer managed. 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. Their physical characteristics influence the frequency and 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 or as large as 15,000 ha have been identified in the country.

Irrigation tasks performed by FMIS. On the whole, irrigation organizations perform water acquisition, water allocation and distribution, resource mobilization, system maintenance, decision making, communication 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 factors. The factors that keep the organization functioning do 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 while in others, it might be only resource mobilization, while in still other systems, the preservation and safeguarding of water rights at the source might be the compelling force, with irrigation tasks performed through contractual arrangements employing other people. Hence, the cementing factor for organization differs from system to system.

Water as a community resource. In farmer-managed systems, water is conceived as a community resource owned by the group. The acquisition of water is a community effort. Hence, the principle of water allocation and water distribution is determined by the community as a whole. The community allocates water to individuals. The allocation principle is to be observed by all. Any violation of the allocation principle by an individual is subject to penalty. The conditions of the penalty are determined by the community.

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 a change takes place in the resource situation within the environment of the system.

Irrigation systems in Nepal are geared for rice cultivation, and most of the committees are active from July to August. After the rice 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. A change in one environmental factor, whether physical or socioeconomic, 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 according 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 have come into existence because of government neglect of the system. In Pithuwa, for example, 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 encouraged the formation of the farmers' irrigation organization in Pithuwa. The 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 this 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. Decisions are made by the general body.

Management committee. An irrigation management committee usually exists to carry 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 10-member committee manages the system. Here the intensity of task performance in water acquisition, distribution, labor mobilization, and system maintenance is so high that the collective effort of a large group of people is required all the time.

Two types of irrigation leaders heading these committees have been observed: hereditary and elected leaders. The hereditary irrigation leaders are generally found in older settlements. However, both types of irrigation leaders are subject to renewal each year.

Remuneration to committee members differs across systems. Cash or kind remunerations are observed. There are systems where no remuneration is provided. However, the committee members' performance does not necessarily depend on the amount of remuneration. Because committee members are also

beneficiaries of the system, the benefit that they derive from agriculture depends on the performance of the irrigation system so their contribution in irrigation management is an honorary job. Their identification with, and commitment to the system are the basic factors motivating them to participate in management.

Constitution, rules, and regulations. Many of the farmer-managed systems do not find it necessary to have a written constitution or written rules and regulations. The rules and regulations governing irrigation water management are known to all within the community. Regular communication between the committee and irrigators is more important.

Tiers of organization. Tiers of irrigation organization depend on the size and complexity of the task to be performed. Each tier has specific tasks. The primary tiers are generally responsible for resource mobilization, water distribution, and maintenance of harmony in the small community. Where several systems share the water source, joint inter-system committees exist to coordinate water acquisition and allocation among the systems and assure that the necessary resources are mobilized in proportion to the command area of each system.

Resource mobilization. The basis for resource mobilization differs from system to system. Resource mobilization may be based on the size of landholding, water share, outlet size, village units, or the number of households in the command area. Besides resource mobilization for regular activities, there are provisions for resource mobilization during emergencies. Structural weaknesses are compensated for by strong management in resource mobilization to keep the system functioning.

Water allocation and distribution. Water allocation and distribution are important tasks for the irrigation organization. Allocation may be based on the size of landholding, labor contributions for maintenance, original investment, water share, or on the type of land. Water may be distributed according to the agreed allocation principle through proportioning weirs *(saachos)* or measured outlets (*lathi*).

Distribution needs intensive supervision. Elaborate distribution schemes are developed where the water supply is barely sufficient. If proper distribution is not done, many suffer. Where there is abundance of water in the system, water distribution is not the major task. Hence, efforts to carry out water distribution are a function depending on the availability and the quantity of water in the system.

Intensive manpower deployment is required to make the system work. Any system with timed rotation or water share distribution requires intensive supervision. The ratio of irrigation personnel required to supervise an area is usually about one person for every 5-10 ha of irrigated area.

Roles and responsibilities of users are defined on the basis of water allocation or water entitlement. Hence, each farmer must contribute either labor or cash for the operation and maintenance of the system.

ISSUES REQUIRING FURTHER RESEARCH

- Further information needs to be collected regarding the principles, logic, and values that influence decision making in FMIS.
- Further research is needed to identify factors that are important to effective irrigation organization and management and those factors that contribute to ineffective management.
- Investigation into the interrelationship between FMIS and the political context could help determine the factors that encourage self-sustaining, self-governing, effective organization for more productive irrigated agriculture. Consideration should be given to developing a strategy which would coordinate government assistance to the characteristics and resources found in FMIS.
- Tools for comparative analysis need to be developed to facilitate analysis of irrigation organizations across geographical locations and cultural environments.

IMPLICATIONS AND ISSUES FOR THE GOVERNMENT TO CONSIDER

The practices employed by farmer-managed irrigation systems in Nepal suggest a number of ways that might improve organization and efficiency in government-managed irrigation systems. The underlying principles that bind

the beneficiaries of farmer-managed systems together can be adapted and applied to government management. The examples of the 21 systems studied and the fact that two-thirds of all the irrigation systems in Nepal are farmer-managed clearly indicate that the farmers have the capacity to shoulder the responsibility for operation and maintenance of their systems. However, it is important to realize that the beneficiaries must perceive the water resource as community property in order to get them to work together for the benefit of all. In agency-managed systems, water is perceived as a government-owned resource, and people do not take responsibility for utilizing it in the best interest of the community.

In farmer-managed systems the beneficiaries participate in the decision-making process of all irrigation-related activities. This makes it possible to enforce the decisions and obtain the compliance of the community. Water distribution and resource mobilization in FMIS are based on water allocation entitlement, thereby reducing inequities. Furthermore, because the beneficiaries are involved in determining water allocation they have a clear idea of their obligations and responsibilities for implementing the system agreed upon. In agency-managed systems, the main task is water distribution by the government. The beneficiaries do not necessarily feel that they have any obligations or responsibilities to the system.

By understanding how and why FMIS function, the government can prepare a plan to share irrigation responsibilities as appropriate in the presently government-managed systems. Appropriate organization for irrigation needs to be perceived by the government as a form of infrastructure to be encouraged. There are so many different patterns of organization in irrigation communities that it would not be wise for the government to decree that all irrigation organizations conform to one model. An attempt must be made to incorporate the participation of farmers in the formation and operation of water users' committees. The structure for organization must be flexible enough to accommodate the changing physical, social, and economic environment.

Government agencies usually consider physical improvement of a system as most important. However, in order for an irrigation system to function, "nonstructural" improvements must be implemented along with structural improvements. Nonstructural improvements include training and employing the farmers in irrigation management, encouraging government irrigation employees to use the farmers as a resource, and giving irrigation organizations a legal status. Farmer-managed systems have proven that even weak physical structures can be compensated for by strong and disciplined irrigation organizations.

References

Asian Development Bank. 1982. Nepal agriculture sector strategy. Manila, The Philippines.

Coward, Walter E. 1980. Irrigation development: Institutional and organizational issues. In Irrigation and agriculture development in Asia, Walter E. Coward (ed). Ithaca, New York: Cornell University Press.

Department of Irrigation. 1988. Sectoral lending strategy paper. Paper presented at the Irrigation Sector Coordination Meeting, Kathmandu, Nepal, 22 February 1988.

Development Research Group. 1986. Rapti rural area development project, medium irrigation appraisal study report. Lalitpur, Nepal: Development Research Group.

Ghimire, L.P; Onta, I.R. 1980. Traditional tunnel technology as applied to hill irrigation in Nepal. Kathmandu, Nepal: Development Research and Communication Group.

His Majesty's Government, Ministry of Finance. 1988. Economic survey of Nepal 1987-88. Kathmandu, Nepal.

Laitos, Robby; Saha, Moin; Parajuli, Umesh; Early, Allen; Pradhan, Prachanda; Baxler, John; Gautam, Upendra. 1986. Rapid appraisal of Nepal irrigation systems. Water Management Synthesis Report 43. Fort Collins, Colorado: Colorado State University.

Martin, Edward D. 1986. Resource mobilization, water allocation and farmer organization in hill irrigation systems in Nepal. Unpublished Ph.D. dissertation. Ithaca, New York: Cornell University.

Martin, Edward D.; Yoder, Robert. 1987. Institutions for water management in farmer-managed systems, examples from the hills of Nepal. Digana Village, Sri Lanka: International Irrigation Management Institute.

Pradhan, Prachanda. 1984. Chhattis Mauja Irrigation System: Community response in resource management, paper for Social Science Research Council-Indian Institute of Management/Bangalore Seminar, January 4-7, 1984.

Pradhan, Prachanda; Giri, Khadka; Tiwari, Dirga Nidhi. 1988. Resource mobilization and organizational support in irrigation systems management: Experiences from Kulariya, Jamara and Rani Kulos of Kailali District in irrigation management in Nepal: Research Results. Kathmandu, Nepal: International Irrigation Management Institute

Pradhan, Ujjwal. 1988. Local resource mobilization and government intervention in hill irrigation systems in Nepal. Ithaca, New York: Cornell University Water Management Synthesis Project.

Riccardi, T. 1977. The royal edicts of Ram Saha of Gorkhe in Kailash, a journal of Himalayan studies. Kathmandu, Nepal: Ratna Pustak Bhandar. Vol. 5, No. 1.

Uphoff, Norman; Meinzen-Dick, Ruth; Nancy, St. Julien. 1985. Improving policies and program for farmer organization and participation in irrigation water management. Ithaca, New York: Cornell University.

Uphoff, Norman. 1986. Improving irrigation management with farmer participation. Boulder, Colorado and London: West View Press.

Water and Energy Commission Secretariat. 1981. Irrigation sector review, report no.3/2/19093/1/1. Kathmandu: Ministry of Water Resources.

