Farmers' Perceptions of System Effectiveness, Level of Participation and Equity in Farmer and Agency Managed Irrigation Systems in Nepal*

Ganesh P. Shivakoti
Department of Agricultural Economics
Institute of Agriculture and Animal Science
Rampur, Tribhuvan University, GPO Box-984
Kathmandu, Nepal

Introduction

Recent studies report that many farmer managed irrigation systems (FMIS) in Nepal are functioning better than those managed by public agencies (Laitos et al., 1986; Pradhan, 1988; Tang, 1992; Yoder, 1986; Hilton, 1990; Ostrom, 1990; Shivakoti, 1992). There are still many FMIS which are not well maintained both due to lack of resources and lack of organization required for the improvement of the systems (HMG/N--Winrock, 1991). In agency managed irrigation systems (AMIS) and 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 1992; Shivakoti, 1992).

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. 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.

Thus, an individual's choice of action in any particular situation depends upon how he or she weighs the benefits and costs of various alternatives and likely outcomes (Tang, 1992). Individual decisions, however, are also influenced by the attributes of the community and the alternative institutional arrangements (which create different action situations) besides physical condition of the system itself.

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 by the responsible agencies is no guarantee that user participation will yield desired equity in getting water to the individual farmers' field. Thus, a potential pitfall exists for agency intervention in farmer managed irrigation systems which is the failure to recognize the conditions that make indigenous

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institutions viable which rely upon shared understandings of rights and duties to enforce compliance with their rules (Ostrom, 1990).

Present study is based on the comparison of individual farmer's perceptions who have fields at a different locations (head, middle and tailend) of a particular irrigation system effectiveness, participation and equity under alternative institutional arrangement (FMIS v/s AMIS: which has created different leadership situations) under different attributes of community (such as caste, socio-economic structure and family structures) in one hill district of Nepal.

This study has attempted to answer the following specific questions:

* How do the characteristics associated with individual users affect the perceptions of effectiveness, level of farmer participation and feelings of equity?

* Are these variations influenced by the physical factors such as the location of the particular parcel to be irrigated?

* How is community leadership developed and associated with the alternative institutional arrangements?

* How do the variations associated with alternative institutional arrangements affect the farmers' perceptions of effectiveness, participation and equity?

Study Methods and Design:

The study design included a personal interview survey phase preceded by Rapid Rural Appraisal (RRA). 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 (Pradhan et al., 1987; Chambers and Carruthers, 1986). The RRA was used to gather background information on 12 irrigation systems and finally select the four irrigation systems to be surveyed. The variables measured in this study included socio-economic status of the household, family structure, and demographic characteristics of the respondent farmers. The contextual variable included leadership structure for irrigation related decision-making situation in community.

The study site included four villages receiving irrigation water from four different irrigation systems located in Kaski district in the Western Development Region of Nepal.

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, 1991; Shivakoti, Giri, Ostrom, 1992; Shivakoti, 1992).

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 FMIS and AMIS. Each pair of FMIS and AMIS shared a common water source i.e.Chaurasi (FMIS) and Hyangja (AMIS) systems diverted water from one stream, Yamdi; and Ghachok (FMIS) and Lahachok (AMIS) 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).

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 the distance from the head 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. Fifty households from each of the four systems, with a total sample size of 200 households (100 each from FMIS and AMIS) out of a total of 1890 households, was considered to be an adequate sample size.

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 open-ended.

Effectiveness was estimated by 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." Similarly, water sufficiency (availability) was used; 4 being "always sufficient (available)" to 1 being "usually insufficient (unavailable)." 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. 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.

Participation was estimated by 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. Involvement of respondent and neighbors in solving problem; "always" to "never" Likert type scales at a 4 to 1 scales were used. 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.

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.

Study Area Overview:

This section 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.

The four irrigation systems -- Chaurasi and Ghachok which are FMIS and Hyangja and Lahachok which are AMIS -- 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.

Settlement Pattern

The surrounding areas of all selected irrigation systems are all old settlement areas. Although the Chaurasi and Hyangja irrigation systems are a little more than 100 years old, the settlement around the system have been far older (more than 500 years). Ghachok system, on the other hand, is in itself more than 400 years old; and settlement have been 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.

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 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.

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. Chaurasi irrigation system is 110 years old which was designed by a local farmer.

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.

Lahachok:

The gross command area of the system is 100 ha which is divided into three big terraces. This system is nearly 250 years old which captured water from the small seasonal rivulets and springs mainly for paddy growing season during the monsoon. The first intervention by any public agency in this system was a grant from International Labor Organization (ILO) during 1979-80. ILO constructed the whole system by realigning the canals and head work at the source at no cost to the farmers.

