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**PARTICIPATORY IRRIGATION MANAGEMENT:**

**Case Study of Bhadrutar and Hakuwa Canals**

**Murari M. Aryal**

HMG-USAID-GTZ-IDRC-FORD-WINROCK PROJECT  
STRENGTHENING INSTITUTIONAL CAPACITY IN THE  
FOOD AND AGRICULTURAL SECTOR IN NEPAL

## FOREWORD

This Natural Resource Management Paper Series is funded through the project, "Strengthening Institutional Capacity in the Food and Agricultural Sector in Nepal," a cooperative effort by the Ministry of Agriculture (MOA) of His Majesty's Government of Nepal and the Winrock International Institute for Agricultural Development. This project has been made possible by substantial financial support from the U.S. Agency for International Development (USAID), the German Agency for Technical Cooperation (GTZ), the Canadian International Development Research Centre (IDRC), and the Ford Foundation.

One of the most important activities of this project is funding for problem-oriented research by young professional staff of agricultural agencies of the MOA and related institutions, as well as by concerned individuals in the private sector. This research is carried out with the active professional assistance of the Winrock staff.

The purpose of this Natural Resource Management Paper Series is to make the results of the research activities related to natural resources available to a larger audience, and to acquaint younger staff and students with advanced methods of research and statistical analysis. It is also hoped that publication of the Series will stimulate discussion among policymakers and thereby assist in the formulation of policies which are suitable to the development of Nepal's agriculture.

The views expressed in this Research Report Series are those of the authors, and do not necessarily reflect the views of their respective parent institutions.

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PARTICIPATORY IRRIGATION MANAGEMENT:  
Case Study of Bhadrutar and Hakuwa Canals

Murari M. Aryal\*

INTRODUCTION

Even small irrigation schemes in the hills of Nepal have the potential to increase food production dramatically. Development programs have referred to traditional irrigation systems with respect.

The construction, operation and maintenance of a traditional scheme are cooperative tasks. Sometimes management is organized as a joint stock company in which farmers own shares. There is often one person with leadership qualities who takes the initiative in organizing local people. The organizers are responsible for raising the necessary capital. Although organization varies from place to place, it often is an informal committee consisting of representatives of the beneficiaries.

The representative committee manages the project. General meetings are held to deal with major project issues. Although it varies, these meetings are usually held annually, a fortnight before the main crop plantation. Where necessary, emergency meetings will be called.

Some traditional irrigation projects also appoint administrative and operational officials. However, since the advent of the panchayat system, the administration of such projects has merged with the local political leadership. The old role of part-time administrative personnel has effectively been taken over by the village pradhan pancha or ward chairman, regardless of whether they own land in the command area. Operational personnel such as dhalpas (canal managers) and chowkidars (watchmen) are still employed full-time and they are usually paid in kind by the beneficiaries.

A study of two canals in the Nuwakot district revealed that they are dynamic. The local people were continuously trying to increase their capacity or improve and extend them. As far as they can, the farmers have developed their systems.

Both systems studied were based on river water diversion. The water is diverted using locally available materials such as stones and foliage. Hollow logs are used for cross drainage. Stone structures are built at the intake and as retaining walls as necessary. No complicated rock cutting or intricate tunnelling requiring special skills are involved.

Water is distributed on the basis of landholding. Farmers with land in the head have the right to use water first but may not use it again until everyone in the system has had a turn during that crop cycle. Unfortunately, fair distribution of water is often not straightforward. Farmers at the head generally take as much as they want at the expense of tailenders, and influential farmers take advantage of their position to use the facilities even when their land is not in the command area.

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\* Murari M. Aryal was a Social Scientist working with the USAID Resource Conservation and Utilization Project when this research was carried out.

The irrigation systems under study include dhalpas to do regular maintenance work along the canals and chowkidars to supervise water rotation. Whenever a breach or damage is discovered it is the dhalpas' responsibility to repair it. If the damage is beyond the capability of the dhalpa, the beneficiary farmers are called upon to help. The canal committee helps the dhalpas to mobilize them. Emergency repair work, particularly during the monsoon rice plantation season, must be done continuously, 24 hours a day, until it is completed.

As well as contributing labor the farmers have to contribute grain to pay for the dhalpas and the chowkidars. Water charges are linked to productivity. In both systems under study, the dhalpas and chowkidars collected the grain themselves at the time of the major crop harvest.