Appendix I

Glossary of Nepali Terms

agheriya	one who leads the maintenance work at the intake
baidar	account keeper/record keeper
chaukidar	watchman, messenger
dhalpa	ditchtender, gatekeeper
dhara	proportioning weir
double	two times
gahak	proportioning weir
ghol	lowland
jhara	labor mobilization
jharulra	laborers
jimmuwal	land revenue collector at the village level
katkandar	representative of the villagers in the committee
khat bunda	proportioning weir

lathi	a stick three-feet long used for measuring the size of the outlet in the main canal
maato muri	land measurement: 80 maato muri = 1ha
mahajhara	emergency mobilization of labor
mamulate	ordinary mobilization of labor
mauja	village
maujane khetara	labor mobilization requiring 20 laborers per village
meth muktiyar	chief supervisor for canal maintenanace work
mukhiya	village chief
muri	measuring units for cereals: 60 kg = 1 muri
nath	a stick seven-and-a-half-feet long used to measure the area assigned to specific villages for canal maintenance work
paanihari	caretaker of irrigation water at field channel level
paani pradhan	person in charge of irrigation water management
panchayat	political unit
pradhan pancha	chief of the village panchayat
pucheriya	assistant of agheriya (who leads the maintenance work in intake)

saacho	proportioning weir
site jhara	labor mobilization on the call of whistle requiring all men above 14 years of age within the command area to report for emergency maintenance work
tar	river terrace
tarai	flat lands in the southern part of Nepal
thari	person in charge of the irrigation work for a specific day

FUNCTION NAME OF THE SYSTEM	WATER USE ACTIVITIES: ACQUISITION		ALLOCATION		CONTROL STRUCTURE ACTIVITIES: DISTRIBUTION					DRAINAGE	DESIGN	CONSTRUCTION	OPERATION	MAINTE
			Water right preservation		Managing water distribution							New canal alignment or relocation of intake	Operation	Maintenance
	Intake repair	Conveyance repair	Source	Command	Within shareholders	Rotation	Continuous flow	By share	Contractor					
Hill irrigation systems														
Raj kulo	0	1	1	1	1	1	1	1	0	1	0	0	1	1
Thulo kulo	0	1	1	0	1	1	0	1	0	0	0	0	1	1
Tallo kulo	1	1	1	1	1	1	0	1	0	0	0	1	1	1
Upallo kulo	0	1	0	0	0	0	1	0	0	0	0	0	1	1
Sota kulo	0	1	0	0	0	0	1	0	0	0	0	0	1	1
Satrasaya phant	0	1	1	1	0	1	0	0	1	0	0	0	1	1
Baraha kulo	0	1	1	0	0	1	0	0	0	0	0	0	1	1
Sange patiyani	0	1	0	1	0	1	1	0	0	0	0	0	1	1
Phalebas	1	1	1	1	1	1	1	1	0	0	0	0	1	1
	2	9	6	5	4	7	5	4	1	1	0	1	9	9
River valley systems														
Charbajar	0	1	0	0	0	0	0	0	0	0	0	0	1	1
Bham Baraha	1	1	0	0	0	1	1	0	0	0	0	1	1	1
Charsaya phant	1	1	0	0	0	0	1	0	0	0	0	0	1	1
Phewa	0	0	0	0	0	1	1	0	0	0	0	0	1	1
Badkapath	1	1	0	1	0	0	1	0	0	0	0	1	1	1
Ranai kulo	1	1	0	0	0	0	1	0	0	0	0	0	1	1
Gorkhe kulo	1	1	0	0	0	0	1	0	0	0	0	0	1	1
Kwadi kulo	1	1	0	0	0	1	1	0	0	0	0	0	1	1
	6	7	0	1	0	3	7	0	0	0	0	2	8	8
Tarai irrigation systems														
Chhatis Mauja	1	1	1	1	0	1	1	0	0	0	0	0	1	1
Pithuwa	1	1	1	1	0	1	1	0	0	0	0	0	1	1
Pancha Kanya	0	0	0	0	0	1	1	0	0	0	0	0	1	1
Lothar	1	1	0	1	0	0	1	0	0	0	0	0	1	1
	3	3	2	3	0	3	4	0	0	0	0	0	4	4
Total of														

Appendix III

Profiles of Irigation Systems

1. Rajkulo, Argeli

Age of the system	:	About 400 years
Location		
District	:	Palpa
Panchayat	:	Argeli Panchayat
Type of the system	:	Hill irrigation system
Name of the source	:	Kurung Khola
Command area	:	48 ha
Number of beneficiaries	:	155
Number of committee members	:	10
Chairman (elected/hereditary)	:	Hereditary
Time for assembly meeting	:	May
Other meetings	:	Emergency meeting at any time.
Water allocation principle	:	To the proportion of land

Water distribution method	:	Through the proportioning wooden weirs *(saacho)*
Resource mobilization	:	Labor contribution to the proportion of landholding
	:	Cash collection as fine. Head-reach farmer provides bullock and plough to desilt the canal.
Maintenance system	:	By the irrigators themselves
Operation	:	By the irrigators themselves
Tiers of organization	:	1
Agriculture		
Crops	:	Rice, wheat and maize
Intensity	:	300 percent
Records of irrigation activities	:	Constitution/Meeting minutes/ Accounts of resource mobilization

2.Thulo kulo, Chherlung

Age of the system	:	50 years
Location - District	:	Palpa
Panchayat	:	Bough Gumha
Type of the system	:	Hill irrigation system
Name of the source	:	Barangdi Khola
Command area	:	40 ha
Number of beneficiaries	:	108
Number of committee members	:	11

Chairman (elected/hereditary)	:	Hereditary
Time for annual meeting	:	March/ May
Other meetings	:	At any time when required
Water allocation principle	:	On the basis of share based on investment or on the basis of water transaction
Water distribution method	:	Through proportioning wooden weir called *"saacho"*
Resource mobilization basis	:	On the basis of water share
Maintenance system	:	By the irrigators
Tiers of organization	:	1
Agriculture		
Crops	:	Rice, wheat and maize
Intensity	:	300 percent

3.Tallo kulo, Chherlung

Age of the system	:	50 years
Location - District	:	Palpa
Panchayat	:	Bouga Gumha
Type of the system	:	Hill irrigation system
Name of the source	:	Barangdi
Command area	:	46 ha

Number of beneficiaries	:	134
Number of committee members	:	8
Chairman (elected/hereditary)	:	Hereditary
Time for annual meeting	:	May/June
Other meetings	:	When required
Water allocation principle	:	Water share on the basis of investment and prior appropriation basis.
Water distribution method	:	Through the proportioning wooden weir called *"saacho"*
Resource mobilization basis	:	On the basis of water share
Maintenance system	:	By the irrigators
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, wheat and maize
Intensity	:	300 percent

4. Upallo kulo, Damka

Age of the system	:	50 years
Location - District	:	Gulmi
Type of the system	:	Hill irrigation system
Name of the source	:	Hungdi

Command area	:	40 ha
Number of beneficiaries	:	113
Number of committee members	:	1
Chairman (elected/hereditary)	:	Hereditary
Time for annual meeting	:	May/June
Water allocation principle	:	Continuous flow
Water distribution method	:	Continuous flow. During scarcity, through proportioning wooden weir
Resource mobilization basis	:	Cash mobilization on the basis of size of landholding
Maintenance system	:	Through contract
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, wheat, early rice or maize
Intensity	:	300 percent

5. Sota Kulo, Damka

Age of the system	:	50 years
Location - District	:	Gulmi
Type of system	:	Hill irrigation system
Name of the source	:	Hungdi

Command area	:	25 ha
Number of beneficiaries	:	95
Number of committee members	:	1
Chairman (elected/hereditary)	:	Hereditary
Time for annual meeting	:	May/June
Water allocation principle	:	Continuous flow
Water distribution method	:	Continuous flow. During scarcity, through *saacho* (propotioning weir).
Resource mobilization basis	:	Cash mobilization on the basis of yield
Maintenance system	:	Through contract
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, wheat, early rice or maize
Intensity	:	300 percent

6.Satrasaya Phant

Age of the system	:	Over 100 years
Location - District	:	Tanahu
Panchayat	:	Abu
Type of system	:	Hill irrigation system
Name of the source	:	Adhi Spring

Command area	:	40 ha
Number of beneficiaries	:	45
Number of committee members	:	10
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May/June
Water allocation principle	:	Rotation
Water distribution method	:	Rotation from head to tail
Resource mobilization basis	:	Cash mobilization on the basis of the landholding
Maintenance system	:	Through contract
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, wheat and maize
Intensity	:	272 percent

7. Baraha kulo of Yampa

Age of the system	:	Over 100 years
Location - District	:	Tanahu
Panchayat	:	Bandipur
Type of the system	:	Hill irrigation system
Name of the source	:	Adhi Spring

Command area	:	15 ha
Number of beneficiaries	:	40
Number of committee members	:	3
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May
Water allocation principle	:	By rotation to the outlets
Water distribution method	:	Rotation system
Resource mobilization basis	:	Labor contribution from each outlet
Maintenance system	:	By the irrigators
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, wheat or peas and maize
Intensity	:	275 percent

8. Sange Patiyani

Age of the system	:	12 years
Location - District	:	Tanahu
Panchayat	:	Demauli
Type of system	:	Hill irrigation system
Name of the source	:	Sange River
Command area	:	208 ha

Number of beneficiaries	:	-
Number of committee members	:	22
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May/June
Water allocation principle	:	Rotation
Water distribution method	:	Rotation
Resource mobilization basis	:	Cash contribution
Maintenance system	:	By the government appointed contractors
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, wheat and maize
Intensity	:	200 percent

9.Phalibas system

Age of the system	:	30 years
Location - District	:	Parbat
Type of system	:	Hill irrigation system
Name of the source	:	Khalte Khola, Lamaya Khola, Bundi Khola, Dhunwa Khola. The first two are perennial. Other streams are used at different seasons.

