

**LOCAL AND EXTERNAL SUPPORT SERVICES IN FARMER-MANAGED
IRRIGATION SYSTEMS IN NEPAL: IMPLICATIONS FOR PERFORMANCE
ENHANCEMENT ¹**
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Background Information:

Farmer managed irrigation systems in Nepal are not restricted to small units. Irrigation systems may be less than one hectare while farmer-managed systems as large as 15,000 hectare sizes have been identified. The irrigation organizations of large or small systems perform water acquisition, allocation and distribution, resource mobilization, system maintenance, communication, and decision-making (Uphoff et. al. 1985). How many farmer-managed irrigation systems there are in Nepal is a matter, at this point, of guesswork. Prachanda Pradhan estimated in 1989, that there were 1,700 farmer-managed irrigation systems in the Terai and 15,000 in the hills (P. Pradhan, 1988: 3). Similarly Poudel in his recent estimate has put the number of systems to be 16,000 in the mountains and hills with an estimated irrigated area of 322,000 ha (Poudel, 1992:9) which is 74 percent of the total irrigated land in the mountains and the hills. He has also estimated a total number of irrigation systems to be 1,700 irrigating a total of 520,000 ha of land in terai which is 68 percent of the total irrigated land in terai.

Support services include all those activities related directly to the irrigated agriculture production system of FMIS. These include a) physical e.g. construction and repair of irrigation facilities, b) agricultural e.g. land development, provision of agricultural inputs (seeds, fertilizers, pesticide, herbicide etc.), and c) institutional which includes: agricultural extension, financing, marketing, training, regulating and auditing; and also water right issues and conflict resolution.

Support services related to the irrigated agriculture production system of FMIS in Nepal are limited to the rehabilitation/improvement of the system and some assistance for operation and maintenance of the system. Other agricultural production related provisions such as supply and marketing facilities and cooperatives for purchasing inputs and marketing outputs are not even coordinated with related agencies. Institutional supports for either strengthening existing organizations or providing foundations for the establishment of the new organizations are

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limited. Legal provisions for the protection of water rights and existing location specific rules of the FMIS are not clearly spelled out.

However, during the last few years many agencies (both governmental and non-governmental) have started either providing a modest level of support services or trying to coordinate with relevant agencies to make provision for providing essential services which are mostly limited to the project areas. The level and types of support services vary with the agencies involved. In the past few years, the major agencies and institutions providing assistance to FMIS include: DOI through its regular assistance program for FMIS through each of the District Irrigation Office (DIO), ISP and ILC, ADB/N, SNV (Mechi Hill Project), ILO/SPWP (Dhaulagiri Project), GTZ (Dhading Project), CARE/Nepal, IRDPs with MLD (such as WB assisted Rasuwa-Nuwakot Project and EEC assisted Gulmi Arghakhanchi Project) and irrigation projects under DSCWM (such as EEC assisted Bagmati Watershed Project and Begnas Tal Rupa Tal Watershed Project (BTRT) assisted by CARE/Nepal), Koshi Hills Agriculture and Rural Development Project (KHARDEP). Shallow tube wells at the individual/community level in Terai have also been tried out at a limited level which demand a little different type and level of services from those that of the surface irrigation systems which are supply of fuels, electricity, maintenance backup for the pumps, most importantly the training for efficient use of water because of cost effectiveness.

The broad questions being discussed in this paper at the sector level include:

- What are the legal and institutional frameworks for the promotion or hindrance of meaningful support services?
- What kind of services are being provided in the FMIS sector?
- How geographically representative is the provision of services and with what frequency and continuity are they being provided?
- Which types of services are being provided by public agencies, non-government agencies and community-based organizations?
- How do service providers tend to specialize and cluster their services and what implications does this have for meeting the needs of FMIS for continuity, flexibility and access?

Policy and Institutional Environment for FMIS Support Services (SS):

The current Eighth Five Year Plan (1992-97) has three important objectives, namely, sustainable economic growth, poverty alleviation and reducing regional imbalance. Priority has been given to agricultural intensification, diversification and commercialization. The development of the programs are conceptually based on sustainability, farmers' resource endowments, geographical areas of comparative advantage, utilization of transport and market accessibility, and the interrelationship among different programs. The main executing agency for meeting the plan objectives is the Ministry of Agriculture (MOA) which has to obtain support from many other organizations, agencies, institutions, and private entities.

the irrigation development strategy of the government for the current eighth plan (1992-97), which is guided by four long term objectives:

- increase agricultural production and benefits from irrigation land through a combination of agricultural and irrigation management programs;
- improve the delivery efficiency of irrigation related services, through institutional improvements within government agencies and the maximum possible of the private sector;
- implement small irrigation projects with improved procedures to identify, design and construct them, with active participation of beneficiary farmers in all the phases.
- select and implement new large and medium scale irrigation projects in the Terai, and in some of the river basins in the hills as a means of augmenting national agricultural production by significant amounts.

Thus, the government has put emphasis on: 1) the improvement of production from existing irrigated area through coordination of agricultural and water supply units; 2) improvement of institutional efficiency; and 3) implementation of small irrigation projects.

The following are the direct support service providers to the farmers besides Department of Irrigation and other irrigation development related agencies which provide services mainly for the improvement of the water delivery mechanisms.

The Department of Agriculture Development (DOAD) is responsible for the implementation of MOA policy and planning and programming for agriculture development of the country. The District Agricultural Development Offices (DADOs) are responsible for supervising the works carried out by the Agricultural Services Centers (ASCs). The ASCs are organized throughout the country on the basis of seven services centers in each of the 16 terai and 4 selected hill districts and six in each of the remaining districts.

Public corporations and institutions operating within the MOA are: Agriculture Inputs Corporation, Agricultural Projects Services Center, Dairy Development Board, Dairy Development Corporation, Tea Development Corporation, Animal Feed Production and Development Board, Agriculture Tools Factory, Agriculture Lime Factory, Cotton Development Board, and Jute Development and Trading Corporation.

The district level institution for development is the "District Development Committee" and assumes accountability for self-reliance and maximum participation of the people in development activities. In addition there a number of private organizations and individuals involved in agricultural development.

Market participants involved other than the parastatals, are private suppliers of agro-inputs and credit (informal money lenders and relatives) and private agencies providing investment inputs such as forestry, irrigation, and physical facilities.

Thus, the support institutions in Nepal are: research; the suppliers of agro-inputs (whether the public, such as AIC, or private sector dealers); marketing systems (whether these are local Haat-bazaars, association of commodity producers, or whole-sale markets); credit agents (whether formal or informal lending agencies); and the various government and private agencies providing investment inputs (such as forestry, irrigation and physical communications).

DEPARTMENT OF AGRICULTURAL DEVELOPMENT (DOAD)

Since the early 70's, the Department of Agricultural Development (DOAD) has had the mandate to provide agricultural extension services throughout Nepal which operates in all 75 districts with each districts supported by several agricultural services centers and subcenters. Irrigation has been identified as one of the most important activity at the service center level due to its potential in increasing production and direct impact on the farming practices due to ready response of the crops to water availability especially during the dry seasons. The National Agricultural Research Center (NARC) operates its outreach programs designed to expand production of specific crops.

