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ORGANIZATIONAL EFFECTIVENESS OF USER AND NON-USER CONTROLLED IRRIGATION SYSTEMS IN NEPAL

By

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ABSTRACT

ORGANIZATIONAL EFFECTIVENESS OF USER AND NON-USER CONTROLLED IRRIGATION SYSTEMS IN NEPAL

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This study, which focuses on the organizational effectiveness of user and non-user controlled irrigation systems in the western hills of Nepal, was conducted with the purpose of assessing the extent to which these systems differ in perceived effectiveness, level of participation and perceptions of equity in meeting the water needs of the farmers being served.

The study design included both survey methodology and rapid appraisal. The conditioning variables included socio-economic status of household, family structure, and demographic characteristics of the respondents. The dependent variable was organizational effectiveness which was measured by perceived effectiveness, level of participation, and perception of equity.

Several hypotheses were tested. The major one was: Perceived organizational effectiveness will be higher in user controlled irrigation systems than in non-user controlled systems as manifested by higher scores of perceived effectiveness, level of participation and

perceived equity.

The findings indicate that leadership pattern for solving problems that relate to dam and canal repair, water acquisition, allocation and distribution of water were significantly different for user and non-user controlled systems. Significant positive relationships were found only between participation and farm size and farm income.

One-way analysis of variance was used to observe the differences in effectiveness, participation and equity among different groups. Only participation mean scores showed a significant mean difference. Also significant differences were observed on the mean response scores by location.

Significant differences were found between effectiveness and participation by control type. Thus, organizational effectiveness was observed more within the user controlled systems as explained by higher effectiveness and participation mean scores.

Important policy implications of the research include: (1) the agency responsible for irrigation system maintenance should reconsider the present policy of creating a dependency syndrome, and should decentralize the decision-making situation to increase system effectiveness; and, (2) to achieve better organizational effectiveness government should turn the system's ownership to the users and provide only emergency back-up services. This may induce higher levels of participation and feelings of fairness among users.

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CHAPTER I

INTRODUCTION

This research is a comparative study of the social organization of two "user controlled" and two "non-user controlled" irrigation systems in Nepal. It investigates user perceptions of system effectiveness, the level of user participation, and feelings of equity within these systems. The findings may help in formulating more effective and equitable policies for organization and management of irrigation systems.

Statement of the Problem

The Government of Nepal has placed emphasis on agricultural development since the Basic Needs Program (BNP) was instituted during 1984/85. A major component of this program is increasing agricultural productivity in the country. Because there is not much room for extending the area under cultivation in Nepal, the policy targets intensive development through improved inputs. One of the alternatives available for development within the agricultural sector in Nepal is expanding irrigation.

Nepal is one of the world's poorest countries. It ranks 115th out of 120 countries in per capita GNP. Average per

capita income was equivalent to US $ 160 in 1988/89, which is the same as that of Bangladesh and Malawi. Agriculture's share of Nepal's GDP was at 57 percent, which is higher than all but three of the very poorest countries. Similarly, the share of the labor force dependent upon agriculture is 93 percent, which is the highest of any country (World Development Report, 1989).

The average size of land holding in Nepal was estimated at about one hectare for a family size of seven persons (IFAD, 1991). The productivity from the land is consistently declining. Looking at some other economic and social indicators, the average life expectancy is 51 years; infant mortality is at about 128 per 1,000 live births (which is highest in the region and higher than all low income countries); and calories available per capita is only 2,052 which is only about 90 percent of the minimum caloric requirement of 2,250 calories per day. Malnutrition is widespread, and children under age of six are most affected. It is reported that two-thirds of the children under six years of age are malnourished. Similarly, there is a low literacy rate, as only 35 percent of males and 18 percent of females are literate. The annual population growth over the last ten years was recorded 2.6 percent as against only 1.6 percent growth in food production during the same period. Consequently, there is substantial concern that agricultural production cannot keep up with population growth (World

Bank, 1990).

Because of increased population pressure on land, large areas of steep and ecologically unsuitable land have been brought under cultivation in recent years. This has caused rapid deforestation, run-off of rain water and erosion of fertile top soils.

Irrigation development in Nepal could help solve the existing food shortages and erosion problems by increasing crop productivity and intensity. Three forms of irrigation management can be found in Nepal. The first is non-user (public agencies) controlled and managed; the second is user (farmer) controlled and managed; and the third form is controlled jointly. The jointly controlled form can be classified either as the user controlled or the non-user controlled depending upon the level of control exercised by the agency or the group of farmers.

It has been estimated that the area with irrigation facilities is 1,058,000 ha; which is 33 percent of the total cultivable area. Of the irrigated land, only one-third has perennial irrigation (Pradhan, 1989). Nepal's irrigation potential has been estimated at 1.9 million hectares for the terai (flat plains) and 0.3 million hectares for the hills (NPC, 1985).

Out of the total irrigated area, 350,000 ha are under agency management whereas 608,000 ha are managed by farmers. The Agricultural Development Bank of Nepal (ADB/N) has

supported the development of about 106,000 ha, which are mainly user controlled (Pradhan, 1989).

In order to meet the objectives of the government's basic needs program, the Working Policy on Irrigation Development (1988) set a target of a total irrigated area of 1,250,000 ha by the fiscal year 1999/2000. To achieve this target during the next ten years, the Department of Irrigation and the Agricultural Development Bank of Nepal (ADB/N), therefore, have to extend irrigation to an additional 816,000 ha (HMG, 1988).

User controlled (or farmer managed) irrigation systems cover much more land area than non-user controlled (or agency managed) ones. Nepal is one of the those countries where there is a complex network of farmer managed irrigation systems (FMIS). Some studies report that certain FMIS are functioning better than those managed by non-users or public agencies (Laitos et al., 1986; Pradhan, 1988; Tang, 1989; Yoder, 1986; Hilton, 1990; Ostrom, 1990). In non-user controlled (or agency managed irrigation systems [AMIS]) and user and non-user jointly managed systems also, some are maintaining systems effectively (Abel, 1975; Wade, 1987; Levine, 1981) while others are not effective although they have comparatively ample resources and technical backing (IMC, 1989; Hilton, 1990; Ostrom, 1990; Shivakoti et al., 1991).

Performance effectiveness of the systems may be

affected by the lack of proper management and, more so, lack of participant involvement in operation and maintenance of the irrigation systems. Considering the relatively large numbers of well managed FMIS, one way to involve people in the AMIS would be through decentralization of the systems, making them accountable to the users, especially for operation and maintenance (O & M).

Well-managed irrigation communities have been described as systems of rights, duties and roles with substantial local control (Hunt, 1989). However, defining duties of O & M rights and local control alone is no guarantee that user participation will yield desired equity in getting water to the individual farmers' field. Thus, a discussion paper on policy issues in development of small irrigation in Nepal (HMG/Winrock, 1991:3) outlines the following reasons for the lack of effective and equitable use of water even in the user controlled irrigation systems:

1. "lack of long-term government strategy to directly relate the development of irrigation to that of the development of agriculture";

2. "preoccupation of the government with AMIS at the cost of FMIS";

3. "absence of legal provisions recognizing local FMIS organizations";

4. "lack of clear government policy pertaining to the strengthening of FMIS"; and,

5. "lack of consistent government policy in FMIS-related investment."

Despite these, there has been substantial official

emphasis on the principle of decentralization in general, since the Decentralization Act (HMG, 1983) and the implementation of the new constitution (HMG, 1991) toward incorporating the choice and demands of citizens.

Considering all these situations, the general problem being explored through this research is the extent to which user and non-user controlled systems have differed in users' perceptions of effectiveness, level of participation and perceptions of equity in meeting the water needs of the farmers being served by the particular system. Specifically: How do the organizational variabilities associated with the user and non-user controlled systems affect the farmers' perceptions of effectiveness, level of farmer participation and feelings of equity?

Historical Overview of Irrigation Development in Nepal

More than 90 per cent of the total irrigated land in the hills, and more than 70 per cent of the irrigated land in the terai, obtain water from FMIS. Most of these FMIS were completed hundreds of years ago, and they are still functioning. A majority of them were constructed by holders of birta (land grants made to the individuals by the king, usually on an inheritable and tax exempt basis), who were entitled to a share of the produce from the tenants (Regmi, 1978). These birta holders could mobilize labor for the construction of canals. Raj Kulo of the Argali irrigation

system in Palpa district, in the mid-western hill region of Nepal, is one of the oldest (constructed in about 1550 AD) which is still in operation (Martin, 1986). According to Martin, the resources required to maintain the hill irrigation systems have necessitated the interdependence between "head" and "tail" farmers, which is partly responsible for the equitable distribution of water in FMIS.

The formal AMIS in Nepal began only in 1923 AD, when the Chandra canal was constructed in the Saptari district in the terai. It was managed by the independent Canal Management Section of HMG under the Public Work Division (Adhikary, 1964). The Department of Irrigation, Hydrology, Meteorology (DIHM) came into existence only in 1952, and became the principal government agency involved in the planning, designing, constructing and managing most public irrigation projects in Nepal.

Before 1988, the major agencies involved in irrigation development were: (1) the Department of Irrigation, Hydrology and Meteorology (DIHM), (2) the Farm Irrigation and Water Utilization Division (FIWUD) of Department of Agriculture, (3) the then Ministry of Panchayat and Local Development (MPLD), (4) the Agricultural Development Bank of Nepal (ADB/N), and (5) Project Boards.

There were major differences in working policies and mandates among these agencies. DIHM was supposed to undertake projects with command areas of larger than 500 ha

in the terai and larger than 50 ha in the hills. On completion of construction works by DIHM, O & M remained a full function of the department and the beneficiaries were expected to pay a water fee to meet a part of O & M costs. In the absence of a clear policy for fixing water charges and their collection, and also due to lack of beneficiaries' involvement in irrigation project identification, design, construction or even in O & M, DIHM was the only agency to decide project priorities and has borne all the costs of construction, rehabilitation and O & M.

DIHM also coordinated construction activities with the International Labor Organization (ILO), World Bank, Asian Development Bank, USAID and other donor agencies' irrigation development projects.

FIWUD identified its projects for assistance based on the collective decisions and requests of the users. If the project met criteria for approval of the scheme, project was approved. Farmers deposited five percent of the estimated cost in the bank in the name of scheme and committed another 20 percent of the estimated cost in the form of labor contribution. The remaining 75 percent came as a FIWUD grant from the government. When the construction was complete, a users' committee was formed, and they took over the system for O & M.

The Ministry of Local Development (MLD) activities concentrated mainly on low-cost technologies for the

improvement of farmers' systems of less than 50 ha command area in size, and with a policy of people's participation. The proportion of participation was not fixed in this case. Construction contracts were awarded to the beneficiaries' groups who also had to undertake O & M responsibilities. The bases for the selection of projects were mainly political.

The ADB/N also played an active role in providing irrigation facilities to farmers, as it was mainly responsible for providing credit to farmers for agricultural activities. ADB/N has also collaborated with CARE/Nepal to finance a few gravity systems.

Some of the larger projects were carried out (and are currently being continued) through semi-autonomous organizations called "Project Boards." Management under this system gave autonomy in personnel recruitment and financial flexibility (Shrestha, 1987).

Besides larger projects, the Department of Agriculture also launched integrated programs, such as the Hill Food Production Programs, where each project maintained its own cadre of irrigation technicians for the project period.

Realizing that there was a lack of coherent and common policies on irrigation development in the past, in 1988 the Government formulated new policies on irrigation development, the main points of which are listed below:

> "Beneficiaries' participation and consent has been made compulsory for project identification, selection, design, construction, operation and maintenance". .....

> "The Department of Irrigation (DOI) and the ADB/N are named the main implementors of irrigation development activities. Whatever the executing agency, the government contribution or share for each particular type of project has been fixed, and ADB/N has to provide loans to the beneficiaries based on a fixed formula". ....
>
> "A high level "National Irrigation Committee" is formed by the government under the chairmanship of the Minister of Water Resources which is responsible for formulating working procedures, establishing priorities, fixing targets and coordinating all the agencies concerned."
> (HMG, 1988:1).

Thus, presently the Department of Irrigation (DOI) and the ADB/N are made the main implementing agencies for major irrigation development activities.

Organizationally, DOI under Ministry of Water Resources maintains a Regional Irrigation Directorate (RID) at each of the five development regions in Nepal. These RIDs supervise and provide support to all of Nepal's 75 districts (which have been included in one of the RID) by maintaining District Irrigation Offices(DIO). These DIOs, coordinated by a Chief District Officer (CDO), maintain a cadre of technicians to construct, supervise, operate and maintain the irrigation systems within the district.

ADB/N also maintains a cadre of technicians at the central level who supervise the overall activities of irrigation development. At the district level, middle-level technicians (overseers-who have two years of training after high school education) supervise the construction and rehabilitation works related to irrigation and other

technical matters. ADB/N also maintains sub-branch offices at many places within a district. These offices also maintain a technician (sub-overseer - three years training at pre-high school level) to supervise irrigation related and other technical matters.

Objectives of the Study

The general purpose of this study is to compare the relative organizational effectiveness of irrigation systems which are controlled by water users with those controlled by non- users. In particular, the concern is with variabilities in users' perceptions of system effectiveness, level of participation, and perceived equities within the system. The specific objectives are:

1. To compare the organizational structure and leadership patterns of user controlled and non-user controlled irrigation systems.
2. Within user and non-user systems, to determine the social and economic characteristics of farmers that affect their perceptions of organizational effectiveness, level of participation and organizational fairness in the management activities of the system.
3. To compare farmers' perceptions of system effectiveness, farmers' participation behavior and their feelings of fairness within each of these

systems.

Organization of the Dissertation

Chapter one of this dissertation has included an introductory discussion on the background of the problem and the study objectives. The second chapter presents a literature review on the issues of organizational effectiveness, level participation, and perceived equities of different irrigation systems with special reference to the South Asian context. Chapter three describes the study methodology, including discussion of operationalization of the concepts, study hypotheses, data collection methods, and data analysis approach.

The research findings are presented and analyzed in chapters four and five. Chapter four describes findings of rapid rural appraisal. Chapter five includes characteristics of respondents and analysis of household data on perceived system effectiveness, level of participation and perceived equities. The final chapter contains the summary, conclusions and recommendations.

CHAPTER II

LITERATURE REVIEW

The current study is a comparison of the organizational effectiveness of user controlled and non-user controlled irrigation systems in Nepal from the point of view of farmers' perceptions of effectiveness, level of participation and feelings of equity. This chapter includes the review of related literature on irrigation management and organizational effectiveness, decentralization and irrigation management, water users groups in farmer and agency managed irrigation systems and their effectiveness, and the participation level and equity issues in irrigation management.

Irrigation Water Management and Organizational Effectiveness

There are many groups with a profound stake in irrigation systems' performance. These stake holders can be divided into two groups: non-users and the users. The non-user groups include: national economic planners, international funding agencies, and irrigation systems managers. Farmers represent the users who are the consumers of the irrigation water and other services provided by the system.

But the viewpoints of these user-farmers have typically been ignored in the planning and execution of irrigation related activities. Chambers (1989) has named this process as the reflection of the "center-outward, core-periphery" perspective that continues to dominate much development thinking. The concerns of non-users in relation to irrigation development, according to Svendsen and Small (1990), tend to be geographically broad, impersonal, and short-term. On the other hand, users' concerns tend to be more local, intensely personal, and long-term.

These concerns of level of control in rural development programs have also been categorized as "delivery system" and "acquisition system" (Axinn, 1987). Thus, the ways in which farmers judge and perceive the outcomes of an irrigation system management will be different between the systems controlled by the users (acquisition system) and non-users(delivery system).

The term "water management" means more than the flow of water in a canal or irrigating a field. "Water management" includes the management of physical resources like acquisition, allocation and distribution of water; activities related to the management of the people who affect the distribution of water, such as formation of water users' groups; utilization of knowledge, skills and incentives to make appropriate decisions on the desired distribution and utilization of water; activities related to

information management; and activities related to crop management like choice of cropping patterns or timing of different agricultural operations (Barker et al., 1984). Thus, it can be said that water management involves social infrastructure which is equal to if not more than physical infrastructure. The relationship between these, according to Levine (1980), is an important component of any irrigation system.

In any viable irrigation association, each irrigator has certain specified organizational rights and duties by virtue of joint collective agreement, not personal physical power or wealth. Freeman et al. (1985) argue that any leadership which cannot enforce joint agreements on particular members with the consent of the general membership is not a viable entity.

Organizations are instruments for bringing people together to do collectively what they can not do as well individually. Given the tight interdependence in irrigation systems, and the fact that water control is a function of collective actions, Freeman et al. (1985) further conclude that water control can be enhanced only through disciplined organizations. They further argue that maximum possible local control over water is best secured by a socio-technical middle level command area, interface which:

-makes staff responsible to local authorities;

-recruits local staffs from command area labor markets;

-provides for routine maintenance by local specialized staffs; and,

-provides a combination of share types which maximize flexibility within physical and technical constraints. (1985:114).

Coward (1980) has suggested organizing a group, such as a farmers' association - preferably at the farmers' initiative or if necessary with initial government assistance - to help in attaining the objectives of irrigation projects.