Command area	:	134 ha
Number of beneficiaries	:	366
Number of committee members	:	12
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May/June
Other meetings	:	At any time when required.
Water allocation principle	:	Share on the basis of investment at the time of construction.
Water distribution method	:	By time rotation on the basis of share
Resource mobilization basis	:	Labor/cash. Labor on household basis. Cash on class of land area
Maintenance system	:	By the irrigators.
Tiers of organization	:	2 - Central committee - Village committee
Agriculture:		
Crops	:	Rice, wheat and maize
Intensity	:	250 percent

10. Charhajar System

Age of the system	:	Over 100 years
Location - District	:	Tanahu
Panchayat	:	Damauli

Type of system	:	River valley system
Name of the source	:	Sange
Command area	:	200 ha
Number of beneficiaries	:	215
Number of committee members	:	2
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May
Water allocation principle	:	Continuous flow
Water distribution method	:	Continuous flow
Resource mobilization basis	:	Labor contribution to the proportion of landholding
Maintenance system	:	By the irrigators
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, wheat, early rice
Intensity	:	120 percent

11. Bhanu Baraha kulo

Age of the system	:	200 years
Location - District	:	Tanahu
Panchayat	:	Bhanu

Type of system	:	River valley irrigation system
Name of the source	:	Chudi River
Command area	:	120 ha
Number of beneficiaries	:	92
Number of committee members	:	7
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May
Water allocation principle	:	Continuous flow
Water distribution method	:	Continuous flow
Resource mobilization basis	:	Labor contribution to the proportion of landholding
Maintenance system	:	By the irrigators
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, wheat, early rice
Intensity	:	187 percent

12.Charsaya Phant System

Age of the system	:	100 years
Location - District	:	Tanahu

Type of system	:	River valley system
Name of the source	:	Chudi River
Command area	:	50 ha
Number of beneficiaries	:	65
Number of committee members	:	5
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May/June
Water allocation principle	:	Continuous flow
Water distribution method	:	Continuous flow
Resource mobilization basis	:	Labor contribution
Maintenance system	:	By the irrigators
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, wheat, early rice
Intensity	:	250 percent

13.Phewa

Age of the system	:	7 years
Location - District	:	Kaski
Panchayat	:	Pokhara Towa
Type of system	:	River valley irrigation system

Name of the source	:	Phewa Lake
Command area	:	255 ha
Number of beneficiaries	:	300
Number of committee members	:	11
Chairman (elected/hereditary)	:	Members are nominated by the District Agriculture Office.
Time for annual meeting	:	No
Water allocation principle	:	Continuous flow
Water distribution method	:	By rotation among the farmers
Resource mobilization basis	:	Government grant
Maintenance system	:	Government appointed contractors
Tiers of organization	:	Not defined
Agriculture:		
Crops	:	Rice and partly wheat
Intensity	:	150 percent

14.Badkapath System

Age of the system	:	Over 100 years
Location - District	:	Dang
Panchayat	:	Goberdiaha
Type of system	:	River valley irrigation system

Name of the source	:	Rapti
Command area	:	800 ha
Number of beneficiaries	:	800
Number of committee members	:	15
Chairman (elected/hereditary)	:	Hereditary
Time for annual meeting	:	January/February
Water allocation principle	:	By the size of stick to outlets
Water distribution method	:	By rotation in the villages or continuous flow
Resource mobilization basis	:	Labor mobilization from the village according to the quantity of water
Maintenance system	:	By the farmers
Tiers of organization	:	3
Agriculture:		
Crops	:	Rice, black lentil and wheat
Intensity	:	165 percent

15.Rani kulo

Age of the system	:	200 years
Location - District	:	Dhamabati
Panchayat	:	Pyuthan
Type of system	:	River valley irrigation system

Name of the source	:	Dharmabati
Command area	:	75 ha
Number of beneficiaries	:	75
Number of committee members	:	5
Chairman (elected/hereditary)	:	Hereditary
Time for annual meeting	:	January/February
Water allocation principle	:	Continuous flow
Water distribution method	:	Continuous flow
Resource mobilization basis	:	Labor mobilization
Maintenance system	:	By the farmers
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice and wheat
Intensity	:	195 percent

16.Gorkhe kulo

Age of the system	:	200 years
Location - District	:	Pyuthan
Panchayat	:	Bijwar
Type of system	:	River valley irrigation system
Name of the source	:	Dharmabati

Command area	:	180 ha
Number of beneficiaries	:	180
Number of committee members	:	11
Chairman (elected/hereditary)	:	Hereditary
Time for annual meeting	:	January/February
Water allocation principle	:	Continuous flow
Water distribution method	:	Continuous flow
Resource mobilization basis	:	Labor mobilization on the basis of landholding
Maintenance system	:	By the irrigators
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice and wheat
Intensity	:	195 percent

17.Kwadi kulo

Age of the system	:	200 years
Location - District	:	Pyuthan
Panchayat	:	Bijayanager
Type of system	:	River valley irrigation system
Name of the source	:	Dharmabati

Command area	:	55 ha
Number of beneficiaries	:	55
Number of committee members	:	9
Chairman (elected/hereditary)	:	Hereditary
Time for annual meeting	:	January/February
Water allocation principle	:	Continuous flow
Water distribution method	:	Continuous flow
Resource mobilization basis	:	Labor mobilization on the basis of landholding
Maintenance system	:	By the irrigators
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice and wheat
Intensity	:	195 percent

18. Chhattis Mauja

Age of the system	:	150 years
Location - District	:	Rupendehi
Panchayat	:	5 Panchayats
Type of system	:	*Tarai* irrigation system
Name of the source	:	Tinan River

Command area	:	3000 ha
Number of beneficiaries	:	4000
Number of committee members	:	Central committee 16 Regional committee 9 Village committee 2-5
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May
Water allocation principle	:	Proportion to the land
Water distribution method	:	Through the independent outlets to each village
Resource mobilization basis	:	On the basis of village
Maintenance system	:	Through labor contribution by the beneficiaries
Tiers of organization	:	4
Agriculture:		
Crops	:	Rice, wheat and maize
Intensity	:	200 percent

19.Pithuwa Irrigation System

Age of the system	:	12 years
Location - District	:	Chitawan
Panchayat	:	Pithuwa
Type of system	:	*Tarai* irrigation system

Name of the source	:	Kayer River
Command area	:	900 ha
Number of beneficiaries	:	Over 1000
Number of committee members	:	Central committee 18 Branch committee 3-5
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May
Water allocation principle	:	Branch outlet continuous on the basis of land
Water distribution method	:	Rotation system
Resource mobilization basis	:	Labor contribution
Maintenance system	:	By the farmers or contract
Tiers of organization	:	2
Agriculture:		
Crops	:	Rice, mustard, maize
Intensity	:	235 percent

20. Pancha Kanya System

Age of the system	:	8 years
Location - District	:	Chitawan
Panchayat	:	Ratna Nager
Type of system	:	*Tarai* irrigation system

Name of the source	:	Pancha Kanya Spring
Command aea	:	600
Number of beneficiaries	:	Over 500
Number of committee members	:	Central committee 11 Branch committee 5
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May
Water allocation principle	:	Only the highlands will get water *(tar)*
Water distribution method	:	Rotation system
Resource mobilization basis	:	O&M fund from the government.
Maintenance system	:	By the Department of Irrigation
Tiers of organization	:	2
Agriculture:		
Crops	:	Rice and mustard
Intensity	:	179 percent

21.Lothar Irrigation System

Age of the system	:	15 years
Location - District	:	Chitawan
Panchayat	:	Piple
Type of system	:	*Tarai* irrigation sstem

Name of the source	:	Rapti
Command area	:	800 ha
Number of beneficiaries	:	300
Number of committee members	:	8
Chairman (elected/hereditary)	:	Elected
Time for annual meeting	:	May-June
Water allocation principle	:	Continuous flow for rice; area limit for early rice
Water distribution method	:	Continuous flow
Resource mobilization basis	:	Labor contribution
Maintenance system	:	By the irrigators
Tiers of organization	:	1
Agriculture:		
Crops	:	Rice, mustard, early rice and maize
Intensity	:	200 percent

Figure 5. Argeli land use and irrigation systems.

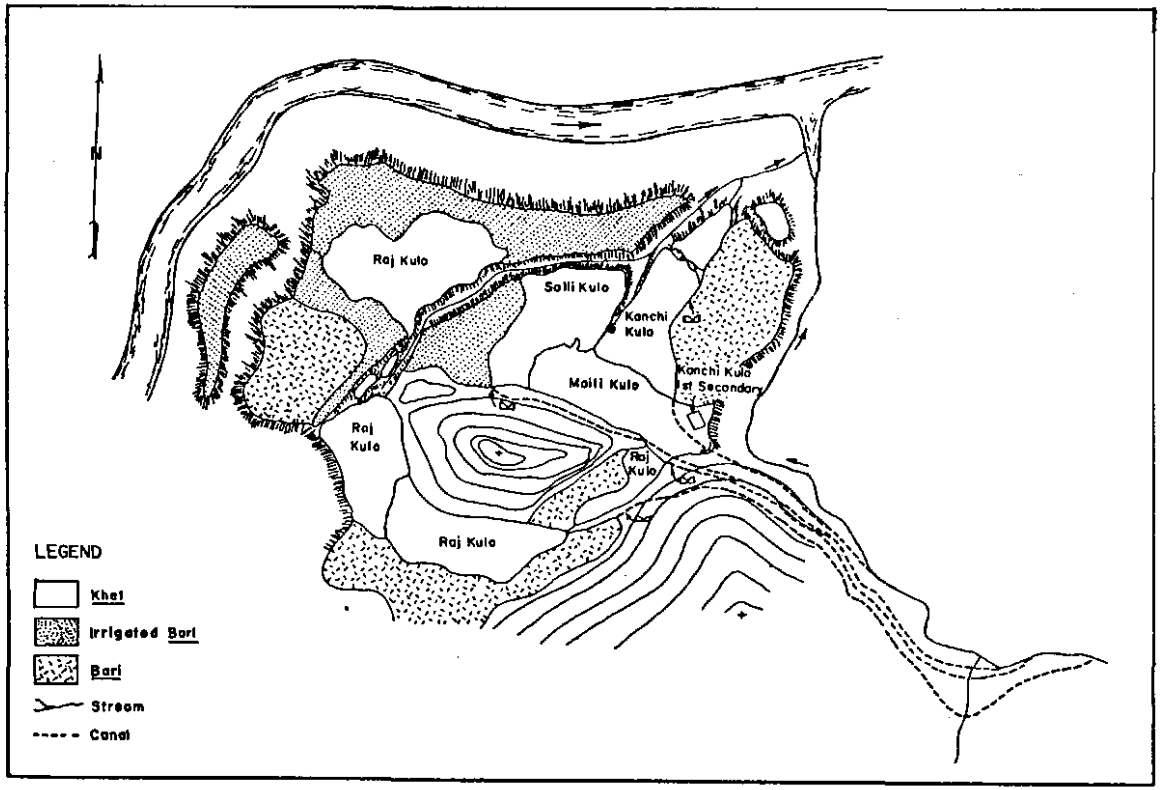


Figure 6. Thulo Kulo and Tallo Kulo, Chherlung land use and irrigation systems.