During the last decade, DOAD implemented several activities related to development of irrigated agriculture. Farm Irrigation and Water Utilization Division (FIWUD), Hill Food Production Project, SINKALAMA (Hill Agriculture Development Project), and Integrated Rural Development Projects (IRDPs) are some of the irrigation related activities which is discussed in detail in the later section of this report. DOAD is responsible for designing and implementing agricultural extension programs in areas where FMIS predominate. However, on large DOI irrigation schemes run through the Irrigation Project Board, each project has its own Agriculture Division looking after agricultural development programs in the project command area.

COOPERATIVES

The Department of Cooperatives, now under the Ministry of Agriculture, is responsible for the promotion of cooperatives. About 760 cooperatives or Sajhas exist throughout the country, including virtually all districts. They were intended to be the main channel for the distribution of agricultural credit, but have not been successful due to farmers debt delinquency, over 500 cooperatives having in turn defaulted and became ineligible for further loans from the ADB/N. Thus, there has been dramatic decrease in the share of the cooperative in the total loans disbursed by the ADB/N (from 54% in the early seventies to 11% in 1993).

AGRICULTURAL INPUT CORPORATION

The Agricultural Input Corporation (AIC) with headquarters in Kathmandu and 11 zonal offices and some 70 branch offices located in almost all districts has 149 warehouses with a total capacity of 71,848 mt of agricultural inputs. Government of Nepal provides transport subsidy to the corporation on the transport of imported fertilizers and an indirect subsidy to stabilize prices. Cooperatives are the major dealers of agricultural inputs through the AIC and they get commission for it. But this favorable treatments to the dealers in comparison to the individuals have been abolished recently.

LOCAL AND DISTRICT DEVELOPMENT COMMITTEE

The preamble of the Village Development Committee Act 1991 emphasizes the need for enhancing people's participation in self-government and village development through decentralization which has been the main rationale for the creation of these VDCs at the grassroots level. At the district level, the District Development Act 1991 provides for the creation of District Council comprising the presidents and vice presidents of all VDCs and the mayors and deputy-mayors of the municipalities in the district. The District Development Committee (DDC) functions as the executive committee of the council.

AGRICULTURAL DEVELOPMENT BANK

Agricultural Development Bank of Nepal (ADB/N) was established in 1968; and its direct involvement in irrigation development started in 1975 mainly under the Small Farmers' Development Program (SFDP). SFDP provides credit facilities to small farmers in a group without collateral on surface and ground water irrigation projects based on self-help approach. Until the end of 1992, ADB/N has supported new construction and improvement of about 12,000 hectare of FMIS and provided loan for additional 105,880 ha of ground water coverage by providing loans to purchase shallow tube wells (STWs) to the small farmer groups (with subsidy) and individual large farmers. The government has put heavy responsibility on ADB/N to improve/rehabilitate an additional 227,000 ha of FMIS by 2000 A.D.

TRANSPORT INFRASTRUCTURE

In Nepal's transport systems the road sub sector has been given high priority. Nepal has 8328 km lengths of roads (1991 statistics). Out of 75 districts, only 53 districts have access to motorable roads. Road densities in Nepal are considerably low comparative other low income countries. Road density of paved and earthen village access roads for various terrain includes 12.88 km/sq km in Terai and 5.76 km/sq km in the Hills. To achieve adequate agricultural development the road densities will have to be considerably increased. Many of the Integrated Rural Development Programs (IRDPs) have included road development enveloping certain number of villages through people's participation. Dhading Development Program has initiated construction of such road using maximum of local materials and local

participation.

Recent Changes in Irrigation Policy

Ministry of Water Resources of HMG/N (1992) has implemented new irrigation policy which outlines the government programs for different types of irrigation systems under different governance types. Although farmers (water users) are recognized as autonomous entities with legal power who have rights and duties of the water uses; full ownership of turnover systems; provision for joint management, and even the completed and handed over systems being the whole property of the users; the water is still regarded as the government property. The government has not given the full recognition of the prior use rights of the farmers and also the guarantee to the farmers that their systems will not be evicted for other competing water uses in the future.

A new Water Resource Act has been published in the Gazette in 1993 which addresses the issue of prioritization of hierarchy of water uses, privatization, incentives, licensing etc. A fundamental characteristics of the new Act is that the ownership of all water resources within the kingdom of Nepal is vested in the HMG and the government has the ultimate power to allow corporations, communities, or individuals to use the water resource. Under the law the priority of the water use is as follows: i. drinking water and domestic use, ii. irrigation, iii. agricultural use such as fishery and animal husbandry, iv. hydroelectricity, cottage industry, industrial enterprises, and mining uses, v. navigation, vi. recreational uses, and vii. other uses.

The Act also gives full authority to the government to utilize or develop water resources as it sees fit. The Act also provides mechanism for conflict resolution through the arbitration of a prescribed committee. However, the district water resource committee as prescribed by the gazette comprises all the line agency officials at the district with Chief District Officer as the chairman and the Local development Officer as the member secretary. There is only one representative member to be nominated by the District development Committee.

The current Eighth Plan (1992-1997) advocates locally available technologies and methods for community irrigation systems that are to be constructed and managed by the users themselves. Even in case of larger irrigation systems, they are to be demarcated into smaller units to be managed by the users. The Eighth Plan has stated the following objectives related to irrigation: i) increase agricultural production through the application of irrigation technologies appropriate to diverse climatic and soil conditions, and ii) provide irrigation facilities for maximum area of land by implementing economically, technically and environmentally sustainable projects with the participation of the farmers.

Support Services Provided to the FMIS:

The support services provided to the FMIS for the last two decades can broadly be categorized into two stages. In one case the services are initiated by the farmers themselves;

and in the other the service providing agency gets the process started. In the farmers initiated cases, it is necessary that the farmers approach the intervening agency for the irrigation project. MLD financed projects, FIWUD - supported systems, ADB/N, CARE, WECS/IIMI, Hill Food Production Program (HFPP) and also World Bank Financed Irrigation Line of Credit (ILC) and Asian Development Bank/UNDP assisted Irrigation Sector Program (ISP), up to a certain extent, fall under the farmer-initiated projects. On the other hand in the case of systems where agencies get the process started, it is not necessary that the farmers approach the agency before the agency takes the decision to implement the project. However, mostly the decisions are made through a political process where a particular group or groups of farmers approach or even lobby for a specific project to be included under the departmental plan. Projects implemented by the then DIHM (now DOI), ILO and the Hill Irrigation Project fall under this category.

Recently the Irrigation Management Project has started its intervention process in selected sites to help develop farmers' management capacities; and also to turn over the DOI systems to the farmers for their O & M. Malebagar Irrigation System, a FMIS in the Tanahu district was assisted for improving O & M of the system. Currently, IMP is working with the Water Users Group in Khageri and West Gandak AMISs to turn over these systems to the farmers. In order to improve the irrigation management practices of Nepali farmers, the Irrigation Management Project (IMP) under DOI has been in operation since 1987.

WECS/IIMI also started an action research project to establish low-cost procedures for identifying the relative needs of all systems in an area, allowing the selection of systems for assistance where the greatest impact on food production could be made. Another objective was develop and test methods for delivering assistance that enhanced farmer-management capability for operation and maintenance at the same time as the physical infrastructure was being improved (WECS/IIMI, 1990). Of significant importance of this project was farmer-to-farmer training as a means to support the services in a sustainable and self-help manner.