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.

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 system is supposed to be at least 400 years old. 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 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.

Demographic and Socio-Economic Characteristics of Respondents

Each of the 200 respondents were asked a battery of questions related to the demographic and socio-economic characteristics of the household. In light of this information, we can examine whether the sample of households served by farmer-controlled irrigation systems is similar in demographic and socio-economic characteristics to the sample of households served by agency-controlled irrigation systems as was intended. As shown in Table 1, it appears that the households in the sample being served by these two types of irrigation systems are very similar to one another.

There is no difference between the two types of systems in regard to the mean age of the head of the household (around 52 years), the size of the family (7 persons), and farm size (17 ropani) (see Table 1). The average parcel size of irrigated field is somewhat higher for non-farmer controlled systems than for user controlled systems. Total income is higher on the user controlled systems (Rs. 30,445 as contrasted to Rs. 22,860) with a higher standard deviation as well. Family income varies substantially on all of these individual systems. As would be expected given the respective ages of these systems, the average number of years that someone in a respondent's family has irrigated a field in the service area is nearly twice as long in the user-controlled as in the non-farmer controlled systems.

In AMIS Brahmins and Chhetries constitute nearly 90 percent of the respondents whereas in FMIS Vaishyas also constitute nearly a quarter of the respondents (see Table 2). The family structure on both types of systems is similar. Most families, whether nuclear or joint, have more than four children in the household. There are more illiterate respondents in AMIS than in the FMIS systems (37% versus 26%). Respondents were asked a whole battery of questions about their level of participation in diverse social activities. About one-fifth of the respondents in both types of systems do not participate in any of the activities. Somewhat over half (53%) of the respondents on the FMIS are medium to high participants in social activities while around 42% of those on the AMIS are similarly active. Respondents were also asked a series of questions about their assets and other indicators of social and economic status. The status distribution of respondents on both types of systems are very similar. A majority of the respondents in farmer controlled systems had their parcels from the middle field of the system. In the case of non-farmer systems, an equal number of respondents had fields in middle and head fields.

It is extremely difficult possible to find empirical settings where most important demographic and socio-economic variables are very similar and institutional arrangements differ. It this case, however, the distribution of households in the two instances of each type of irrigation systems along demographic and socio-economic dimensions are very similar. Let us now turn to the question of what difference the demographic and socio-economic characteristics of respondents make on their perceptions of system effectiveness, levels of participation, and equity.

Relating Respondents' Characteristics with Perceptions of System Performance

In order to examine the relationship between variables, such as family structure, socio-economic status, and location of the irrigated parcel with farmers' perceptions of the performance of their irrigation system, respondents were asked a series of questions about how their system operated. These questions focused on: (1) perceived system organizational effectiveness; (2) reported participation in activities related to maintenance of system; and (3) perceived equity.

To measure organizational effectiveness, the following indicators were included in the survey instrument:

(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 the system in regard to resource utilization and benefit distribution.

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

From the answers to 16 questions on these topics an index of effectiveness was constructed with a range of 1.39 to 3.30 and a means score of 2.66. The reliability of this index (measured by Cronbach's alpha) is .6516 which is just sufficient to meet the criteria for acceptable levels of reliability of .65 recommended by Nunnaly (1978).

To measure the degree of participation on an irrigation system, the following questions were asked:

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

(2) Farmers' assessment of contribution they made to the maintenance of the system.

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

(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.

From the answers to 10 questions on these topics an index of participation was constructed that varied from 1.79 to 3.41 with a mean score of 2.74. The reliability of this measure is .7776.

To measure the equity of 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.

From the answers to 10 questions on these topics an index of perceived equity was constructed that varied from 2.30 to 3.07 with a mean score of 2.84. The reliability of this measure is .8423.

Since many of the variables describing demographic and socio-economic characteristics are interval measures, it is possible to compute a Pearson product-moment correlation coefficient between these variables and the three measures of system performance (See Table 3). There are no significant linear relationship among most of the socio-economic characteristics respondents and any of the three performance measures. Family size, age of the head of the household, annual off-farm income, total annual income, the number and type of livestock held, and the size of the parcel used as reference in the study made no difference on respondents' perceptions of system effectiveness, participation or equity. A significant positive relationship was recorded between farm size and farm income and participation. In addition annual farm income was significantly related to the index of system effectiveness. These data support the proposition that as farm size and farm income increases so do farmers' perceptions of participation and effectiveness.

Socio-economic status (SES) 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 unit (LSU); and (5) material level of living.