Uphoff's matrix (1986) shows that irrigation system activities are not confined only to the physical system activities, but organizational management activities and water use activities also fall under the irrigation system activities. According to Uphoff, one set of management activities focuses directly on the water. Water must be acquired, allocated, distributed, and, if there is excess, drained. A second set of management activities deals with the physical structures for controlling the water.These structures must be operated and maintained. A final set of activities focuses on the organization which manages the water and structures and includes decision- making, resource mobilization, communication and conflict management. However, not all activities are equally important in each environment, and the irrigation management institutions will reflect the relative importance of activities in a particular location (Martin and Yoder, 1987).

An FAO report (1982) suggests that to encourage

participation some sort of farmers' organization is essential. In many countries, the Water Users Association has served as a valuable medium to encourage and achieve farmers' participation. The motivation for promoting farmers' participation in decision- making has increased in recent years.

Barker et al. (1984) have expanded this view to incorporate local groups in matters of system operation at the local level, and also in the decisions regarding the modifications and elaboration of the physical structures and their outputs.

The FAO report outlines the following advantages of participation:

> -Farmers will have a voice in the planning and design of the project.
>
> -Farmers will contribute their specific skills and knowledge of the local conditions.
>
> -Farmers can make a project more cost effective by making their manpower and local resources available.
>
> -Farmers will develop pride and responsibility and consider the system as "theirs" rather than the governments.
>
> -Farmers will develop greater responsiveness to new technologies.
> (FAO, 1982:12)

But in Nepal, the limited functions of government and the tradition of non-intervention in irrigation water management at the community level for hundreds of years led to the development of thousands of farmer-managed irrigation systems. Sixty-seven percent of irrigation agriculture in

Nepal is farmer-managed. By and large, these systems are autonomous, self-governing entities (Pradhan, 1988).

In Nepal, the physical characteristics of the irrigation systems influence the frequency and intensity of a particular task to be performed by the irrigation organization. Pradhan (1988) points out that 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. Regarding the irrigation tasks performed by Farmer Managed Irrigation Systems (FMIS), he points out that irrigation organizations perform water acquisition, water allocation and distribution, resource mobilization, system maintenance, decision-making, communication and conflict resolution tasks. In FMIS, 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.

Svendsen and Small (1990) outline the usefulness of efforts to improve the understanding of farmers' perceptions of system performance as the farmers being able to better understand and accommodate their behavior in their role as manager of the system. Thus, the role and functions that a farmer performs as a member of the particular irrigation system and the benefit he/she is getting from the system may well reflect the individuals' perceptions about the

particular system effectiveness.

Cameron (1981) points out that there are four major approaches in assessing organizational effectiveness used by researchers. They are the: (1) Goal Model, which links effectiveness to the accomplishment of organizational goals; (2) System-Resource Model, which links effectiveness to the acquiring needed resources for system maintenance; (3) Internal Process Model, which links effectiveness to the "healthy systems" where information flows both vertically and horizontally typified by trust; and, (4) Strategic Constituencies Model or the Participant-Satisfaction Model which links effectiveness to stakeholder satisfaction.

The Participant-Satisfaction Approach, according to Keely (1978) and Connolly (1980), defines effectiveness as the extent to which the organization's strategic constituencies are at least minimally satisfied. A strategic constituency represents a group of individuals who have some stake in the organization. That is, they may be resource providers, users of the organization's output, groups whose cooperation is essential for survival of the organization, or those whose lives are significantly affected by the organization. In this approach, an organization is effective insofar as it responds satisfactorily to the demands and expectations of its strategic constituencies.

The Participant Satisfaction Approach, according to Cameron (1980), is most appropriate when constituencies have

influence on what the organization does or when an actions are largely reactive to strategic constituency demands. The mission or the domain of some organizations is mandated by external interest groups; by contrast, other organizations are more proactive and autonomous in their activities. In such organizations, this approach can be very useful approach.

Thapaye et al. (1987) argue that it is not only technical inefficiency for the poor performances of irrigation, rather the social factors, specifically the need for an effective irrigation organization, have also been recognized as a contributing factor to the efficiency of irrigation systems. This has promoted some research on the structure of such systems. Thapaye et al. conclude that gains are obtained from structural differentiation (horizontal and vertical) of irrigation organization and not from increasing size. They further conclude that yield per hectare is not influenced by type (national or communal) of irrigation organization. In case of Nepal, we do not know whether structural differences and the type (user controlled vs. non-user controlled) of irrigation organization make a difference on the performance of systems.

Decentralization in Irrigation Management

The merit of decentralized planning, according to Dantawala (1981), is derived from its ability to discover

dormant resources and skills and its endeavor to activate them. Structural, technological, institutional and organizational obstacles to overall growth as well as its equitable spread can also be better identified when viewed in the proximity of the specific area and the people. More importantly, according to him, every area, however small, has its inherited social and cultural ethos which the planner has to understand if he is planning for the people and not merely for the area.

Owens and Shaw (1974), further suggest that if a state is to create a sense of belonging among the great mass of people, then it must decentralize the decision-making process, not just in policies but in an array of human endeavor. They have identified three essential and complementary elements of a problem-solving system:

> -A decision-making system, which allows decisions to be made at the appropriate level.
>
> -A system of building a knowledge base for the masses and making it accessible to all so that decisions will be based on applied knowledge and experience.
>
> -Effective linkages between levels of the system. (1974:19-20)

Operation of canal irrigation systems in Taiwan has been judged by many people to be quite effective with respect to water use. Abel (1975) reveals four factors that seem to contribute strongly to effective management of the systems.

> -In order to increase agricultural production, Taiwan has recognized water as a scarce factor of production

to be used as efficiently as possible.

-The national government of Taiwan has evolved a basis for centralized planning of irrigation investments and, at the same time, decentralized management of the systems. The management of irrigation systems was devolved into the hands of those who directly benefitted from irrigation. The mechanism used was the cooperative irrigation association. Users of water have participated in the planning and management (i.e. decision- making) of irrigation systems.

-Within the irrigation association information systems were developed which permitted the exchange of agronomic and engineering information between users of the water and the managers of the system.

-The irrigation associations employ systems of incentives for both managers of irrigation systems and users of water which appear to be compatible with the efficient use of water. The systems are essentially owned and managed by the farmer-users of the water. Thus, the managers of the irrigation systems work for the farmers.
(1975:12)

VanderMeer (1980) also discusses the organizational changes that followed two major innovations in a small gravity system of irrigation in Taiwan. These two innovations, (a) the introduction of rotational water distribution, and (b) the structural improvements of canals and head gates, were related to significant changes in the relationship among water users and between water users and the management agency. Change was in the direction of irrigation association and the formalization of farmer groups within the irrigation systems. These farmer groups, acting through their elected chairman provided a regularized structure of communication between management and farmer irrigators.

Bottrall (1985) considers farmer motivation and cooperation essential for the large agency systems to be successful in their operation. This can be achieved by delegating substantial responsibility to farmers, to the extent that they are enabled to put pressure on irrigation staff "from below" to allocate water fairly. Therefore, according to him, participatory management would require the building up of farmers' representation at levels above the water course - to the distributory and scheme levels - so that they are in a position to oversee and monitor the irrigation staff's performance and make them accountable to farmer-users.

But, in any irrigation system, if the government line agency keeps on giving resources without proper farmers' participation, this will lead to dependency. Bagadion's (1980) experience from the Philippines shows that the "give-away approach" increased farmers' dependency on government and did nothing to encourage farmers' self-reliance. Thus, he concludes that the farmers may be organized for decision-making through participation by a catalyst, who should live in the farming community, furnish guidance and assistance but not intervene in decision-making, i.e., the decision-making process should be left to the farmers themselves.

One study finds that farmers disagree with the idea of associating local politics with any irrigators'

organization. They believe water users' organization should remain non-political (Khatri-Chhetri et al., 1987).

A new attempt at decentralization had been made by the Government of Nepal in the 1980s, partly because of the continued failure of Government rural development projects. The basic problems are:

> -Rural development situations are specific to particular localities and groups of people.
>
> -Achievements of the goals of development require an integrated multi-sectoral approach in planning, which has not been a characteristic of rural development in Nepal.
>
> -The participation of the beneficiaries is crucial for effective planning and implementation of local development programs, and for ongoing management of the assets created in the communities, but has often been absent in Nepal.
> (1985:10).

Maetz (1986) outlined the major emphasis of the decentralization policy in Nepal as to promote people's participation, strengthen local institutions, mobilize local resources, secure a balanced development and inter sectoral integration, and to increase the outreaching capacity of development administration. For achieving this, the present government strategy encourages the organization of user groups of identifiable beneficiaries. Therefore, for irrigation management, to involve user groups would be consistent with general government decentralization policy. But, in case of irrigation management, little is researched on whether or not there is organizational expertise developed within the local systems managed by the users

themselves.

It is, therefore, important to compare irrigation systems controlled and managed by the users with those controlled and managed by non- users to identify the variabilities within the systems that exist.

Water Users Association in User and Non-user controlled Irrigation Systems

Coward (1980) says that farmer managed irrigation can also be called community irrigation systems. According to him the irrigation systems for which water users are directly responsible for operation and maintenance, and which are built by themselves or their predecessors, are known as community managed systems.

Although the responsibility is solely with the water users, this does not mean that the system is completely outside the state's administrative frame-work. Water users, at times, may ask the local administration for assistance in maintaining, repairing, or settling disputes concerning water rights (Shivakoti et al., 1987).

The term "community" according to Coward (1980), refers to the community of the water users and not to the residential community. Thus an irrigation community may draw its members from several residential units. The Subaks, or irrigation societies, found on the Indonesian island of Bali have become well known examples of community irrigation

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systems. The major feature of the subak according to Geertz (1980), is the organizational separation of the irrigation community from the residential community. Thus, an individual water user is a citizen of a village and a member of an irrigation society. However, it is not a universal phenomenon where village is pretty close to the irrigation system.

Government assistance to community irrigation systems is an important policy area in countries such as Nepal where community irrigation systems cover large amounts of irrigated farm land. Pradhan (1988) argues that the performance of many community irrigation systems could be improved by various kinds of external assistance such as financial or material resources to strengthen or extend existing diversion structures and water delivery channels. Hilton (1990), from her study in Dang valley of midwestern Nepal has identified five incentives which encourage effective local resource mobilization for cost recovery of recurrent costs in irrigation systems: (1) farmers must have at least some control in system decisions; (2) irrigation systems must be tailored to meet local farmers' needs; (3) reliable water delivery is essential; (4) there must be clear rules which shape the irrigation systems; and, (5) irrigation systems must be designed and organized, primarily as means of providing inputs to agricultural production rather than as political activities.

For Groenfeldt (1986), finding the optimal mix of government/farmer management responsibility is an essential part of achieving optimal system performance. He suggests five factors on which the stability of farmer-agency management seem to be dependent. They are: (1) the use of community organizers, (2) the social environment, (3) a manageable main system, (4) a commitment on the part of the irrigation agency, and (5) the integration of farmer groups with a focus on rehabilitation activities and other tasks.

Korten and Uphoff (1981) suggest that Bureaucratic Reorientation (BR) is also one of the requirements for increasing farmers' involvement in Operations and Maintenance (O&M) activities in systems where farmers do not have control, because existing policies and procedures of the state and of the technical agencies have an effect on farmers' involvement in O & M activities.

Bagadion and Korten (1985) point out that in the Philippines the National Irrigation Authority (NIA) through the participatory approach, demonstrated beneficial effects in three aspects of irrigation: the physical system, the irrigators' association, and the relations between the farmers and the NIA.

One of the strengths of the Philippine communal irrigation program is its clear policy regarding the authority of the local associations. Each system of less than 1000 hectares has one association with responsibility

for operating and maintaining the entire system. According to Bagadion and Korten (1985), the association is a legal entity with water rights registered in its name. This provides the farmers a clear rationale for committing their time and energy to developing their association.

Ostrom (1990) cautions that potential pitfalls exist for government intervention in community irrigation systems. A common pitfall, according to her, is the failure to recognize the conditions that make indigenous institutions viable. Indigenous institutions rely upon shared understandings of rights and duties to enforce compliance with their rules about who is authorized, permitted, or required to take what action. She further cautions that if these arrangements are not understood by public officials and public officials begin to take charge, then the viability of indigenous institution is challenged.

Bottrall (1981) pointed out two major advantages besides improved water course management, emanating from water users associations. Firstly, the association can help to provide a point of contact between small farmers and government for other supporting services like agricultural extension, credit, input, supply and marketing. Secondly, the associations provide a foundation on which a system of representative farmer participation at the project level can be built.

But Hunt (1989) points out that WUAs have often been

conceived as an analog of irrigation communities, but according to him this is a weak analogy. Because irrigation communities have systems of rewards, rights and duties, while WUAs have only a disaggregated bundle of duties. Thus, he suggests that there has to be some rewards to the WUA members for doing the dirty work; the most effective reward according to him is control over water.

Chambers (1980) has identified critical activities for the successful operation of joint bureaucracy-community irrigation systems. They are: (1) Both communities and bureaucracy should be involved in decisions on general policies, including decisions about the timing of water delivery, the units of land to be served, and perhaps the cropping patterns to be followed. (2) Responsibilities for the implementation of these policies should reside with the bureaucracy whenever more than one irrigation community is concerned, but should be the responsibility of community itself when implementation occurs within the zone of a particular community. (3) Responsibility for the enforcement of policies and prosecution of infringements should remain with the bureaucracy.

According to Groenfeldt (1986), the appropriate method for encouraging farmers to cooperate depends on the circumstances. In some cases, formal farmer associations may be beneficial but they should not be seen as a blanket solution. A critical factor in evaluating the potential for

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voluntary cooperation according to him is the history of the irrigation system and of the farmers themselves.

Equity and Participation in Irrigation System Management

Martin and Yoder (1987) argue that irrigation water allocation and distribution are distinctive and important functions for any irrigation system. According to them, 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 the fields that have access to the system's irrigation from those who do not. The second is the quantitative allocation of water in the system among the farmers or the fields. On this basis, Pradhan (1988) concludes that allocations and distribution had implications for equity, and can be a mechanism for expanding the area irrigated.

Schwarzweller et al. (1987), in their study on the impacts of irrigation projects in West Java have concluded that not all villages were affected in the same way and not all families gained equally. Therefore, they suggest that variabilities should be taken into account in the planning and implementation of irrigation projects and programs of agricultural development elsewhere.

Stanbury (1984), in her study on the effects of irrigation development on Indian village women, found out that women's participation in agriculture increased. But

only higher caste women got their equitable share of their participation, whereas the lower caste women lost their wage work due to mechanization in the farming. Irrigation has allowed the village to support an increased population by bringing more land under cultivation, providing more jobs for the landless. Irrigation also has decreased the time required to various household tasks in the Indian village. Both upper and lower caste women have benefitted from labor savings in their respective households. Nevertheless, lower caste women have been hurt by labor-saving developments in the households of their potential domestic and agricultural employers. Thus, Stanbury cautions against assuming that irrigation benefits reach all women equally.

According to Korten (1983) participation is a process to release people from being the subject of development and make them agents of modernization and change. In the case of irrigation systems, the success of a system depends largely upon the active participation and cooperation of individual farmers. Thus, Korten concludes that there is increasingly widening awareness of the importance of farmers' participation in irrigation development and operation and maintenance of the systems.

McPherson and McGarry (1987) also define participation as the inclusion of intended beneficiaries in the solving of their own problems. They discuss the benefits of participation as :

- lower costs;
- a greater likelihood of user acceptance of the technology;
- appropriate and socially accepted designs;
- user care and maintenance of the facilities;
- the assumption by the users of part if not all of the responsibility for operation and maintenance (McPherson and McGarry, 1987).

According to Miller (1979), there are three pertinent aspects of participation:

> -Participation in decision-making which is the process of discussion to reach collective consent on a plan, program or project.
>
> -Participation in the implementation of action based on collective decision made above which is meant to include action involvement in terms of self-help labor, local building materials and supervision of construction.
>
> -Participation in sharing of benefits on an equitable basis from the action and in sharing costs incurred in undertaking the action.

Participation has been viewed as either mobilizing or empowering masses, and both orientations have their own justifications. Shingi et al. (1987) define participation as associating oneself (individually or as a member of a group) with a task, be it a program, scheme project, activity, or movement, with an appreciable degree of either adaptive, emotional, expressive, or instrumental involvement including both its positive and negative connotations.

Shingi and Bluhm (1987) in their study on participation in irrigation projects in north-western Indian villages, conclude that participation depends on the degree of: (1) dependence on the gains from the activity in which participation is required; (2) dependence on the group

effort to achieve these gains; (3) certainty that common resources will be managed properly; (4) certainty that the gains will be distributed equitably; (5) certainty that opportunity for others to exploit the situation of their self-interest is limited; and (6) certainty that returns will be commensurate with risk and investment. Thus they suggest more trust relationships.

The present study has tried to differentiate the rights (equity) and responsibilities (participation) as perceived by the individual members of the household within an irrigation system, and between the systems managed and controlled by users themselves and the systems controlled by non-users. Thus, this study has analyzed the structural variables which have influenced the equity and participation within a system and among the systems in rural hill villages of Nepal.

