Design Issues in Farmer-Managed Irrigation Systems: Experiences in the Hills of Nepal

B. N. Acharya

INTRODUCTION

This paper is based primarily upon case studies of an action-research project executed in 1988-89 in a remote mountainous region of Nepal. Our firm was commissioned as consultants to the Water and Energy Commission Secretariat (WECS) of the Ministry of Water Resources, His Majesty's Government of Nepal, to assist with the implementation of a WECS/Ford Foundation project aimed at seeking low-cost strategies for assisting farmer-managed irrigation systems. Our firm was involved with 9 out of the 19 farmer-managed irrigation systems that were included in the project in the Sindhupalchok District.

We are currently serving as consulting engineering advisers to an integrated rural development project launched in the Dhading District of Nepal. Our consultancy efforts for both the Dhading and Sindhupalchok projects have gone towards innovating effective low-cost alternatives to the methods and processes currently followed by government line agencies responsible for promoting small irrigation and building local roads in the mountains. This paper attempts to outline some of our experiences as consultants promoting farmer-managed irrigation systems in the Sindhupalchok and Dhading districts, where beneficiary participation in the design and implementation of the systems received emphasis as an alternative to the conventional line-agency approach of assistance. Information on the farmer-managed irrigation systems that received assistance in both projects is summarized in Table 1.

1 B.N. Acharya is an engineer and owner of B.N. Acharya Consulting Civil & Structural Engineers of Kathmandu, Nepal.
BACKGROUND

All the projects we worked with were located 5-32 kilometers (km) from the nearest road head, and could be reached from Kathmandu, the capital, by motor vehicle and on foot within one to two days of travel. All the systems were located on mountainous slopes (about 10°-30°) at altitudes of 1,100-2,000 meters (m) above mean sea level, and 100-1,000 m above a main river. Most of the systems were served by secondary or tertiary tributaries of the main river of the area, which carry very large flows in the rainy season (June-September), and barely sufficient water flow for all the fields during the dry season (February-April).

Table 1. Farmer-managed irrigation systems receiving assistance in Sindhupalchok (Group 1) and Dhading districts (Group 2).

<table>
<thead>
<tr>
<th>System name</th>
<th>A</th>
<th>B</th>
<th>Canal length</th>
<th>Canal capacity</th>
<th>Command area</th>
<th>C</th>
<th>D</th>
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<tr>
<td></td>
<td>NRs</td>
<td>km</td>
<td>a</td>
<td>b</td>
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<td>ha</td>
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<td>Chahare Khola Ko Kulo</td>
<td>196</td>
<td>126,615</td>
<td>2.6</td>
<td>2.9</td>
<td>56</td>
<td>200</td>
<td>126</td>
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<td>Soit Bagar Ko Kulo</td>
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<td>62</td>
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<td>Dovanewar Ko Kulo</td>
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<td>2.0</td>
<td>54</td>
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<td>Magar Kulo</td>
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<td>160,805</td>
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<td>114,321</td>
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<tr>
<td>Naya Dhara Kulo</td>
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<td>139,720</td>
<td>2.1</td>
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<td>Bedi Kulo</td>
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<td>--</td>
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<td>88</td>
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<td>Karki Danda</td>
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<tr>
<td>Mayang Khola</td>
<td>20</td>
<td>150,000</td>
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<tr>
<td>Peritar</td>
<td>6</td>
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<td>--</td>
<td>1.0</td>
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Table 1 (continued)

A = Number of beneficiary households
B = Project grant
C = Percent of design changes necessary at implementation stage
D = Increase in work output over estimates
lps = liters per second
a = Before project improvements
b = After improvement work
Group 1 - Cluster 1 - Assisted by B.N. Acharya Consulting Civil & Structural Engineers, Nepal
Group 1 - Clusters 2 and 3 - Assisted by others
Group 2 - Farmer-managed irrigation systems currently receiving assistance from Dhading Development Project/German Agency for Technical Cooperation (DDP/GTZ) under the Agricultural Development Bank of Nepal/Small Farmer Development Project in Dhading District

The majority of the beneficiaries in these systems were illiterate or near-illiterate farmers who pursued mixed subsistence mountain agriculture. Rice, wheat, and maize were the primary crops, grown on level terraced fields, mainly for home consumption. About 85-90 percent of the farmers grew sufficient food to last the whole year. About 50 percent of the farmers also sold some rice for cash. Most of the young females also wove carpets which was a significant source of off-farm cash income.