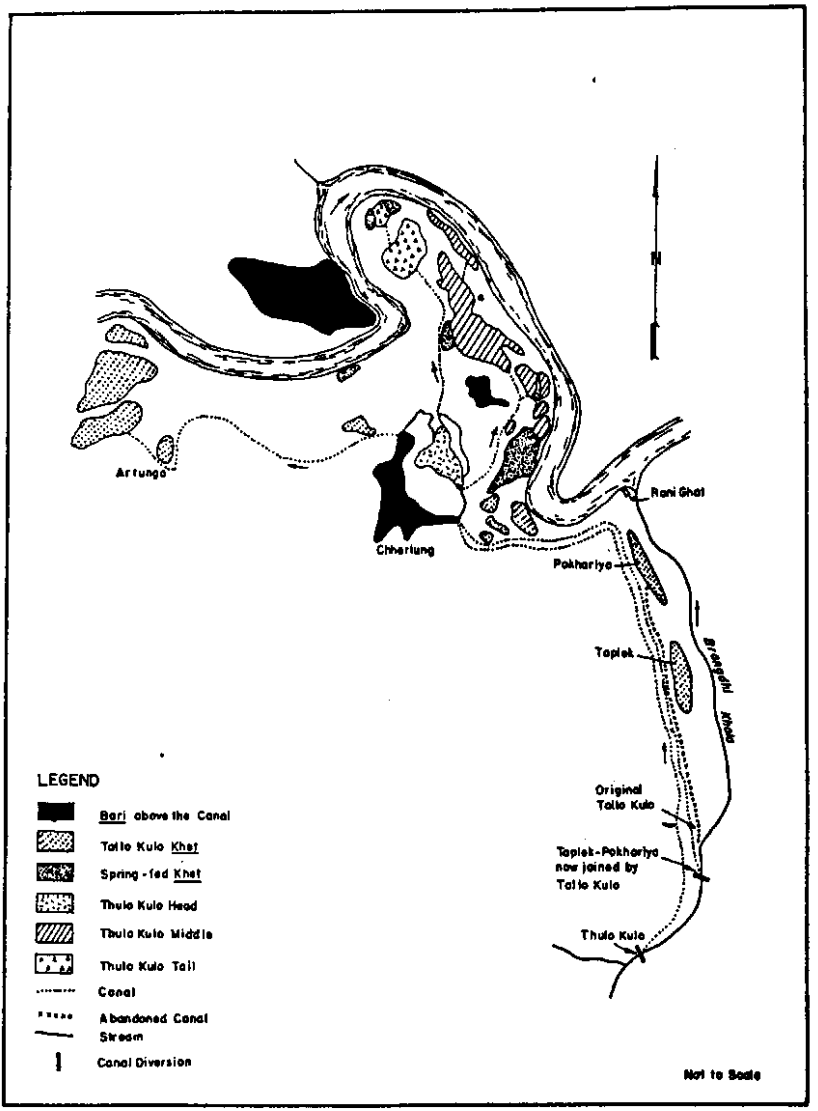


Figure 7. Upallo Kulo, Damka and Sota Kulo irrigation systems.

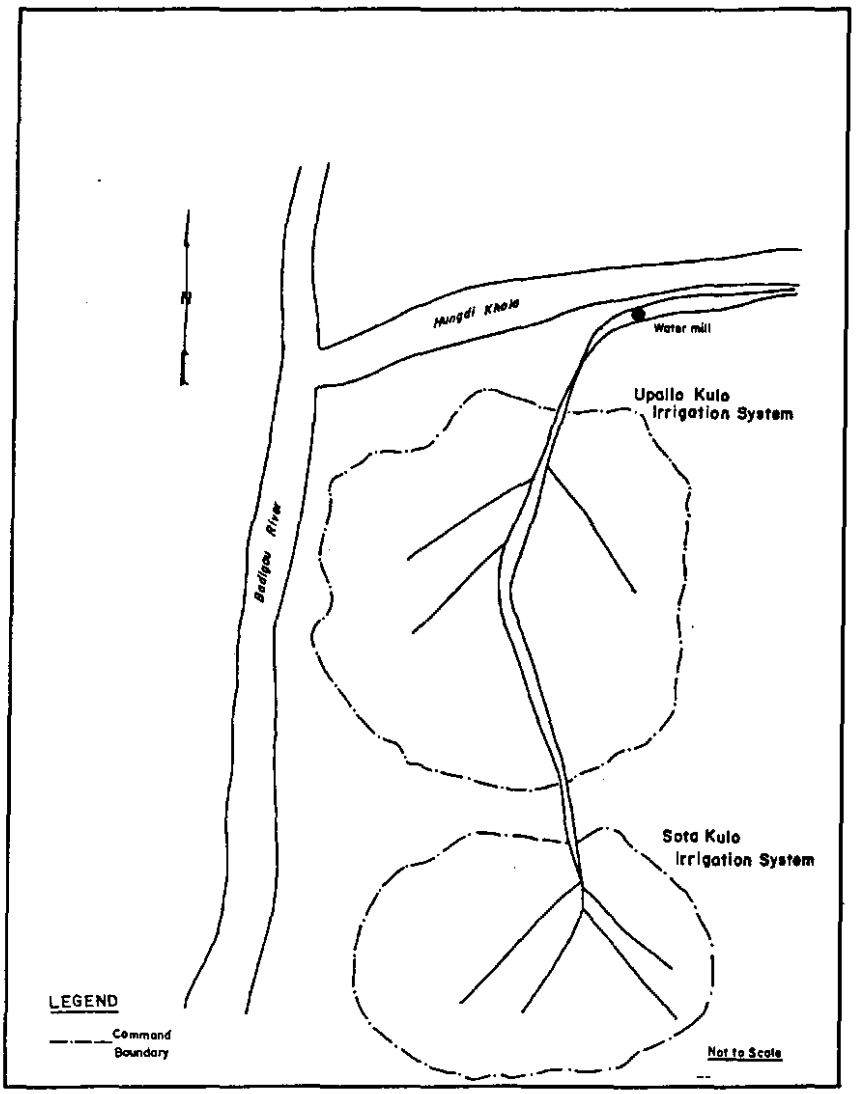


Figure 8. Satrasaya Phant irrigation system.

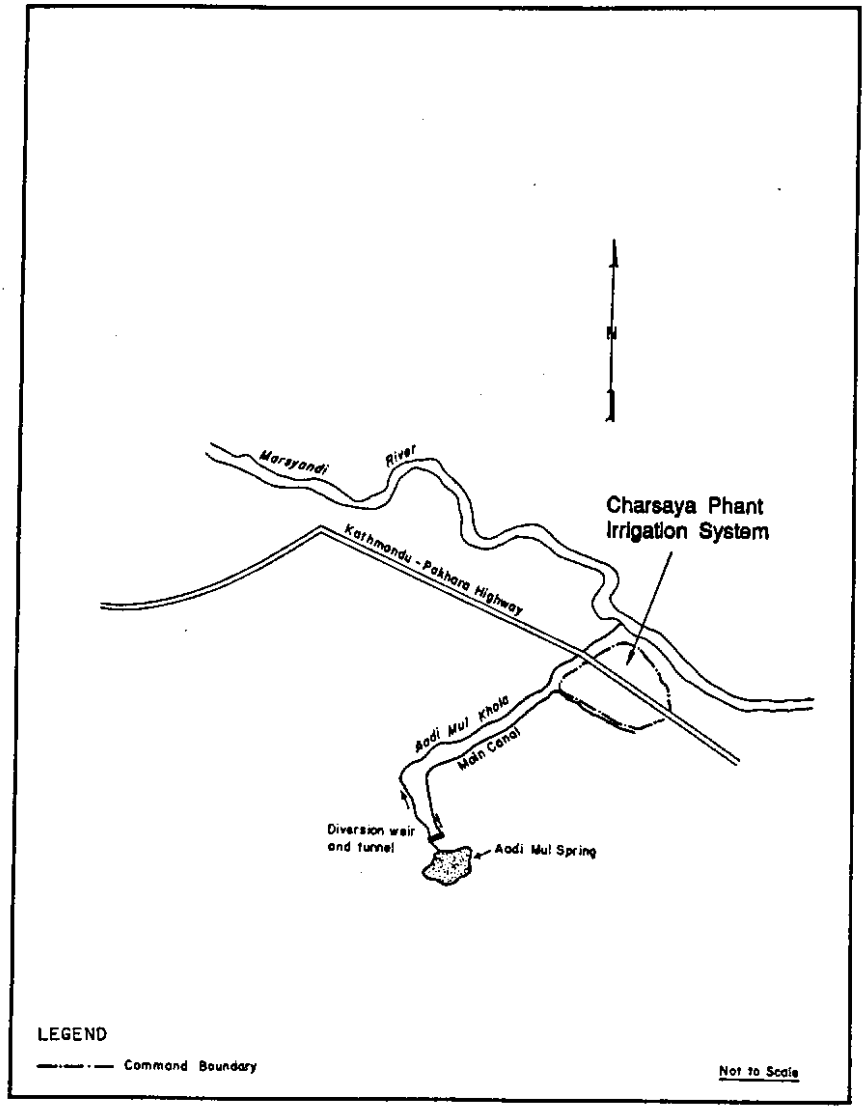


Figure 9. Baraha Kulo of Yampa Phant irrigation system.