CHAPTER III

METHODOLOGY

This chapter describes the procedures used to compare the organizational effectiveness of user controlled and non-user controlled irrigation systems in rural hills of western Nepal by investigating the perceived effectiveness, level of user participation and feelings of equity within these systems.

An indicator frequently used in the evaluation of irrigation systems is the effectiveness of water use. Related to this is the question of which type of criterion is appropriate for the analysis - technical, economic, or social effectiveness. The objectives towards which the system is being operated determines which are the more relevant criteria, although all may be of interest. With the overwhelming majority of the hill population having high reliance on subsistence agriculture for livelihood, achieving the widest distribution of benefits from irrigation is an important objective, (i.e. water reaching the most farmers). Thus, social criteria dominate the objectives selected for this study.

Study data were collected from a sample of respondents among the irrigation water users within two user controlled

and two non-user controlled systems.

A Rapid Rural Appraisal (RRA) of 12 irrigation systems conducted during May - June, 1990 provided the background information about the systems selected. The second method used to collect study data was through face-to-face personal interviews with a sample of respondents administered through a written questionnaire. This was accomplished during October-November, 1990 by a team of four interviewers consisting of the researcher himself and three graduates from the Institute of Agriculture and Animal Sciences at Rampur, Nepal, where the researcher is a member of the faculty.

Because the purpose of this chapter is to provide details on the study methods, the chapter begins with the study design, which is followed by operationalization of the concepts, study hypotheses, data collection method, and data analysis approach.

Study Design

Freeman et al. (1978) explain that:

> "since the irrigation systems present multi-faceted realities which cannot be tapped adequately by any single discipline, researchers' attempts and efforts have been to find any new strategic variables which universally explain much in all systems".

Whyte (1984) says that reliance upon a single research method is bound to impede the progress of science. Thus, the research design of this study is based on the combination of

two methods; RRA and survey method.

RRA was used to gather background information and select the four irrigation systems which would be used for the second phase out of 12 systems. Pradhan et al. (1987) point out that, given constraints of time, money, and manpower, RRA is a useful tool for identification of key issues and problem areas, and also for giving direction for further investigation. The "quick and dirty image" often associated with the RRA can be overcome with a well-developed frame-work and a team that is integrated in its effort. Chambers and Carruthers (1986) have suggested many measures for offsetting frequent appraisal biases while carrying out field work. The use of RRA methodology in the current study was based on the guidelines provided by Chambers and Carruthers, 1986; Pradhan et al., 1987.

In a review of approaches and applications of research methodology in the study of irrigation organization, Coward (1978) has outlined four research approaches that are used by social scientists in the study of social organization: participant observation, survey research, documentary research, and comparative analysis. However, two or more of the approaches frequently are combined in any specific research project.

Survey research techniques are a widely used method of data collection in the contemporary social sciences. Surveys are well suited to a number of important tasks in irrigation

research. Freeman et al. (1978) identify the following uses of survey research methods in irrigation:

"(1) describing the structure of a policy problem;

(2) providing data for better estimation and specification of gaming/simulation models which can be manipulated for analytical purposes;

(3) a survey can yield distributions of preferences for alternative policies and problems;

(4) descriptive facts generated in survey research can be employed to educate clients-officials and farmers; and

(5) survey research can contribute to effective field work by identifying deviant cases which do not exhibit behavior expected either by theory or experience."

Operationalization of the Concepts

Socio-economic variables are useful for describing the village context and the study population within the system and they are also useful for making system variability comparisons. The conditioning variables used in this study include socio-economic status of household, family structure, and demographic characteristics of the respondents. Socio-economic status of household has been categorized on the basis of scale of farm operation, social participation, livestock ownership, material level of living and off-farm income. Family structure of the household has been classified on the basis of the number of family members, age of the head of household and of the dependents and type (joint or nuclear) of family structure. Other

demographic variables included in the study are family size, caste, age and education level of the principal farm operator, area of the irrigated parcel of study and its location.

The evaluative criterion of this study is the organizational effectiveness of a system. Different levels of user control of the irrigation systems are controlled by the study design. In assessing organizational effectiveness, the focus of research attention is on the following variables:

1. perceived effectiveness;
2. level of participation; and
3. perceived equity.

Perceived effectiveness pertains to the farmers' general attitude about the efficient functioning of the system, based on the perceptions of frequency and timeliness of the irrigation water available, and quantity of water available in the field. The operational definition of perceived effectiveness is the average of responses on 16 items ranked by respondents about irrigation systems' physical effectiveness on a four point scale with four being the highest.

Level of participation has been defined in this research as the farmers' involvement in the social and technical administration of the irrigation system and in decisions that affect the management of the system.

Particularly relevant are the farmers' expressed feelings of satisfaction with how the system is functioning, and the basis for the satisfaction or dissatisfaction. The operational definition of level of participation includes the item statements about perceived level of involvement of respondents, their neighbors, and their leaders on maintenance of the irrigation system on a four point scale with four indicating the highest level of participation for each activity.

Perceived equity has been defined as the water users' expressed feelings of justice and fair treatment in water acquisition, allocation and distribution in the individual fields. The operational definition of perceived equity includes the perceived fairness in irrigation water related decisions ranked by the respondents with each item classified on a four point scale with four being always fair.

Leadership structure for each decision-making situation in a community has been identified on the basis of the cumulative response to choice for assistance among (1) functionaries related to the water users association (WUA), (2) functionaries related to the village council, (3) neighbors and relatives, (4) administrative officials related to irrigation, and (5) water monitors.

Indicators of the conditioning and dependent variables

The conditioning variables included in the study, as outlined above, are socio-economic status of the household, family structure and other demographic characters. To identify operational measures for these conditioning variables, three or more indicators have been identified for each. The demographic characters are considered as independent (continuous) indicators for the purpose of analysis.

Socio-economic status of a household has been measured by: (1) size of the operational holding; (2) off-farm income of the family; (3) social participation; (4) number of livestock standard unit (LSU); and (5) material level of living. Specific measures of the indicators are:

Size of the operational holding -- Measured in Ropani (20 Ropani = 1 ha) of land operated by the family.

Off-farm income of the family -- Measured in Rupees (32 Rupees = 1 US $) earned (saved and sent to home) annually by the members of family working in or outside village.

Social participation -- Measured by kinds and number of local organizations to which the head of the household or other member of the family belong.

Livestock Unit -- Livestock numbers owned and raised by the household converted into standard units.

Material level of living -- Indicated by the house structure, numbers of stories and rooms, court area, the material possessed such as radio, chairs, desks, cots, books and watch.

Family structure is approached through four variables: age of head of household, age of dependents, family type

(joint or nuclear) and number of family members.

Other socio-economic and demographic indicators include: education level of head of household, family size, annual farm income, total annual income, and area of the irrigated parcel of study.

The dependent variable in this study is the organizational effectiveness. This variable has been measured by (1) perceived system effectiveness; (2) reported participation in activities related to maintenance of system; and (3) perceived equity.

Perceived effectiveness: The framework for comparative analysis of organizational effectiveness of system includes the following indicators:

(1) Farmers' perceived judgement about system design and construction.

(2) Farmers' perceived water sufficiency in own and neighbors' fields, and by location of the fields.

(3) Farmers' perceived water use efficiency by location of the fields and system as a whole.

(4) Farmers' familiarity with and assessment of the system rules.

(5) Farmers' assessment of system regarding resource utilization and benefit distribution.

(6) Farmers' perception of rule enforcement and equal treatment.

Participation: Degree of participation was measured by the following indicators:

(1) Farmers' knowledge about their operation and maintenance responsibility of the system.

(2) Farmers' assessment of contribution made to the

maintenance of the system.

(3) Farmers' satisfaction level about their involvement in solving problems together with other irrigation users.

(4) Farmers' satisfaction level on the job performance by the irrigation leaders.

(5) Farmers' assessment of involvement in helping neighbors and own field channels maintenance.

Equity: In order to measure equity in irrigation distribution, the following indicators were used:

(1) Farmers' statements of perceived fairness of water share allocation criteria.

(2) Farmers' statements of perceived fairness in frequency of water distribution criteria.

(3) Farmers' statements of perception of fairness on water allocation timing in the field.

(4) Farmers' perception of efficient distribution of water field location.

(5) Farmers' perception of fairness of system treatment.

Hypotheses

The following hypotheses and sub-hypotheses were constructed to test the main research question that the organizational effectiveness of user controlled irrigation systems are significantly different from non-user controlled irrigation systems.

H1: User controlled and non-user controlled irrigation systems are operationally different in terms of leadership patterns for solving: (a) dam and main canal repair problems; (b) field problems; (c) water allocation and distribution problems; and (d)labor and other resources mobilization problems.

H2: Within an irrigation system, individual farmers' characteristics affect their perceptions of system effectiveness, level of participation and their feelings of satisfaction about the system's fairness.

H2A: There are significant linear relationships among the socio-economic characteristics of the respondents and the responses towards the perceptions of system effectiveness, level of participation, and feelings of equity.

H2B: There are significant differences in mean score responses of perceptions of effectiveness, participation and equity among different family structure groups.

H2C: There are significant differences in the mean score response of perceived system effectiveness, participation and equity among different socio-economic status groups.

H2D: There are significant differences in the mean score responses of perceived system effectiveness, level of participation and feelings of equity by the location of the irrigated field of the respondents.

H3: There are positive relationships among perceived effectiveness, level of participation and perceived fairness of the system by individual farmers within the system.

H4: User controlled irrigation systems manifest higher perceptions of system effectiveness, level of participation and feelings of fairness than non-user controlled irrigation systems.

H4A: The correlation between level of perceived effectiveness and the level of participation of the system are stronger in user controlled systems than in the non-user controlled systems.

H4B: The correlation between the level of participation and satisfaction with the fairness of system are stronger in user controlled systems than in the non-user controlled systems.

H4C: The correlation between the level of perceived effectiveness and satisfaction with

the fairness of the system will be stronger in user controlled systems than in the non-user controlled systems.

H5: Perceived organizational effectiveness will be higher in case of user controlled irrigation systems than in the non-user controlled systems as manifested by higher scores of perceived effectiveness, level of participation and perceived equity.

Data Collection Strategies

Aspects of the data collection process include: (1) selection of the study site, (2) sampling procedures, (3) instrumentation and (4) the data collection process.

The study site includes four villages receiving irrigation water from four different irrigation systems located in Kaski district in the Western Development Region of Nepal. The site selection criteria were based on many factors.

The researcher spent two months collecting background information on 12 irrigation systems using the Rapid Appraisal Method. This was part of a study on "Effects of Different Types and Levels of Intervention in Farmer Managed Irrigation Systems in Nepal" (Shivakoti et al. 1991). This study was supported by the Workshop in Political Theory and Policy Analysis at Indiana University for the USAID supported project in Nepal on "Decentralization, Finance and Management."

A number of other factors also affected the selection of these twelve systems. The twelve irrigation systems

selected for that study were assisted by different agencies at varying levels of intervention. All but two systems are in the mid-hill districts of Gorkha, Kaski, Lamjung and Tanahu in the Western Development Region. Two systems are in Makwanpur district, in the Central Development Region which was included in the study because two agencies had not intervened in the mid-western hills. Availability of secondary information: such as Rapid Appraisals reports prepared by others, Irrigation Management Center (IMC) Applied studies, Baseline Studies; accessibility from the IMC office at Pokhara; and also the principal researcher's dissertation research sites selection criteria were some of these factors. Table-1 summarizes the names of the systems, the districts in which they are located, the total command area and intervening agencies, and also identifies the four systems which were selected for the major survey research.

For the selection of the four research sites out of these 12 irrigation systems, the most important criterion was the user/non-user control factor. The systems were chosen within a political sub-division (one district) within a single watershed project area. These included two pairs of systems: one pair each selected from the user controlled and non-user controlled systems. Each pair of user and non-user controlled systems shared a common water source i.e. Chaurasi (user controlled) and Hyangja (non-user controlled) systems diverted water from one stream, Yamdi; and Ghachok

Table 1: Basic information on selected irrigation systems and their intervening agencies.

Name of the system	District	Command area (ha)	# of household	Intervening agency
1. Manechhango & Pangduri	Gorkha	32	68	ADB/N, MPLD
2. Rangdi Khola	Gorkha	20	55	Hill Food Prod. Program
3. Hyangja*	Kaski	300	545	DIHM: Hill Irrigation Dev. Program
4. Chaurasi*	Kaski	100	285	Dept. of canals
5. Thuli Besi	Kaski	20	52	CARE/Nepal, MPLD
6. Ghachok*	Kaski	200	650	ILC/DOI
7. Lahachok*	Kaski	100	410	ILO/DIHM/DOI /MPLD
8. Bhorletar	Lamjung	220	194	ILO/DIHM
9. Handetar	Lamjung	260	513	DIHM/IMP
10. Malebagar	Tanahu	22	59	IMC/DOI
11. Rapti-Nawalpur	Makwanpur	175	208	FIWUD/MPLD
12. Bhalu Tar	Makwanpur	31	64	CARE/ADB/N

Note: *=Irrigation system selected for the survey research.
Data Source: Different reports (Laitos et al., 1986; IMC, 1990) and field survey (1990).

(user controlled) and Lahachok (non-user controlled) systems diverted water from another stream, Lasthi. These four systems were also located within one day of walking distance at a radius of 25 square kilo meters. The systems were of comparable sizes (within a range of 100-300 hectares).

Sampling Procedure

All the households owning khet (low land) and using irrigation water from the four selected systems were included in the study population. Because the availability of water to a field depends largely upon distance from the head reach to the field, the sampling was drawn from all types of farmers, according to the location of their fields. The sampling unit was the particular parcel of the land recorded in the land survey record. The sample was stratified, based on the variation of farmer location on the water course, employing the categories of head, middle and tail. Sometimes a single farmer had several plots of land in different locations. To overcome this problem, farmers were asked to tell the location of the field which was most significant to them in relation to production and productivity. Thus, the farmers were also categorized according to location.

Babbie (1986) suggests cluster sampling in developing countries due to the absence of exhaustive lists of the elements comprising the target population. But in the case of the mid-hills of Nepal, the cadastral survey map of the Land Resource Mapping Project (LRMP) which was completed recently during 1986 is a fairly accurate map showing individual fields. The district land survey department has a record identifying the owner of each parcel of land. The Nepal Malaria Eradication Office in each sub-center keeps

household lists updated every three months, which were also available. These were the basis on which the target population could be identified, and a sample drawn from it.

Babbie also suggests that, the larger the sample, then the more precise will be the estimate of the characteristic in the population. This is especially true in the lowest ranges of the sample size,i.e. below 100. However, in the hills of Nepal, the irrigation systems selected covered more than 100 households. For comparative study, a sample size of nearly 25 or more has been said to be reasonable in rural villages in Nepal (Pyakuryal, 1982). But, sample size also depends upon the homogeneity/heterogeneity of the respondents (Babbie, 1986). The study area was relatively homogeneous in terms of average land size, caste, language spoken and other socio-economic factors. Therefore, 50 households from each of the four systems, with a total sample size of 200 households (100 each from user controlled and non-user controlled systems) out of a total of 1890 beneficiaries, was considered to be an adequate sample size.

Data Collection Instruments

Three different sets of instruments were used to collect data. The first phase included the study of background materials, such as rapid appraisal reports, applied and baseline studies, as well as descriptions of the systems by the Western Regional Directorate of Irrigation.

In the second phase, an inventory checklist was prepared and the information was gathered by using the RRA method. Additional information was also collected in this phase by interviewing different persons working in related agencies. These two sets of data helped the author to select the study systems, and also to prepare background information on the sample villages.

The information collected by RRA method included: (1) description of the general area, (2) settlement patterns, (3) irrigation systems (including their organizational structures and institutional rules for operation and maintenance), and (4) agriculture system and services.

The third set of data collected came from a structured personal interview schedule administered to the selected 200 respondent farmers. Most of the items in the schedule for assessing effectiveness, participation and equity were close-ended questions. Questions relating to the socio-economic variables, on the other hand, were mostly open-ended. The interview schedule was organized in the following sections: (1) location; (2) household information; (3) farm size and operational holding; (4) livestock and poultry numbers; (5) material level of living; (6) farm and off-farm income; (7) level of involvement in the socio-economic organization; (8) organizational effectiveness - relating to effectiveness, participation and equity ; and (9) leadership structure.

1. Location: In this section, information was collected on the village and ward of the respondent's house, the name of the respondent, identification of the irrigation system, and the location of the particular selected study parcel.
2. Household information: In household information, several questions were included concerning caste, number of family members, their ages, gender, respondent's age and education level.
3. Farm size and operational holding: was estimated on the basis of farmers' statements about the land category and type. Land categories included area of land owned, rented in and rented out in Ropani (20 Ropani = 1 ha); and land types included khet(irrigated lowland) and pakho (unirrigated upland) where pakho land was assumed to be valued at equivalent to half of khet land.
4. Livestock and poultry numbers: were determined as livestock standard unit (LSU) as defined by the National Farm Management Study of 1983 where the conversion units are: adult buffalo = 1.1 LSU, adult cattle = 0.8 LSU, draft bullock = 1.00 LSU, heifer buffalo = 0.6 LSU, heifer cattle = 0.5 LSU, buffalo calf = 0.25 LSU, cattle calf = 0.20 LSU, goats and lambs = 0.2 LSU, kids = 0.1 LSU and poultry = 0.05 LSU.