#### METHODOLOGY

Bhadrutar and Hakuwa irrigation systems were chosen because:

- both were noted for their comparative effectiveness; they offered contrast in terms of the size of their command area and their life span--one had been there many years and the other is new;

- there is a wide socioeconomic range within the two command areas that makes them representative of the region;

- Bhadrutar is on dry flat bench land with high potential but without irrigation there is little prospect of intensifying agriculture. Hakuwa is on low land where, without irrigation, they can rely on the monsoon; and

- both areas are easily accessible; Belkot is 45 minutes walk and Bhadrutar is 90 minutes walk from the nearest road head.

The study was conducted in the winter of 1984/85, when the winter wheat crop was planted. Otherwise a slow season, it was a good time for interviewing the farmers and observing water management practices for the winter crop.

There are about 200 farm households living on 150 ha of irrigated farm land in Bhadrutar. Hakuwa canal in Belkot irrigates about 12 ha of land belonging to 40 families.

Forty-five farmers in Bhadrutar and 30 in Belkot were interviewed to establish a profile of community management in the respective areas. They were selected at random and informal interviews were conducted at tea houses, working in the fields, along the canals while supervising the water flow, resting and during house visits. No formal questionnaires were used and field reports were completed while resting during the evening. Informal interviews were also conducted with people at the village and district levels outside the command area group.

#### The Sites

Bhadrutar is located on the north bank of the Likhu river in Nuwakot district in Bagmati zone. The nearest road head is at Chhahare. A new link road between Kathmandu and Trisuli is being built which will

eventually connect Gurje Bhanjayang with Chhahare. The irrigated fields are in three separate tars, the Sera Phant, the Pachase Phant, and the Bismane Phant, all between 80 and 100 meters above the river.

Belkot is west of the Kathmandu-Trisuli road. Hakuwa canal feeds water from Hakuwa River to flat upland about 40 meters above the river.

#### Ethnic Groups

About 50 percent of the people of Bhadrutar are Brahmins, 40 percent Chhetris and a few Tamangs and untouchables. Rais account for five-seven percent and are the oldest inhabitants in the canal area. Several generations ago the Rais were a fishing people. Now they have moved up out of the main river valleys and have become farmers although the command area is not strictly a settlement area. The Brahmins, Chhetris, Rais and Tamangs live on the ridge to the north and west (in Bhadrutar Panchayat) or to the south across the river Likhu (in Khole Gaon Panchayat). The settlements are an hour's walk away and the farmers "commute" to their fields in the tars. The hills to the north are girded by a belt of trees half way up, covering about a quarter of the hill area. The forest has been carved away both above and below for fuel and for fodder. The command area of the canal is at the base of this hill.

The Belkot people who live in the command area of Hakuwa canal are all Brahmins or Jaisis except two Kumal households. To the west of the command area is a hill still covered by dense forest.

The Jaisis are the oldest inhabitants of the village. They constitute more than 75 percent of the panchayat population. Before Nepal was unified, Belkot was an army garrison post of strategic importance that belonged to the principality of Kathmandu. It is surprising to find only a few Chhetris or other warrior castes here and none of them own land in the canal command. The two Kumal households were brought from neighboring Gorkha district to help with canal construction.

#### Farming Practices

Most farmers plant only a monsoon crop of flooded rice in their khet (irrigated lowland) fields mainly because of the uncertain water supply in the winter and widespread and loosely supervised grazing.

The most common variety of irrigated paddy is Monsuli. The seedlings are transplanted in July and harvested in November/December. Monsuli is a recently introduced variety. Earlier, the farmers cultivated the Sali variety of flooded paddy but yield was not satisfactory. Monsuli produces less straw for weaving and as fodder but the harvest is more than enough to make up for this.

Those who are fortunate enough to live near their fields have the option of cultivating winter wheat and/or a spring crop of irrigated rice. About 40 percent is winter wheat. Water requirements for wheat are minimal; it needs to be watered about four times during its growth. Seasonal heavy dew gives it additional moisture.

Bari (dry upland) depends on rain as its source of water. Bari is rarely planted with only one crop; it is divided throughout the year

between maize, millet, soyabeans, sesame, blackgram, mustard and potatoes, or else it lies fallow.

One recent development in the study area is the introduction of a fast growing maize variety from Arun. It is high yielding and needs little water. It has caused a small green revolution in Bhadrutar.