The support process of DOI in FMIS has started with either constructing new irrigation systems or construction of diversion works and lining parts of the existing canals. The projects are conceptualized to help increase water availability in the project area either by expanding the system or increasing the quantity of water in the command area on the basis of financial resources available. As mentioned earlier, users are not usually consulted when the system has been identified for a feasibility study which is usually done by consultants or by DOI technicians. Such a feasibility study usually contains limited information on socio-economic, agricultural and water management aspects of the existing FMIS. Systems are usually constructed by contractors and no attempts are made to form a users' committee. After the completion of the system construction, maintenance works are also contracted to outside contractors.

The development of small and medium-scale irrigation schemes has been included in the Government's Irrigation Support Program (ISP). Under this program, the Government has proposed a sector lending strategy for the following reasons: a) To facilitate planning and

implementation of the irrigation program in a coordinated sectoral frame-work consistent with the national goals and strategies; b) To make irrigation development more cost effective through the adoption of appropriate technologies, increased use of locally available materials, and by minimizing overhead costs; c) To implement speedily a sizeable program of small and medium-sized irrigation schemes; and d) To build indigenous institutional capacity and give more responsibility to the national institutions for the selection, design and construction of irrigation schemes and for establishing sectoral priorities.

Under the ISP, the government has prepared irrigation development targets for small and medium scale irrigation schemes covering the five development regions of the country over three successive five year development plan periods from 1985 to 2000. Financing assistance for the program has been arranged with various donors. Thus far, the government has obtained financial assistance from the Asian Development Bank and the World Bank for the initial implementation of the program. Technical assistance financed by UNDP aimed at strengthening the capacity of DOI in implementing the ISP and in institutionalizing the farmer-participatory approach in DOI, would assist DOI in the implementation of the investment projects.

The implementation of the Irrigation Line of Credit (ILC) financed by the World Bank under HMG's ISP started in 1989 in the Western Development Region which uses water exclusively from rivers/streams which form part of the Narayani river basin. ILC was later extended to the selected districts of the west, mid-west and far-west development regions of the country. On receiving a majority of farmers' genuine demand for the project, the technicians conduct a feasibility survey. According to the working policy of DOI if the project is feasible, the farmers have to organize themselves into a Water Users' Association (WUA) and register at the district office according to the Water Resources Act 1993; and also agree with the terms and conditions of the assistance to be provided by HMG regarding the required contribution towards capital cost, and their responsibilities in planning, construction, operation and maintenance of the subproject. Farmers have to deposit 1 to 5 percent cash, contribute 6 to 20 percent labor equivalent to the total cost and ILC provides 75 to 93 percent of the total cost, depending on the per hectare cost of the system construction/rehabilitation.

The District Irrigation Office (DIO) of the DOI is mainly responsible for executing the assistance to the FMIS. The range of assistance varies from construction of completely new irrigation system over the several existing FMIS to providing material assistance such as gabions for creating stone walls at the intake points or lining in the critical part of an irrigation system. The DIO is the only agency with regular government budget for the minor repair and maintenance of the FMIS. Many of the irrigation systems have started getting material assistance from DIO for their emergency maintenance of the systems during the monsoon season.

In addition to providing regular assistance from the DIOs, the Department of Irrigation coordinates with different bilateral and multilateral agencies to assist improving FMIS in

different districts and part of the region and also in a particular watershed depending upon the objectives of the projects to be undertaken. Many times, assisting FMIS forms a part of the major Integrated Rural Development Program (IRDP). With the inception of first IRDP--Rasuwa Nuwakot Integrated Rural Development Program under the loan assistance of World Bank in late 70s, Nepal has experienced many IRDPs in operation (and many of them are discontinued). Important ones are Koshi Hills (British aid), Sagarmatha IRDP (ADB/N loan assistance), Resource Conservation and Utilization Project and Rapti IRDPs (USAID supported), Karnali-Bheri IRDP (Canadian assistance), Integrated Hill Development Program (Swiss assisted) and Gulmi-Arghakhanchi IRDP (EEC/France assisted). All of these projects were designed to improve the productivity of the project area; and hence, irrigation are (were) one of the activity in the total development project. But, once the funds were allocated to the related line agency (DOI and ADB/N in case of irrigation), the responsibility of the project was considered to be finished; and external evaluation of the projects were done at the end of different phases of project implementation.

In most of the projects, the implementing agency is the project office maintained Kathmandu and the district headquarters usually the Local Development Office of the District Development Council under the Ministry of Local Development being the coordinating agency based on the philosophy of Decentralization. But improvement/repair and maintenance of the irrigation systems are the responsibility of the DIO engineers and overseer. Upon the recommendation from the individual village development council representatives, the overseer of the DIO makes the feasibility and detailed engineering survey; and the contracts are awarded either to the user themselves or the outside contractors. The payments are made directly to the contractor upon the certification of completion of satisfactory works by the user group chairman and the supervising overseer/engineer from the DIO.

Some of the agencies, however, have been trying to integrate the activities with NGOs such as CARE/Nepal; and these projects have been far better in performance (both in the fund utilization and quality of works and increase in the productivity by acquisition of reliable and adequate quantity of water). Rapti IRDP funded under USAID has coordinated with CARE/Nepal on providing the technical assistance both for the engineering and agricultural aspects. Recent evaluation of the EEC assisted Gulmi Arghakhanchi IRDP Irrigation projects has pointed out that: a) irrigation systems contracted out to the outside contractors performed poorly due to miscommunication, poor standard of work done, financial aspects are kept in secret and are suspect; b) lack of coordination among the line agencies at the district level; c) non-involvement of beneficiary farmers (Polge, 1993).

Since 1985, Department of Soil Conservation and Watershed Management (DSCWM) with the assistance from different donor agencies is involved in the activity of soil conservation and watershed management and at the same time to uplift the standard of living of rural poor in Nepal. The watershed management approach is an integrated approach which combines especially the improved method of hill farming and conservation practices with other methods of gully control, methods of checking soil losses, river bank protection and control of

landslide occurrence. Thus, in helping these measures, irrigation repair and maintenance activities at landslide prone areas are considered to be one of the important factor to help protect an watershed area. Thus, Projects such as Bagmati Watershed assisted through the technical and financial assistance from EEC have been helping farmers to build/improve their irrigation systems. Beganas Tal Rupa Tal watershed project in the Kaski district is similarly activity of DSCWM with assistance from CARE/Nepal.

(I)NGOs and parastatals have played significant role in irrigation development in Nepal. The contribution of ADB/N by itself and in partnership with other (I)NGOs have played key role in the improvement of FMIS during the last decade. The role of ILO and IIMI have already been discussed. Besides them, CARE/Nepal and SNV are currently making significant contributions to this area. SNV has been recently involved in irrigation development as compared to CARE/Nepal. The principal involvement of SNV is in Mechi Integrated Rural Development Project.

It is helpful to categorize the program types at this point to further discuss the process of providing support services in detail. The objectives of each of the support programs that were intended to assist farmer managed irrigation systems in Nepal can be broadly categorized under the following types. Also the systems selected for assistance and the agencies involved can also be separated as follows. However, the systems are not mutually exclusive. One system may fall under more than one category.

