PART II: KEY NOTE SPEECHES

HOW FARMER MANAGED IRRIGATION SYSTEMS BUILD SOCIAL CAPITAL TO OUTPERFORM AGENCY MANAGED SYSTEMS THAT RELY PRIMARILY ON PHYSICAL CAPITAL

ELINOR OSTROM[1]

Let me share with you some of the experiences I have had in studying irrigation systems in Nepal since 1989.[2]

Some of you may not know how it is that I came to be a scholar with a deep interest in Nepal in general and Nepal irrigation and forestry in particular. The USAID program on decentralization funded a seven-year cooperative project between Syracuse University, Indiana University, and Associates in Rural Development in Burlington, Vermont. That program was asked to evaluate the decentralization program then established in Nepal. Professor Larry Schroeder, Dr. James Thomson, and I were sent to Nepal to do the evaluation.

Before I left Bloomington, I called Dr. Norman Uphoff and asked whom I should be sure to meet on my very first trip to Kathmandu. He indicated that the two most important people for me to meet were Dr. Prachanda Pradhan and Dr. Robert Yoder. What a fortuitous recommendation. And, what a great honor for me to share this program organized by Prachanda Pradhan with both Norman Uphoff and Robert Yoder.

I well remember my first discussion with Prachanda (Bob was not in Kathmandu at that time). I told Prachanda about some of our earlier research on irrigation, inshore fisheries, forest resources, and groundwater basins and he was quite interested in what we had done. I indicated I had read some of his work with Yoder and others on irrigation in Nepal and was quite interested in learning more. At that point, he gave me a very thorough questioning about the seriousness with which I would approach this topic. Prachanda was obviously used to overseas consultants who fly in, take up a lot of people's time, duplicate materials, and then are never

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2 The continuous support of the Ford Foundation in New Delhi is deeply appreciated by all of us who have worked on the NIIS database through the years. We also appreciate the helpfulness of Dr. John Ambler and Dr. Ujjwal Pradhan, who have consistently supported our efforts with effective collegial input as well as essential resources.

heard from again. After asking me a whole host of questions including how we train graduate students, I obviously passed the test. I was graciously granted a long interview with him and the possibility of copying a large number of original case materials located in his fantastic files.

In stark contrast, I found that the original mission on which we were sent to be extraordinarily difficult. As many people in the audience will remember, the decentralization program "in effect" in 1989 was among the most *centralized* decentralization programs one could find in the world at that time. Several interviews with key officials in Kathmandu convinced me that we would not be able to be very constructive in reviewing that policy. Simply criticizing a government policy is not terribly useful. After several discussions with Larry Schroeder and Jamie Thomson and with the officials at USAID, we came up with a much more effective project. Since many of the irrigation systems in Nepal were already effectively decentralized, we would focus our study on the performance of Farmer Managed Irrigation Systems (FMIS) as contrasted to Agency Managed Irrigation Systems (AMIS).

During the rest of that first trip, we collected extensive materials, talked with scholars familiar with irrigation in Nepal, and prepared to do a serious study of the reasons why FMIS seem to be so much more effective than AMIS in Nepal.

It was on that trip that I also learned about the work of Ganesh Shivakoti. He was at that time just finishing his doctorate at Michigan State University. We were in great good fortune when we were able to bring Ganesh to Bloomington for a period of time after his doctorate. He worked with Paul Benjamin and others at the Workshop in the design and execution of our project. As many of you know, we created a structured database called the Nepal Irrigation Institutions and Systems (NIIS) Database.[3] We shared the design of this database with a number of

3 The NIIS database is currently located at the Institute of and Agriculture and Animal Science in Chitwan and at the Workshop in Political Theory and Policy Analysis, Indiana University, in Bloomington, Indiana. Many faculty and graduate students at both institutions have devoted substantial time and effort to acquiring accurate and valid information about many irrigation systems in Nepal. We are all indebted to the many farmers who have spent long periods of time with us in the field telling us about the history and operation of their system as well as many Department of Irrigation staff members who have shared information and insights with us.

colleagues who are deeply familiar with irrigation, and began to code the 135 case studies that we had collected from our trips to Nepal and from the published literature—many of them authored by Pradhan and Yoder.

Discussions with colleagues at the Department of Irrigation (DOI) and the Institute of Agriculture and Animal Science (IAAS) in Rampur, and at several irrigation systems, showed us that the approach we were taking was likely going to be fruitful and generate some important information for policymakers into the future.