Cultural perceptions and practical limitations affect a farmer's choice of crop. Rice translates directly into "wealth" and is easy to market. Buyers come to the village to purchase it and it is easy to store because of its hard husk and because it is usually stored over the dry season. Rice is the preferred food as well as the preferred crop.

Wheat is not so desirable. It grows better with chemical fertilizers, which is an additional cost to the farmer. Most of the farmers in the study area have had limited experience of cooking and eating wheat so they prepare it in only a few ways. Many said they did not feel as well eating wheat as rice. The grain is also more difficult to store because the husk is softer and therefore more susceptible to mildew. It is more difficult to market. For this combination of cultural and practical reasons, acceptance of wheat has been slow in the study area.

Land prices have fluctuated in the past but because there have been few land transactions in the study area none of the farmers interviewed were sure what were the current prices. One recent sale of khet land in February 1985 fetched about NRs.3000 per ropani. It was not possible to get an accurate estimate for bari land.

Bhadrutar and Belkot have similar livestock ownership patterns. Goats are the most important market animals. There were slightly more buffaloes per household in Belkot primarily due to the higher availability of fodder. The buffaloes are generally stall fed and other animals, except bulls during work seasons, are grazed.

Labor is hired or exchanged. The daily wage is one paathi (about five kg) of rice or wheat but labor is usually exchanged reciprocally without wage, in which case "the employer" provides a midday meal.

## IRRIGATION

### The Canals

Bhadrutar canal is about six km long. It is a gravity system in which water is diverted from the Likhu river upstream at Sera Nuhan. The main canal channels the water up to the trail to Talakhu and then meanders along the foot of the hills, but above the tars, crossing a major landslide area. The landslide area prevents water from reaching the command area after the annual heavy rainfall and the resulting landslides. Farmers must rebuild the canal over the affected area for winter irrigation.

The system consists of the main canal with three branch outlets to secondary canals, one to each phant, two wooden culverts and other structures to protect the canal at stream and rivulet crossings and from unmanageable landslides.

Hakuwa canal is also a gravity system in which water is diverted from the small Hakuwa River at Pani Muhan and channelled along earthen-lined canals, occasionally supported by stones, for about 1.5 km. The main canal runs for less than 200 meters along the river and then meanders along the hill base. There are no outlets to secondary canals.

Two experienced Kumals from neighboring Gorkha district were contracted by the people of Belkot to construct the canal. It was done by sightings only, without instruments, but they were remarkably accurate. They established the best location for the intake and placed stakes to mark the alignment of the canal. This was done starting at the proposed intake and sighting through the trees and along steep cliffs, marking each sighting with a stake until they arrived at the command area.

The two Kumals were paid NRs.500 and given two matomuris (one ha = 78.6 matomuris) of potential khet land each within the command area. One of them later sold the land, but the other bought additional land from the inhabitants and also from his comrade and permanently settled there.

Construction work began on the auspicious day of Bhai Tika (a day on which brothers are honored) during Tihar 1960, and water reached the command area in time for the monsoon paddy crop. 1961 was a dry year in the area and the water, although marginal, from the canal was more precious than had been anticipated. That same year the main financial contributor received back much of his expenditure on the canal.

The Kumals were assisted by local people who provided voluntary labor as well as the land for the canal. Once started, the work was not stopped or interrupted. As it progressed, even those who had initial doubts contributed their labor for the success of the canal.

The initial cut of the canal was small and irrigated less than five ha. However, the successful flow of water proved to all the skeptics that such a scheme was possible despite steep cliffs, rugged forest, and tunnels and channels cut into vertical cliffs. Work to enlarge the canal continued almost immediately and the Kumals were retained for another five months for another NRs.500 plus food for the days they worked. Water was released to all in the command area for the next winter crop.

The availability of water introduced the concept of growing winter crops in the command area. Earlier it had been a single crop area. However, in 1961 two crops were grown and the additional income generated from the second, high value crop helped the farmers to repay the principal financier of the irrigation project.

As a result of the canal, the "green revolution" matured into a three crop cycle, introduced by some of the more progressive farmers in the command area. This practice was taken up by all the farmers and since 1970 the command area as a whole produces three crops a year.

When water arrived in the command area, the main financier acted as the final arbitrator and distributed water to ten households who signed legal bonds to pay him NRs.75 each at 20 percent interest per annum. He retained his right to irrigate his fields for the risk he had taken to finance the construction of the canal and the dearth of rain compelled his neighbors to accept his terms.