- Grants made for and/or the construction of large scale permanent diversion works, to line main or branch canals and expansion of systems: DIHM, WECS/IIMI, ILO, Hill Irrigation Project, ILC, FIWUD are the responsible agencies for such type of intervention.
- Grants and/or loans made at low interest rates to enable farmers to make major capital investments in their facilities: CARE/ADB/N, ADB/N, ILC and HFPP are the responsible agencies for such types of intervention.
- Grants made for flood control or other disaster that exceed farmers' capacities to respond, either as watershed development strategy or emergency funds: CARE, DSCWM, MLD are the agencies providing help for such type of services.
- Efforts to train farmers in irrigation system management and organizational skills or in better agricultural practices; and also efforts to turn once intervened systems back to farmers for O & M: IMC, IMP, ISP and WECS/IIMI are the agencies responsible for taking over these functions.

It is interesting to note that although the objectives of user initiated or non-user initiated systems are the same in many systems, the process of intervention has guided different outcome or the performance. Even the same intervening agency has different working patterns based on the external financing agencies' terms and conditions. Each of these different intervening agencies' type and level of intervention is presented below. Part of the discussion on process of providing assistance have been reviewed from the earlier work by Shivakoti (ODI:1992).

Assessment of Sector Support Services

Table 1 presents a comparative analysis of the number of systems, total command area and cost per hectare of improvement/rehabilitation of different FMIS supported by different agencies during 1985-1992. A total of 636 community irrigation systems have been reported improved/rehabilitated by major agencies supporting irrigation development in Nepal. Out of these 636 systems, 475 systems are located in the hills and remaining 161 systems are located in the terai. Considering the large number of FMIS in the hills, the proportion of improvement assistance seems in the right direction. The single dominant program providing assistance is the ISP under loan from World Bank Irrigation Line of Credit (ILC) and Asian Development Bank assisted Irrigation Sector Program (ISP) under Irrigation Sector Support Program (ISSP). The second largest agency is ADB/N. CARE/Nepal comes as the third largest INGO providing assistance in improving FMIS under its different programs where irrigation happens to be one of the activity of overall resource management in the project area. Out of 98 irrigation systems supported by CARE/Nepal, 56 of the systems are implemented through the joint program of ADB/N in its first phase of irrigation development. These number of systems have been reported twice here.

Although there are a total of 56 newly constructed irrigation systems, most of these irrigation systems are not completely new in the sense that there were small tributaries and natural springs from which farmers were irrigating part of their systems during the main paddy season in monsoon. Thus, we can also consider these systems as the expanded/rehabilitated systems.

A total of 61,582.6 hectares of command area of FMIS have been improved by major agencies during the last five years or so out of which nearly half of the area (29,279 ha) are located in the terai; and remaining area are located in the hills. Although the number of systems improved in the hills are nearly three times more than terai, the area covered by individual systems are much more smaller in the hills than in the terai. Again in terms of area coverage, DOI/ISP has covered a large number of hectrage; and ADB/N and CARE/Nepal have almost equal area covered in the improvement of irrigated agriculture. One important to note here is that improvement of FMIS by all the agencies except DOI has taken longer period of time in a smaller scale which has direct impact on the quality and cost of improvement of the individual systems the discussion of which comes in the later section.

Table 1 has also presented cost of improvement of different FMIS on a per hectare basis assisted by different agencies. The trend clearly indicates that the systems assisted by the INGOs such as CARE/Nepal, SNV, IIMI and under the loan assistance of ADB/N are far less than those assisted through the regular government line agencies such as DOI, MLD and DSCWM. It is argued that the INGOs do not account for the personnel salaries and other office maintenance expenses; and hence the per hectare cost of improvement comes low. But under the ISP and other programs, these figures presented here do not account for the other expenses as well. These figures are the actual amount being allocated for the improvement of particular system. It might be interesting, however, to compare the overall per hectare cost

Table 1: Total number of households, irrigated area and cost of improvement/rehabilitation of irrigation systems in Nepal on a per hectare basis supported by different agencies (Base year=1983/84)

Intervening agency and irrigation type	Reference years	National Urban Consumer Price Index	Total no. of households	Total no. of systems	Total command area in ha	Cost of construction/ improvement in Rs./ha
DOI/ILC: 1. New construction in <u>Hills</u> 2. Rehab: <u>Hill</u> <u>Terai</u>	1991/92	2.521	N.A. N.A. N.A.	10 147 33	3,255 8,166 16,475	26,349.00 10,918.00 4,331.00
DOI/ISP: 1. New construction in <u>Hills</u> <u>Terai</u> 2. Rehab: <u>Hills</u> <u>Terai</u>	1991/92	2.521	N.A. N.A. N.A. N.A.	9 1 64 29	611 495 4,461 6,767	13,735.00 5,232.00 9,662.00 4,172.00
DOI/SINKALAMA: 1. New construction all in <u>Hills</u> 2. Rehab: <u>Hills</u>	1989/90	1.799	N.A. N.A.	25 27	1,307 1,448	8,086.00 7,141.00
ILO/SPWP/DOI: 1. New construction all in <u>Hills</u> 2. Rehab: <u>Hills</u>	1991/92	2.521	211 1,814	3 22	92.5 696.5	23,439.00 13,466.00
WECS/IIMI: 1. All rehab & improvement <u>Hills</u>	1986/87	1.366	N.A.	19	974	2,405.00
SNV-Mechi Program/DOI: 1. New construction all in <u>Hills</u> 2. Rehab: <u>Hills</u>	1989/90	1.799	555 1070	6 12	140 816	14,046.00 3,430.00

EEC-Gulmi Arghakhanchi IRDP/MLD 1. New construction all in <u>Hills</u> 2. Rehab: <u>Hills</u>	1989/90	1.799				
			165 519	2 14	69 100	2,311.00 11,815.00
Bagmati Watershed/ DSCWM/EEC: 1. All rehab & improvement in <u>Hills</u>	1988/89	1.640	N.A.	13	162.5	15,650.00
CARE/NEPAL: 1.ADB/N:SFD- Central/East	<u>1987/88</u>	1.517	<u>9,141</u>	<u>98</u>	<u>7,047.6</u>	<u>3,321.00</u>
2.BTRT/DSCWM	1985/86	1.206	3,111	33	3,200.0	3,780.00
3.ADB/N:SFD- Rapti	1988/89	1.640	1,615	17	102.0	3,435.00
4.NRM Project -Mustang <u>Hills</u>	1987/88	1.517	2,031	23	2,047.6	3,019.00
-Mahottari <u>Terai</u>	1990/91	1.975	835	14	384.0	6,709.00
5.Remote Area:Basic Need Program -Solu <u>Hills</u>	1990/91	1.975	1,342	6	1,342.0	2,092.00
-Bajura <u>Hills</u>	1991/92	2.559	69	1	25.0	5,056.00
	1991/92	2.559	138	4	95.0	2,552.00
ADB/N: <u>Hills</u> <u>Terai</u>	1988/89	1.640	3,739 5,477	88 70	3,162.5 5,337.0	3,122.00 3,385.00

Data Source: Documents (listed in the references) and the end-of-the year statement (as of July 15, 1993) of the respective agencies and for the National Urban Consumer Price Index the reference includes: Nepal Rastra Bank, Quarterly Economic Bulletin. Vol. XXVII, No. 2. Mid-Feb 1993 p 37.