Our team coded most of the cases that we had brought back to IU, but then found that we had a serious problem of missing information regarding key variables for some of our cases. Whenever one uses a structured coding form to extract data from a case that someone else has written, it is almost inevitable that one finds that the case author did not share the same conceptual framework and thus did not record information on all of the key variables in the new analysis. It was at this point that we went to Dr. John Ambler who was then with the Ford Foundation. We shared with him some of our initial papers and exciting findings that we had already extracted from the completed cases. The high performance of FMIS in Nepal when contrasted with the performance of AMIS was well documented in our initial papers, even with substantial missing data. John not only supported a field visit to return to sites where we needed to obtain missing information, he encouraged us to add cases to our sample. By adding some of the smaller government systems as well as FMIS, he helped us strengthen our analysis. He was concerned—and legitimately so—that our findings regarding the higher performance of FMIS might be interpreted as due largely to the size of FMIS and not to the form of organization. By adding larger FMIS and smaller AMIS to our database, we were able to increase the number of medium-sized irrigation systems where we could do a side-by-side comparison to complement the earlier data that we had coded. Given the support of the Ford Foundation, we were able to visit 80 systems, fill in missing data, corroborate the coding we had done earlier, and add new systems. Much to all of our relief, we found that our earlier coding had been quite accurate and that adding new systems only strengthened the relationships we had found earlier and did not weaken them (see Lam, 1998).

With the hard work of many colleagues at the Institute of Agriculture and Animal Science in Chitwan, we have added still further cases to the database. We have now analyzed information on the structure and performance of 231 irrigation systems (183 FMIS and 48 AMIS) in Nepal (see Joshi et. al., 2000). Since we have undertaken a lot of statistical analysis through the years, I won't bore you with many tables and figures. There are, however, some important facts that have been consistently found in our studies (see Ostrom, Lam, and Lee, 1994; Ostrom, 1996; Sowerwine et. al., 1994; Shivakoti et. al., 1997; and Shivakoti and Ostrom, 2002).

What we have consistently found through all of our analyses is that FMIS generally achieve higher levels of performance than AMIS in regard to the following performance variables:

(1) The physical condition of the system—how well maintained is the system given the type of headworks and canals in use?
(2) The technical efficiency of the system—of the water that reaches the head end of a system, what proportion reaches the tail end?
(3) Agricultural productivity—what is the cropping intensity achieved on a system?

Further, we have consistently found that FMIS are more capable of getting water to the tailenders of a system. Of the FMIS included in our analysis, for example, 53 percent are able to deliver adequate levels of water in a predictable fashion to the tail end of their systems while only 11 percent of the AMIS have a similar record (Joshi et. al., 2000).

How is this consistently higher performance possible when most of the AMIS have iron and steel head gates, cement-lined canals, and all the advantages of modern technology? Even controlling for the size of a system and the slope and other relevant physical characteristics, FMIS consistently outperform AMIS in Nepal. One finding that we have come across helps us understand perhaps how this all happens. We have the rather intriguing finding that systems that do *not* have permanent headworks have higher performance records than those systems with modern cement and steel headworks. On the other hand, we find modernized systems with fully-lined canals do have high performance. Why this difference?

Having been on a number of FMIS and talking with colleagues who have attended the annual meetings of such associations, we think we understand why this may be the case. There appears to be two basic reasons: the internal dynamics among farmers related to water distribution, and the importance of getting water to the tail end. These two are related.

It would appear that on many of the AMIS—even though the headworks is a modern control structure—the system was not developed with an effort to clarify the existing water rights and management regime of various farmers. The government, or a donor, built the system and then presumed that the farmers would figure out how to distribute the water. Given that a substantial amount of labor is saved by the installation of permanent headworks as contrasted to the need to construct and reconstruct traditional headworks frequently, farmers on such a system do not have to confront one another every spring to discuss how they are going to repair or even produce entirely new headworks in order to get any water at all.

I do not have to tell the people in this room the importance of the annual meetings that occur on FMIS to discuss relative allocations of water and labor duties. On most FMIS, farmers near the head end do not have enough labor to be able to maintain the system year after year. The headenders need the tailenders. Thus, the tail-end farmers have some real voice on these systems. We consistently find that when high labor requirements exist, water tends to be distributed more equitably between the head- and tail-end farmers.

On AMIS, where maintenance requires much lower labor contributions from the farmers, the head-end farmers no longer need the labor contributions of the tailenders. This enables those who are in the physically most advantaged situation—the headenders—to be sure their fields are thoroughly watered before they let any water pass on down the canal. Thus, on these systems the proportion of tail-end farmers who receive water in the dryer seasons (the non-monsoon seasons) is much smaller. Thus, one of the major recurrent patterns is that those farming near the head end of an AMIS obtain a larger proportion of the water. Those farming near the tail end receive a smaller proportion. The overall cropping intensity and productivity for the system is thus less.

The findings regarding the lining of canals are also related to getting the water to the tail end of the system. When the canal is lined, it ensures that a larger proportion of the water gets to the tail end. Thus, lining canals has helped tail-end farmers, while building modern headworks has led to an internal dynamic among the farmers that has harmed the tail-end farmers. Of course, no necessary relationship exists between the type of headworks and reduced productivity. Everyone here knows, however, that the way farmers relate to one another, manage their own affairs, and allocate their own water affects overall productivity. Since water fees are not uniformly collected and used to manage the system from which they are collected, no one "needs" the inputs of the tail-end farmers. Without being needed, their interests can be ignored.