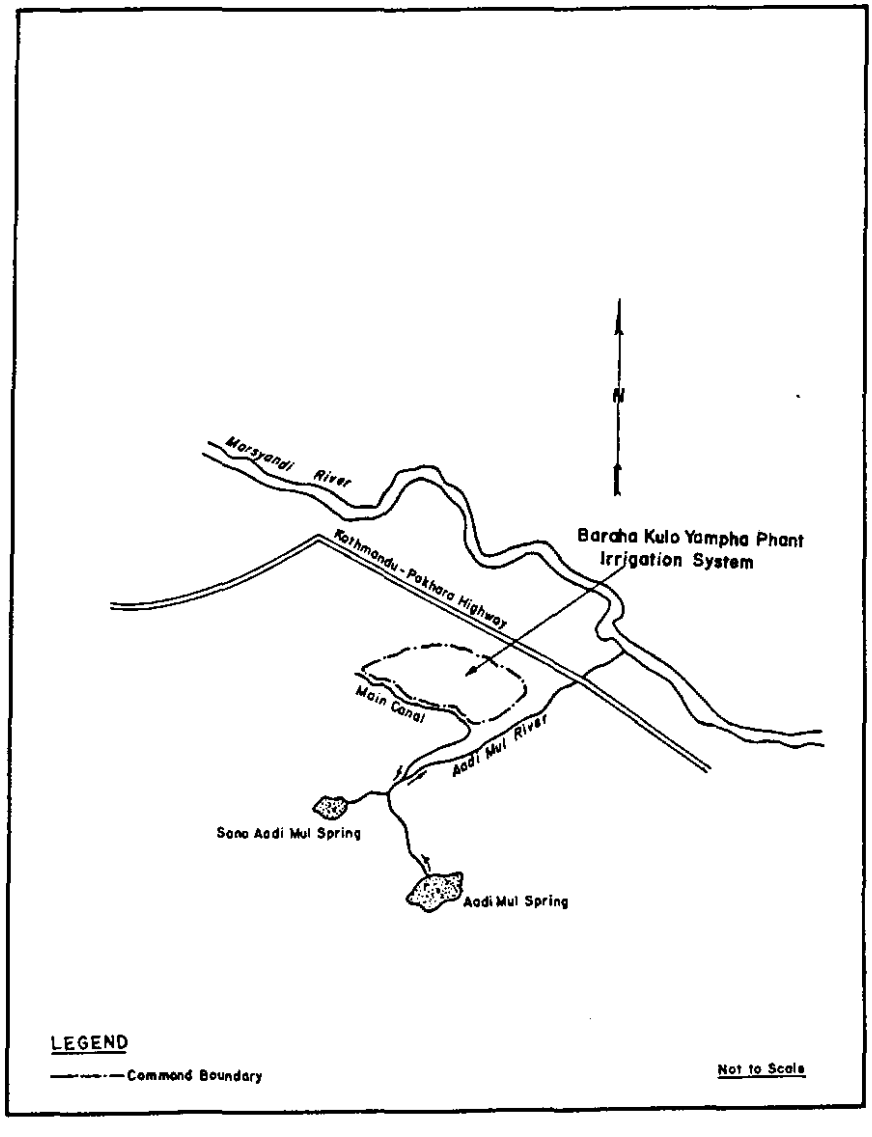


Figure 10. Sange Patiyani irrigation system.

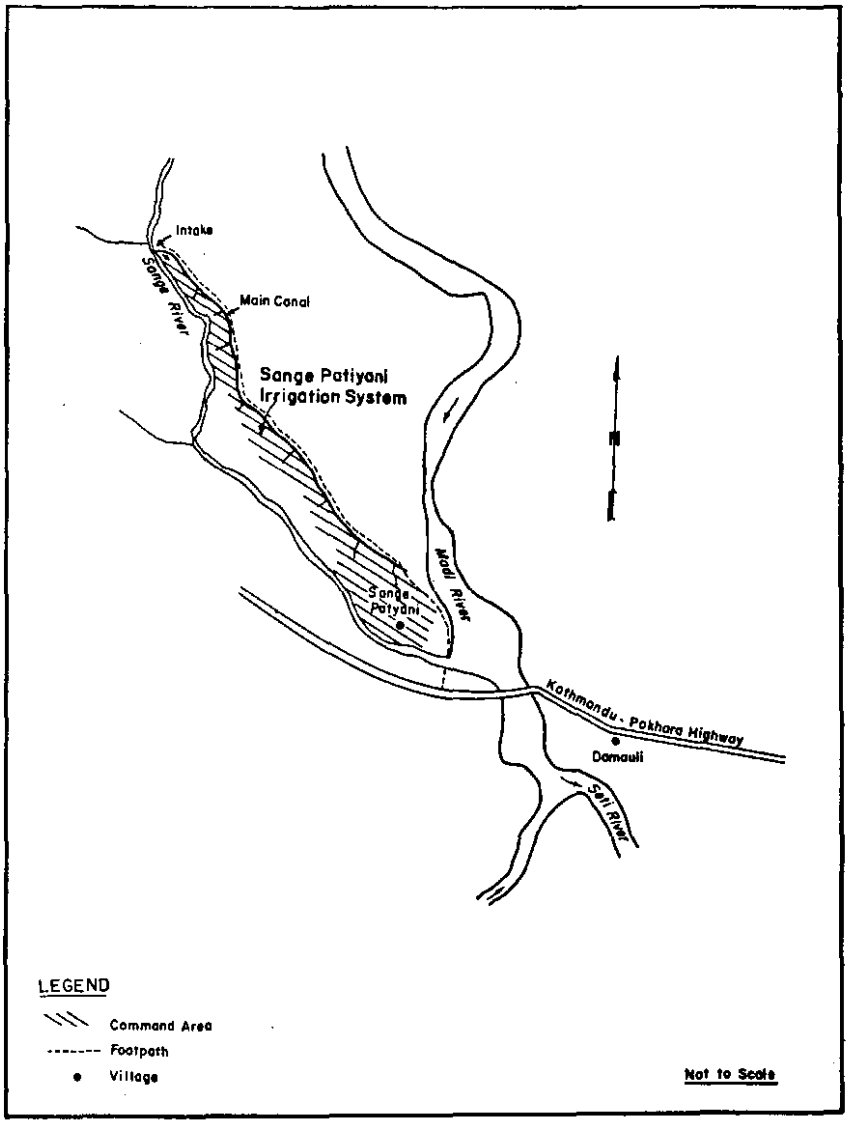


Figure 11. Phalibas Tallo Kulo irrigation systems: Devisthan Village, Parabat District, West Nepal.

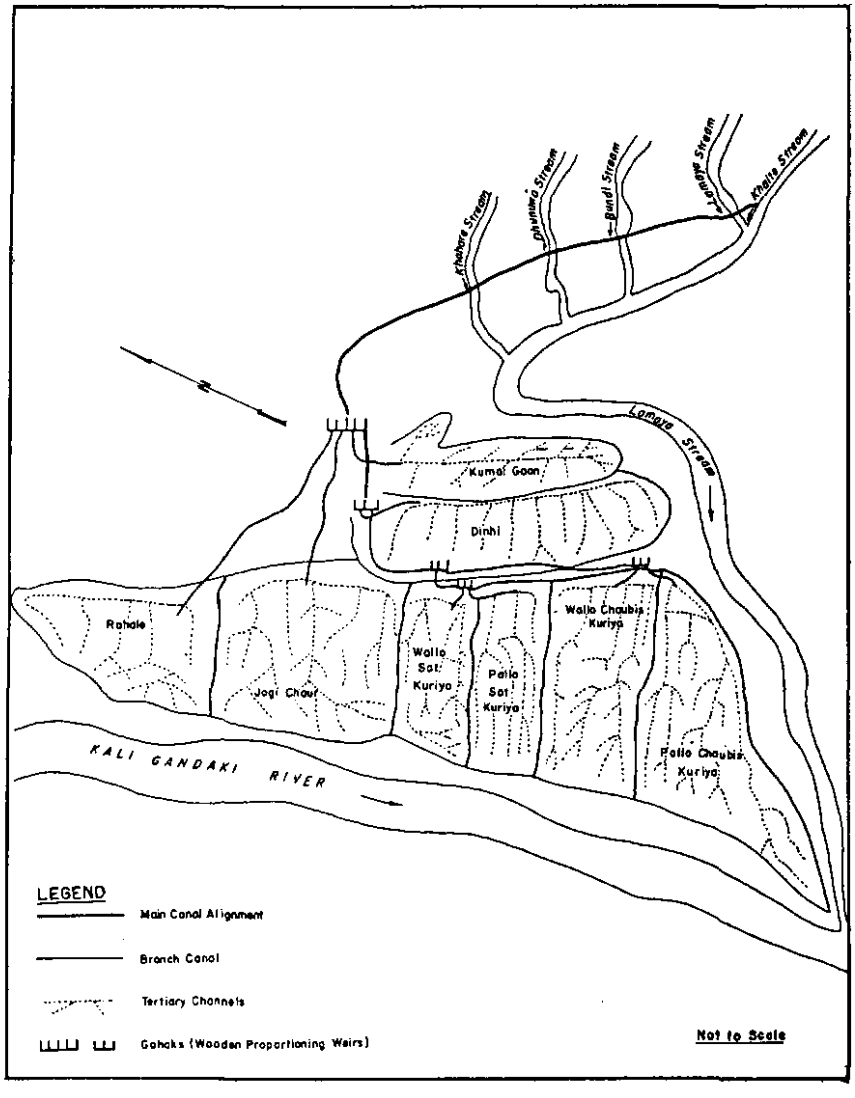


Figure 12. Charhajar irrigation system.