Note * = The cost of construction has been standardized using National Urban Consumer Price Index using Base Year= 1983/84. The exchange rate for One US \$ were Nepalese Rupees 14.60 and 16.50 respectively for the year 1983 and 1984 respectively.

of improvement including the cost of personnel salaries and office maintenance. As expected cost of improvement are higher in the hills than in the terai due to difficult terrain and landslide prone areas prevalent in the hill. Also the systems assisted by INGOs and the ADB/N loan are based on low cost technologies are also smaller in size, and per hectare costs are relatively lower.

Table 2 presents the cost sharing criteria of different intervening agencies in the improvement of the FMIS. Farmers have contributed between 75% and 1% of the total cost. As discussed earlier, DOI requires under its ISP program a cash contribution of 1 to 5% of the total

improvement/rehabilitation cost, percentage depending on the total costs incurred. The cash provided through the ADB/N is as high as 30% of the total costs. The repayment schedule of the ADB/N loan is usually three and five years, two additional years' grace period being given without interest for systems suffering major damage during the construction period. ADB/N has also started providing higher subsidies to the improvement of irrigation systems to follow the standard procedure set by the working policy of the DOI. Thus, in the Table 2 there are two different farmer and agency contributions reported.

The District Irrigation Offices (DIOs) have allocated a fixed amount of annual maintenance budget and also the DIOs coordinate distribution of different material assistance such as gabon wires and cement from the environmental programs to help repair and maintain FMIS in the district. Depending upon the demand from the farmers, these materials and the annual maintenance budgets are distributed to the FMIS. Thus, there is wide variation in the contribution

Table 2: Farmers' Contribution Towards Rehabilitation/Construction Cost

Agency providing support services	Farmers' Contribution as % of Total Cost				Agency Contribution (%)
	Cash (%)	Labor (%)	Other (%)	Total (%)	
DOI/District Irrigation Offices	neg.	10-50	5-25**	15-75	25-85***
DOI/ILC/ISP	1-5	6-20	-	7-25	75-93
DOI/SINKALA MA	5	20	-	25	75
DOI/ILO/SPWP	1-5	6-20	20-25***	27-50	50-73
WECS/IIMI	0-5	5-25	-	5-30	70-95
SNV-Mechi Program/DOI	-	15-25	-	15-25	75-85@
EEC-Gulmi Arghakhanchi IRDP/MLD/DOI	1-3	5-30	-	6-33	67-94
Bagmati Watershed DSCWM/EEC	-	1.5-12.5	-	1.5-2.5	87.5-98.5
CARE/NEPAL:					
1. ADB/N:SFDP	-	20	20*	40	60
2. BTRT/DSCWM	-	30	-	30	70
3. NRM Project	-	23-30	-	23-30	70-77
4. Remote Area	-	25	-	25	75
ADB/NEPAL	- 1-5	20	30*	50	50
		-	6-20*	7-25	75-93

Note: *=Loan from the Bank, **=mostly assistance in gabon wire, cement and other materials, ***=ILO has provided support to the ADB/N to provide loan in selected systems, @=SNV adjusted contribution to the standard percentages set by DOI Working Policy.

Data Source: Documents (listed in the references) and the end-of-the year statement (as of July 15, 1993) of the respective agencies.

to be borne by the farmers. Most of the agencies supporting the improvement of the FMIS have contributed more than 75% of the total cost. The variability in the contribution percentage by the farmers is minimum in case of CARE/Nepal projects than other projects. Farmers' contribution in all the intervention programs is mostly in terms of labor contribution.

SELECTED SUPPORT SERVICES PROGRAMS

This section presents a short description of successful cases and makes comparison on the changes in physical and organizational structures; and their effect on the agricultural performance. The description also includes the essential support services provided by different intervention programs and also makes comparison of the process of assistance provided by these service providing institutions. For the comparison of before after scenario, past experience of the author with these systems and published documents and reports (listed in the references) besides discussion and walk through of the irrigation systems with the key informants were followed. The study team consisted of an agriculturist, irrigation engineer and social scientist. These three field researchers spent one day in smaller systems and two days in larger systems walking through from the source to the tail end with key informants in each system. Besides discussion with the farmers, the related local level support service officials such as Group Organizer of the Small Farmers Development Program, JT/As in the Agricultural Services Center, manager of Sajha cooperatives, chairman and other members of the cooperative society, WUO chairs, secretaries and the farmers from the head and tail end were also interviewed. The instrument used for interviewing these range of respondents was a checklist prepared before the field study. Thus, these findings are based on the information provided by these respondents.

Eighteen irrigation systems assisted by different agencies at varying levels of intervention were selected for this study from the Central and Western part of Nepal. Besides agency interventions, a number of other factors also affected the selection of these eighteen systems. Availability of secondary information such as Rapid Appraisals, IMC Applied studies, Baseline Studies; WECS/IIMI publications, and the authors' previous work also influenced the selection of systems.

Basic Information

Table 3 presents the basic information on the selected irrigation systems. The command area reported here are the areas which can at least be irrigated during the wet season. During the dry period, almost all the systems listed below get reduced to only half either due to unavailability of the water in the source or farmers growing generally crops in a limited area which need irrigation due to competitive demands for other inputs as well.

Table 3: Basic Information on Selected Irrigation Systems

Name of System	District	Command Area (ha)	# of House hold	Intervening Agency	Initiated by	Controlled by
Chaurasi	Kaski	100	285	Dept. of Canals	F	F
Manechhango & Pangduri	Gorkha	32	68	Gorkha 3268 ADB/N; MPLDA/FF	A/F	F
Rangdi Khola	Gorkha	20	55	HFPP-Hill Food	A/F	F
Ghachok	Kaski	200	650	ILC/DOI/ISP	A/F	F
Thuli Besi	Kaski	20	52	CAREN/MPLD	A/F	F
Bhalutar	Makwanpur	31	64	CARE/ADB/N	A/F	F
Rapti-Nawalpur	Makwanpur	175	208	FIWUD/MPLD	A/F	F
Majh Kulo Baguwa	Sindhupal chok	33	116	WECS/IIMI; MPLD	A/F	F
Atmara	Kaski	16	36	CARE/N	A/F	F
Banskot	Nuwakot	90	1,000	ISP/DOI	A/F	F
Gahatadi	Nawal-parasi	67	92	ADB/N	A/F	F
Kumroj 2nd	Chitwan	390	318	CARE/N SFDP/ADB/N	A/F	F
Satra Saya Phant	Tanahu	60	83	ILC/DOI	A/F	F
Malebagar	Tanahu	22	59	IMC/DOI	A	F
Hyangja	Kaski	300	545	DIHM	A	A
Lahachok	Kaski	100	410	ILO/DIHM; DOI/MPLD	A/F	A
Bhorletar	Lamjung	220	194	ILO/DIHM; DOI	A/F	A
Handetar	Lamjung	260	513	DIHM; IMP/DOI	A	A

Note: A=Agency; F=Farmers

Data Source: IMC 1990, WECS/IIMI 1991, Laitos et al. 1986, and Field Survey.