Well, what do we learn from all of this? One lesson I hope we are sure to learn is that we cannot be smug and self-satisfied. Not all FMIS operate as well as others. Some have failed totally. Some systems have succeeded for long periods of time before breaking down. On average, however, farmers do a much better job of governing and organizing on their own systems than government officials do on their systems.

Further, we cannot assert that mud and wooden dams will always be more efficient than modern engineered works. It is not the modern engineering that leads to a reduction in productivity but rather the primary focus on physical capital and absence of a focus on social capital (see Uphoff, 2002). All too many farmers in Nepal face a three- to five-month period every year of hunger. All too many of their families are not able to get a decent education or reasonable health care. Thus, if improvements in physical capital were matched with the recognition of prior social capital and efforts to enhance future social capital, the negative relationship between modern headworks and performance could be reversed.

Achieving a higher standard of living without losing some of the strong capabilities of self-governance is a major challenge. To do so, however, requires listening to farmers in the first place and gaining information about their needs, their property rights, their ways of governing irrigation, and facilitating their plans for ways of managing improved physical capital. For some engineers who pride themselves on their technical training, the idea of listening to farmers who have much less formal education is an anathema. The farmers, however, have much more local knowledge about the biophysical conditions in their region. And, if they have managed their own system in the past, they know what kind of property rights and duties have been established in the past that need to be taken into account in any effort to "modernize" a system. An effective irrigation system is not just an accumulation of good physical capital. No physical plant runs effectively anywhere in the world without a build up of social capital among those operating the systems.

When donors speak to me about increasing the democratic process in Nepal and other countries, I immediately think of enhancing the capability of FMIS and forest-user groups. Some outside interventions have, however, endangered these democratic institutions by ignoring them or presuming they did not exist. Where they have survived, however, they are a solid foundation on which to build broader-based democratic institutions (so long as we do not confuse party dominance of an electoral process with a democratic process). True democratic processes allow individuals from all walks of life to perceive and articulate the problems that are most important to them and find ways of overcoming them. The farmers of Nepal have for many centuries found ways of solving some of their problems relatively well by associating, sharing knowledge, getting technical information where relevant, and monitoring government to be sure that it is honest, fair, and efficient. FMIS, and the FMIS Trust in particular, will play a major role in the democratic process in Nepal well into the future.

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UNDERSTANDING AND UTILIZING THE SOFTER ASPECTS OF 'SOFTWARE' FOR IMPROVING IRRIGATION MANAGEMENT

NORMAN UPHOFF[1]

INTRODUCTION

Purposeful efforts to introduce participatory management into the irrigation sector began about 25 years ago, with the innovations introduced into Agency Managed Irrigation Systems (AMIS) by the National Irrigation Administration (NIA) in the Philippines with Ford Foundation assistance (Bagadion, 1997; also F. Korten, 1982, and F. Korten and Siy, 1988). This was followed in 1980 by an initiative to establish farmer organizations in the Gal Oya irrigation scheme in Sri Lanka as part of a USAID-supported project there (Wijayaratna, 1985; Uphoff, 1996; Wijayaratna and Uphoff, 1997). Then during the 1980s and 1990s there were a variety of efforts made to institutionalize farmer participation in poorly-managed large-scale systems in India, Indonesia, Nepal and elsewhere around the world.

These efforts supported by donor and government agencies and NGOs evoked greater interest in Farmer Managed Irrigation Systems (FMIS), such as the indigenous *subak* organizations on the island of Bali in Indonesia that had been documented previously by Geertz (1967). Other examples from other parts of Asia were analyzed by Coward (1971, 1976, 1977, 1979). One of the most important case studies which demonstrated that farmer management could be effective for large systems and sustained over many decades was provided by Pradhan (1983) on the Chhatis Mauja scheme in Nepal. This capability was further documented by Martin (1986), Yoder (1986) and Pradhan (1989) for numerous other FMIS in this country.

These AMIS and FMIS "streams" of experience and analysis were not treated as separately as this simplification of history suggests. The experimentation in the Philippines began with smaller communal irrigation systems, ones receiving public sector support but under local

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jurisdiction. Over time the lessons learned from these smaller systems were transposed to larger, publicly-managed ones, which went through a transition toward farmer management. There has thus been some cross-fertilization, and even comparative analysis such as offered by Valera and Wickham (1978). Too often, however, these remained separate domains for action and evaluation, the first dealing mostly with larger schemes operating within the public sector while the other dealt with smaller systems under community or group management.

Experience has not been uniform. There have been difficulties often in achieving or maintaining the kinds of effective management in AMIS as in FMIS, even when certain structures or incentives were introduced from the latter to the former, as in the Philippines. This failure relates to the lack of attention to the 'softer' side of irrigation management which is this paper's focus.