5. Material level of living: was estimated by the house type, roof structure, area of the court yard, possession of radio, watch, books, chairs, desks and cots.

6. Farm and off-farm income: Total farm income was estimated by the market value of the commodities produced on the farm; and the off-farm income was measured in terms of money available for the household spending earned away from the farm by one or more member of the family.

7. Level of involvement in the socio-economic organizations: was determined by reported membership in the local organizations, position held, and involvement in the stages of local development projects.

8. Organizational effectiveness: In this section, statements designed to measure perceived effectiveness, perceived participation and perceived equity were offered to each respondent for evaluation. Sixteen statements were used to estimate the perceived effectiveness, and 10 items each were administered to estimate participation and equity. The average cumulative scores of effectiveness, participation and equity were used to estimate perceived organizational effectiveness of a particular system. Reliability of the

instrument was measured by Cronbach alpha. Alpha coefficients measured .6516 for effectiveness, .7776 for participation and .8423 for equity. These coefficients indicate that consistency of the survey response was acceptable. An alpha greater than .65 is recommended for research purposes (Nunnaly, 1978). Since validity and reliability are two criteria to be met by any research instrument, in this context, the content validity of the instrument used in this research was evaluated by Guidance Committee Chair during a visit to Nepal in August, 1990; and also by another Guidance Committee Member, who is in the faculty of the Sociology Department at MSU. A Resident Scientist of International Irrigation Management Institute (IIMI) at Kathmandu and a faculty member at the Department of Sociology and Anthropology of Tribhuvan University in Nepal also evaluated the content validity of the instrument.

8a. Effectiveness: was estimated by (1) perceived judgement on system design and construction - where the 4 point Likert-type scale was used: 4 being "very well - no problems" and 1 being "terrible - many problems." (2) Similarly, water sufficiency (availability) was used: 4 being

"always sufficient (available)" to 1 being "usually insufficient (unavailable)." (3) Statements related to measuring effectiveness in resource mobilization and benefit distribution: "excellent" to "not good at all" Likert-type scales were used at a 4 to 1 scale. (4) Statements related to system effectiveness in treating benefit distribution: "very fair" to "very unfair" Likert-type scales were used at a 4 to 1 interval scale.

8b. Participation: was estimated by (1) knowledge and level of involvement in operation and maintenance of the system: "always" to "never" Likert type scales were used at a 4 to 1 scale, (2) involvement of respondent and neighbors in solving problem: "always" to "never" Likert type scales at a 4 to 1 scales were used, (3) job responsibility of the leaders and one's own assessment of responsibility: "always" to "never" Likert type scales at a 4 to 1 interval scales were used.

8c. Equity: was estimated by statements related to fairness in water acquisition, allocation, distribution, canal alignment, and system treatment, each statements were ranked "always" to "never" Likert type scales at a 4 to 1 interval scale.

9. Leadership structure: for irrigation related decision-making situation in a community was determined by response categories counts which included (1) water users' association chair/member, (2) village council chair/member /secretary, (3) neighbors and relatives, (4) district irrigation and general administration officials, and (5) water monitor.

Data Collection Process

Data were collected during two time periods as mentioned earlier: once during May - June, 1990 using Rapid Rural Appraisal technique; and the second during October - November, 1990 using face-to-face interviews with the respondents.

The study team for the rapid appraisal spent one day in smaller systems to two days in larger systems walking through each system from the source to the tail end with key informants in the respective system. User committee members and/or site staffs and farmers at different locations were also consulted for information. The background information, besides visual observations was collected using a checklist designed for the study.

The second phase of data collection featured the survey method where data were collected by a team of interviewers composed of the researcher and three agricultural graduates

who were from the locality and had experience in interviewing farmers. The interviewers were familiar with the study area, spoke local language (which is Nepali itself), and manifested a positive and supportive attitude.

The interviewers were trained for a period of one week in the field; and each item was discussed and made clear before starting the field data collection process. Interviewing was done by visiting each respondent's house, as certain things had to be visually observed and recorded by the interviewer. The maximum time taken for an interview was one and half hours. All the interviewers stayed at the same lodging; and each evening there was a short meeting to discuss the problems related to the data collection process. The data were collected for one village at a time.

Data from other sources, like the village committee, the minutes of the meetings of the users committee, the district and regional offices of the irrigation department, local development office of the district and other related agencies were collected by the researcher himself.

Data Analysis Approach

Data were coded, entered and analyzed using SPSS/PC+ microcomputer software. Frequency runs were conducted to detect coding and/or data entry errors; and necessary corrections were made accordingly after checking errors and inconsistencies.

Socio-demographic and economic variables are used to describe the village context and study population. The variables included age, family size, family structure, literacy, size of land holdings, caste, social participation level, farm and off-farm income, and average number of years of household irrigating the field. These variables are analyzed by generating response frequencies, percentages, means and standard deviations as appropriate.

To test hypothesis - 1 regarding the equality of means between user controlled and non-user controlled systems in terms of leadership structure, cross tabulation and the chi-square statistic were used.

Pearson's product moment correlation coefficients were computed to examine the nature and extent of linear relationship between continuous socio-demographic and economic characteristics and the effectiveness, participation and equity to test the sub-hypothesis - H2A. One-way analysis of variance and the Tukey procedure were used to determine the differences in effectiveness, participation and equity scores by interval variables such as family structure, socio-economic status and location of the parcel by testing sub-hypotheses - H2B to H2D. Thus, Pearson's correlation coefficient and one-way analysis of variance were used to test hypothesis - 2.

Hypothesis - 3 on relationships between level of effectiveness, participation and equity; and hypothesis - 4

on interrelationship between effectiveness and participation (sub-hypothesis - H4A), participation and equity (sub-hypothesis - H4B) and effectiveness and equity (sub-hypothesis - H4C) were tested by using Pearson's correlation coefficients.

The t-test was used to analyze the difference in estimates of effectiveness, participation and equity scores by control type for testing hypothesis - 5.

CHAPTER IV

STUDY AREA OVERVIEW

This chapter presents descriptions of the general area, settlement patterns, irrigation systems (including their organizational structures and institutional rules for operation and maintenance), and agriculture system and services. All of these are based on the findings from RRA methods.

Area Overview

The four irrigation systems -- Chaurasi and Ghachok which are user controlled systems and Hyangja and Lahachok which are non-user controlled systems -- are all located in Kaski District of the Western Development Region within a radius of 25 square kilometers. The river source of Hyangja (lower intake) and Chaurasi (upper intake) systems is the Yamdi River. The intake points for these two systems are only 200 meters apart. Similarly, the source of Ghachok (upper intake) and Lahachok (lower intake) is the Lasthi khola (rivulet); and the intake points of these systems are 500 meters apart.

Hyangja irrigation system irrigates Wards 1,2,3, and 4 of Hyangja Village Council. Chaurasi irrigation system

irrigates Wards 5,6,7,8, and 9 of Hyangja Village Council. Lahachok irrigation system irrigates Wards 3,4,5,6,7,8,and 9 of Lahachok Village Council. Ghachok irrigation system irrigates Wards 2,3,4 and 5 of Ghachok Village Council and Wards 4 and 5 of Machhapuchhre Village Council.

In Nepal, the formal organization governing villages is the Village Council (called Village Panchayats until March, 1990). A Village Council has nine wards. A ward is the smallest political unit. There can be one or more than one hamlet or village in a ward. If a village is very big, that village might be in more than one ward. Several Village Councils make one district (there are about 4,000 Village Councils in all 75 districts of Nepal). The district has an assembly, and each Village Council has its own local assembly. At the Central level, there are both a national assembly (upper house) and a house of representatives (lower house) which are the highest political units in the government hierarchy.

The nearest accessible market center to all villages in this study is Pokhara town. The Hyangja system irrigates the lower Villages of Hyangja Village Council and the Chaurasi system irrigates the upper villages of Hyangja Village Council. The Pokhara - Baglung highway passes through both of the systems; and the lower and upper Hyangja villages are about 6.0 - 8.0 km northwest of Pokhara valley. Lahachok is 3 km further away, northwest of lower Hyangja along the

trail towards Annapurna mountain base camp. And Ghachok is farthest - 6 km away northwest of lower Hyangja along the trail towards Fishtail (Machhapuchhre) mountain base camp.

Pokhara is a market,tourist and educational center; and district head quarters of Kaski District, and also Regional Head Quarters of Western Development Region (WDR). Pokhara, given its setting on the highway connecting the capital, Kathmandu (200 km); Sunauli in Indian border (220 km); and Baglung towards the northwest (70 km), has emerged as an important market and tourist center. There is also an all weather airport which connects many of the remote airports in the high hills of Western Nepal. Educational institutions which offer upto post-graduate level in business management, liberal arts, and educational administration; undergraduate level in the field of engineering, medicine, forestry and sciences education are also located in the Pokhara area. There are district and regional hospitals available for health care.

Support services, such as agricultural research centers, agricultural extension centers, donor assisted rural development projects from rural electrification to watershed development, livestock and veterinary services and agricultural inputs are also available to farmers.

Settlement Pattern

The surrounding areas of all selected irrigation

systems are all old settlement areas. Although the Chaurasi and Hyangja irrigation systems are little more than 100 years old, the settlement around the system is said to be far older (more than 500 years). Ghachok system, on the other hand, is in itself more than 400 years old; and settlement is believed to be present at least for the last 700 years. Lahachok system, although relatively younger than Ghachok, is believed to be at least 250 years old; and the settlement of surrounding villages is as old as Ghachok.

Nearly forty percent of the settlers in the villages surrounding Hyangja and Chaurasi systems are Brahmins. An equal number of families are Chhetries, and those remaining are Newars, Kami, Sarki and Damais. There are 926 families residing in different villages of upper and lower Hyangja of which 545 families use the irrigation facility from Hyangja system and 285 families use the Chaurasi irrigation system.

About 75 percent of the households belong to Brahmin caste in Lahachok; and out of remaining 25 percent, half of the households are Chhetries. Newars, Kami, Damais and Sarkis constitute another 12 percent of the village population. Out of the total of 635 families residing in the Lahachok villages, 410 families irrigate their parcel of lands through this system.

In the case of Ghachok irrigation system, the users are settled in two Village Councils. The irrigation system is sandwiched between Machhapuchhre and Ghachok Village

Councils. Nearly 40 percent of the users are Gurungs from Machhapuchhre; and out of remaining 60 percent, another 40 percent are Brahmins and Chhetries constitute 15 percent. Sarkis, Damais and Kamis constitute only 5 percent of the total population in the Ghachok Village Council. Out of the total of 1,165 families living in different villages of two Village Councils, 650 families have their fields receiving irrigation facilities from the system.

Four Irrigation Systems

Hyangja

The gross command area of the Hyangja system is 300 ha, which extends from the left bank of the Yamdi river to the right bank of Seti river. The command area is divided into three parts: low lands on the right bank of Seti river, and terraced fields divided in two by Pokhara-Baglung highway. The lower Hyangja areas covered by irrigation include: Chapaghat, Chhapthok, Sankalpuathar, Majgaon, Dandalithar, Parajulithar, Thapathar, Karkithar, Lamachaur, and Kunwarthar.

History: Farmers started digging a canal on their own to irrigate 300 ha of land in Hyangja in 1968. That year Rs. 15,000 (Rs. 10=1 US$ approx.) were made available to this system by the district administration, and the farmers cleaned gravel and boulders out of the canal. An additional support of Rs. 25,000 in 1970 enabled farmers to construct

900 m canal. In 1982, the Department of Irrigation, Hydrology and Meteorology (DIHM) undertook this project as part of the Hill Irrigation Development Program and received financial assistance from the Asian Development Bank in Manila. Although the construction was completed in June, 1986 water was first released to the system in June, 1985. At present DIHM (now DOI) maintains a project office at site, and all the responsibilities of repair and maintenance lie with the project office.

Description of the physical system: The source of the system is the Yamdi river where the intake of the system is a permanent diversion structure. The main canal of Hyangja irrigation system is 1.95 km and follows the alignment of the old farmer constructed canal. The canal is completely lined. There are four branch canals with a total length of 6 km; and also 10 outlets in the main canal to distribute water to the farmers' field channels. Nine super passages across the main canal have been constructed to bring water from the Chaurasi farmer managed canal above to these fields. Thus, the unique feature of Hyangja is that Chaurasi exists about 200 m upstream of Hyangja's main canal. These canals run parallel to each other. The head of Hyangja irrigation system used to be the tail commanded by Chaurasi system, and this tail received very little water. Field channels exist in this part of the new system.

System operation, maintenance, and water delivery:

Activities and problems related to water acquisition, allocation and distribution are the responsibility of the DOI project office. Water is allocated and distributed by four dhalpas (water monitors employed by the project office) from the head to the tail of the system. The institutional arrangement for water distribution is such that there is continuous mode of water supply during the monsoon (rainy season) and rotation among the branch canals during winter and spring (dry seasons). The basis for water distribution at the field level is land area to be irrigated. Water allocation and distribution up to branch canal level is the responsibility of dhalpas; and thereafter at the field level the responsibility lies with the water users themselves.

Department of Irrigation's (DOI) project office is responsible for all maintenance on the main and branch canals. Up to the date of this field research, the DOI had made no plans to obtain farmer participation in main and branch canal maintenance. Each farm channel is considered to be the responsibility of the individual farmers. Field channel maintenance is a collective activity for all farmers whose fields are served by the field channel. There are no sanctions imposed for non-participation.

Institutions and social environment: There are basically three socio-economic classes of farmers at Hyangja: large landowners, small landholders, and landless farmers who often work as agricultural laborers and/or work in some

other development projects. The smaller landholders account for most of the land and population in Hyangja. These constitute 90 percent of the farmers (out of more than 900 total farm families), and they own 0.1 to 0.5 ha of land as compared to 5 or 6 large land owning families who own between 2.5 and 5.0 ha of land which accounts for 10 percent of the command area.

The large landowners are high caste Brahmins. But many castes own smaller pieces of land, including Brahmins, Chhetries and Sarkis. The landless people are also of many castes from Chhetries to Sarkis.

More than 95 percent of the farmland is owner-operated with the assistance of landless agricultural laborers. The little share cropping that exists is shared on equal halves of the produce produced between the owner of the land and the tenant.

The power structure at Hyangja is basically feudal. A few older, larger farm families possess most of the power. These families are very active in local affairs and politics.

Almost all classes of farmers in Hyangja live along or close to the main Pokhara-Baglung highway, bisecting the irrigation system.

Because the operation and maintenance of the system are done by the irrigation project office, although a water users' association (WUA) has been formed, it is

dysfunctional. The local political representatives (village council chair, vice chair and nine ward members) were automatically functionaries in the WUA. With the change towards a multi-party democracy system, the present structure requires separate local development entities. Thus, it is hoped that the new-formed WUA will be more effective in managing the system than in the earlier situation. But at the branch level, the farmers formed branch canal water management committees to distribute the water after it was released through the gates of branch canals. Thus, the organizational structure is the two tier type, one at the system level and the other at the branch canal level.

Agriculture system and services: The main crops grown in the area are paddy followed by wheat, millet, corn and mustard. Potatoes are grown year-around in nearby Chapaghat. The average cropping intensity of the area is 207; and it is 275 in the head reach. Middle fields have a cropping intensity of 255, whereas it is only 160 in the tail end. The tailend fields are severely limited by unavailability of water during the dry seasons.

The productivity of major crops are above average in the region. The productivity of paddy, corn and wheat for the year 1990 was 2.5, 1.65 and 1.45 mt/ha respectively. Farmers maintain their own local seeds. The use of "improved" varieties for crops except for wheat and maize,

is practically nil.

The major changes in agricultural practices have been the introduction of fruits and vegetables due to proximity of Pokhara town and transportation facilities available. There is Small Farmers Development Program (SFDP) office to provide institutional credit for the small farmers. Farming System Research site is also located at Hyangja. Beside this, agricultural service center is located within the system area. There is one high school and three primary schools in the area.

Chaurasi:

The gross command area of the system at present is 100 ha, which was 200 ha until 1982 prior to construction of Hyangja irrigation system. Hyangja irrigation system, which has 300 ha command area, has now incorporated 100 ha of Chaurasi irrigated tail end, which is now the head fields for Hyangja system. An additional 200 ha of unirrigated land was converted into irrigated land by Hyangja system. The upper Hyangja areas covered by Chaurasi irrigation system include: Suikhet, Majgaon, Bastolathar, Sauthar, Jaishithar, Sarkitole, Upper Chapaghat, and Upper Hyangja.

History: Chaurasi irrigation system is 110 years old. The system was designed by a local farmer named Bali Raj Thapa in 1878 A.D., during Rana regime. The area irrigated in the beginning was 8,400 mato muri (80 mato muri = 1 ha) which is equal to 105 ha of land. The designer, Bali Raj Thapa, was

awarded 300 mato muri (15 ha) of land without tax by the government at that time. The Thapa family enjoyed this privilege until 1962 A.D.; birta system was abolished when the land reform program was launched.