While SES variables other than farm income and farm size had little impact on farmers' evaluations of system performance, the location of a farmer's irrigated parcel was related to these measures. As mentioned above the sampling unit for this study was a parcel of land recorded in the land survey office. If a farmer owned more than one parcel, he was then asked which of several parcels was the most important to the farmer in terms of its productivity. Whether this parcel was located at the tail, in the middle, or at the head of the irrigation system affects the way farmers evaluate the performance of an irrigation system.

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 of effectiveness, participation and equity by location. In Table 5a shows a significant difference in the way that farmers evaluated system effectiveness depending upon where their most important parcel of irrigated land was located. Farmers who owned parcels in the head and middle sections of these four irrigation systems evaluated their system effectiveness more positively than farmers whose parcels were located at the tailend of these systems.

Similar procedures were followed to examine the differences in participation scores by location of the parcel. As shown in Table 5b, there were significant differences observed among the respondents with parcels at the head, middle and tail end of an irrigation system. In particular, the evaluation made of participation by farmers whose parcels were located in the middle section were significantly more positive than either those located in the head reach or the tail enders. The data arrayed in Table 5c show that there were also significant differences in the mean equity scores between head reach farmers and the tail enders. Farmers located at the head end of these systems perceived the systems to be operating more equitably than the farmers at the tail (but not more favorably than the farmers owning parcels at the middle).

<u>The Interrelationship Among Effectiveness, Participation, and Equity</u>

A further question to be explored is whether there are relationships among the evaluations that farmers give to their system. As shown in Table 6 a significant positive relationship exists between effectiveness and equity. In other words, farmers who perceive their system to be fair also tend to perceive their system as being effective. The other performance measures are not significantly related. In Table 7, we explore whether there are any differences in the strength or direction of the relationships among performance measures in farmer managed as contrasted with agency managed systems. There is a significant and stronger correlation between effectiveness and equity in the case of farmer controlled systems. Although the correlations between effectiveness and participation and also between participation and equity are higher in the case of farmer controlled systems, the differences are weak and not significant.

Whether farmers are utilizing an irrigation system that they themselves control or that is organized by the national government does make a difference in their overall evaluations of system effectiveness and the levels of participation. As shown in Table 8, there is a significant difference between the average effectiveness and participation scores on farmer managed versus agency managed systems. In both cases, systems controlled by the farmers are given higher average ratings than systems controlled by a government agency. On the other hand, no significant differences were found in the equity scores between farmer and non-farmer controlled systems.

Leadership Structure for Irrigation Related Decision-making Situation

As mentioned in the beginning we have consistently found that the performance of farmer managed irrigation systems tends to be higher -- controlling for relevant physical variables -- than agency managed systems. In the previous section of this paper, we show that the farmers obtaining water from a farmer managed system tend to evaluate system effectiveness and levels of participation higher than farmers obtaining water from an agency managed system.

An advantage of using data obtained from structured interviews with a sample of respondents is that one can begin to examine if there are systematic patterns of relationships among farmers and officials that differ in these two types of systems. And, indeed, we do find substantial differences in the patterns of relationships between farmers and different leaders in farmer-controlled as contrasted to agency-controlled systems. Different types of leadership structures have been developed in these two kinds of systems over a period of time and they affect how farmers react to different types of problems.

Respondents were asked to whom they would turn for help in relation to a series of hypothetical situations. These questions included the following types of situations:

1. Emergency situations
   a. When the irrigation dam bursts
   b. When the main canal is washed away
2. Dissatisfaction with policies concerning water allocation

3. Dissatisfaction with water distribution activities
   a. When water is not available in a canal
   b. When there is no water in a particular field

4. Conflict resolution problems
   a. Disputes over labor contributions
   b. Disputes over resource mobilization
   c. Water stealing problems

5. Routine filling out of irrigation related papers.

For each type of decision-making situations the answers given by farmers were classified into five responses: (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 farmers (100 respondents) and those controlled by non-farmers (100 respondents).

Emergency Situations

Given the torrential downpours that occur each summer in Nepal, it is not unusual for irrigation dams to burst or main canals to be washed away. However, these situations are serious for farmers as whether they can bring their crops to harvest depends on getting some kind of an emergency structure in place as soon as possible. Farmers were asked to whom they would turn in relationship to these two different emergency situations. In the case where farmers were asked to whom they would turn if their dam were to burst, there is a significant difference in response between the farmer controlled and non-farmer controlled systems. Almost all (98%) of the respondents in FMIS would seek assistance from their own WUA functionaries or village council members. The majority of respondents in FMIS, on the other hand, chose to go to district irrigation and general administration officials for assistance (Table 9). Similar responses were given to the question of what they would do if the main canal were washed away. Again almost all respondents in the two FMIS systems would turn to either to the members of their Water Users Committee or to their village council while most respondents in the two AMIS systems would turn to district irrigation authorities. That farmers would turn to the officials responsible for their irrigation system in these kinds of emergency situations is not too surprising. Thus, that at least half of the farmers in both kinds of systems would turn either to the WUA and its chair or to district irrigation officials is what one would expect. What one might not expect is that farmers on systems that they run themselves would turn so heavily to their own village council in addition to the WUA. In other words, in times of emergency, all but a very few farmers indicate that they would turn to self-organized, local councils.