The fact that the management of irrigation systems everywhere presents similar problems, water being one of the most uniform substances in the world and irrigation being a widespread activity, has attracted attention from a number of social scientists (e.g., Wade, 1982, 1988; Ostrom, 1990; and Uphoff, 1986, 1991).

There is now wide consensus that farmer participation in irrigation management, whether in small-scale local systems or large-scale government schemes, *with appropriate organizational structures and incentives* can improve efficiency and often equity under quite a range of conditions. However, I would propose that there need to be changes also in the domain of thinking and assigning values, not just in structures and incentives.

Differences between AMIS and FMIS can be conceived in the changes in three different aspects of irrigation management: operational objectives, irrigation duty, and functions performed, that need to be achieved to have appropriate structures and incentives.[2]

	AMIS	FMIS
Operational objectives	Flexibility	Simplicity Transparency Equity

[2] I thank Dr. Prachanda Pradhan for his suggestions along these lines.

		Flexibility
Irrigation duty	Technical requirements	Technical and social requirements
Functions	Hydraulic	Hydraulic and managerial

There is no longer much disagreement that *in principle*, participatory irrigation management can be more successful than non-participatory alternatives. Arguments now focus on whether, and under what conditions, participatory management will be preferable *in practice*. This shift in thinking is partly because there is a growing democratic spirit at large in the world that does not accept purely bureaucratic management or unaccountable political decision-making. But the merits of a participatory approach have been demonstrated often enough that its proponents now get "the benefit of the doubt" rather than having to shoulder "the burden of proof" as before. This reflects a substantial change in public and private thinking over the past two decades.

What I would like to do in this paper is to expand upon the present thinking that accepts the value of having farmer organizations actively and responsibly involved in irrigation management, whether of large schemes or small systems. Such water user organizations are understood to be a kind of "software" that is essential for making more effective and efficient the "hardware" of physical structures for the capture, conveyance, distribution and drainage of irrigation water (Uphoff, 1986).

Thus far, the ways in which such "software" can be constructed and maintained have been analyzed mostly in terms of what I would characterize as the "harder" aspects of social relationships and interactions:

- Attention has focused mostly on ***material incentives*** and on what are considered to be ***"rational" calculations of interest***.
- Farmers have been regarded essentially as ***individual decision-makers*** who are seeking to maximize their respective well-being cooperatively but independently of one another.

I accept that this kind of "rational actor" analysis can capture a large part of social reality, and that it has some advantages such as *parsimony* and *predictability*. But my experiences in Sri Lanka and Nepal with introducing and evaluating participatory irrigation management there leads me to question the *completeness* and even the *adequacy* of such a perspective. I want to suggest here that we need to learn how to incorporate some of the "softer" aspects of social relationships and interaction, dealing more with norms, values and ideas, into our planning for and support of participatory irrigation management. This can give more sustainability to such efforts, I will argue, as well as greater effectiveness, efficiency and equity.

I will suggest first some *empirical* foundations for this alternative, enlarged perspective on the promotion of farmer management in irrigation systems. This leads into a discussion that is more *theoretical*, seeking to provide explanations for different outcomes and to give some guidance for facilitating the creation and strengthening of social capacity for participatory management.

EXPERIENCE FROM SRI LANKA

My involvement with participatory irrigation management started with the opportunity for Cornell's Rural Development Committee to work with the Agrarian Research and Training Institute (ARTI) in Sri Lanka to introduce this kind of management into the Gal Oya irrigation scheme under a USAID-funded water management project starting in 1980. We learned, after agreeing to accept this assignment, that Gal Oya was considered the most badly managed and most difficult irrigation system in the country, being the largest and most physically deteriorated.

- The **main reservoir** had filled only twice in the 30 years since it was constructed, so this was a chronically water-short system. The bottom third of the command area almost never got water deliveries during the dry season, and the middle reaches had had uneven and unreliable water supply. There were even some shortages within head-end areas.
- The **command area** in the Gal Oya Left Bank, where the project was focused, had expanded by at least 25% beyond the original 50,000 acres (1 ha. = 2.475 acre) developed, water shortage notwithstanding. In the past three decades many offspring of the initial settlers had encroached on reserved right-of-way areas to acquire their own land for cultivation, making maintenance and system management more difficult.