Characteristics and Performances of Irrigation Institutions

Organization

During the period of implementation of the intervention process, the farmers have to organize themselves to meet certain commitments on their part. Some FMIS have formal and some other systems have informal organizations. Even prior to provision of support services, the organization process is started. Formal organization in this report is defined very loosely; if the users' committee exists with written minutes of meetings, the organization is termed as formal. When there is mass gathering of users as and when needed and they pass resolutions without written records, such organizations are termed here as informal organizations. Many support service providing agencies especially for the improvement and rehabilitation of the systems, these agencies require organization in the system, such as a construction committee or a water users' group, as a pre-condition for providing assistance. Thus, many informal organizations have formalized themselves, and in the systems with 150 ha or more to be irrigated (Rapti-Nawalpur in our case) there are sometimes even two tiers of organizational structures, at the system level and the branch canal level. The changes in organizational structure before and after intervention are presented in Table 4.

Table 4: Changes in Organizational Structure of Irrigation Systems

Name of System	Type of Organization		No of Committee Members		Chair/members of WUG Selection Procedure	
	Before Intervention	After Intervention	Before Intervention	After Intervention	Before Intervention	After Intervention
Chaurasi	FO (1)	FO (2)	11	11 30*	VPC Member-	VC Member SEL/ELE
Manechhango & Pangduri	IN (1)	FO (1)	3	7	SEL	SEL/ELE
Rangdi Khola	IN (1)	FO (1)	3-5	6	JIM/SEL	SEL/ELE
Ghachok	IN (1)	FO (1)	3-5	7	JIM/SEL	SEL/ELE
Thuli Besi	IN (1)	FO (1)	5	9	JIM/SEL	SEL/ELE
Bhalutar	-	FO (1)	-	11	-	SEL/ELE
Rapti-Nawalpur	IN (1)	FO (2)	3-5	11 70*	SEL -	SEL/ELE SEL/ELE
Majh Ko Kulo	-	FO (1)	-	9	-	SEL/ELE
Atmara	IN (1)	FO (1)	5	7	SEL	SEL/ELE

Banskot	FO (1)	FO (2)	7	9	VPC Chair	VDC Chair SEL/ELE
Gahatadi	-	FO (1)	-	9	-	SEL/ELE
Kumroj 2nd	IN(1)	FO (1)	5	9	S/ELE	SEL/ELE
Satra Saya Phant	IN (1)	FO (1)	3-5	9	JIM	SEL/ELE
Malebagar	IN (1)	FO (1)	3-5	7	SEL	SEL/ELE
Hyangja	-	FO (2)	-	9 25*	- -	VPC Members SEL/ELE
Lahachok	In (1)	FO (1)	11	9	VPC Member	VC Member
Bhorletar	IN (1)	FO (2)	5	9 32*	VPC Member -	VC Members SEL/ELE
Handetar	IN (1)	FO (2)	5-7	10 53*	JIM/SEL -	- VC Members

Note: Figures in the parentheses indicate number of tiers in the organization. IN=informal; FO=formal; VPC=Village Panchayat Council; VC=Village Council; SEL=selected; ELE=elected; JIM=Jimwala (land revenue collector at the village level); *=branch canal committee members.

Data source: Field survey.

Resource Mobilization

Resources mobilized for annual maintenance of the system are mainly in the form of labor. In most of the systems examined, labor contribution on a per hectare basis has been reduced significantly after intervention. The smaller systems which mobilized the equivalent of one day equivalent of labor for repair and maintenance before intervention now contribute only half a day of labor after intervention. In almost all the systems which mobilize labor resources for annual maintenance still contribute on the basis of land irrigated by the system. But for the emergency repairs, the labor mobilization criteria in all the systems is on a per household basis.

Water Allocation and Distribution

The smaller irrigation systems with 20-30 ha of command area in the hills do not have water allocation problems except during the dry season. During the dry season, water is allocated on a rotational basis, usually the headend farmers irrigating first and tail enders thereafter. In the systems which have more than two branch canals, conflicts over water allocation criteria among the beneficiaries from different branches are recorded frequently.

Water distribution in the individual fields is responsibility of the *pani pale* in the smaller systems, whereas in case of larger systems with users control, village council peons with multiple functional responsibilities are employed for water distribution. The institutional arrangements for water distribution in different systems are presented in the Table 5.

Table 5: Institutional Arrangements for Water Distribution

System	Mode	Basis	Roles
Chaurasi	Rotation (m,w,s)	Land area	VDC peon & WUG
Manechhango & Pangduri	Continuous (m) Rotation (w,s)	- Land area	User committee
Rangdi khola	Continuous (m,w,s)	-	User committee
Ghachok	Continuous (m)* Rotation (m**,w,s)	- Land area	Pani pale
Thuli Besi	Rotation m,w,s	Land area	Pani pale (water monitor)
Bhalutar	Continuous (m)* Rotation (m**,w,s)	- Land area (tail end to head)	Pani pale
Rapti-Nawalpur	Continuous (m,w,s-head) Rotation (m**,w,s-tail)	- Land area	Pani pale
Majh Ko Kulo Baguwa	Rotation (m,w,s)	Land area	WUG
Atmara	Continuous (m) Rotation (w,s)	- Land area	User Committee
Banskot	Continuous (m) Rotation (w,s)	- Land area	User committee
Gahatadi	Rotation (m**,w,s)	Land area	User committee
Kumroj 2	Rotation (m**,w,s)	Land area	Pani pale
Satra Saya Phant	Rotation (m,w,s)	Land area	Pani pale
Malebagar	Rotation (m,w,s)	Land area	Pani pale
Hyangja	Continuous (m)* Rotation (m**,w,s)	- Land area	DOI water monitor & WUG
Lahachok	Rotation (m,w,s)	Land area (head to tail)	VDC peon
Bhorletar	Continuous (m)* Rotation (m**,w,s)	- Land area	DOI water monitor & WUG
Handetar	Rotation (m,w,s)	Land area	DOI water monitor & WUG

Note: m=monsoon, w=winter, s=spring, *=water allocation up to branch canals level, **=water distribution at the field level
Data Source: Field survey.

Agricultural Performance

The discussion on agricultural performance includes changes in cropping pattern, cropping intensity and yield rates due to intervention. These indicators are also influenced by other variables such as availability of markets, modern input and technology - these all usually follow due to availability of irrigation facilities. In the systems selected for the study,

Table 6: Change in Average Yields of Major Crops Following Interventions

Name of the System	Pre-intervention Reference Year	MCI *		Change in Production, MT/HA		
		Before Intervention	After Intervention	Paddy	Maize	Wheat
Chaurasi	1984**	180	225	0.25	0.15	0.50
Manechhango & Pangduri	1987	122	166	0.55	0.40	0.28
Rangdi Khola	1985	150	225	1.2	0.74	0.49
Ghachok	1988	165	202	0.18	0.10	0.40
Thuli Besi	1988	190	230	0.60	0.17	0.85
Bhalutar	1985	203	232	1.29	-0.18	0.06
Rapti-Nawalpur	1986	145	264	0.89	0.46	0.30
Majh Kulo Baguwa	1985	280	300	1.10	0.10	0.50
Atmara	1988	200	225	0.25	0.20	0.15
Banskot	1987	225	250	0.20	0.10	0.30
Gahatadi	1986	150	200	1.0	0.15	0.20
Kumroj 2	1987	225	275	0.60	0.15	0.50
Satra Saya Phant	1989	225	300	0.50	0.20	0.25
Malebagar	1987	195	206	0.10	0.14	0
Hyangja	1985	135	207	0.75	0.15	0.50
Lahachok	1980	147	188	0.25	0.15	0.50
Bhorletar	1978	162	213	1.23	0.45	0.95
Handetar	1988***	121	137	0.72	0.36	0.45

Note: MCI = Multiple Cropping Index ** = prior to construction of Hyangja by DIHM; *** = prior to IMP intervention.
Data source. Key informants' interview and Laitos et al. 1987, WECS/IIMI 1991, IMC 1989.

support services are available mainly through cooperatives, banks and agricultural services centers. Table 6 shows changes in average yields of major crops before and after intervention. Significant yield gains have been achieved in paddy, maize and wheat yields in those systems where there was also significant changes in cropping intensities.