When the irrigation system was expanded by enlarging the initial cut of the canal the probable beneficiaries, in addition to providing labor and paying NRs.500 plus food to the Kumal contractors, agreed to pay the main financier another NRs.300. Thus, he made a profit on his investment through the sale of water to his fellow farmers but none of his neighbors complained.

The latest expansion of the Bhadrutar canal was in 1956. Farmers cultivating land just below Bismane Phant approached the canal committee and proposed an extension of the canal up to their land. The proposal was accepted on condition that they build the extension network themselves and that no water would be available to them until and unless the three tars had sufficient water. These conditions were accepted and the extension built. As the Bhadrutar canal is drawn out of the perennial and rich water source of the Likhu river, it has sufficient water for the command area and no conflict over water has ever arisen there.

#### Water Ownership

Irrigation systems throughout Nuwakot district distribute water rights according to land ownership. Water shares are not bought or sold like land although the price of land is influenced by the availability of irrigation water.

Although few land transactions were reported in the study area, the price of a ropani (0.05 ha) of irrigated khet land was more than double than the expected price for a ropani of bari land. In Hakuwa a ropani of well-irrigated khet land fetched NRs.3000 while the average price quoted for a ropani of bari land was NRs.1200-1400. In Bhadrutar khet was priced at NRs.3200 per ropani while bari land sold for NRs.1300.

The tradition of water ownership was manifest in the acceptance of the practice of water being made available first to the farmers who own land near the canal source, both in Bhadrutar and Belkot. After those farmers their immediate neighbors take water and so on until all the land in the command area has been irrigated once. The term water ownership is valid in terms of the farmer who does not want to irrigate his land one year but has the right to allow anyone in the command area to use his share of water irrespective of whether the borrower has already used his share. However, this situation seldom occurs but when it does, it creates problems since many farmers must compete for water.

The water quantity that is diverted from the main canal into the side or distribution canal is determined by the width of flow through a horizontal weir rather than by the volume which would require measurement of the depth of flow as well. When additional land is brought under cultivation in the command area around any distribution or branch canal, the width of flow through the horizontal weir is proportionately increased. However, this is not frequent since very little additional land has been brought under irrigation in the recent past.

The share of water for each distribution canal created no problems in Bhadrutar since water is plentiful there. However, in Hakuwa, farmers who owned land at the tail of the canal complained, until recently, about the lack of water to their fields and the misuse and overuse of water by farmers on upper terraces.

The problem of unequal distribution of water among beneficiaries was worse during the winter. This is expected since the canal carries less water than and the practice of cultivating winter wheat, which requires more water, has become popular.

Although no accurate estimates could be made of the influence of irrigation on land prices in Bhadrutar, Table 1 shows the land price changes since 1956. Although attempts were made, it was difficult to verify these figures, which were provided by the villagers, with the official records available at the Land Reform Office and Land Revenue Collection Office at Bidur, the district headquarters. The official records are often either underreported to incur less tax or overestimated to ensure that a seller does not change his mind later.

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Table 1. Khet Land Prices in Hakuwa (NRs.)

Year	Price/Ropani	Year	Price/Ropani
1956	100	1978	2200
1957	100	1979	2200
1958	110	**	
1959	115	1981	2800
1960	125	**	
1961	135	1984	3000
1962	500		
1963	750		

Source: Field Survey

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Since water share transactions are not possible between individuals and since, particularly in Bhadrutar, water is constantly in demand from neighboring fields, the canal committee has decided to ask for contributions from potential beneficiaries to extend the canal structure, particularly at the severely eroded landslide-prone area. This will ensure a smoother water flow enabling the system to meet the increased demand and also to regularize the existing supply. In the Hakuwa command there is no such possibility as all utilizable land is covered by the canal.

#### Water Delivery

Water is physically distributed among beneficiaries for rice cultivation initially through a device similar to the saacho (key) system in Chherlung (see Martin and Yoder, 1982). The saacho used at Bhadrutar is a horizontal weir made from a log with two or more weir openings. The sides of the openings are cut vertically and the depth of all openings is equal. The concerned farmers check occasionally to see whether the depth has decreased as a result of salt collection.

The openings of the saacho are spaced far enough apart that the discharge through each of them can be diverted into separate field channels and also into the three branch canals. The ratio of the weir openings to the field canals is equal to the ratio of the land commanded by the field canal to the total land commanded by the branch canal.

The distribution of water along these lines has resulted in more water being available to land in the Bismane Phant than in Pachase and Sera Phant areas as the openings to the three branch canals are equal while Bismane Phant has less land than the other two.