- The **soils** in the Left Bank were not very suitable for irrigation, having limited water retention capacity and being originally intended for sugar cane rather than rice production. This was not very good productive rice land, which contributed to **widespread poverty**.
- Because this scheme was populated by settlers brought in from other parts of the island during the 1950s, local communities had **little solidarity**, either traditional or modern, and there was accordingly a lot of **endemic conflict**.
- Some of the settlement of Gal Oya has been **semi-voluntarily**, as many settlers were selected by the headmen in their home villages to be relocated to this new scheme to meet quotas. Some were former prisoners who were given release if they would settle in Gal Oya with their families. Settlers had **low self-esteem** and were little respected by officials.
- Given the perennial and serious water problems, **water theft, conflicts over water**, and **anarchic behavior** were common. At the time the rehabilitation project began, 80% of gates and other control structures were broken or inoperable. Water was being regularly measured and controlled at only six locations within the 65,000-acre command area. Engineers could not distribute water effectively even if and when they wanted to do so.
- The head-end and tail-end areas were under **different administrative units** because the command area was so large and overlapped two districts, complicating management decision-making in the head and tail.
- The area was considered a **'hardship posting'** within the administration because of its distance from the capital and its lack of amenities, so irrigation and other officials tried to avoid assignment there, or got transferred out as soon as possible, which made for many vacancies and high turnover in the public service.
- To make matters worse, there were definite **ethnic divisions** as the head-end and middle areas had been settled by Sinhalese households, and the tail-end areas by Tamil families. This exacerbated the normal tensions and conflicts one finds between upstream and downstream water users.

This was thus a very unpromising place to begin introducing, validating and institutionalizing participatory irrigation management. The Irrigation Department's Senior Deputy Director for Water Management informed us: "If we can make progress in Gal Oya, we could make progress anywhere in Sri Lanka." The top civil servant in Ampare District, where most of the Left Bank system was located, informed our young organizers as they completed their training and were about to begin work among Gal Oya farmers: "If you can bring even ten or fifteen farmers in Gal Oya to work together, that will be a big achievement." He was trying to encourage them by setting low initial expectations, so did not say that the number of farmers to be gotten into water user associations within the next four years was probably between ten and fifteen *thousand*.

Results from Organizing Efforts, 1981-85[3]

It seemed almost a miracle that demonstrations of cooperative behavior and collective action were evident soon after the organizers began living and working in villages. The first round of activity began under the threat of dire water shortage as the main reservoir was only 25% full at the start of the 1981 dry season. Yet despite this -- or maybe because of it -- within six weeks' time, about 90% of farmers in the 5,000-acre pilot area were doing, at their initiative (prompted and supported by the organizers) some combination of:

- **Channel cleaning** by voluntary group labor, removing silt, weeds, and other debris from channels that had not been maintained properly for 5, 10, sometimes even 20 years
- **Rotating of water deliveries** between upstream and downstream water users so that all could get approximately equal shares of the available scarce water,
- **Voluntary saving of water**, with as much as one-sixth of water allocations upstream being donated to needier farmers downstream,
- **Adhering to a common cultivation calendar**, and
- **Managing and reducing conflicts**, to the extent possible.

An indication that there was, suddenly, a high degree of solidarity and cooperation was the fact that in this first season, all of the changes made in voluntary rotational water deliveries were from head-end-first to tail-end-first systems rather than vice versa. These changes indicated a high degree of trust, or resolve to share shortages, since main system management in the absence of rehabilitation of the physical facilities meant that water deliveries to distributory-canal command areas were still unpredictable.

3 I thank my colleague Dr. C. M. Wijayaratna, who was instrumental in the Gal Oya organizing effort, for his suggestions on this and following sections.

The schedule for alternating deliveries of water, five days on, then five days off, was seldom kept, so agreeing to let other farmers draw water first entailed some risk.

The 1982 dry season started with even greater water shortage as the water available in the main reservoir was only 20% of its capacity. Even so, the demonstrations of farmer cooperation and solidarity continued and even accelerated, as documented in Uphoff (1996). This paper will recount only briefly the process and results of the organizational effort. By December 1985, when the USAID project ended, and Cornell-ARTI involvement with the Gal Oya farmer organizations was abruptly terminated, about 12,500 farmers were active in participatory water management in the upper and middle reaches of the Left Bank system.[4] As discussed below, these organizations have persisted and even gained strength in important ways, though the promised support from government was less helpful than planned and expected.

Since 1985, practically the whole Left Bank has received irrigation water deliveries even during the dry season as the efficiency of water use in the system has been at least doubled. An evaluation done for the International Irrigation Management Institute (IIMI; now IWMI, the International Water Management Institute) found that the amount of rice (in kg) produced per unit of water (m^3) issued from the main reservoir had been increased about four-fold as a result of project activities (Wijayaratna and Uphoff, 1997: 178). With more reliable supplies of water, farmers began investing in things that would raise their production.

A post-project benefit-cost analysis concluded that the rate of return on project investment was an unusually high 28% (Aluwihare and Kikuchi, 1991). Some of these improvements can be attributed to the physical rehabilitation of the system. But a quantitative evaluation by IIMI staff estimated that *at least half* of the measurable improvements in efficiency could be attributed to the 'software' created by the project (Amarasinghe et. al., 1998), even though this amounted to only about 10% of project investment. This is the kind of evidence that makes a strong case for investment in the creation of water user associations and for participatory management overall. But the Gal Oya case is even more important for its

4 There could have been as many as 10,000 more farmers in downstream areas formally involved in water user groups if threats had not been made by the LTTE, an armed group seeking a separate Tamil state. These farmers could not safely be associated with a government-sponsored program so had to proceed informally after our cadre of Tamil organizers had gotten water user groups started.

sustainability and evidence of remarkable solidarity among farmers that under-girded their technical accomplishments.