Summary, Conclusions and Policy Implications

The result of this study implies that where the support services backed up by local initiative are there the agricultural performance are higher than in those systems which have only water supply as the goal. The joint efforts at the local level by the intervening/implementing agencies especially by CARE/Nepal and ADB/N partnership providing support to the construction of agricultural service centers, procurement of inputs together with the irrigation facilities are some of the successful cases as discussed earlier where performance of those systems assisted by these agencies are higher than other systems although the level of assistance are at the equal level.

There are very good impacts of institutional loans to the FMIS due to both availability of loans for the improvement of the irrigation systems and availability of the loans for purchasing modern inputs required to increase the productivity of the land. In those systems where CARE/Nepal and ADB/N provided the assistance for the improvement of the systems as well as the technical advice to the farmers on improved cultivation practices, these systems have excelled the performance than assisted by other agencies.

The cost sharing criteria of each of the intervening agencies are different. Farmers have contributed upto 66 percent of the total costs in some cases, to no cost in the other cases. Cost sharing in all systems is mainly in terms of labor. The cash contributions in terms of loans from the bank is as high as 32 percent of the total costs and the repayment rates are higher in those systems where the support services are also available.

Thus, we can imply that support services at the local level will enhance the performance of the irrigation systems. Although none of the intervention agency did include the marketing cooperatives in their assistance plan, many agencies have however helped cooperatives to procure the inputs required by the farmers; and these systems have performed better. In future assistance programs, marketing facilities should also be considered at local and outlet (secondary market centers) level controlled and managed by the farmers which will save tremendous amount of resources and farmers will get more share to their produce. If government and/or financial agencies such as banks could provide effective transport facilities, cold storage and market yard, these locally initiated cooperatives could benefit a lot.

The systems where the WUG functionaries were also involved in the other community works such as community forestry, vegetable and fruit cultivation, membership in the cooperatives and also the community trusts; especially through the Small Farmers Development Program (SFDP) of the ADB/N in close cooperation with CARE/Nepal -- were able to demonstrate more cohesiveness among the users and hence the performance of these systems were higher than in those systems where only irrigation facilities were provided.

Many public agencies have required organization in the system as qualifier for the intervention. Thus, many informal organizations have formalized themselves, and in the systems with 100 ha or more to be irrigated there are sometimes even two tiers of organizational structures, at the system level and the branch canal level. But by just creating standard organizations (blue print approach throughout the country: for example Water Resource Act 1993) without sufficient training backups suitable to the local conditions, these organizations will remain dysfunctional. To help these organizations function better, the strategy of WECS/IIMI intervention programs of farmer-to-farmer training during the time of WUG/WUO annual meetings in the long enduring FMIS will be very crucial.

Many FMIS were assisted on the assumption of increasing the capacity of the existing **Sajha** Cooperatives for the support services and implementing the extension programs. **Sajha** cooperatives

are the only organization to provide improved inputs mainly the imported chemical fertilizers from the parastatals such as Agricultural Input Corporation, Agricultural Tools Factory and other seed supplying government farms.

There is substantial increase in the area of spring paddy and winter wheat cultivation; and, hence increase in cropping intensities. These changes are relatively higher in those systems where there are agricultural support services. Significant yield gains have been achieved in paddy, maize and wheat yields in those systems where there are also significant changes in cropping intensities.

Several implications of this review and field study can be drawn upon especially on the role of public institutions to provide support services in relation to increasing irrigated agricultural production. The role of government is crucial for the improvement of support services especially related to providing the congenial atmosphere as a promoter and facilitator of the farmer needs for improved farming practices. Providing services only to rehabilitate/improve physical condition of the irrigation system alone is not sufficient. Thus, in addition to providing physical improvement support, institutional and legal frame-work, some additional points should be taken care of to increase the productivity and hence improve the standard of living of the users residing in the area. Thus, following considerations are important for enduring and sustained public provision of support services in Nepal.

User groups have started forming cooperatives for specific activities such as the marketing of cash crops, fruits, vegetables and livestock products in limited areas. User group formation for specific enterprises at specific locations is an important area of work for the middle level technicians to facilitate farmers forming these groups.

Cooperatives for providing inputs are an important factor to be taken into account and the role of AIC and private dealers is crucial in this aspect. Cooperatives need support from the government such as subsidies in fertilizers in the area of locational disadvantages while in the area of comparative advantages the private sector can compete with cooperatives for providing competitive and efficient services to the farmers.

There is also a need for the development of marketing facilities where new production enterprises are taken up. A consolidated effort is needed to develop markets which helps further the development of commercial agriculture. Also, it is necessary to strengthen and facilitate the existing weekly Haat-Bazaars prevailing throughout the country. Marketing outlook/information channels/farmer protection in the present context is crucial for both the subsistence and commercial farmers.

Post harvest activities from processing to storage to transport to market facilities need to be worked out. It is important that the farmers be provided with information on market price and the infrastructure improved upon. The post harvest technology and market price information provision should be the joint responsibility of the irrigation technicians, agricultural subject matter specialists and the JT/As.

REFERENCES

- Aryal, B.K., L.P. Ghimire and R.R.S. Neupane. 1990. "Status Report on Handetar Irrigation System (A Pilot DOI Managed Irrigation Scheme for Turnover to Beneficiaries)" Irrigation Management Project. Kathmandu, Nepal.
- Buffum, Bill. 1993. "Three Years Later: An Evaluation of the Sustainability of CARE Nepal Natural Resources Management Project." Draft Report. Kathmandu, Nepal.
- Center for Rural Technology. 1992. Performance Evaluation of ADB/DDP Supported Farmers Managed Irrigation System in Dhading District. Report Submitted to Dhading Development Project/GTZ, Pulchowk, Kathmandu, Nepal.
- HMG/N, Ministry of Water Resources, Department of Irrigation, Planning Design and Research Division. 1991. Assistance to Farmer-Managed Irrigation System: Experience from Nepal. N. Ansari and P. Pradhan (ed.). "Paper presented in the seminar on "Improving Farmer Managed Irrigation Systems: Experiences of Different Agencies and Organizations" held on 27 June, 1990. Kathmandu, Nepal.
- HMG/N, Department of Irrigation. 1992. Evaluation of the SINKALAMA Irrigation Program of the Hill Area Development Project. Research and Training Branch, Kamaladi, Kathmandu.
- HMG/N, Ministry of Water Resources. 1992. Irrigation Policy: 1992. Singh Durbar, Kathmandu.
- MHG/N, Ministry of Water Resources. 1992. Water Resources Act, 2049. Singh Durbar, Kathmandu.
(unofficial translation)
- HMG/N. 1989. "Western Regional Directorate of Irrigation: Profile of the Irrigation Schemes." Western Regional Directorate of Irrigation, Pokhara. (in Nepali)
- Hunt, Robert C. 1989. "Appropriate Social Organization? Water User Association in Bureaucratic Canal Irrigation Systems." Human Organization. Vol. 48, No. 1, Spring 1989. p.86.
- IMC. 1989. "Turn-over Process of Agency-managed Irrigation Systems in Nepal." IMC Applied Study Report No. 11. Irrigation Management Center (IMC), Pokhara, Nepal.
- IMC. 1989. "Operation and Maintenance Case Study of Malebagar Irrigation System, Bhimbad, Tanahu." IMC Applied Study Report No. 9. Irrigation Management Center (IMC). Pokhara, Nepal.
- IIMI. 1991. Process and Performance Evaluation of ADB/N Supported Irrigation Schemes. Volume 1. Main Report. Kathmandu, Nepal.
- Lam, W.F., and Shivakoti, G. 1992. "A Before and After Analysis of Farmer-to-Farmer Training as an Intervention Strategy." Nepal Irrigation Institutions and Systems Technical Report Number 3. Bloomington, Indiana University, Workshop in Political Theory and Policy Analysis.
- Laitos, R. et al. 1986. "Rapid Appraisal of Nepal Irrigation Systems." Water Management Synthesis Report 43. Fort Collins, Colorado: Colorado State University.