There is no device similar to a saacho in Hakuwa canal. The main canal enters the field and irrigates the land through the terraces. The common practice is for the farmer at the head to use as much water as he needs and then turn the canal water off his land to his neighbor and so on. No farmer has access to water a second time until all the farmers served by the system have used the water at least once.

Nepalese farmers prefer water to be supplied as a continuous flow through all their fields all the time for their rice crop. As the supply during peak demand times is much less than what is needed for continuous flow, a rotation procedure is adopted. Water is allocated by the saacho to a branch canal which provides water to the field canals. When water is scarce, saachos are used to allocate water to field canals from the branch canals and when water is plentiful every farmer directs as much water as he wants to his field.

In the dry season, when water is limited, rotation is effective. One rotation unit is formed by the beneficiaries who own land in the command area around a particular field canal or who receive water from the same opening in a saacho. The time period over which each farmer receives water is proportional to the percentage of land he owns in the field canal area. Frequently, a farmer is a member of more than one rotational unit because his land is commanded by more than one field canal. There are occasionally farmers' groups within a rotation unit and water is rotated within the unit from one group of farmers to another. Rotation time periods vary.

While water is scarce, a farmer will attend his field day and night to ensure that no one is stealing water from his share. This is assuming that he receives his share promptly when it is his turn. One member of each rotation unit is assigned to look after the entire branch canal to ensure that no one belonging to another rotation unit tampers with the system thus depriving the unit of its share.

When irrigating monsoon rice, a frequent problem is the collapse of a canal due to floods or landslides. Repair work often takes several hours and by the time it is completed many farmers turns may have been skipped. This is resolved by shortening the length of each subsequent turn to allow those who missed to receive water.

The cropping pattern on khet land in Hakuwa and Bhadrutar areas is rice in the monsoon followed by wheat then maize and early rice in the winter. Although there is enough water during the pre-monsoon season to grow rice, farmers in Bhadrutar prefer to plant maize on a 50:50 basis with early paddy.

All the irrigated land in both study areas has been converted into khet and unirrigated bari land is used to grow wheat and maize.

To grow a rice-wheat-maize (early paddy) crop rotation each year, and preparation time between crops must be minimized. At this stage of

the cropping cycle a punctual supply of water is essential. If this fails, one crop must be dropped from the annual rotation. Water control and reliability is ensured by carefully monitoring the water level in the canal and responding to the decrease in the supply of water immediately, night or day, with emergency rotational maintenance.

### Responsibility

Allocation of water for land preparation is supervised by the dhalpas and chowkidars. Although they are not irrigation organization leaders but paid employees, they do have organizational responsibilities. All requests for water must be made to them, and as far as possible they deliver water in the order the specific requests are received.

This system of making someone responsible for water allocation is used only in Bhadrutar; there is no similar system for Hakuwa. Each Hakuwa farmer is personally responsible for water allocation in a terrace irrigation system in which water flows from the top terrace down.

In Bhadrutar, when the overall water supply is low, the dhalpas and chowkidars allow the total flow in the canal to flood one field at a time. To allow equity in timely planting of every farmer's land they decide, on the basis of daily requests for water, what portion of each farmer's land will be irrigated when his turn comes. As not all the land can be efficiently irrigated by flooding, the portion to be irrigated is frequently determined by the total land area owned. Water is allocated by turn onto a portion of a farmer's land, depending on the size of the field. The farmer must then wait for another one or more turns to complete his winter planting.

In Hakuwa, the farmers decide what portion of a particular farmer's land is to be irrigated for pre-monsoon paddy and how much land is to be left for winter maize crop. The maize crop generally gets little water as most of it is diverted to wet fields for early paddy cultivation; only a small quantity, if any, is used to irrigate maize. The usual process for irrigating maize is to allow water to run over the field when the standing crop of wheat is about a week from harvest. By harvest time the soil moisture is just right for plowing and planting the maize. Wheat is usually harvested one day and maize is planted the next day.

### OPERATION AND MAINTENANCE

Both systems possess peculiarities in their operation and maintenance procedures which are expressed in the informal organizations which govern canal operation. Both systems lack formal committees but all landholders in the command area receive water from the system and are informally organized to coordinate activities to minimize conflicts and ensure equitable distribution of work. Non-members pay the dhalpas and chowkidars to maintain the system and are included in the maintenance labor force. They also patrol the canals themselves to see that the canal linings are intact, ensure that the system has not been tampered with, and check that the dhalpas and chowkidars are doing their jobs properly and that no branch or field canals has undue advantage over others. If they discover damage, they must redirect the water through another outlet so the canal lining does not erode further. The farmers are not structured, but informally they are efficiently organized.