In the history of this 110 year old system, in all but three years the system has been managed by the users. In 1960 a catastrophic flood washed away the source diversion structure. Emergency repair and maintenance was beyond the capacity of farmers. So operation and maintenance of the system was taken over by the Minor Irrigation Division under the Deparment of Canals. After three years, the system was handed over to the District Administration which in turn handed it over to the farmers for regular repair and maintenance. This intervention and turnover of the system undertaken by a public agency is unusual in Nepal.

Description of the physical system: The source of the system is the Yamdi river where the intake is a brush dam; and the intake is 200 meters upward from the Hyangja irrigation system. The canals run parallel to each other. The people of the area are uncertain about command boundaries. There are no major branches of the 2.5 km long irrigation system; but there are numerous field channels directly diverting water to the respective fields.

System operation, maintenance, and water delivery: All the activities related to water acquisition, allocation and distribution are the responsibility of the users and their

selected/elected representatives. There is one Katuwale (village peon) who is responsible for all community activities including irrigation. His job, related to irrigation, is to inform all the representatives, and in turn to the users, regarding labor contribution if there is major damage to the intake or main canal and also during the period of regular repair and maintenance.

There are two types of maintenance works; emergency and routine. In case of emergency maintenance the labor contribution is on a per household basis. But the regular maintenance labor contribution is on the basis of area irrigated. The farmers had to pay a cash contribution of Rs. 746.00 and 9 person days per hectare of irrigated land for annual maintenance during 1990. After the construction of the Hyangja irrigation system, although the volume of work at the intake is the same, the number of beneficiaries has decreased to half due to reduction of the command area. Thus, the amount of resource to be mobilized has doubled after 1982.

The institutional arrangement for water distribution is rotational among the users during all the seasons. The basis for water distribution at the field level is land area to be irrigated.

Social and institutional environment: Like lower Hyangja, upper Hyangja also has basically three socio-economic classes of farmers: large landowners, small landholders, and

landless farmers. But the majority of the farmers fall within the small landholders category.

Unlike lower Hyangja, large landowners are both Brahmins and Chhetries. Small landholders are represented by all four castes of people. The proportion of landless people is less than lower Hyangja.

Nearly all the farmland is owner-operated. The power structure at upper Hyangja is possessed by the same individuals as lower Hyangja. Like lower Hyangja, almost all classes of farmers at Chaurasi (upper Hyangja) live along or close to the main Pokhara-Baglung highway.

The organizational structure is of two tier: one at the system level and the other at individual village level. The main system committee has 11 members and there are 30 members in five village committees. The function of the main committee is mobilization of resources mainly labor for regular and emergency maintenance. The village level committees are mainly responsible for water allocation and distribution.

Agriculture system and services: The main crops grown in the area include paddy followed by corn, wheat, millet and mustard. The overall cropping intensity was 225 for the year 1990. The cropping intensity was highest in the middle fields, which was 260, followed by the head being 210 and the tail being 165.

The productivity of the major crops included paddy at

2.5 mt/ha, corn 1.65 mt/ha and wheat 1.45 mt/ha, which is the same as lower Hyangja. There were no major changes in the agricultural practices; and the institutions providing support services are the same for both upper and lower Hyangja. There is a separate primary school but the high school is same for lower and upper Hyangja.

Lahachok:

The gross command area of the system is 100 ha which is divided into three big terraces. The head terrace is called Gouchar Phant, middle terrace is called Lahachok Phant, and the tail end fields are called Bhirkatera Phant. The individual areas covered by irrigation system include: Bhirkatera, Gaichaur, Chhapalithar, Badrithar, Sauthar, Batulethar, and Paudelthar.

History: This system, according to the local people, is nearly 250 years old which captured water from the small seasonal rivulets and springs called Boxe Khola, Andhera Khola, and Tinmana Tari mainly for paddy growing season during the monsoon. This system also diverted excess water from Lasthi spring after Ghachok system farmers had diverted water in their system in the upstream. This system was initiated by Adhikari and Bastola families who had migrated from Baitadi district of the far western region of Nepal.

The first intervention by any public agency in this system was a grant from International Labor Organization (ILO) during 1979-80. DIHM constructed the whole system on

behalf of ILO by realigning the canals and head work at the source at no cost to the farmers. During the construction period, locally available resources - both materials and labor - were maximally utilized according to the working principles of ILO. But even after completion of construction of the system, the O & M remains the responsibility of the DOI; and farmers are reluctant to take the system over for regular O & M.

Description of the physical system: DIHM constructed the system by diverting water from Lasthi Khola - a perennial stream about 500 meters down the intake source from Ghachok farmer-managed irrigation system. The agency has incorporated all the monsoon springs from Andhera Khola, Tinmana Tari, and Boxe Khola to increase the volume of water and also to rehabilitate the old farmers' constructed canals. The main canal of Lahachok irrigation system is 2.6 km which is partly lined. There are five branch canals out of which branch number 1 supplies water to the head; branch numbers 2, 3, and 4 supply water to the middle field; and branch number 5 supplies water to the tail end.

The conflict between Ghachok and Lahachok started to emerge only after the construction of the system was completed by DIHM. The riparian right in Nepal forbids any other system to divert water from within 500 meters of an existing source. The farmers at Ghachok did not object to the construction of another intake point within 500 meters

during the construction period, thinking that since the source of their system is located upstream, they have the right to the water. But recently Lahachok farmers have demanded equal share of water based on the legal provision of getting equal share for the sources within 500 meters.

System operation, maintenance, and water delivery: Activities related to water acquisition, allocation and distribution are the responsibility of the users and their selected/elected representatives. After reorganization of the irrigation sector under DOI, this system has formed a water user association (WUA) to get financial assistance from district irrigation office mainly for repair and maintenance. The users have to contribute labor, but still users are reluctant about assuming O & M responsibility. Thus, although regular maintenance is done partially by users (mainly by contributing labor), major operation of regular and emergency maintenance is done by the district irrigation officials; and hence, the system is controlled by the non-users.

The institutional arrangement for water distribution is rotational among the users during all seasons. But if the water is scarce, the head farmers are entitled to use of water followed by middle and tailend farmers. The basis for water distribution at the field level is land area to be irrigated.

Social and institutional environment: There are basically

only two socio-economic classes of farmers: large landowners and small landholders, out of which nearly 90 percent of the farmers fall within the small landholder category. The percentage of landless people in the villages is less than one percent.

The large landowners are a mix of Brahmins, Chhetries and Newars. Small landholders are represented by all four castes of people. But the majority (almost 75%) of the total population in the village consists of Brahmins.

Almost all the farm land is owner operated. But within a family, one or more members of the family may work outside village; and their land is cultivated by their nearest kin. Thus, although the average holding is reported officially between 0.4 and 0.8 ha per family actual holdings seem to be more than one hectare per family. Chhetries, Newars, Kamis, Damais, and Sarkis are settled near the head; and they own most of the head fields. Brahmins are settled below middle and above the tail end of the system; and they own almost all the middle and tail end fields.

The organizational structure is of one tier only at the system level, which is also practically dysfunctional. The WUA has nine members whose function is to mobilize labor and contract in any assistance from the district administration, for which the members are mistrusted by the other users on suspicion of mismanagement of funds. The water allocation and distribution criteria are decided by informal gatherings

of the users.

Agriculture system and service: The main crops grown in the area include paddy, maize, millet, wheat and mustard. The average cropping intensity was 188; and it was 245 in the head fields, followed by 170 in the middle and 124 in the tail end. The tail end fields are severely limited by unavailability of water throughout the year.

The average productivities of major crops were 2.35 mt/ha for paddy, 1.8 mt/ha for corn and 1.45 mt/ha for wheat during the year 1989-90. Farmers maintain their own local seeds. There is very limited use of improved varieties of crops, and also minimal use of chemical fertilizers.

The major changes in agricultural practices have been raising improved breeds of dairy cows and buffaloes; and introduction of improved forage resources in the area during past five years. In Lahachok, there is a Pokhara dairy milk collection center; and livestock and agriculture services sub-centers. There are three primary schools and one high school in the village.

Ghachok:

The gross command area of this system at present is 200 ha, although it was 170 ha prior to rehabilitation under World Bank financing during 1989-90. The head terraces are called Dandako Muhan, Rehela Kulo, and Okhala Kulo. The middle terraces are called Thulo Chhaharo Kulo, Phalama Kulo, and Patan Kulo. The tail end terraces are called

Biruwa Kulo and Dundako Muhan.

History: The system is supposed to be at least 400 years old. It has diverted water from Lasthi rivulet since then. The local belief is that the system was constructed by the Gurung community in the beginning. The system is considered to be one of the best managed and an example of ethnic harmony between the Brahmins and the Gurungs. Gurungs live in the upper villages of Ghachok; and they have parcels mostly at the head fields. Brahmins and other caste people live below the command area in lower Ghachok; and their parcels are mostly at the middle and tail end. The system was intervened for the first time by district irrigation office during 1989-90 under the assistance of the Irrigation Line of Credit (ILC) which was financed by the World Bank. The construction work was supervised by the district irrigation office.

According to new working policies, to receive any assistance, the farmers must organize themselves into a WUA. The Ghachok system also received ILC financing and the work was completed during July, 1990. The problem for the user committee members and farmers was a delayed budget release towards the end of the fiscal year, due to which users could not control the quality of work as they were busy with their own farming. Thus, they were highly dissatisfied with the quality of work of the contractors and also the supervision negligence of the technicians from the district irrigation

office.

Description of the physical system: The source of the system is Lasthi Khola where the intake of the system is a permanent diversion structure completed in the first quarter of 1990. The length of the main canal is 2.2 km and follows the old farmer constructed canal. The canal is partially lined. There are eight branch canals, the total length of which is nearly 6.0 km. The main canal is east bound whereas all the branch canals run north-south direction. Five hundred meters below the intake structure, Lahachok system has its intake, which is west bound and all the branch canals run north-south. There is conflict between Lahachok and Ghachok for water sharing.

System operation, maintenance, and water delivery: All the activities related to water acquisition, allocation and distribution are the responsibility of the users and their elected/selected representatives. There is one katuwale (village peon) responsible for irrigation and community forestry. This person is responsible for allocation and distribution of water in different branches and also in the individual farmers' fields. He has also to call the representatives and in turn to the users for labor contribution as and when required.

In case of regular maintenance work, labor is mobilized on the basis of area irrigated. If there is emergency repair and maintenance, the farmers are required to contribute the

resources on a per household basis. The labor contribution has decreased from 2.5 person days/ha to 1.5/ha after rehabilitation.

The institutional arrangement for water distribution is continuous up to branch canal level during the monsoon, and rotational among the users during monsoon, winter and spring seasons. The basis for water distribution at the field level is land area to be irrigated.

Social and institutional environment: The socio-economic classes of farmers in Ghachok is entirely different from rest of the systems of study. This is because one member each from almost all the households of the Gurung community in Machhapuchhre Village Council (upper Ghachok) work either for British Gorkha army or the Indian army. These families have above average incomes among the system beneficiaries. A second group of farmers are large landowners who are mostly Brahmins. The smallholder farmers include Brahmins, Chhetries, Gurungs, Kami, Sarkis and Damais. There are practically no landless people residing in the Ghachok village.

Nearly all the farmland is owner operated. The power structure in Ghachok is divided between the Gurungs and Brahmins at upper and lower villages. Thus, the farmers are also settled according to the locality; Brahmins and other castes in the lower part of the village and the Gurungs in the upper part of the village.

The organizational structure is only one tier. There are seven representatives, selected one from each branch; and chair person and secretary are selected out of these seven members. Usually if the president is from lower Ghachok, the secretary is selected from upper Ghachok, or vice versa.

Agriculture system and service: The main crops grown in the area include paddy followed by wheat, corn, or millet. The overall cropping intensity was 202 for the year 1990. The cropping intensity was highest in the middle, which was 255, followed by head and tail end where the cropping intensities were 162 and 145 respectively.

The productivity of paddy was 2.4 mt/ha and for wheat and corn the productivity were 1.50 mt/ha and 1.75 mt/ha in the area. There has been no major change in agricultural practices in the area. Farmers grew seeds selected from their own produce. Except for the corn and wheat, local seeds are used.

There is a Small Farmers Development Program (SFDP) office to provide institutional credit for the small farmers. Farmers sell their milk through the Lahachok collection booth. There is also a livestock service center in the village. For agricultural services the farmers have to go to the adjoining Lahachok sub-centers. There are two primary schools, one middle, and one high school in the locality.

CHAPTER V

SYRVEY FINDINGS AND ANALYSIS

The information in this chapter is organized as follows: (1) socio-demographic and economic characteristics of the respondents, (2) testing of equality of means of leadership structure for irrigation related decision-making situations between user controlled and non-user controlled systems, (3) relating respondents' characteristics to effectiveness, participation and equity, (4) the interrelationship among effectiveness, participation and equity within the systems and also comparison by control type, and (5) testing the difference in system organizational effectiveness through the estimates of effectiveness, participation and equity by control type.

Characteristics of Respondents

This section presents socio-economic and demographic characteristics of the 200 personal interview respondents, by control type of the system. The information presented in this section includes six continuous variables: (1) age of the head of household, (2) family size, (3) farm size, (4) parcel size, (5) total income including farm income and off-farm income, and (6) average number of years the households

have been irrigating the farms; and six interval variables: (1) caste, (2) family structure, (3) education level of the respondent, (4) social participation level of the family, (5) socio-economic status of the family, and (6) location of the parcel. These characteristics are presented in the appendix tables by individual systems.

The mean age of the head of household for user controlled systems was 52.69, with a standard deviation of 11.44 as compared to mean age for non-user controlled system of 51.9 with a standard deviation of 13.4 (Table 2). The average family size in user controlled systems were 6.66 with a standard deviation of 2.53 and 6.9 with a standard deviation of 2.66 for non-user controlled systems.

Average farm size was almost the same: 16.83 for user controlled systems and 16.9 for non-user controlled systems (Table 2). The average irrigated field's parcel sizes were higher for non-user controlled systems than for user controlled systems. Total income was higher by Rs. 30,445, with very high standard deviation of Rs. 32,637 in user controlled systems as compared to only Rs. 22,860 with Rs. 15,924 standard deviation in non-user controlled systems (Table 2). This suggests high variability in income range within the individual systems.

Table 2. Characteristics of the households in the study villages by control type (N=200)

Characteristics	Control type			
	User controlled		Non-User controlled	
	Mean (n=100)	SD	Mean (n=100)	SD
1. Age of the household head	52.7	11.4	51.9	13.4
2. Family size	6.7	2.5	6.9	2.7
3. Farm size (ropani)	16.8	9.5	16.9	10.9
4. Parcel size (ropani)	3.1	2.8	4.1	4.1
5. Total income (in 000 Rs.)	30.4	32.6	22.9	15.9
6. Average number of years household irrigating field	207	121	96	87

In non-user controlled systems Brahmins and Chhetries constituted nearly 90 percent of the respondents whereas in user controlled systems Vaishyas also constituted nearly a quarter of the respondents. In terms of family structure, both user and non-user controlled systems were either nuclear with young dependents or joint with more than four children. There were more illiterate respondents in non-user controlled systems than in the user controlled systems (Table 3). The majority of the respondents of both the systems had low social participation level. However, Medium to high levels of participation were more frequent in user controlled systems than those of non-user controlled systems. Non-user controlled systems had comparatively lower socio-economic status respondents than those of user controlled (Table 3).

Table 3. Socio-economic and demographic characteristics of respondents by control type (N=200)

Characteristics	Control type	
	Users controlled Number (n=100)	Non-Users controlled Number (n=100)
Caste		
Brahmin	54	55
Chhetries	23	32
Vaishyas	21	7
Sudras	2	6
Family structure		
Nuclear with children dependent	16	15
Nuclear with young dependent	44	45
Joint with children dependent	31	36
Joint with young dependent	9	4
Education		
Illiterate	26	37
Literate	43	30
High School	17	25
College Education	12	8
Social participation level		
No	20	18
Low	27	40
Medium	30	28
High	23	14
Socio-economic status		
Low	25	31
Medium	54	51
High	21	19

A majority of the respondents in user controlled systems had their parcels from the middle field of the system. In the case of non-user systems, an equal number of respondents had fields in middle and head fields (Table 4).

Table 4. Location of irrigated parcel of the respondents

Location	User controlled Number (n=100)	Non-User controlled Number (n=100)	Total Number (N=200)	(%)
Tail	23	23	46	23.0
Middle	49	38	87	43.5
Head	28	39	67	33.5

Leadership Structure for Irrigation Related Decision-making Situation

The irrigation related decision-making situation in rural communities in Nepal has developed over a period of time to create and maintain community cohesiveness and feeling of ownership. Different types of operations to be performed and the resource needs of these different jobs demanded joint community effort to keep the system providing water. Different types of leadership structures have been developed over a period of time. They are based on the control type exercised by the particular community.

Leadership structure for irrigation related decision-making situations in the four systems was classified by response to choices for assistance among (1) functionaries related to the water users' associations (WUA), (2) functionaries related to the village council, (3) neighbors and relatives, (4) district irrigation and general administration officials, and (5) water monitors. The patterns of leadership in the specific work situation were

compared in the systems controlled by the users and those controlled by non-users. The following nine specific situations were identified: (1) when the irrigation dam bursts, (2) when the main canal is washed away, (3) when there was no water in a particular field, (4) filling out irrigation related papers, (5) water stealing problems, (6) water allocation problems, (7) water distribution problems, (8) labor contribution disputes, and (9) other resource mobilization problems.