All of the farmer-managed irrigation systems contained canals and temporary intakes which were repaired and maintained by the beneficiaries as often as necessary. All the canals had been built by the farmers using local materials and indigenous, traditional knowledge and experience. The systems had contour canals built in steep mountain slopes, dissected by cross drains, ridges, valleys, and cliffs, susceptible to landslides and erosion. Canal lengths ranged from 1 to 2.6 km, and canal capacities varied from 25 liters per second (lps) to 130 lps, serving command areas of 2-126 hectares (ha). Table 1 gives these details for each system.

Each irrigation system had well-defined beneficiary groups but no formal water users' organization. The beneficiary groups worked together to deliver water to their fields in times of necessity. They all experienced difficulty conveying water and operating and maintaining their irrigation systems. In each system there were a few active members who took leadership and responsibility while other members were opposed to any new initiatives.

All improvement work was carried out within the existing structure of water rights and beneficiary groups so as to cause the least amount of social and political problems within the community. In Sindhupalchok, after improvement of nine of the farmer-managed irrigation systems (refer to Group 1 in Table 1), canal capacities almost doubled on the average. Command areas increased from a total of 459 ha to 623 ha, a 36 percent increase.

DESCRIPTION OF THE PROJECT ACTIVITIES

The purpose of the Sindhupalchok project was to develop and test methods, techniques, and technologies for low-cost assistance to farmer-managed irrigation systems in an action-research mode. Project activities were designed to:
1. Preserve the farmer-managed character of each system,
2. Identify ways and means to ensure and effectively utilize farmer participation in the entire process,
3. Develop and test ways to strengthen beneficiary groups to make them more effective in carrying out improvement work and managing their water,
4. Test methods for mobilizing local resources, knowledge, experience, and labor in improving the management and physical capacity of farmer-managed irrigation systems,
5. Test appropriate low-cost design techniques and technologies for physical structures, and
6. Capture and document all lessons and experiences and recommend improvements.

A specific amount of money (as seed money) was budgeted by the Water and Energy Commission Secretariat (WECS) for improvements in each system. This money was used for paying all the labor provided by the beneficiaries and for purchasing necessary materials. All material purchases were made by the WECS and all skilled and unskilled labor (except for weaving wire crate boxes) was provided by the beneficiaries of each system. Utilization of contractors for construction was prohibited. Our firm provided the necessary technical and managerial support and helped fulfill all formal requirements for both the WECS and the beneficiaries.

All activities were carried out with the cooperation, agreement, and assistance of the beneficiaries and the WECS. All accounts and records were open to public perusal. The major part of our effort went towards holding dialogues with the beneficiaries to strengthen beneficiary organization and allowing them a full voice in all decisions. The WBCS field engineers arranged labor payments against muster rolls prepared by us on behalf of the beneficiaries. At the completion of the construction work, the WECS senior engineer conducted a final inspection in the presence of our engineers and the beneficiaries of each system. A brief outline of various stages of the process follows.

**First stage:** Planning and Field Design

- Held first dialogue with the beneficiaries to form a formal user organization and collect data.
- Held second dialogue to determine the physical improvements to be made and to conduct field design.
- Prepared the field cost estimate report for the WBCS.
- Prepared the inception report.

**Second stage:** Detailed Design

- Prepared and submitted working drawings and detailed cost-estimate and design report.
- Followed up to obtain project approval from the WECS.

**Third stage:** Implementation
* Supervised improvements.
* Redefined needs and priorities of farmers, made design changes, formalized all changes according to the WECS requirements.
* Helped the WECS make labor payments.
* Carried out follow-up to final inspection.

Fourth Stage: Post-Implementation

* Prepared and submitted completion report for each system.
* Prepared and submitted draft of final report.
* Conducted seminar on all aspects of the project to disseminate information on lessons learned.
* Prepared and submitted final reports.

ISSUES RELATING TO BENEFICIARY PARTICIPATION AND ORGANIZATION

One of the most important lessons learned in Sindhupalchok was that beneficiary participation in all decision making and construction of physical improvements by the beneficiaries themselves turned out to be a viable low-cost assistance approach. Low-cost assistance was possible because the beneficiaries participated actively in all of the following activities:
1) forming and strengthening their water users' organization, 2) identifying their needs and priorities, 3) solving all local problems, 4) providing necessary logistics locally which reduced overhead costs, 5) arranging for collection and transportation of construction materials, 6) mobilizing the beneficiaries for all work performed, and 7) supervising and motivating labor. Inherently, by their active participation, the farmer-managed character of these irrigation systems was maintained.