Dissatisfaction with Water Allocation Policies

On all irrigation systems, major decisions have to be made concerning the allocation of water to different parts of an irrigation system. These allocation decisions can adversely affect farmers located on one branch of a system if they feel that they are not being allocated sufficient water. Farmers were asked what they would do if they were dissatisfied with the policies made in regard to the allocation of water to different branches of canals and different locations in a system. On the AMIS, only 30 percent of the farmers responded that they would turn to district officials; 36 percent indicated that they would turn to the WUA for help and another one-fifth indicated they would turn to the lowest official in the system -- the water monitor.

On the FMIS, almost 4 out of 5 farmers would turn either to their WUA or their village council and most of the remaining farmers would turn to their water monitor. Thus, water allocation problems in the case of non-farmer controlled systems were viewed as being solved both by insiders and outsiders as opposed to only insiders in case of farmer controlled systems (Table 10).

Dissatisfaction with Water Distribution Activities

Farmers were asked what they would do in regard to two different types of water distribution activities. In the first instance they were asked about problems related to water in the field channels. In the second instance, they were asked about problems related to water in specific fields. (See second and third parts of Table 10). Water distribution in the field channels and on individual farmers' fields is primarily 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 FMIS had a multiplicity of reliance as opposed to the water monitor being the major leader in case of AMIS. There was a significant number of farmers who responded that they relied on relatives and neighbors in case of FMIS as opposed to a negligible number of farmers from AMIS relying on their neighbors. Findings in Table 10 show that farmers of FMIS approacned different community leaders when there is no water in the field whereas a majority of the farmers in the AMIS relied mostly on water monitors. Thus, there was diversity of leadership pattern in FMIS as compared to AMIS to solve the problems related to field water availability problems.

Conflict Resolution Problems

Farmers were asked about three different types of situations in which there were disputes. The first had to do with labor mobilization. The farmers were asked who did they approach when there were labor contribution disputes. The second had to do with resource mobilization related problems. And the third had to do with the problems associated with someone stealing water. It is usual practice among the farmers to approach the leaders to resolve conflicts rather than fighting each other.

No significant differences exist in regard to the reliance of the farmers on local leaders to solve problems of labor contribution disputes between the FMIS and AMIS. Both groups of farmers indicated that they would approach functionaries of village council or the members of the WUA. A similar pattern is observed related to the farmers' responses to conflict over resource mobilization problems. What is extremely interesting, however, is the lack of a difference in these dispute resolution problems. What it means is that farmers being served by AMIS do not think about approaching governmental authorities when there are disputes over labor or resource mobilization problems. In both types of problems, more than 90 percent of the farmers in both types of systems indicate that they would turn to local institutions or neighbors and relatives rather than to the district officials or to a water monitor.

The third type of dispute that was discussed with respondents had to do what someone stealing water. Stealing is one of the major sources of conflict among farmers on most irrigation systems. There was a significant difference of the farmers' reliance on leadership to settle this problem. Nearly half of the farmers from FMIS approached their neighbors and relatives to solve the problem. In other words, stealing was perceived by almost an majority of farmers on farmer-controlled systems as something that one relied on social sanctions to resolve rather than turning to officials. The other half of the respondents on farmer-controlled systems relied either on WUA functionaries or village council functionaries. While the leadership patterns involved in the case of AMIS are significantly different from those of the FMIS, what is also very interesting is how few farmers on the AMIS turn to district officials or even to the water monitor in times where someone steals. Almost 80 ° of the farmers on the AMIS turn to their own water user committee, the village council or their neighbors and relatives.

Routine Filling Out of Irrigation Related Papers

When we get to a routine problem such as filling out irrigation related papers, there is no significant difference in the responses to this question across the two types of systems. The majority of farmers from both groups of farmers relied on either the village council secretary or their neighbors and relatives.

Conclusions and Implications:

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

1. There was a significant difference only in participation among different groups by socio-economic status. The big farmers tend to respond with higher level 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 AMIS 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 response on participation and equity might also have been influenced by exercise of their special higher status on water monitors and other project officials.