Demonstration of Organizational Capacity in Sri Lanka, 1997

In the 1997 dry season, more than a decade after outside assistance for farmer organizations had been withdrawn, farmers faced an unusually acute shortage of water. The water level in the main reservoir was so low as the planting season approached that the Irrigation Department (ID) decided it would not even begin making water issues for cultivation because it did not have enough water in storage to sustain a full season.[5]

Farmers in the Left Bank were understandably distressed by this decision. They insisted that they could manage with even a much reduced supply of water because they had learned -- and had the organizational capacity -- to grow a crop with less water than was the norm -- 4 acre-feet of water per acre of cultivated land. Some quick research done by educated farmers on past inflows to the reservoir and issues from it during the dry season led the farmer organizations to conclude that there some additional supply would become available during the season, even without rain, from water already stored in the water table. (Engineers did not want to concede that they had forgotten to take this into account when making their calculations of dry-season supply.)

After the farmer organizations had mobilized support from politicians and administrators for going ahead with the cultivation season, the Irrigation Department agreed to provide 60,000 acre-feet of water however and when the farmer organizations decided to use it. The Department recommended, however, that (a) the water made available be used on the first 15,000 acres of land on the Left Bank to avoid seepage and conveyance losses from distributing the water over the whole area, and (b) farmers should not grow rice, because of its high water requirements.

The Department also advised farmers that it would not accept any responsibility for crop failures if its recommendations were not followed and that farmers would be cultivating at their own risk.

With an assurance of 60,000 acre-feet of water, the farmer organizations discussed how to distribute this among themselves. Rather than favor

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5 The following account is discussed in detail, with documentation of sources, in Uphoff and Wijayaratna (2000).

some areas over others, they decided, against officials' advice, that the water would be shared equally throughout the whole Left Bank, and also that farmers could decide for themselves what crop they would grow. With this information, farmers set about cleaning channels very carefully and carrying out very careful management of the available water supply. The whole Left Bank was planted, and mostly with rice, even though farmers could count on *less than one foot of water per acre* instead of the usual norm of 4 feet.

Farmers were correct in their assumption that there would be some additional water supply. Irrigation Department records show that an additional 38,000 acre-feet were issued to the Left Bank from the reservoir during the season, making the total 98,000 acre-feet. But this was still *only about 1.5 acre-feet per acre*. There was some rainfall during the season, indeed a little more than average for the dry season. But even so, farmers had to manage their crop with only about one-third as much water issue as normally expected.

To everyone's surprise and satisfaction, the crop results were excellent, with average to better-than-average rice yields over practically the whole of the Left Bank, harvesting 85 to 95 bushels per acre, according to Agriculture Department records. Meticulous management of this reduced amount of water had given tremendously high productivity of water, though this achievement would have been less surprising if farmers and officials had known at that time about the System of Rice Intensification (SRI) that was developed in Madagascar in the 1980s and is being evaluated now in a growing number of countries. It raises rice yields with about half the water.

From SRI, we are learning that rice is not an aquatic plant as commonly thought (DeDatta, 1987: 43, 297-298). Consequently, yields can be higher when rice is grown in moist but unsaturated soil, rather than in continuously flooded fields, as has been the dominant practice for millennia (Uphoff, 1999; Stoop et. al., 2002; Uphoff, 2002). The fact that farmers did not have as much water as usual to cultivate their rice thus probably worked to their advantage.

However, this was not known at the time (and farmers did not use the other SRI agronomic practices that can give higher yields when fields are not kept flooded; Rabenandrasana, 1999). Farmers thought that by sharing their limited water supply equally and making minimal water allocations per acre they were taking a big gamble. In any case, the *efficiency* with which Left Bank farmer organizations distributed water in this crisis situation was remarkable.

In some ways even more remarkable was their commitment to *equity*. It is rare to find such determination to distribute water equally among head-end, middle and tail-end farmers. Farmers' decision and their implementation of it is even more remarkable when we consider that the Gal Oya Left Bank was divided upstream from downstream along ethnic lines. Most of the farmers in the head and middle reaches are Sinhalese, while *almost all those in the tail areas are Tamil*.

I need not remind readers of the two decades of violence that has occurred along this ethnic division (though those involved have been a minority in both groups; see Uphoff, 2001).

The Sinhalese majority could have monopolized the season's water simply because it had locational advantage. This could have been legitimated by pointing to the recommendation of the Irrigation Department that justified using all of the scarce water at the head, claiming that this would be increase efficiency by reducing seepage and conveyance losses.

Yet all Left Bank farmers committed themselves through their farmer organizations to an equal sharing of water as an act of solidarity. This was at a time when armed conflict was ongoing between the LTTE guerillas seeking a separate Tamil state and the government's armed forces resisting this claim, with often gruesome non-combatant losses on both sides.