In Sindhupalchok NRs 1,874,500 (approximately US$72,100* at the exchange rate of NRs 26/US$) was spent in providing assistance to 19 farmer-managed irrigation systems containing a total of 975 ha of land owned by 2,350 farmers. The assistance to these irrigation systems (excluding technical support), amounted to NRs 1,923 (US$74 at the rate of NRs 26/US$) per hectare of land served. In other government-managed irrigation systems this amount of investment may be used just in conducting a feasibility study. (The Department of Irrigation spends up to NRs 3,000/ha for feasibility studies of systems containing 100-150 ha).

Low-cost assistance more effective with strong, united beneficiary organization. Low-cost assistance was more effective in those farmer-managed irrigation systems where the beneficiaries

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* The exchange rate of Nepali rupees to US dollars has gradually increased during the life of the project, from NRs 21.9 = US$1 in 1986 to 28.2 in October 1989.
and their organizations were most active. For example, in 5 systems where the beneficiaries were
more active and dedicated, they produced 57 percent, 37 percent, 32 percent, 25 percent, and 19
percent more output than the minimum required (column D in Table 1).

Only the beneficiaries were sufficiently qualified to identify their needs and determine their
priorities. Very often when our field engineers and the WECS officials interfered and tried to set
priorities for the beneficiaries' problems arose and it became necessary to revise or amend the
program.

Our experience with the project confirmed that a strong beneficiary organization was a
prerequisite for achieving optimum involvement of the farmers in designing the improvements
and making decisions. Work in those farmer-managed irrigation systems with strong beneficiary
organizations progressed more smoothly and the amount of financial assistance received was less
of a constraining factor. In systems with weaker beneficiary organizations, even when the
financial assistance was high, it was observed that the funds could not be spent as effectively as
in the case of the systems with strong organizations.

Whenever the beneficiary group was large (e.g., 183 households in one system) and divided
into rival (communal and political) groups, management and organization posed great problems.
These groups were not cohesive enough to strengthen their beneficiary organization and decision
making was hampered by divergent factions. Project activities were implemented by creating a
sense of competition between the rivals but this proved to be a very inefficient way of spending
the money. In contrast, in a system with 196 beneficiary households pertaining to a united
community it was easy to manage and organize the farmers into one of the best and most effective
beneficiary organizations despite the large size of the group.

Flexible design necessary to accommodate beneficiary input. For 9 of the systems in which
we worked, an average of 50 percent of the designed works required revisions related to either cost
or implementation. In 5 of the irrigation systems, 55-71 percent of these changes were made at
the requests of the beneficiaries. For 4 other systems, 22-44 percent of the changes were
beneficiary initiated. An important lesson to be learned from this experience is that the design
for improvements to farmer-managed irrigation systems must be flexible enough to allow for
changes requested by the beneficiaries.

Beneficiaries need budget-ceiling information to establish priorities. At the time the first
dialogue was conducted with the beneficiaries the farmers were asked to state their needs.
However, given no financial parameters, the farmers at first produced a long list of needs and
priorities that were unrealistic. Only when each system was advised of the amount of financial
assistance available to it, could the farmers establish concrete priorities. At this time they were
also able to demand changes in the design to suit the budget available and determine how to make
optimal use of the financial assistance. Once they knew the limits of the assistance they were also
able to determine how to raise additional resources to fulfill their needs. This experience points
out and verifies the necessity that the farmers be told how much financial assistance will be given
to them before the fixing of priorities and design of the improvements occur, thereby minimizing
the need to revise both designs and priorities.

Beneficiaries require assistance with bureaucratic requirements. Experience in Sindhupal-
chok showed that only rarely are the beneficiaries capable of keeping records and performing
bookkeeping and fulfilling formalities in accordance with government requirements. This task
had to be performed by the consultant in the name of the beneficiaries.
DESIGN ISSUES PERTAINING TO TECHNIQUES AND TECHNOLOGIES

*Detailed drawings and cost estimates should be kept to a minimum.* Three-dimensional physical site details can never be reflected completely on two-dimensional drawings, and these drawings are only good for those who can read them. The farmers cannot read the plans, thus they must depend upon explanation by engineers and overseers to understand what is in the drawings. Because engineers and overseers from outside the irrigation system have different objectives and priorities from the beneficiaries, it would be wise to make the farmers independent of reliance on the drawings to the extent possible.