All landholders who receive water from the system in a particular rotation period are members of the rotation group. Each group must oversee the canal for a day and they assign this responsibility to one of their number. However, the maintenance of the field canal serving that particular rotation unit is the responsibility of the whole group and the members sort out who contributes labor for that day.

Rotation units are not necessarily equal in numbers but because the water flow from the saacho is proportionate to the land area around the field canal, an equal amount will be available to each field, irrespective of where it lies. This system does not always run smoothly. It does reduce the chance that one farmer is favored above others, but in Bhadrutar, Bismang Phant receives more water than the other two.

If a patrolling farmer reports damage, it is the dhalpas' job to organize the beneficiaries to do the necessary maintenance work. They visit the damaged section and then collect as many people as it takes to repair the canal in as short a time as possible.

Dhalpas rarely declare an emergency because, except for big landslides, damage is usually repairable. Big landslides are irreparable, at least during heavy rain, and any declaration of emergency is useless. Villagers recall five emergencies declared in the last 50 years. All five were declared to deal with damage at the intake site caused by torrential rain, although not enough to cause a serious landslide.

When an emergency is declared, all landholders served by the system, regardless of the area of land owned within the command area, must report for work and continue working until the repair work is complete. Depending on the magnitude and seriousness of the damage, workers are assigned in shifts and work day and night.

In addition to emergency maintenance, both canals undergo annual maintenance organized by the dhalpas. Canals are cleaned and repaired each year just before the monsoon. Days worked on annual maintenance are proportionate to the area of land owned and served by the system.

Generally the dhalpas are supposed to be the supervisors and are excused from canal maintenance work. This holds only during regular maintenance of the canal. The dhalpas are generally found working when any break in the canal is reported by the chowkidars or by the beneficiaries patrolling the system on a particular day. The dhalpas can be replaced at any time but will remain in their positions as long as they carry out their work well. With informal committees like the Bhadrutar ones it is difficult to replace anyone once he is appointed since nobody has the formal authority to do so.

The job of dhalpa is often passed from father to son. This is beneficial because it avoids election favoritism and a new dhalpa is well-trained as he grows up.

The post of chowkidar was created in Bhadrutar's system after an unsuccessful experiment combining canal management with panchayat leadership. The present chowkidars have worked as such since this system was built and they, like the dhalpas, own land within the command area.

## RULES AND CONFLICT MANAGEMENT

Farmers who participate in the Bhadrutar irrigation system have developed a tacit understanding among themselves and they easily resolve the few conflicts that arise. They have no written rules and there is no need to levy fines; social ostracization of an erring farmer is the most effective punishment and errors are rarely made twice, by that farmer or anyone else. Other workers refuse to contribute their labor, either as exchange work or for wages, on the farm of an erring beneficiary. As nobody is self-sufficient and it is difficult to hire labor from elsewhere, this causes great hardship.

Social ostracism has been effective in dealing with those who are consistently absent without good reason on mandatory work days. Dhalpas maintain mental records of who has done how many days' work and who is cheating. When it becomes necessary the name of the person is made public and he becomes an outcast until and unless he promises and does his share of the work. If he then breaks his promise punishment may extend to the non-cultivation of his farm for a crop season, unless he has managed to make alternative arrangements. Absence from work during an emergency normally leads to non-cooperation by fellow farmers for a whole year which results in heavy crop losses for the man.

Farmers are excused from work if they are seriously ill, if there is a marriage or religious ceremony at their house or if someone in their family dies. In the event that any of these occurs, it becomes known all over the village very quickly. The converse is also true. It is difficult to fabricate an excuse and not be discovered.

## CONCLUSION

Bhadrutar and Hakuwa canals are the most successful community-managed terrace irrigation systems in Nuwakot district, functioning with entire community participation and completely without government financial or technical assistance. The farmers involved in both systems are proud of what they have constructed and are averse to alterations in their techniques. Except for help with the big landslide area which is beyond their current capability, the beneficiaries do not want government money or interference in their carefully-balanced systems.

## REFERENCE

Martin, F. and R. Yoder, 1982. Community Managed Irrigation in the Hills of Nepal.

Papers in this Series:

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