2. Among the independent variables, location of the irrigated parcel showed significant difference in the mean scores of effectiveness, participation and equity. 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.

3. FMIS 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 farmers, (1) the stronger the feelings of system effectiveness, (2) the higher the level of participation, and, (3) the greater the feelings of equity.

4. 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.
5. The two FMIS and two AMIS 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 farmer controlled FMIS have developed different types of leadership structures over a period of time by exercising higher level of control in the community situation. The FMIS have adopted an approach of self-help and looking inward at varied types of leadership for assistance.
6. In the case of AMIS, 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.

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

1. The diversified leadership patterns established by the farmer controlled FMIS tend to develop a feeling of ownership of the system. The non-farmer controlled AMIS may be able to 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-farmer controlled systems.
2. There is a difference in the level of participation and feelings of equity among farmers 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 farmers. To create feelings of fairness and to increase the levels of participation, systems managed and controlled by non-farmers might be turned over to the farmers. 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-farmer controlled AMIS, the farmers 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 farmers regarding system rules, and it could develop a system that could be free of political entity i.e. independent irrigation organization.

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Table 1 Characteristics of the households in the study villages by control type (N=200)

Characteristics	Control type			
	FMIS		AMIS	
	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	1.1	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

Table 2. Socio-economic and demographic characteristics of respondents by control type (N=200)

Characteristics	Control type FMIS Number (n=100)	AMIS Number (n=100)
Caste		
Brahmin	51	55
Chhetries	[illegible]	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
Location of parcel		
Tail	23	23
Middle	49	38
Head	28	39

Table 3. 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

Table 4. Analysis of variance of participation by socio-economic status

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	3.04	1.52	5.35	.005
Within Groups	189	53.67	.28		
Total	191	56.710			

Multiple Range Test: Tukey Procedure

Group	Socio-economic status	(n)	Mean	S.D.	Group 1	2	3
Gr1	Low	(54)	2.31	.485			
Gr2	Medium	(78)	2.72	.586	*		
Gr3	High	(39)	2.86	.446	*		

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

Table 5a. Analysis of variance of effectiveness by location

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	2.64	1.318	15.96	.000
Within Groups	171	14.12	.083		
Total	173	16.758			

Multiple Range Test: Tukey Procedure

Group	Location	(n)	Mean	S.D.	Group 1	2	3
Gr1	Tail	(44)	2.38	.25			
Gr2	Middle	(78)	2.62	.29	*		
Gr3	Head	(52)	2.70	.31	*		

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

Table 5b: 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	3.66	1.83	.32	.002
Within Groups	189	53.05	.28		
Total	191	56.71			

Multiple Range Test: Tukey Procedure

Group	Location	(n)	Mean	S.D.	Group 1	3	2
Gr1	Tail	(46)	2.54	.50			
Gr2	Middle	(83)	2.85	.523	*	*	
Gr3	Head	(63)	2.60	.559			

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

Table 5c: 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	3.94	1.97	6.97	.002
Within Groups	177	52.16	.295		
Total	179	56.11			

Multiple Range Test: Tukey Procedure

Group	Location	(n)	Mean	S.D.	Group 1	2	3
Gr1	Tail	(43)	2.66	.56			
Gr2	Middle	(77)	2.87	.54			
Gr3	Head	(60)	3.05	.53	*		

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

Table 6. Correlation coefficients for effectiveness, participation and equity

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

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

Table 7: Pearson correlation coefficient for effectiveness, participation, and equity by control type

Control type	Correlation Coefficient
Between effectiveness and participation:	
FMIS	.134
AMIS	-.075
Between effectiveness and equity:	
FMIS	.547**
AMIS	.402**
Between participation and equity:	
FMIS	.241
AMIS	.166

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

Table 8. T-test analyzing effectiveness, participation and equity scores when considering control type

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

Table 9. Leadership pattern in emergency situation and dissatisfaction with water allocation and distribution activities by management type (n=200)

Leadership pattern	Control type	
	FMIS (n=100)	AMIS (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		
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 = 48.92[illegible]9 with 4 df significance .0000		

Table 9 contd......

Leadership pattern	Control type FMIS (n=100)	AMIS (n=100)
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 = 4[illegible].6575 with 4 df significance .0000

Table 10. Leadership pattern by control type solving conflict resolution problems and filling out of irrigation related papers (n=200)

Leadership pattern	Control type FMIS (n=100)	AMIS (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

Leadrship pattern		FMIS (n=100)	AMIS (n=100)
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			
When there is water stealing problem:			
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			
Routine filling out of 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	3	20
Chi square = 24.7857 with 4 df significance .0001			