In case of when the dam bursts situation, there is a significant difference in response between the user controlled and non-user controlled systems. The majority of the respondents in user controlled systems sought to ask for assistance with the WUA functionaries (listed as number 1 in the table) and village council members (2). The majority of respondents in non-user controlled systems, on the other hand, chose to go to district irrigation and general administration officials (4) for assistance (Table 5a). Similar responses to the question of when the main canal is washed away situation were recorded between user and non-user controlled systems.

Findings in Table 5b show that farmers of user controlled systems approached different community leaders when there is no water in the field whereas a majority of the farmers in the non-user controlled systems relied mostly on water monitors. Thus, there was diversity of leadership

pattern in user controlled systems as compared to non-user controlled systems to solve the problems related to field water availability problems. However, there was no significant difference in the response of the reliance to the leaders when filling out irrigation related papers. The majority of farmers from both groups of farmers relied on

Table 5a. Leadership pattern by control type when dam and main canals are washed away (n=200)

Leadership pattern		Control type	
		User controlled (n=100)	Non-user controlled (n=100)
When the dam bursts:			
1.	Water users' association chair/member	50	29
2.	Village council chair/member/secretary	48	13
3.	Neighbors and relatives	2	6
4.	District irrigation and general administrative officials	0	48
5.	Water monitor	0	4
Chi square = 79.6642 with 4 df significance .0000			
When the main canal is washed away:			
1.	Water users' association chair/member	49	30
2.	Village council chair/member/secretary	48	13
3.	Neighbors and relatives	1	6
4.	District irrigation and general administrative officials	3	50
5.	Water monitor	1	4
Chi square = 74.7631 with 4 df significance .0000			

either the village council secretary or their neighbors and relatives.

Water stealing problem was one of the major sources of conflict among the farmers. There was a significant difference of the farmers' reliance on leadership to settle this problem. Nearly half of the farmers from the user controlled systems approached their neighbors and relatives to solve the problem; and another half relied either on WUA functionaries or village council functionaries (Table 5b). But in the case of non-users, the majority have relied on the village council functionaries, followed by members of WUA, neighbors and the water monitor. Thus, the leadership pattern seems to be more scattered in non-user controlled systems than in user controlled systems for solving the problems of water stealing.

Problems related to water allocation in different branches of canals and different locations in a system were being approached to village council and WUA functionaries in the case of user controlled systems. Farmers of non-user controlled systems relied on either WUA functionaries or the irrigation project officials to solve their problems. Thus, water allocation problems in the case of non-user controlled systems were solved both by insiders and outsiders as opposed to only insiders in case of user controlled systems (Table 5c).

Table 5b. Leadership pattern by control type when there are field related problems (n=200)

Leadership pattern	Control type	
	User controlled (n=100)	Non-user controlled (n=100)
When there is no water in the field:		
1. Water users' association chair/member	5	8
2. Village council chair/member/secretary	18	2
3. Neighbors and relatives	31	21
4. District irrigation and general administrative officials	0	7
5. Water monitor	46	62
Chi square = 24.7857 with 4 df significance .0001		
When filling out irrigation related papers:		
1. Water users' association chair/member	23	7
2. Village council chair/member/secretary	57	62
3. Neighbors and relatives	20	26
4. District irrigation and general administrative officials	0	4
5. Water monitor	0	1
Chi square = 14.5260 with 4 df significance .0058		
When there are water stealing problems:		
1. Water users' association chair/members	20	22
2. Village council chair/member/secretary	29	32
3. Neighbors and relatives	48	25
4. District irrigation and general administrative officials	0	1
5. Water monitor	3	20
Chi square = 21.0564 with 4 df significance .0003		

Table 5c further suggests that Water distribution in the field channels and individual farmers' fields were

Table 5c. Leadership pattern by control type when there are water allocation and distribution problems (n=200)

Leadership pattern	Control type	
	User controlled (n=100)	Non-user controlled (n=100)
When there are water allocation problems:		
1. Water users' association chair/member	37	36
2. Village council chair/member/secretary	40	11
3. Neighbors and relatives	6	2
4. District irrigation and general administrative officials	0	30
5. Water monitor	17	21
Chi square = 48.9249 with 4 df significance .0000		
When there are water distribution problems:		
1. Water users' association chair/member	16	20
2. Village council chair/member/secretary	25	6
3. Neighbors and relatives	28	8
4. District irrigation and general administrative officials	0	16
5. Water monitor	31	50
Chi square = 43.6575 with 4 df significance .0000		

mainly the responsibility of the water monitor. The criteria for distribution were decided either by WUA members or the village council functionaries. When there were problems, the farmers of the user controlled systems had a multiplicity of reliance as opposed to the water monitor

being the major leader in case of non-user controlled systems. There was a significant number of farmers who responded that they relied on relatives and neighbors in case of user controlled systems as opposed to a negligible number of farmers from non-user controlled systems relying on their neighbors.

Table 5d. Leadership pattern by control type when there are labor and other resource mobilization problems (n=200)

Leadership pattern	Control type	
	User controlled (n=100)	Non-user controlled (n=100)
When there are labor contribution disputes:		
1. Water users' association chair/member	45	50
2. Village council chair/member/secretary	50	39
3. Neighbors and relatives	3	5
4. District irrigation and general administrative officials	0	1
5. Water monitor	2	3
Chi square = 3.3028 with 4 df significance .5085		
When there are resource mobilization problems:		
1. Water users' association chair/member	37	25
2. Village council chair/member/secretary	50	60
3. Neighbors and relatives	12	9
4. District irrigation and general administrative officials	1	6
5. Water monitor	0	0
Chi square = 7.2317 with 4 df significance .0649		

There was no significant difference in reliance of the farmers to solve problems of labor contribution disputes between the user and non-user controlled systems. Both groups of farmers either approached functionaries of village council or the members of the WUA (Table 5d). A similar pattern was observed on the farmers' responses of reliance on solving the resource mobilization problems.

It was hypothesized in H1 that user controlled and non-user controlled systems are organizationally different in terms of leadership pattern. The analysis of the findings supported this hypothesis. Leadership patterns for solving major problems related to dam and canal repair, water acquisition, allocation and distribution problems, were different. However, reliance of farmers of both systems on their leaders for solving minor problems such as labor and other resources contribution problems, and filling out irrigation related papers were not significantly different.

Relating Respondents' Characteristics with Effectiveness, Participation, and Equity

It was hypothesized that within an irrigation system, individual farmers' characteristics affect their perception of effectiveness, level of participation, and their feelings of satisfaction about the system's fairness. The Pearson product moment correlation coefficient was computed to examine the relationship between continuous demographic and

economic variables such as age, family size, age of the head of household, farm size, farm and off-farm income, and area of irrigated parcel, and the reported mean scores of effectiveness, participation and equity. To examine the relationship between interval variables such as family structure, socio-economic status and location of the irrigated parcel, and the effectiveness, participation and equity; one-way analysis of variance and Tukey procedure were used.

Table 6. Pearson correlation coefficient for selected socio-economic characteristics and effectiveness, participation, equity

Characteristics	Correlation coefficients		
	Effectiveness	Participation	Equity
Family size	-.005	.045	-.005
Age of the head of house-hold	-.027	-.050	.024
Farm size	.053	.305**	.084
Annual farm income	.191*	.302**	.107
Annual off-farm income	.086	.013	-.026
Total annual income	.125	.085	.002
Livestock standard unit	.092	.113	-.027
Cultivated area of study parcel	.022	.090	.120

1-tailed significance: * = .01 ** = .001

Findings in Table 6 show no significant linear relationship

among those socio-economic characteristics and effectiveness, participation, and equity. A significant positive relationship was recorded only between the participation and farm size and farm income; and also a positive significant relationship was recorded between the reported score of effectiveness and annual farm income. These data support the proposition that as the farm size and farm income increases so does the farmers' perceptions of participation and effectiveness.

Table 6 also shows that family size of the respondents and perceptions of effectiveness and equity are weakly negatively correlated. This indicates that perceptions of effectiveness and equity are not greatly influenced by family size. Similarly perceptions of effectiveness, participation and equity are weakly correlated to the total income, livestock unit and area of the irrigated parcel which indicates minimum influence of these characteristics on those perceptions.

One-way analysis of variance and the Tukey procedure were used to examine the differences in mean scores of effectiveness, participation and equity in terms of family structure. As shown in Table 7, there were no significant differences on effectiveness scores of responses by different groups in family structure.

Table 7. Analysis of variance of effectiveness by family structure

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	3	.191	.064	.654	.585
Within Groups	170	16.566	.097		
Total	173	16.758			

Multiple Range Test: Tukey Procedure

Group	Family structure	(n)	Mean	S.D.	Group* 4 3 2 1
Gr1	Nuclear with children	(30)	2.554	.389	
Gr2	Nuclear with young	(76)	2.609	.317	
Gr3	Joint with children	(55)	2.552	.251	
Gr4	Joint with young	(13)	2.654	.324	

* No two groups are significantly different at the .05 level.

Table 8 below shows that in response to participation rating, the highest mean scores were reported by joint families with young dependents followed by nuclear families with children dependents below 8 years, nuclear families with young dependents more than 8 years, and joint families with children dependents below 8 years. The F ratio and the corresponding Tukey procedure, however, showed no significance difference on participation scores as reported by the respondents.

Table 8. Analysis of variance of participation by family structure

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	1.438	.479	1.631	.184
Within Groups	188	55.271	.294		
Total	191	56.710			

Multiple Range Test: Tukey Procedure

Group	Family structure	(n)	Mean	S.D.	Group* 4 3 2 1
Gr1	Nuclear with children	(30)	2.847	.408	
Gr2	Nuclear with young	(86)	2.649	.543	
Gr3	Joint with children	(63)	2.643	.537	
Gr4	Joint with young	(13)	2.869	.792	

* No two groups are significantly different at the .05 level.

Table 9. Analysis of variance of equity by family structure

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	.518	.173	.546	.651
Within Groups	176	55.588	.316		
Total	179	56.106			

Multiple Range Test: Tukey Procedure

Group	Family structure	(n)	Mean	S.D.	Group* 4 3 2 1
Gr1	Nuclear with children	(30)	2.843	.568	
Gr2	Nuclear with young	(78)	2.891	.576	
Gr3	Joint with children	(62)	2.847	.553	
Gr4	Joint with young	(10)	3.080	.471	

* No two groups are significantly different at the .05 level.

Among the respondents under different family structure in terms of equity responses there were no significant

differences, as shown in the Table 9 above.

A similar test was performed to find out whether mean response scores of effectiveness, equity and participation differed according to the socio-economic status of the respondents. As presented in Table 10, there were no significant differences in the mean scores of effectiveness between the response of different groups although high socio-economic groups had the highest mean reported.

Table 10. Analysis of variance of effectiveness by socio-economic status

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	.335	.168	1.745	.177
Within Groups	171	16.422	.096		
Total	173	16.757			

Multiple Range Test: Tukey Procedure

Group	Socio-economic status	(n)	Mean	S.D.	Group* 1 2 3
Gr1	Low	(53)	2.52	.322	
Gr2	Medium	(86)	2.61	.312	
Gr3	High	(35)	2.62	.285	

* No two groups are significantly different at the .05 level.

Analysis of variance of participation mean scores by socio-economic status, however, showed a significant mean difference between medium and high socio-economic status respondents to that from lower ones. The highest scores were reported by medium status respondents and the lowest

responses were reported by the high status respondents. The results are presented in Table 11.

Table 11. Analysis of variance of participation by socio-economic status

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	3.040	1.520	5.353	.005
Within Groups	189	53.669	.284		
Total	191	56.710			

Multiple Range Test: Tukey Procedure

Group	Socio-economic status	(n)	Mean	S.D.	Group 1 2 3
Gr1	Low	(54)	2.51	.485	
Gr2	Medium	(99)	2.72	.586	*
Gr3	High	(39)	2.86	.446	*

* Denotes pairs of groups significantly different at the .05 level.

The result of one-way analysis of variance and Tukey procedure, to test the difference in equity responses in terms of socio-economic status, shows that the F ratio and the corresponding Tukey procedure showed no significant difference. The results are presented in Table 12.

Table 12. Analysis of variance of equity by socio- economic status

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	.904	.452	1.449	.237
Within Groups	177	55.202	.312		
Total	179	56.106			

Multiple Range Test: Tukey Procedure

Group	Socio-economic status	(n)	Mean	S.D.	Group* 1 2 3
Gr1	Low	(52)	2.77	.552	
Gr2	Medium	(91)	2.93	.562	
Gr3	High	(37)	2.90	.558	

* No two groups are significantly different at the .05 level.

Analysis of variance of effectiveness, participation and equity; by caste, literacy, and social participation level, which are the indicators of socio-economic status, were also analyzed. The results of that analysis are presented in the Appendix Tables. No major significant difference in the effectiveness, participation and equity mean scores were recorded among the different groups.

The mean scores of effectiveness, participation, and equity were tested by location of the irrigated parcel using analysis of variance. Significant differences were observed in the mean scores in effectiveness, participation and equity by location. Table 13 below shows the significant differences at the 0.05 level among the different locations

of irrigated of the parcel fields in terms of effectiveness. Tukey procedure showed that reported effectiveness scores of head and middle farmers were significantly different from tail enders.

Table 13. Analysis of variance of effectiveness by location

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	2.637	1.318	15.963	.000
Within Groups	171	14.121	.083		
Total	173	16.758			

Multiple Range Test: Tukey Procedure

Group	Location	(n)	Mean	S.D.	Group 1 2 3
Gr1	Tail	(44)	2.384	.248	
Gr2	Middle	(78)	2.617	.292	*
Gr3	Head	(52)	2.701	.310	*

* Denotes pairs of groups are significantly different at the .05 level.

Similar procedures were followed to examine the differences in participation scores by location of the parcel. As shown in Table 14, there were significant differences observed among the respondents at head, middle and tail end. Tukey procedure showed that the participation scores of middle farmers were significantly different from head reach and tail enders.

Table 14. Analysis of variance of participation by location of the parcel

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	3.661	1.8306	.521	.002
Within Groups	189	53.049	.281		
Total	191	56.710			

Multiple Range Test: Tukey Procedure

Group	Location	(n)	Mean	S.D.	Group 1 3 2
Gr1	Tail	(46)	2.545	.501	
Gr2	Middle	(83)	2.849	.523	* *
Gr3	Head	(63)	2.595	.559	

* Denotes pairs of groups are significantly different at the .05 level.

Findings in Table 15 show that there were significant differences in the reported equity mean scores between head reach farmers and the tail enders.

Table 15. Analysis of variance of equity by location of the parcel

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	3.941	1.970	6.986	.002
Within Groups	177	52.165	.295		
Total	179	56.106			

Multiple Range Test: Tukey Procedure

Group	Location	(n)	Mean	S.D.	Group 1 2 3
Gr1	Tail	(43)	2.656	.562	
Gr2	Middle	(77)	2.868	.542	
Gr3	Head	(60)	3.052	.529	*

* Denotes pairs of groups are significantly different at the .05 level.

The results of analysis on relating respondents' characteristics with effectiveness, participation and equity do not necessarily support the hypothesis that individual farmers' characteristics affect their perception of effectiveness, participation and equity. However, there is significant positive relationship between participation and farm size, and farm income. Thus, the notion that as the farm size and income from farm increase so do the perceptions of participation is supported. Effectiveness and equity response scores are not affected by farmers' individual characteristics.

The examination of the mean scores of effectiveness, participation and equity by using one-way analysis of variance showed no significant difference between different groups in the family structure. Socio-economic status of the respondents also did not influence the responses for effectiveness and equity. There was significant mean difference on the reported participation mean scores between medium and high socio-economic status from that of lower ones.

Thus, individual farmers' characteristics have not influenced the effectiveness and equity scores but participation scores seem to have been influenced by socio-economic status.

The Interrelationship Among Effectiveness, Participation, and Equity

It had been hypothesized that there are positive relationships between the perceived effectiveness, level of participation and perceived equity of the system by individual farmers within the systems. The study results show that effectiveness and participation are very weakly related. But there is significant positive relationship between effectiveness and equity. This indicates that as the perception of effectiveness increases, the perception of fairness of the system also increases. This result supports the expectation as hypothesized in hypothesis H3. Table 16 further shows that there is positive relationship between participation and equity but the relationship is only moderate without significant relationship.

Table 16. Correlation coefficients for effectiveness, participation and equity

Variables	Correlation Coefficient
Effectiveness & Participation	.0841
Effectiveness & Equity	.4689**
Participation & Equity	.1439

1-tailed Significance: * = .01 ** = .001

It was also further sub-hypothesized that (i) the correlation between effectiveness and participation will be stronger in user controlled systems than in the non-user controlled system (H4A); (ii) the correlation between the

level of participation and feelings of equity will be stronger in user controlled systems than in the non-user controlled systems (H4B); and, (iii) the correlation between effectiveness and equity will be stronger in the user controlled systems than in the non-user controlled systems (H4C). The results of analysis in Table 17 show that there is significant and stronger correlation between effectiveness and equity in the case of user controlled systems. Thus, we accept sub-hypothesis H4C. Although the correlations between effectiveness and participation and also between participation and equity are higher in the case of user controlled systems, the differences are not significant and are also very weak.