Also, theoretically there is no limit to the extent of details and possibilities that can be figured into an estimate for an improvement work. There can be unlimited unknowns for conducting proper estimates, and determination of all the unknowns costs energy and money. As a result of our experience with participatory rural works including farmer-managed irrigation systems, I recommend that only the basic minimum of detail regarding engineering, drawing, planning, and designing should be conducted as required by the government. Instead, the energy of the engineers and overseers can best be spent supporting the beneficiaries directly in the field. When the engineer provides the necessary expertise directly in the field, all the three-dimensional physical details are right in front of his eyes. At this time the engineer can provide the best design acceptable to the beneficiaries, with a minimum of drawing and detailed estimates, and in a manner more readily understood by the beneficiaries. Whenever there is a necessity for more complex explanations, it would be much more effective if the engineer would demonstrate how actual structures (or models) function.

*Traditional techniques and technologies can serve as a valuable resource.* To facilitate low-cost assistance to farmer-managed irrigation systems, simple and effective designs easily adapted to local conditions are most readily accepted by the beneficiaries. The hill farmers of Nepal have developed many appropriate skills and techniques based upon local materials and knowledge acquired over decades and sometimes centuries of experience. Many of the skills and techniques can be replicated in other settings. However, our experience in Sindhupalchok and Dhading revealed that there is no collection and consolidation of this valuable wealth of information. Collecting and reporting on these traditional practices would be a valuable resource for determining methods of achieving low-cost assistance and ongoing beneficiary participation.

*Use of local resources enhances beneficiary participation and reduces costs.* Utilization of local skills and techniques is a sustainable approach -- the farmers themselves can carry out necessary improvements in the future. With the optimum utilization of local materials as well, the need for imported material can be largely eliminated thereby greatly reducing the cost and making the farmers further independent of outside assistance. In the case of the farmer-managed irrigation systems with which we worked the beneficiaries mobilized all local labor for all improvement work. Funds from the Water and Energy Commission Secretariat (WBCS) were used to pay the labor.

In Sindhupalchok we saw that motivated beneficiaries with a limited budget were able to accomplish exceptionally large work outputs wherever local materials, skills, and techniques were adopted. A limited budget did not prevent them from completing all the works. The beneficiaries were not dependent upon imported materials or labor, so they simply resorted to working a little longer and a little harder to fulfill their targets despite the budget limits. In
Dhading, the Bhumistan-Karki Danda irrigation system was selected to receive loan assistance from the Agricultural Development Bank of Nepal (ADB/N) and the Small Farmer Development Project (SFDP). Improvements to the system were estimated to cost NRs 256,000. The farmers of Bhumistan-Karki Danda decided to build and operate their system without taking out a loan from the bank. They used local materials, skills, and techniques. In the following rainy season they studied the system carefully and discovered its weak points, then used the loan assistance to build the necessary structures. Eventually the beneficiaries were able to complete improvement of the system at only about two-thirds the cost of the original estimate.

Experience in Sindhupalchok and Dhading demonstrated that wherever dependence upon imported materials and technology were proposed, the farmers were not able to manage the work. This resulted in work delays and loss of quality. For example, obtaining and installing a reinforced cement concrete slab casting took 15 management interventions while an alternative locally available flat stone slab was obtained and installed with only 3 management interventions.

The farmers' work output exceeds government norms. His Majesty's Government of Nepal has established a set of norms or standards that specify not only what to build and how to build but also set the limits of material and labor required to complete the job. These norms are used for executing works under the contract system used by government line agencies and they were used for estimation and specification of the improvement works to be done in the Sindhupalchok project. However, these norms were found to be generally inflated and not suitable for participatory assistance to farmer-managed irrigation systems.

Ecological issues in fragile mountain terrain need to be addressed. The government norms did not consider design factors that might meet the ecological needs and concerns of mountain farm communities. Nepalese mountains are young and fragile. Canal building in mountains without appropriate resource-conservation measures can seriously contribute to accelerated soil erosion. Appropriate resource-conservation technology requires mass balancing revegetation efforts on naked slopes, bioengineering measures integrated with stone structures, and prevention of water infiltration in steep fragile slopes. These measures can be incorporated using local materials, skills, and techniques and would not be unnecessarily costly while at the same time be locally sustainable. The government needs to give attention to this aspect and perhaps be prepared to spend a little more initially to support protection of the ecology of the mountains.