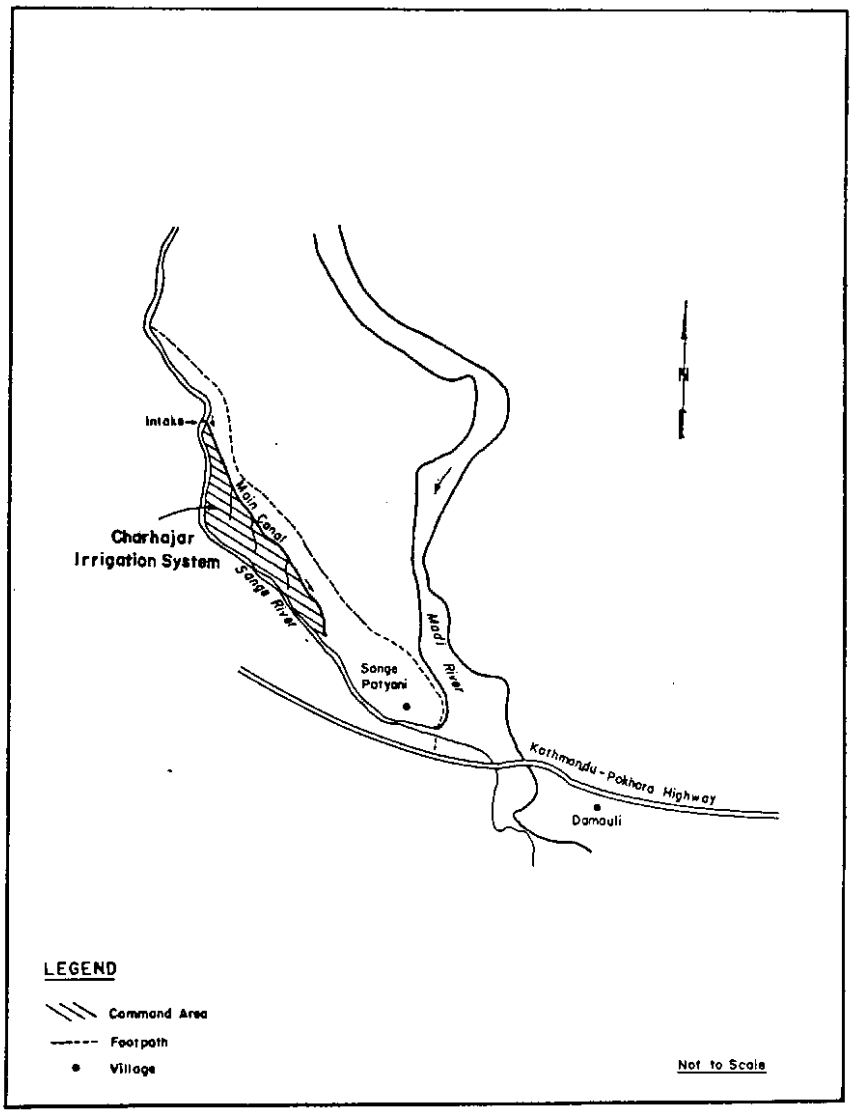


Figure 13. Bhanu Baraha Kulo irrigation system.

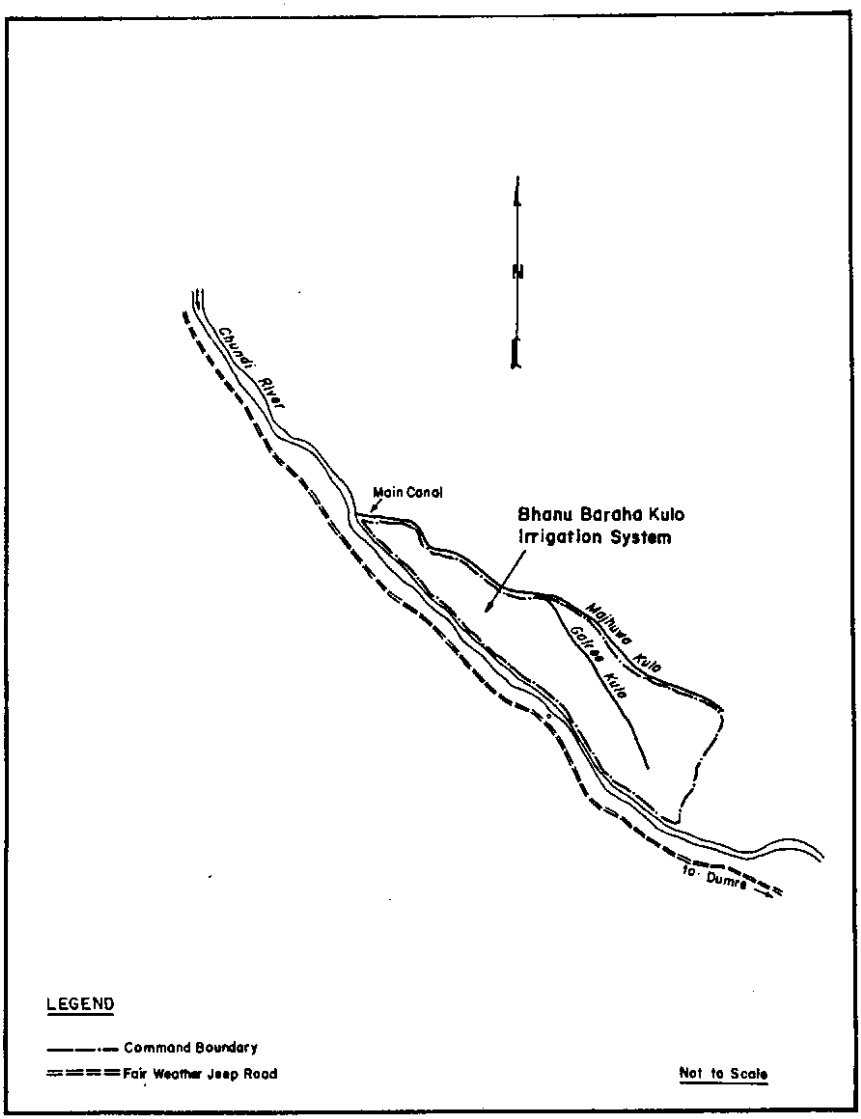


Figure 14. Charsaya Phant irrigation system.

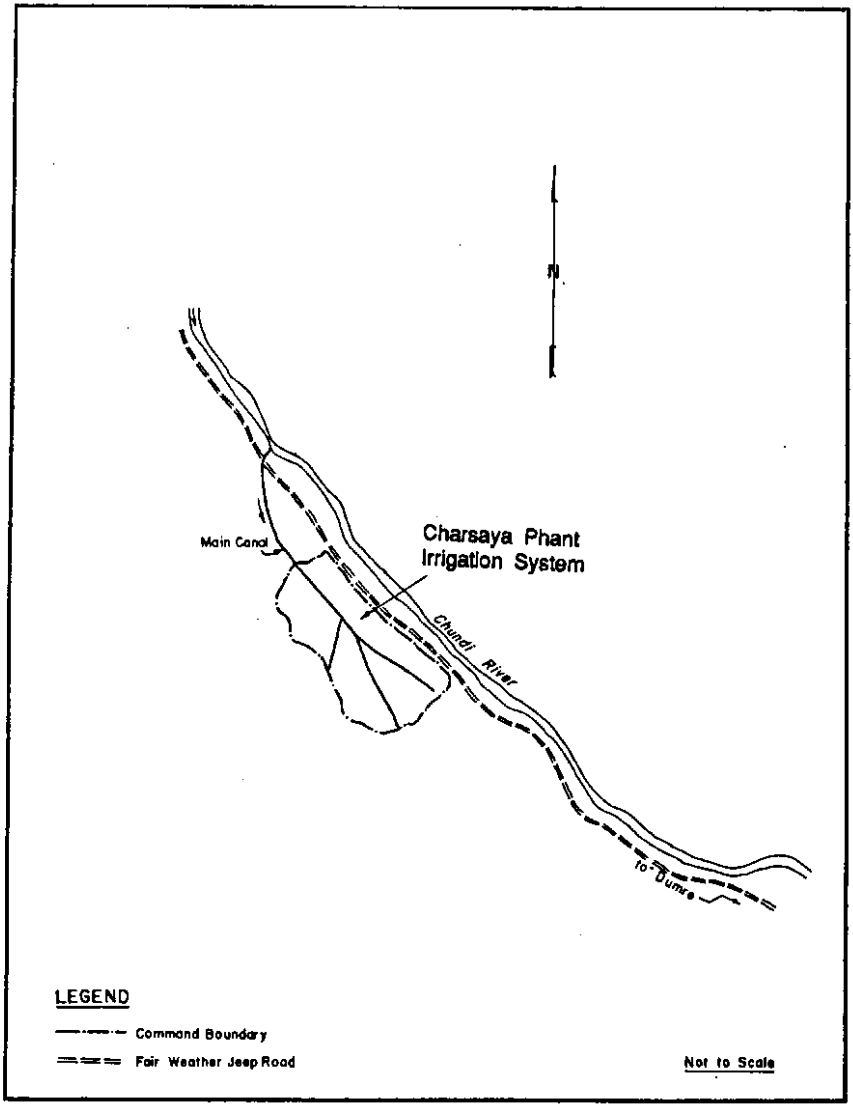


Figure 15. Phewa irrigation system.