The Gal Oya Left Bank farmers had, however, maintained since the farmer organization effort began in 1981 that ethnic differences and divisions should have no place in their agriculture and community life. In 1997, they put this conviction to a demanding test by agreeing to share scarce water equally among all farmers depending on the Left Bank irrigation system. That their virtue, as well as their gamble, was rewarded by a good harvest for all is very gratifying.

Of particular relevance for our concerns with farmer management of irrigation systems is the fact that participatory management capacity remains strong 20 years after organizations were first introduced. When I last visited Gal Oya, in March 2001, the farmer-representatives who met with me insisted that there are now no irrigation problems that they cannot resolve among themselves or with the cooperation of ID engineers. The water management situation in the Left Bank is completely changed from what it was when the organizational effort started.[6]

Unfortunately, farmers are feeling increasingly squeezed economically as their costs of production have been rising faster than their income from production given the low price for rice. But this is a consequence of government policies and globalization trends, beyond the scope of what participatory irrigation management can accomplish.

Experience from Nepal

One might suggest that such positive, cooperative outcomes from farmer participation in irrigation management reflect the benign social and cultural environment of Sri Lanka, ignoring the high levels of conflict and violence during the 1980s and continuing into the 1990s.[7] Others know better than idea the experience with farmer irrigation management in Nepal, but I was involved with Prachanda Pradhan, Upendra Gautam and others in one of the first formal efforts in Nepal to introduce AMIS participatory management.

These efforts were in the Sirsia-Dudhaura irrigation scheme near Birganj as part of the USAID-supported Nepal Irrigation Management Project (NIMP) starting in 1986. The USAID mission in Nepal had been impressed with the accomplishments of our efforts in Sri Lanka and designed a farmer-management component into the NIMP. Our field efforts in Sirsia-Dudhaura began in 1987 and my involvement continued through 1990, when the project was reorganized and the involvement of Cornell was terminated because of dissatisfaction with the prime contractor. (We were working on participatory irrigation management under a sub-contract to a consulting firm.)

As explained above, the choice of Gal Oya within Sri Lanka required us to

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6 In 1988, based upon positive evaluations of the changes achieved in Gal Oya and some other systems where participatory management had been introduced, the Sri Lankan cabinet made such management national policy. There are now about 250,000 farmers participating in water user association within major irrigation systems operating under the aegis of the Irrigation Department, and about that many within Mahaweli Authority irrigation schemes (Brewer 1994). Some of these organizations may not operate as effectively as those in Gal Oya because there was less investment of resources and personnel in establishing organizational 'software' elsewhere.

7 Over 60,000 persons have died in the violence engendered by the claims of secessionists for the creation of a separate Tamil state; and another 50,000 lost their lives in the insurrection launched by the Janatha Vimukhti Peramuna (JVP) in 1983 and not suppressed until 1989 (see Gunaratna, 2000).

work in one of the most difficult irrigation schemes in that country; Sirsia-Dudhaura was a similar choice in Nepal. This system was hydrologically very complex, with two different main sources of water supply, the Sirsia and Dudhaura rivers, with two separate main canals, which had overlapping command areas, so that some parts of the system had two different sources of supply.

More important, and making for more difficulties, was the social, economic and political situation since Sirsia-Dudhaura is, literally, a stone's throw from the Indian State of Bihar.

It has the same kind of stratification and domination of social caste and economic class that have made Bihar one of the most notorious parts of the Indian subcontinent for inequality, conflict and exploitation. We were told when we first visited to acquaint ourselves with the field situation that dacoits were able to move at will in the area from sundown to sun-up, so that Irrigation Department and other government personnel simply surrendered the area to outlaw control and lawlessness for much of the time. Farmers had to find ways to survive within the constraints of unequal land tenure, great disparities in political and economic power, and heavy social restrictions. Only a few could think of prospering.

Into this situation, we fielded trained social organizers, following the examples (precedents) of institutional organizers in Sri Lanka, and community organizers in the Philippines, as well as group organizers in the Small Farmer Development Program (SFDP) in Nepal operated by the Agricultural Development Bank of Nepal (Rahman, 1984). They were somewhat better educated than the fieldworkers used in these other programs, but were able to establish rapport quite well. Within three months, we were seeing similar examples of cooperation and altruistic action that had been seen in Gal Oya within six weeks. Unfortunately, we did not find the kind of leadership and vision within the Irrigation Department at system and higher levels that helped accelerate and institutionalize our Gal Oya efforts. But within the communities, we found farmers playing similar roles as in Gal Oya and helping transform the operation and maintenance of the system.