Large canals are extremely costly to build and are also environmentally risky in steep mountain slopes. Excavation costs increase at geometrically progressive amounts for every increase of the canal width or capacity. Traditional farmer-managed irrigation systems in the mountains have always been small. The farmers sometimes resort to building another parallel canal a little below the first one rather than enlarging the capacity of the first. Again, gathering more information on the traditional practices of farmer-managed irrigation systems would serve as a valuable resource for the design and implementation of other low-cost improvement projects. Meanwhile, it is clear that low-cost assistance to irrigation systems in the mountains is feasible only for small canals because they are manageable and pose the least danger to the mountain ecology.
ISSUES PERTAINING TO STRUCTURAL ADJUSTMENTS IN THE DESIGN

Multiple, repetitive design requirements waste time and energy. During the second dialogue of the Sindhupalchok project a field design book was opened for each system. In the field design books all the measurements of possible improvements for each system were recorded and design sketches were made with all pertinent dimensions for each structure based upon advice and suggestions of the beneficiaries. Material quantities and cost estimates supported by analyzed rates were also prepared in the field for each structure. Based upon the costs calculated priorities of the farmers were also established.

The field design estimates were utilized by the government agency for fixing budget ceilings for each system. In addition, preparation of detailed designs, working drawings, and detailed quantity and cost estimates were completed in the conventional line-agency approach for the purpose of getting the project officially approved and sanctioned for implementation. Later, during the project-implementation stage needs and priorities established during the second dialogue demanded major changes. The government agency’s official was flexible enough to allow such changes. However, a considerable amount of the consultant’s energy was required to fulfill the official formalities of making and arranging such changes. It took us 99 man-months to fulfill all the requirements of the project whereas our original estimate was 49 man-months. The consultant’s energy could have been better utilized in helping the beneficiaries solve their problems directly in the field.

A very high degree of the consultant’s time was spent in preparing the working drawings, revised quantity estimates, revised rate analyses, revised priced bills of quantities, and revised breakdowns of materials and labor required for each work or structure of each system. The energy spent to undertake field design work was a waste when it had to be repeated at the detailed design stage when design details, working drawings, and estimates were again required. And later, when changes were made during the implementation stage this same work had to be redone. All of the field designs in all of the systems required revisions once the farmers were advised of the amount of the project grant. An average of 50 percent of the detailed designs had to be revised again when the project reached the implementation stage due to revisions requested by the farmers’ group and technical or economic considerations encountered at the specific sites. (Column C, Table 1). Our experience supports the recommendation that field design work and the necessary changes in the detailed design be made during the implementation stage. Other drawings and estimates are unnecessary.

At the implementation stage, the conventional line-agency approach was followed from the beginning to the end. One senior engineer and one field engineer with supporting temporary staff from the WECS, and two field engineers, one overseer, one monitoring engineer, one coordinator, and nine field supervisors with our firm were constantly engaged in fulfilling the official formalities to release the money from the government bureaucracy and transfer it to the beneficiaries. Compliance with the many official formalities required so much of the field staff’s time that field personnel often were not able to supervise the field work to the extent desirable. In contrast, in Dhading, for participatory rural works and farmer-managed irrigation systems supported by the Agricultural Development Bank of Nepal/Small Farmer Development Project
and Dhading District Panchayat Secretariat, only a few field design sketches prepared by overseers on A4 size white paper and a few pages of quantity and cost estimates were formal requirements.

For low-cost assistance to small rural farmer-managed irrigation systems, the government will have to find a simpler approach than that applied to larger civil works. This approach should set priority on the minimization of dependency of the farmers upon engineers, overseers, supervisors, and accountants from outside the system. First, the need for technical knowledge and expertise, and strict financial controls must be simplified. Our experience demonstrated that most of the necessary knowledge and skills lie with the people themselves. This approach should also require only the absolute minimum of technical and administrative manpower which would be best engaged in fulfilling minimum official formalities such as transferring the money from the government to the people and assisting the farmers directly in the field, tackling outstanding technical and organizational problems.