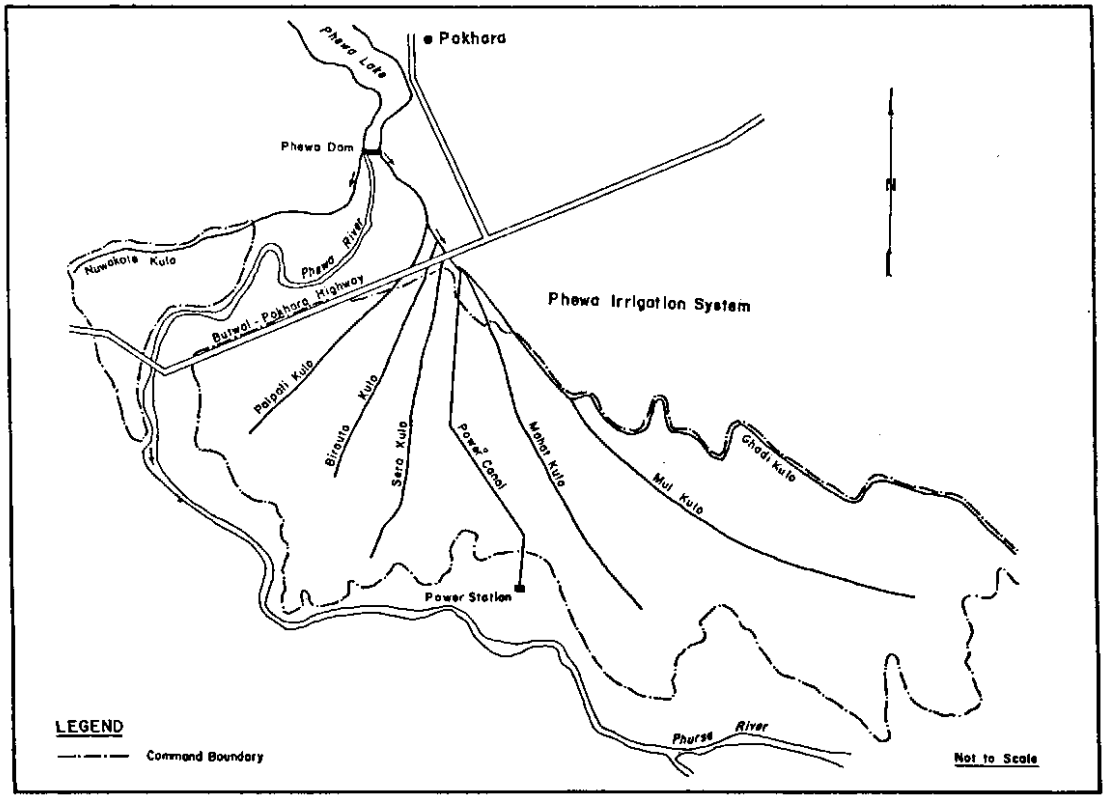


Figure 16. Badkapath irrigation system - Dang.

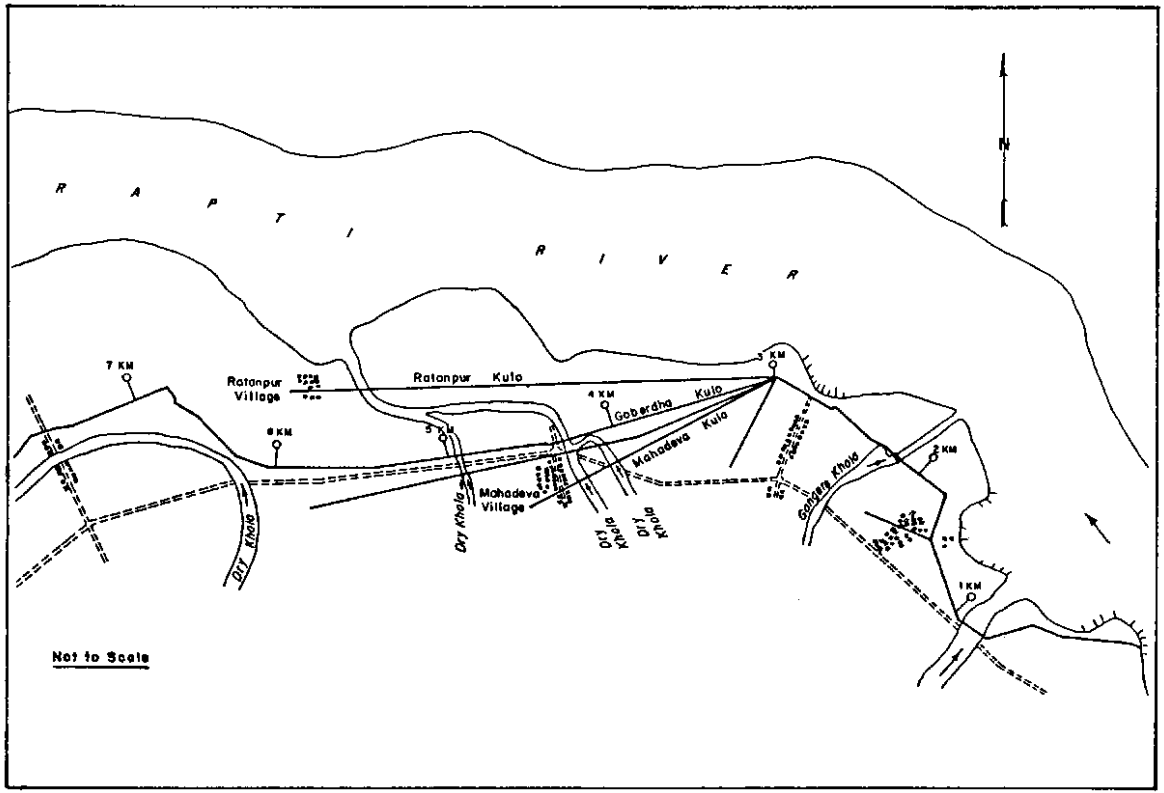


Figure 17. Rani, Gorkhe and Kwadi Kulos.

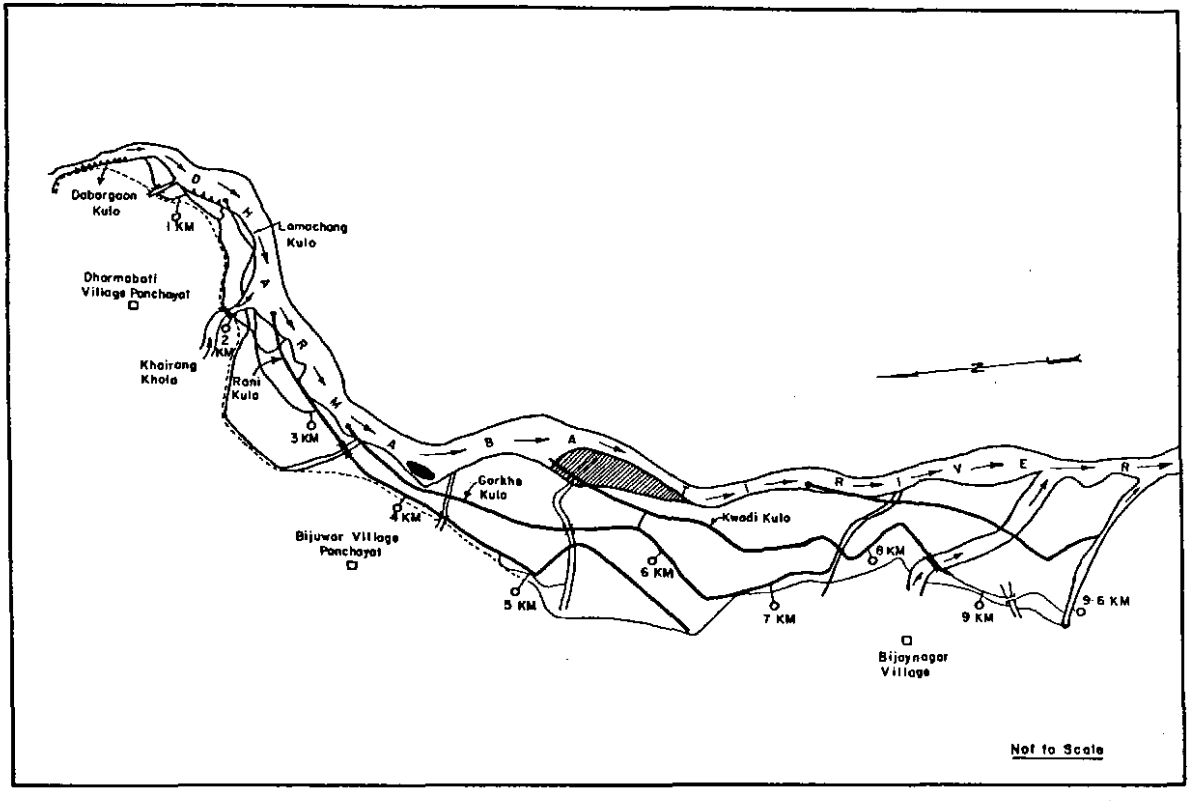


Figure 18. Chhattis Mauja irrigation system: main and branch canals.

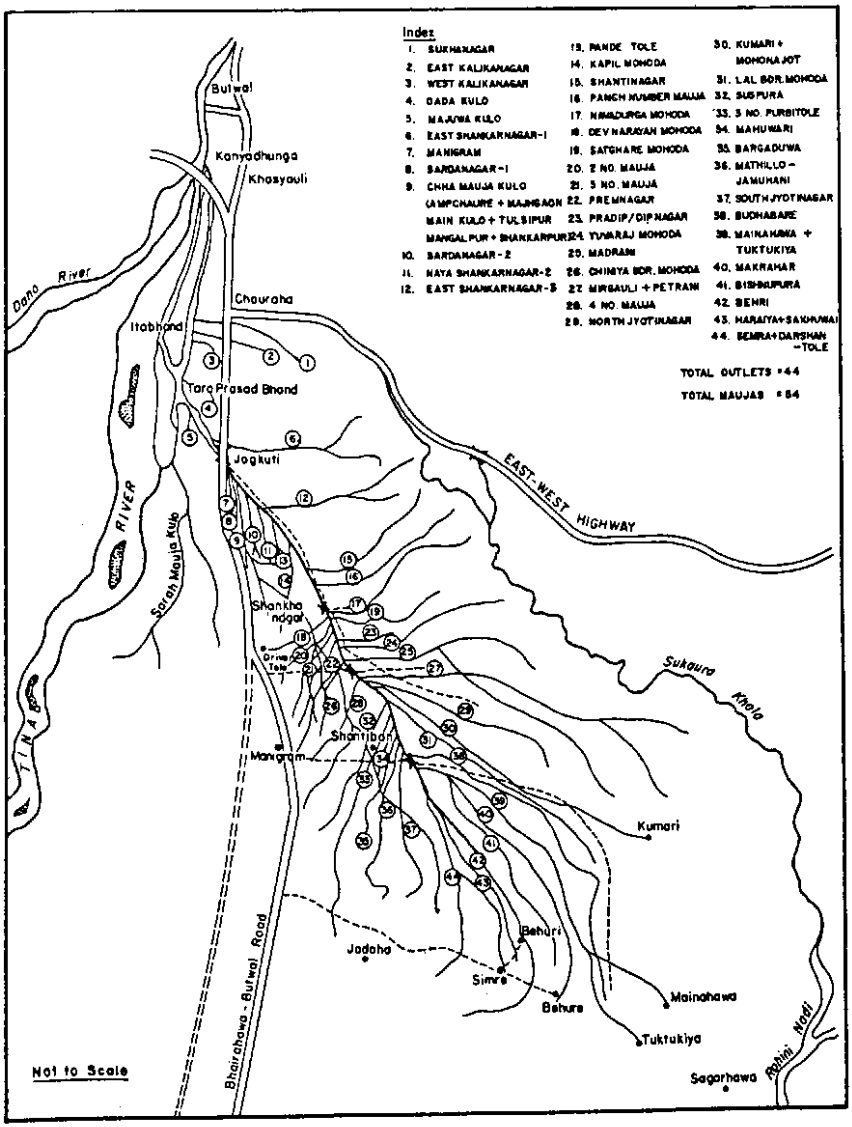


Figure 19. Pithuwa irrigation system.