Table 17. Pearson correlation coefficient for effectiveness, participation, and equity by control type

Control type	Correlation Coefficient
Between effectiveness and participation:	
User controlled	.134
Non-user controlled	-.075
Between effectiveness and equity:	
User controlled	.547**
Non-user controlled	.402**
Between participation and equity:	
User controlled	.241
Non-user controlled	.166

1-tailed significance: * = .01 ** = .001

Testing the Difference in Estimates of Effectiveness, Participation and Equity

The other hypothesis proposed in the beginning said that user controlled systems manifest higher levels of effectiveness, participation, and equity than the non-user controlled systems. T-tests showed significant differences the reported mean scores of effectiveness and participation between the user controlled and the non-user controlled systems. But no significant differences were found in the equity scores between user and non-user controlled systems. The results are presented in Table 18.

Table 18. T-test analyzing effectiveness, participation and equity scores when considering control type

Group	(n)	Mean score	t-value	Prob.
Effectiveness:				
User controlled	(97)	2.65	2.93	0.004
Non-user controlled	(77)	2.51		
Participation:				
User controlled	(97)	2.85	4.11	0.000
Non-user controlled	(95)	2.54		
Equity:				
User controlled	(90)	2.87	0.17	0.863
Non-user controlled	(90)	2.88		

CHAPTER 6

SUMMARY, CONCLUSIONS AND IMPLICATIONS

This final chapter identifies the key findings of the research, draws important conclusions from the analysis of findings and relates the findings to policy and research implications.

Summary

Agriculture development has been the priority of the government of Nepal for last two decades. This has been reinforced by the government placing an emphasis on agricultural development since the basic needs program was instituted in 1984/85. Since there is not much room for extending area under cultivation in Nepal, the policy targeted intensive development through improved inputs. One of the inputs available for pursuing development within the agricultural sector in Nepal was irrigation.

Three forms of irrigation management can be found in Nepal. The first is non-user (public agencies) controlled and managed, the second is user (farmer) controlled and managed; and the third form, which is controlled jointly, can be classified either as the user controlled or the non-user controlled depending upon the control type exercised by the agency or the group of farmers.

The general problem being explored through this research was the extent to which user and non-user controlled systems differed in effectiveness, participation and fairness in meeting the water needs of the farmers being served by the particular system.

The study design included a personal interview survey phase preceded by a rapid rural appraisal. The RRA was used to gather background information and for selection of the four irrigation systems to be surveyed. The conditioning variables used in this study included socio-economic status of household, family structure, and demographic characteristics of the respondents.

The contextual variable included leadership structure for irrigation related decision-making situation in community.

The dependent variable in this study was the organizational effectiveness which was measured by (1) perceived effectiveness; (2) participation in activities related to maintenance of system; and (3) perception of equity.

The following hypotheses were tested:

1. User controlled and non-user controlled systems are different in terms of leadership patterns.

2. Within an irrigation system, individual farmers' characteristics affect their perceptions of system effectiveness, level of participation, perceptions of feelings of equity.

3. There are positive relationships among perceived effectiveness, level of participation, and

perceived equity of the system by individual farmers within the system.

4. User controlled systems manifest higher perceptions system effectiveness, level of participation, and feelings of fairness than non-user controlled systems.

5. Perceived organizational effectiveness is higher in case of user controlled systems than in case of non-user controlled systems as manifested by higher scores of perceived effectiveness, level of participation and perceived equity.

The systems were chosen within a political sub-division of Kaski district in the midhills of western Nepal. These included two pairs of systems: one pair each selected from the user controlled and non-user controlled systems. Each pair of user and non-user systems shared a common water source. The user controlled system Chaurasi and the non-user controlled system Hyangja diverted water from Yamdi river. Similarly, Ghachok (user controlled) and Lahachok (non-user controlled) systems diverted water from Lasthi stream.

All the households owning khet (low land) and using irrigation water from the selected systems were included in the study population. The sample was drawn from all types of farmers, according to the location of their fields. Thus, the sampling unit was the particular parcel of the land recorded in the land survey record. A stratified random sample of fifty respondents were selected from each system, making a total sample size of 200.

The instrumentation used was inventory checklist which was completed by using RRA Method. The other instrument used

was a structured interview schedule, to collect data from the selected 200 farmers.

Data were collected during two phases: once during May - June, 1990 using RRA technique; and the second during October - November, 1990 using face-to-face interviews with the respondents.

Socio-demographic and economic variables were used to describe the village context and study population.

Among the characteristics of the household, family size, mean age of the head of household, farm size, and irrigated parcel area size between the users and non-users controlled systems were found to be nearly the same. However, there were high household annual income differences; user controlled systems averaging Rs.30,445 and non-user controlled systems having a mean of Rs.22,860.

In terms of family structure, both user and non-user controlled systems were either nuclear with young dependents or joint with sufficient number of children. Non-user controlled systems had comparatively lower socio-economic status respondents than those of user controlled.

The pattern of leadership in the work specific situation between the systems controlled by the users and those controlled by non-users were found to be different. In case of dam and main canal repair situation, a majority of the respondents in user controlled systems sought assistance from the WUA functionaries and village council

members while majority of respondents in non-user controlled systems chose to go to district irrigation and general administrative officials for assistance

There was diversity of leadership patterns in user controlled systems as compared to non-user controlled systems to solve the problems related to field water availability, water allocation and water distribution problems. The majority of farmers from the user controlled systems approached either their neighbors and relatives or WUA functionaries and village council functionaries. But in case of non-users, a majority of farmers relied on the village council functionaries followed by members of WUA, neighbors and water monitor.

The leadership patterns for solving major problems related to dam and canal repair, water acquisition, allocation and distribution problems, were significantly different between the user controlled and non-user controlled systems. Reliance of both groups of farmers on their leaders for solving minor problems such as labor and other resources contribution problems, and filling out irrigation related papers were not significantly different.

There were no significant linear relationships among socio-economic characteristics and effectiveness, participation, and equity.

There were no significant differences between effectiveness, participation and equity scores of responses

by different groups in family structure. Analysis of variance of participation mean scores by socio-economic status, however, showed a significant difference between medium and high socio-economic status respondents from that from lower ones. But the socio-economic status of the respondents did not influence the responses for effectiveness and equity. Significant differences were observed in the mean scores in effectiveness, participation and equity responses by location. Effectiveness scores of head and middle farmers were significantly different from tail enders. Similarly, participation scores of middle farmers were significantly different from head reach and tail enders.

The results of analysis on relating respondents' characteristics with effectiveness, participation and equity did not support the hypothesis that individual farmers' characteristics affect their perception of effectiveness, participation and equity. However, there was significant positive relationship between participation and farm size, and farm income.

The study results also showed that effectiveness and participation were very weakly related. But there was significant positive relationship between effectiveness and equity. There was significant and stronger correlation between effectiveness and equity in case of user controlled systems. The highest level of participation were found among

those with largest farm size and income.

Significant differences were found in the reported mean scores of effectiveness and participation between the user controlled and the non-user controlled systems. But no significant differences were observed in the equity scores between user and non-user controlled systems. The perceived effectiveness was higher in user controlled irrigation systems and participation was higher in the user controlled systems.

Conclusions

From the study findings and the analysis, it may be concluded that:

1. User controlled and non-user controlled irrigation systems in Kaski district of the midwestern hills in Nepal are organizationally different in terms of leadership patterns for solving major problems related to dam and canal repair, water acquisition, allocation and distribution problems. The user controlled systems have developed different types of leadership structures over a period of time by exercising higher level of control in the community situation. The user controlled systems have adopted an approach of self-help and looking inward at varied types of leadership for assistance.
2. In the case of non-user controlled systems, on the other hand, the leadership lies with outsiders for the

major activities. Thus, the development of irrigation leaders within the system itself does not take place extensively. The feeling of "our irrigation system" as opposed to "the project run irrigation system" seems to be the critical factor for the development of local irrigation special task related leadership.

3. There was a significant difference in participation among different groups by socio-economic status. The big farmers tend to respond with higher levels of participation and equity: this could be attributed to the combination of higher proportion of water available, and relatively lower levels of participation in the labor and other resources to be contributed for the system repair. It was observed by the researcher in the field that in the case of non-user controlled systems participation was not required. The water allocation and distribution was purely based on the area of the land to be irrigated. The finding that big farmers tend to give higher responses on participation and equity might also have been influenced by exercise of their special higher status on water monitors and other project officials.

4. Among the independent variables, <u>location of the irrigated parcel</u> showed significant difference in the mean scores of <u>effectiveness</u>, <u>participation</u> and <u>equity</u>. The tail enders always reported lower mean scores than

the middle and head reach farmers. Middle field respondents reported higher mean scores for participation and equity. This might be related to the fact that head reach farmers have the advantage of getting water first in their fields, and the system may be effective in providing water, but it might not be equitable because of the greater amount of labor and other resources the head reach farmers have to provide at the intake and main canal during emergency repair and maintenance.

5. User controlled systems manifest relatively higher interrelationships among effectiveness, participation and equity. The effectiveness, participation and equity scores are strongly associated with the control type. Thus, we can conclude that the more the system is controlled by the users, (1) the stronger the feelings of system effectiveness, (2) the higher the level of participation, and, (3) the greater the feelings of equity.

6. The differences in organizational effectiveness by control type were more closely associated with perceived effectiveness and level of participation than with equity. Equity seems to be related to locational advantage/disadvantage, rather than to control. Also equity, defined here as the perceived fairness of the system, could have been treated by farmers more as a

"given" factor, while effectiveness and participation, were influenced by control type. Basically, the farmers probably do not expect equity - it is not in their experience.

Study Implications

Based on the summary and conclusions this section presents some policy implications of the research.

1. The diversified leadership patterns established by the user controlled systems tend to develop a feeling of ownership of the system. The non-user controlled systems could increase their systems' effectiveness by decentralization of decision-making. The agency responsible for irrigation system maintenance should reconsider the present policy of creating a "dependency syndrome" in the non-user controlled systems.

2. There is a difference in the level of participation and feelings of equity among users from different socio-economic status groups. If there is no perceived equity in water allocation and distribution criteria, obligatory participation could become a burden to the users. To create feelings of fairness and to increase the levels of participation, systems managed and controlled by non-users might be turned over to the users. The experiences of more equitable systems elsewhere within the country could serve as the models

for guiding principles of rules and role.

3. Perceptions of system effectiveness, level of participation and feelings of fairness are associated with the control type. To increase the organizational effectiveness of non-user controlled irrigation systems, the users could be given more control. Decision-making related to irrigation activities, water acquisition and allocation could become the function of local leaders. This might provide more reliable water delivery, familiarity of the users regarding system rules, and it could develop a system that could be free of political entity i.e. independent irrigation organization.

Limitations and Future Opportunities

This study is limited to only four medium sized irrigation systems and is location specific, i.e. western hills in Nepal. Because the study is focussed on the medium size (for hills) irrigation systems, it may not represent the condition of other irrigation systems. Furthermore, availability of water, farmer interaction, landholding system, physical structure of the system, and other socio-demographic and economic factors may influence farmers' responses. Thus, opportunity exists for future research with more systems from different ecological zones.

Following recent political changes in Nepal, there has been reorganization of the water users associations. The non-user controlled systems have been replaced by separate water users associations instead of attaching organizations within the political and administrative units. Village Panchayats have been replaced by Village Development Councils. The response to the system effectiveness questions might have been influenced by these reorganizations.

Two of the systems included in the study received technical assistance for rehabilitation between the period of rapid appraisal and the field study. The local contracting process created dissatisfaction among the respondents, which might also have influenced the response of the farmers. Thus, it might be helpful if a longitudinal study is conducted in the future.

There were slight differences in the findings from RRA method and the personal interview sample survey research method. The low literacy level of the respondents might have influenced the survey responses. RRA responses might have been influenced by key informant biases. It might be useful to conduct a study of the information gap between two methods in terms of validity of the information.

The results of irrigation research have been said to be more reliable and valid when conducted by interdisciplinary teams, especially in measuring performance indicators such

as effectiveness, participation and equity. Thus, it might be appropriate in future research to attempt to measure the same concepts with a more multidisciplinary approach.

APPENDIX A

SURVEY QUESTIONNAIRE

MICHIGAN STATE UNIVERSITY
DEPARTMENT OF RESOURCE DEVELOPMENT
323 NATURAL RESOURCES BUILDING
EAST LANSING, MI-48824, USA.

"ORGANIZATIONAL EFFECTIVENESS OF USER AND NON-USER CONTROLLED IRRIGATION SYSTEMS IN NEPAL"

QUESTIONNAIRE

House hold Number: _____

STUDY AREA AND HOUSEHOLD IDENTIFICATION

LOCATION:

DISTRICT:_____

VILLAGE:_____

WARD #:_____

NAME OF THE IRRIGATION SYSTEM:_____

NAME OF THE RESPONDENT:_____

CASTE:_____

WHAT IS THIS SURVEY ABOUT

We are exploring some of the different ways that irrigation systems, like this one, are managed. In particular we want to learn from your experiences. The information will help us make recommendations to improve the system and, thereby, to increase your agricultural productivity.

In addition to some general questions about your household and your farm, we'll ask you about how well this system is organized and what can be done to improve it.

The interview will take about one hour or may be an hour and a half. Your responses will be held in strictest confidence. Your name will not be revealed anywhere. Your participation is voluntary. You can stop answering at any time. We very much appreciate your cooperation.

I. BACKGROUND

A. HOUSEHOLD INFORMATION

S. No.	Name	Relation to head of h.h.	Gender	Age	Education	Annual on farm work weeks	
						Busy season	Slow season
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							

Does any one or more of your family member work to earn income other than farming? ( ) yes ( ) no

If yes,

Particular	Relation to the h.h. (who does it?)	Unit (weeks in a year)	Amount in Rs.
Regular income such as pension, remittances			
Living and working outside village			
Off-farm wage/salary			
Retail trade			
Cottage industry at home			

B. AREA HELD AND CULTIVATED:

Land Category	Khet (irrigated) land Ropani-Ana-Paisa	Pakho (unirrigated) land Ropani-Ana-Paisa
1. Land owned		
2. Land rented in		
3. Land rented out		
4. Land (Guthi)		
5. Other status(specify)		
Total		

C. AVAILABILITY OF IRRIGATION WATER AND DISTANCE FROM HEAD REACH TO THE PLOTS

Parcel #	Area	Location (Head, Middle, Tail)
1.		
2.		
3.		
4.		
5.		

D. LAND UTILIZATION AND PRODUCTION OF MAJOR CROPS

Area and prtoduction of different crops last year:

Crops	Total area	Total production	Qty. consumed	Qty.sold
1. Monsoon rice				
2. Spring rice				
3. Wheat				
4. Mustard				
5. Millet				
6. Summer maize				
7. Winter maize				
8. Potato				
9. Other (specify)				

E. LIBESTOCK AND POULTRY NUMBERS:

Are you raising any livestock or poultry?( ) yes ( ) no

If yes,

Type		Number
Milking		
	cow	
	buffalo	
Dry		
	cow	
	buffalo	
Draft animal/ox		
Steer		
Heifers		
	cow	
	buffalo	
Calves		
Sheeps and Goats		
Poultry		

F. MATERIAL LEVEL OF LIVING:

Main living house

Roof structure

( ) thatched roof
( ) wooden planks
( ) stone
( ) zinc sheet
( ) concrete roof

House structure

( ) thatched
( ) stone and clay
( ) bricks
( ) concrete

No. of stories _____

No. of rooms _____

Separate kitchen annex? ( ) yes ( ) no

Do you have radio ( ) yes ( ) no

Area of court yard? _____ sq. meters

Do you have books at home? ( ) yes ( )no
if yes about how many ?_____

Do you have chairs & desks? ( ) yes ( ) no
if yes about how many ?_____

Do you have cots? ( ) yes ( ) no
if yes about how many? _____

Do you have watch? ( ) yes ( ) no
if yes about how many?_____

G. SOCIO-ECONOMIC ORGANIZATIONS:

Are any one or more of the family members involved in any of the formal or informal organizations? ( ) yes ( ) no
If yes,

Organization	Member's relation to the h.h.	Position held	Contribution money (Rs.)	Contribution kind Grain or or other resource (Rs.)	Supervision (m/d)
1. Cooperatives					
2. Water users' association					
3. Village association					
4. Class organization					
5. School committee					
6. Other (please specify)					

Are any one or more of your family members involved in the development work which benefits to all your neighbors?

( ) yes ( ) no

If yes, please identify which development project at what stage were you or other member of your family involved?

Development project	Member's relation to the h.h.	Defining need	Planning	Implement	Operation & maintenance
Community irrigation					
Domestic water supply					
School building					
Road construction					
Reforestation					

NOW LET US CONSIDER THE PARTICULAR IRRIGATION SYSTEM:

II. A. EFFECTIVENESS

a. How well do you think this particular system is designed?