Martin, E.D. and Robert Yoder. 1987. "Institutions for Irrigation Management in Farmer Managed Systems: Examples from the Hills of Nepal." Kathmandu, IIMI.

Martin, E.D. and Robert Yoder. 1987. "Organizational Structure for Resource Mobilization in Hill Irrigation Systems." in Irrigation Management in Nepal: Research Papers from a National Seminar. Bharatpur, Nepal.

Metcon Consultants. 1988. Nepal: Koshi Hills Development Program: Irrigation Study 1988 KHARDEP, Agricultural Project, c/o BTCO P.O. Box 106, Kathmandu, Nepal

Ostrom, Elinor. 1988. "Decentralization, Financing and Management" Project Document. Associate in Rural Development. Vermont.

Ostrom, Elinor. 1992. Crafting Institutions for Self-Governing Irrigation Systems. San Francisco, Calif.: Institute for Contemporary Studies Press.

Ostrom, Elinor, Paul Benjamin, and Ganesh Shivakoti. 1992. Institutions, Incentives, and Irrigation in Nepal. Volume 1, Bloomington, Indiana University, Workshop in Political Theory and Policy Analysis.

Polge, Marc. 1993. Status of the Irrigation in GARDP. Volume 1: Main Findings and Proposal for Future Implementation. Gulmi Arghakhanchi Rural Development Project. Mascott Ltd. Rural Development Consultants, Finchampstead, U. K.

Poudel, S.N. 1992. Irrigation Profile of Nepal. Research and Training Branch, Department of Irrigation, Kathmandu, Nepal.

Pradhan, P. 1988. Pattern of Irrigation Organization in Nepal: A Comparative Study of 21 Farmer-Managed Irrigation Systems. International Irrigation Management Institute, Colombo, Sri Lanka.

_____. 1989. Increasing Agricultural Production in Nepal: Role of Low-cost Irrigation Development Through Farmer Participation. Colombo, Sri Lanka: International Irrigation Management Institute.

Pradhan, Ujjwal. 1993. "Farmers' Water Rights and Their Relation to Data Collection and Management." Paper presented at the workshop "From Farmers' Fields to Data Fields and Back: A Synthesis of Participatory Approaches to Resource Information System" held at the Institute of Agriculture and Animal Science, Rampur, Chitwan. March 21-26, 1993.

Shrestha, M.M. 1987. "Problems, Prospects, and Opportunities in Developing Farmer-managed Irrigation Systems in Nepal: The Department of Agriculture's Farm Irrigation Program." in Public Intervention in Farmer-managed Irrigation Systems. IIMI, Digana Village via Kandy, Sri Lanka.

Shivakoti, Ganesh. 1991. "Effects of Public Intervention in Farmer-Managed Irrigation Systems in Nepal." Paper presented at the Second Annual Meeting of the International Association for the Study of Common Property, Winnipeg, Canada.

_____. 1992. Variation in Interventions, Variation in Results: Assistance to FMIS in Nepal. Irrigation Management Network Paper 11. Overseas Development Institute. London.

_____. 1993. "Alternative Interventions to Assist Farmer-Managed Irrigation Systems in Nepal." Paper presented at the International Workshop on **Community Management and Common Property of Coastal Fisheries and Upland Resources in Asia and the Pacific: Concepts, Methods and Experiences**. sponsored by the IDRC held at the International Institute of Rural Reconstruction, Silang, Cavite, Philippines.

_____. 1994a. Study of Support Services for Farmer-Managed Irrigation Systems in Nepal. A Research Report submitted to the Local Management Program, International Irrigation Management Institute, Colombo, Sri Lanka.

_____. 1994b. "Management Transfer of Agency-Managed Irrigation Systems in Nepal: Are There Any Lessons to be Learned From Farmer-Managed Irrigation Systems?" Paper presented at the International Conference on **Irrigation Management Transfer** organized by IIMI and Wuhan University of Hydraulic and Electrical Engineering held at Wuhan, Hubei Province of People's Republic of China during September 20-24, 1994.

Shivakoti, Ganesh and Ujjwal Pradhan. 1994. "Managing Support Services: A Comparative Study of Processes and Performance of FMIS Interventions in Nepal." Paper presented at the seminar/workshop **Improving Support Services to Farmer-Managed Irrigation Systems (FMIS) in Nepal** organized by IMWUD-Department of Irrigation and IIMI-Nepal, September 1-2, 1994. Kathmandu, Nepal.

Shivakoti, Ganesh and A. Shukla. 1995. "Public Interventions to Provide Support Services to Farmer-Managed Irrigation Systems and Their Performances in Nepal." Paper presented at the International Conference **The Political Economy of Water in South Asia: Rural and Urban Actions and Interactions** held at Madras Institute of Development Studies, Madras, India, January 5-8, 1995.

SNV/NEPAL. 1991. Mechi Hill Irrigation and Related Development Program (HMG/N in Cooperation with SNV/Nepal). November 1991. Review of Phase-I.

SNV/NEPAL. 1992. Mechi Hill Irrigation and Related Development Program: Progress Report for F.Y. 1991/92. Mechi Program, PCO/SNV, Ilam/Kathmandu.

Tang, Shui Yan. 1992. Institutions and Collective Action: Self-Governance in Irrigation. San Francisco: Institute for Contemporary Press

Uphoff, Norman, R. Meinzen-Dick, and N.S. Julien. 1985. "Getting the Process Right: Farmer organization and participation in Irrigation Water Management." Paper prepared for Water Management Synthesis II project. Consortium for International Development, Cornell University, Ithaca, NY.

Yoder, Robert. 1984. "Time Tested Technologies for Irrigation in Nepal: Himalayan Fold Engineering Success, Limitations and Possible Extension." Paper presented at the 1984 Annual Meeting of the Nepal Studies Association, Thirteenth Annual Conference on South Asia, University of Wisconsin, Madison, 2-4 November.