Facilitator role is extremely time-consuming. In Sindhupalchok, the beneficiaries participated in making decisions in all phases of the process, mobilized labor, and carried out the work plan. The consultant motivated and assisted the beneficiaries and supervised all technical and administrative work to ensure as far as possible the integrity of the design and control of quality. The WBCS purchased the necessary construction material, arranged labor payments, and did the final inspection of the completed works. The consultant acted as intermediary between the beneficiaries and the WBCS officials. The consultant’s role was that of a facilitator to help transfer the project funds from the government to the beneficiaries. The government’s role was that of a controller. The triangular relationship of the beneficiaries, the consultant, and the government could be compared to the legs of a three-legged table whose equilibrium was assured only when the three legs were of equal length and strength.

In this delicate relationship the consultants had a heavy burden. Cost overruns exceeded double our estimates. If we were to do the job over again and meet the same bureaucratic requirements we would have to charge a consulting fee two-and-a-half times more. However, the rehabilitation work can be accomplished for the same consulting cost if the administrative burden of completing the many bureaucratic requirements for government are simplified, made more flexible, and unnecessary procedures eliminated.

Labor mobilization on “piece-work” basis is a workable option. The Sindhupalchok experience clearly showed that mobilization of beneficiaries to accomplish improvements in their irrigation systems instead of employing the conventional contract system is a very viable low-cost assistance strategy. Labor payments were made against prepared muster rolls. However, whenever the beneficiaries were not fully motivated there was a tendency for the laborers to cheat in the work output. Thus, a piece-work system was experimented with. In this system, a group is assigned a specific task to be performed within a specific time for a certain amount of money. Our experience supports the use of a participatory piece-work system as an option for labor mobilization. Care must be taken to assure that such a system is not interpreted as a “contract award.” Under a properly supervised piece-work system low-cost assistance can be realized optimally and effectively. In order for a piece-work system to be an option present government rules and regulations need to be changed. Our experience also supports a recommendation that contract awards for labor should be completely ruled out of low-cost assistance packages.
LESSONS LEARNED AND CONCLUSIONS RELATED TO INNOVATIVE APPROACHES

Local materials and local labor are the two most significant resources required for promoting assistance to farmer-managed irrigation systems. What is needed most is not so much "bureaucratic handouts" as strong village-level organizations to enhance the self-help potential of the people. Using external funds as "seed money" to organize the people can give good results. Also necessary are guidance, motivation, training, and orientation to help the people help themselves. The self-help approach appears to us as the only sustainable approach for assistance to farmer-managed irrigation systems, in particular in the context of mountainous Nepal.

Once local organizations are established and strengthened the only bottleneck to low-cost assistance for planners in the future would be how to organize the necessary technical and financial support while fulfilling official bureaucratic requirements. For this, planners would need to simplify the process and organize the technical support package innovatively.

Where necessary, the capacity of the people should be enhanced through training, orientation, and motivation organized at the local or regional level. An innovative financial support package would need to be flexible to meet the needs of the farmers and would be feasible if the government would recognize and trust the beneficiary organizations to help them utilize the financial assistance effectively. Without flexibility, low-cost assistance would be virtually impossible.

After the technical and financial supports are organized the government should next ensure that the work is scheduled so that the farmers are able to work when they are free to work and not when the government is ready to spend. Timely budget releases, timely decision making, and timely labor-payment arrangements are frequently recurring problems while dealing with the government budgetary system. An innovative alternative would be to channel funds through commercial banks so that funds are not frozen. The beneficiaries would receive loans from the banks and carry out necessary improvements, receiving funds as needed. The loans can easily be converted into grants after the beneficiaries complete the work. The government agency would have to provide necessary managerial and technical support in assisting the beneficiaries and in fulfilling the official formalities. It would be an added advantage if the same promotor would assist with implementation and strengthening of the beneficiary organization.

At the project-implementation stage all processes and procedures should be completely comprehensible to the farmers and open for their discussion and review. This would strengthen the beneficiaries' hand and would be a key to its success. Wherever there is lack of candidacy there is a chance for middlemen to enter and benefit at the expense of the people. This should be avoided. If the user organizations are strong, capable, and self-sustaining, there is much less chance for middlemen to enter and exploit.

For low-cost assistance to farmer-managed irrigation systems the government's central line agencies in particular do not appear to be the best partners because they follow complicated procedures, are inflexible, and are difficult to monitor, evaluate, and control. District-level line agencies like the district panchayat, the Agricultural Development Bank of Nepal, and the district's technical units can be appropriate partners. Also, local consultants/engineers are essential to the implementation process that seeks to incorporate farmer participation. Expatriate engineers do not have the necessary insight and understanding of the complex local, traditional,
political, and sociological aspects that operate within the farmer community which influence farmer participation and resource mobilization.