( ) very well-no problems ( ) so,so - minor problems but generally ok
( ) not very well-some problems ( ) terrible-many problems

b. In general, how well do you think this system is constructed?

( ) very well-no problems ( ) so,so - minor problems but generally ok
( ) not very well-some problems ( ) terrible-many problems

c. Is the quantity of water available suffiecient to meet the needs of your particular field?

( ) always sufficient ( ) usually sufficient ( ) some times insufficient ( ) usually insufficient

d. Is the quantity of water available sufficient to meet the needs of your neighbors' fields?

( ) always sufficient ( ) usually sufficient ( ) some times insufficient ( ) usually insufficient

e. Is the quantity of water available sufficient to meet the needs of head farmers?

( ) always sufficient ( ) usually sufficient ( ) some times insufficient ( ) usually insufficient

f. Is the quantity of water available sufficient to meet the needs of tail-end farmers?

( ) always sufficient ( ) usually sufficient ( ) some times insufficient ( ) usually insufficient

g. How often is water available at the most needed time for your crops?

( ) always ( ) usually ( ) some times not available
( ) hardly ever, never available

h. What is your assessment of the use of water i.e. no wastage in some fields and some fields dry by the system as a whole?

( ) excellent ( ) pretty good ( ) not so good ( ) not good at all

i. What is your assessment of good job of using water by the head farmers?

( ) excellent ( ) pretty good ( ) not so good ( ) not good at all

j. What is your assessment of good job of using water by the tail enders?

( ) excellent ( ) pretty good ( ) not so good ( ) not good at all

k. Are you familiar with any rules used for labor mobilization and water allocation in this system?

( ) yes, very familiar ( ) yes, but not very familiar
( ) no, not very familiar ( ) not at all familiar

l. How well do you think these rules are matched to the physical terrain?

( ) excellent ( ) pretty good ( ) not so good ( ) not good at all

m. Is the system FAIR to you in terms of relating your efforts to returns i.e. does your profit from irrigation outweigh the resources and labor you most contribute?

( ) v. fair ( ) usually fair ( ) some what unfair ( ) v. unfair

n. Is the system FAIR to your neighbors in terms of relating efforts to returns?

( ) v. fair ( ) usually fair ( ) some what unfair ( ) v. unfair

o. Are the rules basically followed by all?

( ) Always ( ) usually ( ) hardly ever ( ) never

p. Is the basis of participation always same for you and your neighbors?

( ) always ( ) usually ( ) hardly ever ( ) never

B. PARTICIPATION:

a. How long are you and your family members irrigating your field from this system? _____ years

b. Was your family involved in the construction of this irrigation from the very beginning?
( ) yes ( ) no

c. What was the level of involvement of your family members in system maintenance during past several years?
( ) yes, regularly ( ) yes, sometimes on occassion
( ) no, not often ( ) no, never

d. How often does the irrigation committee meet?

( ) once a month ( ) once in two to four months
( ) once in four to six months ( ) once in a year

e. How often do you attend the committee meeting?
( ) always ( ) usually ( ) rarely ( ) never

f. During a normal season, about how much time do you spend helping with the maintenance of the system?

( ) one day or less per season ( ) 2-3 days per season
( ) 4-5 days per season ( ) 5-7 days per season
( ) more than 7 days per season.

g. Do you communicate with the representatives of your system when there is trouble in the system?

( ) always ( ) somtimes ( ) hardly ever ( ) never

h. Do the represnetatives listen and take account of your complaints?

( ) always ( ) somtimes ( ) hardly ever ( ) never

i. Do you talk with your neighbors about system problem?

( ) always ( ) somtimes ( ) hardly ever ( ) never

j. Do you and your neighbors ever collectively communicate with representatives?

( ) always ( ) somtimes ( ) hardly ever ( ) never

k. Do you ever assist your neighbors with their own irrigation problems?

( ) yes, regularly ( ) yes, sometimes on occassion
( ) no, not often ( ) no, never

l. Compared with other farmers in the area, how do you rate your own and your household's participation in helping to maintain the system?

( ) strong participation ( ) some participation
( ) occassionally when there are big problems
( ) not very often ( ) hardly ever

m. Is the resource mobilization (i.e. materials and labor contribution) criteria decided by all the users together?

( ) always ( ) some times ( ) hardly ever ( ) never

n. Is the system fair to you on resource mobilization criteria?

( ) always ( ) sometimes ( ) hardly ever ( ) never

o. Is the system fair to your neighbors on resource mobilization criteria?

( ) always ( ) sometimes ( ) hardly ever ( ) never

C. <u>EQUITY</u>:

a. Have you ever felt that water allocated to your fields is not fair?

( ) never ( ) hardly ever ( ) sometimes ( ) always

b. Have you ever felt that water allocated to in your neighbor's fields is not fair?

( ) never ( ) hardly ever ( ) sometimes ( ) always

c. Have you ever felt that the time allocated irrigating your field is not fair?

( ) never ( ) hardly ever ( ) sometimes ( ) always

d. Have you ever felt that the time allocated irrigating your neighbors'field is not fair?

( ) never ( ) hardly ever ( ) sometimes ( ) always

e. Have you ever felt that the water distribution criteria from the main canal in the canal irrigating your field is not fair?

( ) never ( ) hardly ever ( ) sometimes ( ) always

f. Have you ever felt that water distribution criteria from the main canal in the head fields are not fair?

( ) never ( ) hardly ever ( ) sometimes ( ) always

g. Have you ever felt that the water distribution criteria from the main canal in the middle fields are not fair?

( ) never ( ) hardly ever ( ) sometimes ( ) always

h. Have you ever felt that the water distribution criteria from the main canal in the tail end fields are not fair?

( ) never ( ) hardly ever ( ) sometimes ( ) always

i. Have you ever felt that this irrigation has not treated fairly?

( ) never ( ) hardly ever ( ) sometimes ( ) always

j. Have there been time when you were not treated better than your neighbors?

( ) never ( ) hardly ever ( ) sometimes ( ) always

k. Who are the persons benefitting most from the system?

( ) head farmers ( ) middle farmers ( ) tail enders
( ) head and rich ( ) middle and rich ( ) tail ender and rich
( ) all equal

l. Have there been any instances when you have been imposed penalty for not participating in the operation and maintenance of the system?

( ) yes, quite often ( ) yes, somestimes ( ) no, hardly ever
( ) no, never

m. Have there been any instances when your neighbors have been imposed penalty for not participating in the operation and maintenance of the system?

( ) yes, quite often ( ) yes, somestimes ( ) no, hardly ever
( ) no, never

n. What is your impression on system's rules on imposing penalty equally to all members?

( ) v. unfair ( ) unfair ( ) fair ( ) very fair

o. How often do you think penalty should be imposed on defaulters to improve water equity?

( ) always ( ) frequently ( ) sometimes ( ) rarely ever

D. LEADERSHIP:

Who do you turn for help if

dam bursts _____

irrigation canal is washed away _____

there is no water in your field _____

filling out forms/papers related
to irrigation _____

solving problems related to water
allocation in your field _____

solving problems related to water
distribution in your field_____

solving problems related to
your labor contribution disputes_____

solving problems related to other
resources contribution disputes
such as bamboo, tree trunks and
branches for repairing system_____

there is dispute with your neighbor
on water theft charges_____

APPENDIX B

HOUSEHOLD CHARACTERISTICS AND ITEM MEAN SCORES FOR EFFECTIVENESS, PARTICIPATION AND EQUITY

Table 19. Characteristics of Households in the Study Villages (N=200)

Characteristics	Non-User Controlled				User Controlled			
	Hyangja		Lahachok		Chaurasi		Ghachok	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age of Head of Household	53.5	13.3	50.4	13.4	50.7	10.7	54.6	11.9
Family size	7.3	3.1	6.5	2.1	6.5	2.4	6.8	2.6
Farm size (ropani)	16.4	9.0	17.4	12.6	16.2	9.3	17.5	9.8
Irrigated parcel size (ropani)	4.4	3.6	3.9	4.5	3.4	3.1	2.9	2.5
Livestock in standard unit	5.0	3.7	3.3	1.6	3.6	1.9	5.7	6.6
Total income (in 000 Rs.)	27.7	16.5	17.7	13.8	25.1	19.6	35.8	41.4
Average number of years family irrigating their field	54	81	140	70	167	86	247	137

Table 20. Socio-economic and demographic characteristics of respondents by system (N=200)

Characteristics	Name of the systems: Hyangja No. (%) (n=50)		Lahachok No. (%) (n=50)		Chaurasi No. (%) (n=50)		Ghachok No. (%) (n=50)	
Caste:								
Brahmin	20	40	35	70	31	62	23	46
Chhetries	26	50	6	12	15	30	8	16
Vaishyas	3	6	4	8	2	4	19	38
Sudras	1	2	5	10	2	4	0	0
Family Structure:								
Nuclear with children dependent	3	6	12	24	9	18	7	14
Nuclear with young dependent	21	42	24	48	24	48	20	40
Joint with children dependent	23	46	13	26	13	26	18	36
Joint with young dependent	3	6	1	2	4	8	5	10
Education:								
Illiterate	20	40	17	34	9	18	17	34
Literate	16	32	14	28	25	50	18	36
High School	11	22	14	28	10	20	7	14
College Education	3	6	5	10	6	12	8	16

Table 20 continued

Characteristics	Name of the systems: Hyangja No. (%) (n=50)		Lahachok No. (%) (n=50)		Chaurasi No. (%) (n=50)		Ghachok No. (%) (n=50)	
Social Participation Level:								
No	9	18	9	18	10	20	10	20
Low	23	46	17	34	18	36	9	18
Medium	12	24	16	32	14	28	16	32
High	6	12	8	16	8	16	15	30
Socio-economic Status:								
Low	10	20	21	42	14	28	11	22
Medium	27	54	23	46	26	52	28	56
High	13	26	6	12	10	20	11	22
Location of the Parcel:								
Tail end	12	24	11	22	12	24	11	22
Middle field	14	28	24	48	23	46	26	52
Head field	24	48	15	30	15	30	13	26

Table 21: Effectiveness items score means and standard deviations (N=200)

	Items	Mean	SD
1.	System design assessment	2.36	.72
2.	System construction problem	2.05	.72
3.	Water sufficiency in ones own field	2.28	1.06
4.	Water sufficiency in neighbor's fields	2.37	1.08
5.	Water sufficiency in the head fields	3.16	.84
6.	Water sufficiency in the tail-ends	1.39	.58
7.	Water availability at needed time	2.23	.95
8.	Water use efficiency of the system	2.72	.67
9.	Water use efficiency by the head farmers	2.71	.64
10.	Water use efficiency by the tail-enders	3.10	.66
11.	Familiarity with the system rules	2.84	.86
12.	Assessment of rules	2.65	.77
13.	System effectiveness in resources utilization	2.66	.74
14.	System effectiveness in benefit distribution	2.69	.65
15.	System effectiveness in rule enforcement	2.71	.82
16.	System effectiveness in equal treatment	3.30	.74

Table 22: Participation item score means and standard deviations

	Item	Mean	SD
1.	Level of involvement	3.41	1.11
2.	Collective criteria for resource mobilization	2.09	1.01
3.	Frequency of committee meeting	1.79	1.00
4.	Frequency of participation in maintenance	2.29	1.15
5.	Communication with representatives	2.74	.94
6.	Representatives listen and act	2.97	.92
7.	Neighbors counselling with system problems	3.20	.80
8.	Collective communication with the representatives	2.48	.81
9.	Assistance to neighbors on field channel problems	2.76	.75
10.	Ones own participation rating	3.07	.87

Table 23: Equity item scores means and standard deviation.

	Item	Mean	SD
1.	Fairness in water allocation towards individual's field	2.87	.87
2.	Fairness in water allocation towards neighbor's field	2.94	.85
3.	Fairness in time allocated in individual's field	2.87	.87
4.	Fairness in time allocated in neighbor's field	2.93	.81
5.	Fairness in water distrivbution in individual's field	2.89	.86
6.	Fairness in water distribution in the head fields	3.02	.91
7.	Fairness in water distribution in the tail-end	2.30	1.04
8.	Fairness in the canal alignment	3.00	.72
9.	Fairness of system treatment to the individuals	2.84	.92
10.	Fairness of system on resource mobilization criteria	3.07	.81

APPENDIX C

ANALYSIS OF VARIANCE FOR EFFECTIVENESS, PARTICIPATION AND EQUITY

Table 24. Analysis of variance of effectiveness by caste

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	.512	.171	1.787	.151
Within Groups	170	16.245	.096		
Total	173	16.757			

Multiple Range Test: Tukey Procedure

Group	Caste	(n)	Mean	S.D.	Group* 4 3 2 1
Gr4	Brahmins	(94)	2.59	.312	
Gr3	Chhetries	(50)	2.57	.313	
Gr2	Vaishyas	(26)	2.66	.302	
Gr1	Sudras	(04)	2.28	.149	

* No two groups are significantly different at the .05 level.

Table 25. Analysis of variance of participation by caste

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	4.082	1.361	4.860	.003
Within Groups	188	52.628	.280		
Total	191	56.710			

Multiple Range Test: Tukey Procedure

Group	Caste	(n)	Mean	S.D.	Group 4 3 2 1
Gr4	Brahmins	(106)	2.778	.638	*
Gr3	Chhetries	(52)	2.473	.505	
Gr2	Vaishyas	(28)	2.825	.534	*
Gr1	Sudras	(06)	2.467	.638	

* Denotes pairs of groups significantly different at the .05 level.

Table 26. Analysis of variance of equity by caste

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	1.960	.653	2.124	.099
Within Groups	176	54.146	.308		
Total	179	54.106			

Multiple Range Test: Tukey Procedure

Group	Caste	(n)	Mean	S.D.	Group* 4 3 2 1
Gr4	Brahmins	(98)	2.874	.548	
Gr3	Chhetries	(49)	2.849	.600	
Gr2	Vaishyas	(26)	3.058	.525	
Gr1	Sudras	(07)	2.486	.372	

* No two groups are significantly different at the .05 level.

Table 27. Analysis of variance of effectiveness by literacy level

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	.397	.132	1.375	.252
Within Groups	170	16.361	.096		
Total	173	16.758			

Multiple Range Test: Tukey Procedure

Group	Literacy level	(n)	Mean	S.D.	Group* 4 3 2 1
Gr1	Illiterate	(51)	2.576	.316	
Gr2	Literate	(64)	2.546	.318	
Gr3	High school	(38)	2.597	.265	
Gr4	College education	(21)	2.702	.345	

* No two groups are significantly different at the .05 level.

Table 28. Analysis of variance of participation by literacy level

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	.873	.291	.980	.403
Within Groups	188	55.836	.297		
Total	191	56.710			

Multiple Range Test: Tukey Procedure

Group	Literacy level	(n)	Mean	S.D.	Group* 4 3 2 1
Gr1	Illiterate	(60)	2.640	.556	
Gr2	Literate	(71)	2.666	.566	
Gr3	High school	(40)	2.730	.501	
Gr4	College education	(21)	2.862	.519	

* No two groups are significantly different at the .05 level.

Table 29. Analysis of variance of equity by literacy level

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	.430	.143	.453	.716
Within Groups	176	55.676	.316		
Total	179	56.106			

Multiple Range Test: Tukey Procedure

Group	Literacy level	(n)	Mean	S.D.	Group* 4 3 2 1
Gr1	Illiterate	(58)	2.895	.597	
Gr2	Literate	(68)	2.874	.556	
Gr3	High school	(35)	2.803	.487	
Gr4	College education	(19)	2.984	.593	

* No two groups are significantly different at the .05 level.

Table 30. Analysis of variance of effectiveness by level of involvement in the community activities

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	.267	.089	.918	.433
Within Groups	170	16.490	.097		
Total	173	16.757			

Multiple Range Test: Tukey Procedure

Group	Level of involvement	(n)	Mean	S.D.	Group* 4 3 2 1
Gr1	No	(31)	2.54	.234	
Gr2	Low	(58)	2.57	.353	
Gr3	Medium	(53)	2.58	.314	
Gr4	High	(32)	2.66	.289	

* No two groups are significantly different at the .05 level.

Table 31. Analysis of variance of participation by level of involvement in the community activities

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	8.817	2.939	11.537	.000
Within Groups	188	47.893	.255		
Total	191	56.710			

Multiple Range Test: Tukey Procedure

Group	Social involvement	(n)	Mean	S.D.	Group 1 2 3 4
Gr1	No	(35)	2.41	.599	
Gr2	Low	(65)	2.60	.521	
Gr3	Medium	(56)	2.72	.452	*
Gr4	High	(36)	3.08	.449	* * *

* Denotes pairs of groups significantly different at the .05 level.

Table 32. Analysis of variance of equity by level of involvement in the community activities

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	7.079	2.360	8.471	.000
Within Groups	176	49.026	.279		
Total	179	56.106			

Multiple Range Test: Tukey Procedure

Group	Level of involvement	(n)	Mean	S.D.	Group 1 2 3 4
Gr1	No	(30)	2.44	.441	
Gr2	Low	(61)	2.94	.591	*
Gr3	Medium	(54)	2.98	.529	*
Gr4	High	(35)	3.99	.474	*

* Denotes pairs of groups significantly different at the .05 level.

APPENDIX D

BIBLIOGRAPHY

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