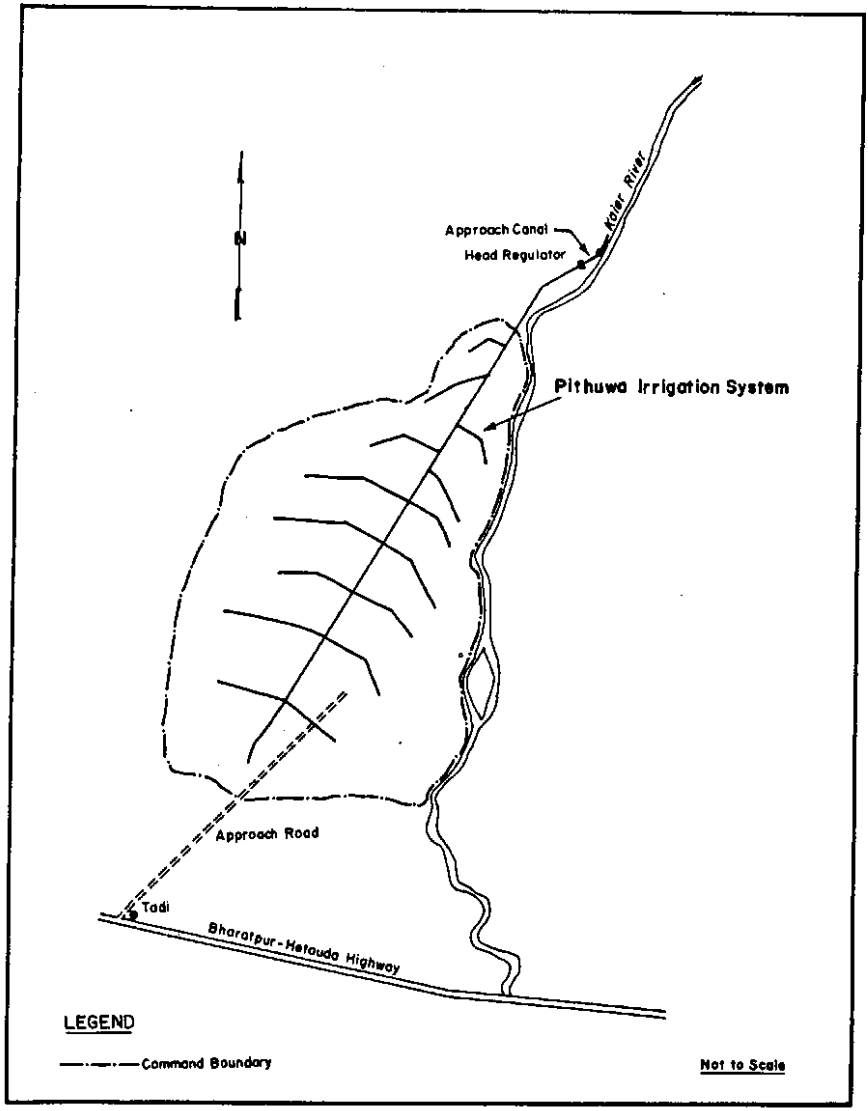


Figure 20. Pancha Kanya irrigation system.

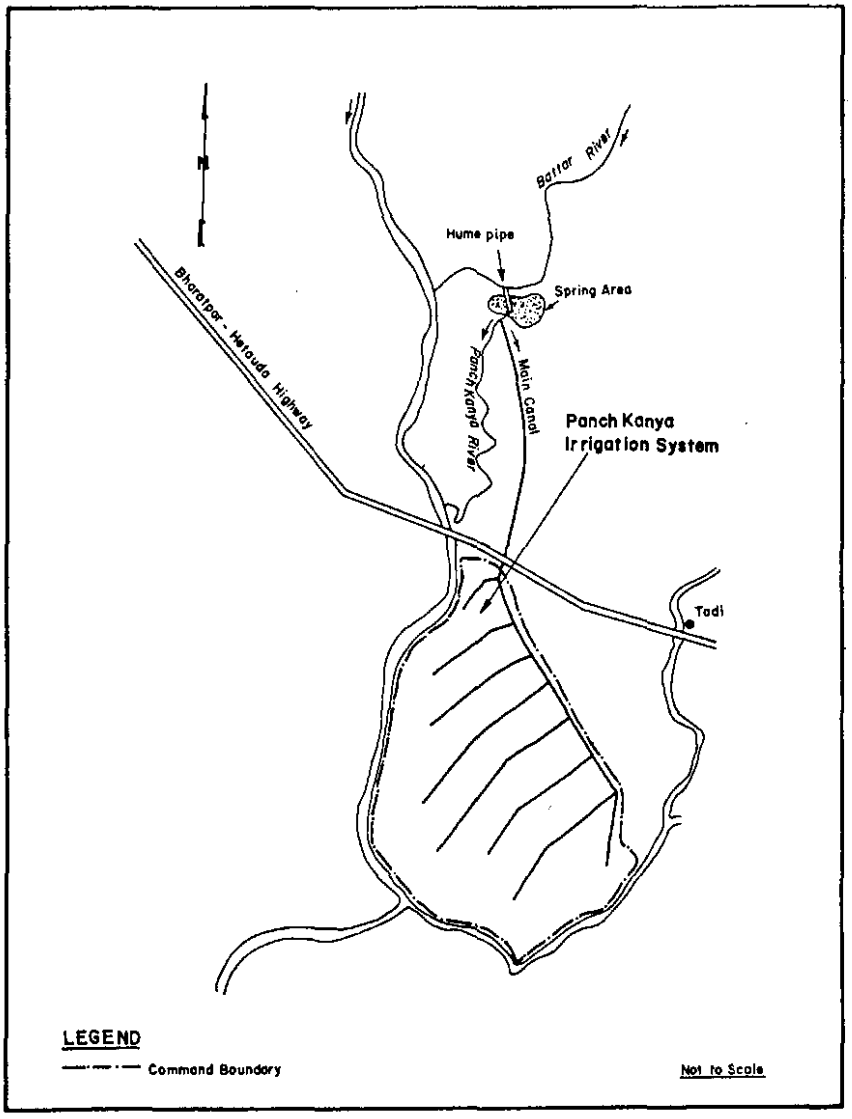
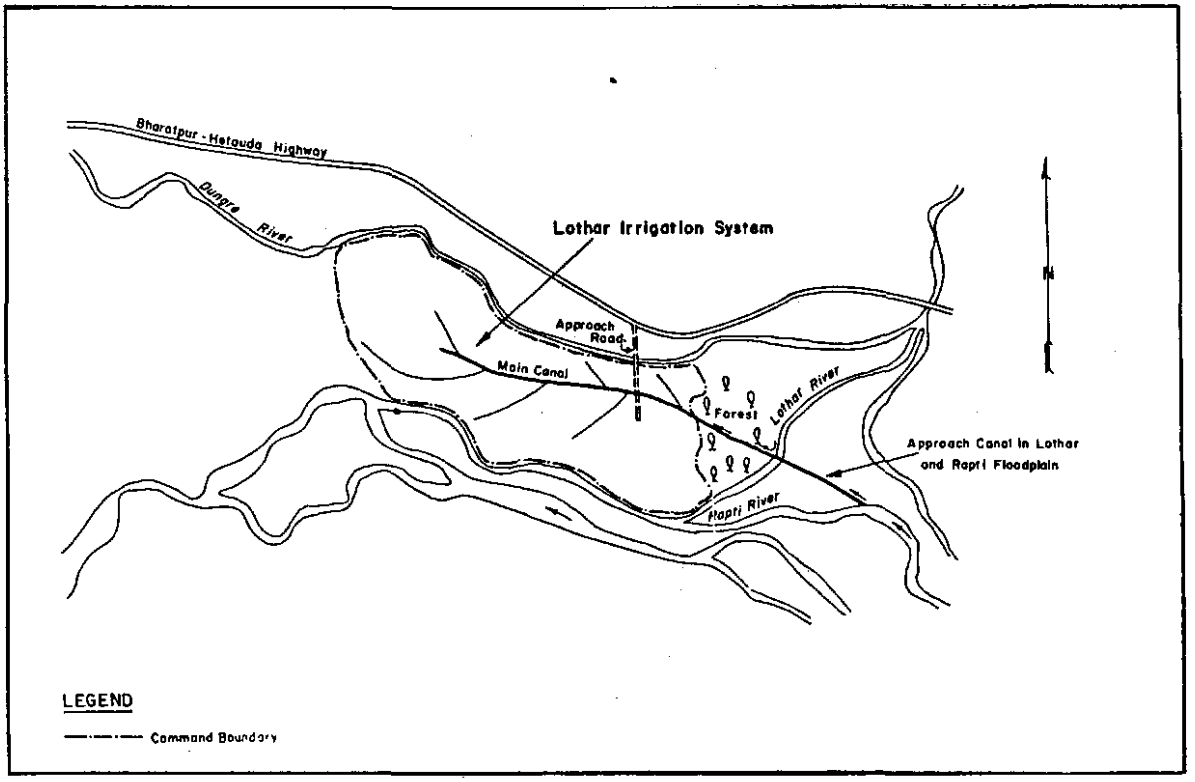



Figure 21. Lothar irrigation system.