We found other examples of farmer-management that could give encouragement and inspiration to Sirsia-Dudhaura water users, beyond the remarkable case of Chhatis Mauja. The Pithuwa irrigation system, documented by Laitos et. al., 1986, gave Sirsia-Dudhaura farmers a very good example of how the assumption of responsibility, and willingness to commit farmer resources to system O&M, could greatly benefit all concerned. Given the impatience of the donor agency, human and financial resources as well as attention were redeployed to other systems, and the Sirsia-Dudhaura effort could not be consolidated as anticipated.

Anyone concerned with farmer-managed irrigation improvements, researchers as well as officials and practitioners, should seek a generic appreciation of what is required for effective participatory management. This requires thinking through an appropriate set of complementary roles and responsibilities between farmers and government agencies. Roles and responsibilities of water user organizations are the most important elements in this, and governments are often unwilling to accept either a very large role or independent responsibilities. But experience has shown that this kind of 'investment' has high returns if better system performance is the goal.

TAKING THE 'SOFTER' SIDE OF 'SOFTWARE' SERIOUSLY

It is widely understood that a first requirement for better management is the creation -- or strengthening, where they exist but are not fully effective -- of **water user associations** of some kind, formal or informal, large or small, voluntary or compulsory. Without such organizational structures in place, the transaction costs of cooperation to manage water through the decisions and actions of hundreds, even thousands, of water users are overwhelming.

Such associations are often referred to as the "software" of irrigation management, necessary to make effective the "hardware" of dams, weirs, pumps, canals, gates and other physical mechanisms for water acquisition, distribution and control. In AMIS, the administrative "software" of an irrigation bureaucracy can perform many of the activities needed for decision-making and implementation. But because the success of irrigation efforts depends ultimately on farm-level water use, it is hard to get both effectiveness and efficiency, let alone equity, from operation and maintenance handled solely by government officials and employees.

An Analytical Framework for Understanding Organization

What is needed is *organization* in its generic sense, those basic *functions* which distinguish situations that are "organized" from those that are "unorganized." Previous efforts to understand irrigation management generically, and particularly the farmer participation aspects of it (Uphoff, 1986), have led us to conclude that there are four basic functions to be performed by any *organizations*, bureaucratic or participatory, that seek to manage the *physical structures* that in turn manage *irrigation water*. These four sets of activities, or functions, are:

- **Decision-making**, including planning,
- **Resource mobilization and management**,
- **Communication and coordination**, and
- **Conflict resolution**, to the extent needed.[8]

The management of any irrigation system requires that these four functions, or sets of activities, be regularly performed, (a) either ***formally or informally***, and (b) ***at all levels***, from the field channel level to the main system level. For carrying out these activities, there are likely to be:

– ***Roles***,
– ***Rules***,
– ***Precedents***, and
– ***Procedures***, that make organizational activities more effective.[9]

The four sets of activities -- decision-making, resource mobilization, etc.-- are essential for the:

– **Design**,
– **Construction** or **implementation**,
– **Operation**, and
– **Maintenance** of the ***physical and social structures*** which in turn create or control the
– **Acquisition**, by design, construction, operation and maintenance of structures,
– **Allocation**, by design, implementation, operation and maintenance of rights,
– **Distribution**, by design, construction, operation and maintenance of canals, and
– **Drainage** of ***water***, by design, construction, operation and

8 See Uphoff (1986: 37-53, also 165-167). These four sets of activities, which are very concrete and specific, parallel the four functions that Parsons (1951) identified in more abstract terms as essential for all social systems: goal attainment, adaptation, integration, and pattern maintenance.

9 This formulation gives equal weight to *roles*, which I have stressed in my analysis of irrigation management, and *rules*, emphasized by my colleague Elinor Ostrom (1990).

maintenance of facilities.[10]

Contrasting Structural Analysis with Alternative Approaches

Whether one gives more emphasis to *roles* or to *rules* when seeking to analyze, evaluate or promote irrigation management, these are essentially *structural* aspects of organization -- or of social capital if one thinks in these terms (Uphoff, 2000). These encompass aspects of social relationships that *structure interactions*, making behavior more predictable and stable over time. This can happen because people in roles conform to the expectations (theirs and others') about how persons in that role should perform, or because rules are accepted as binding on people with sanctions employed if they are not followed. *Precedents and procedures* also structure behavior by *expectations* of how people should and will act and by creating *repertoires* for behavior.

With this set of factors creating patterns for behavior, structural analysis explains what persons will do in terms of individual calculations of what are their *incentives* -- the relative magnitudes of benefits vis-à-vis costs from different decisions and courses of action. These can operate independently of roles, rules, precedents and procedures, but will be more effective when considered in conjunction with roles, rules, etc.

While incentives are not, strictly speaking, structural, being a consequence of people's desires, perceptions and evaluations of alternatives, they fit into this category because when trying to create and maintain organizations, incentives are planned and manipulated so as to get behavior that is desired (from the viewpoint of those persons doing the designing and managing) and to make it predictable.

Moreover, the standard approach, focusing on the calculation of individual self-interest, ignores the influences on decision-making and behavior that come from more collective considerations, such as costs and benefits for the community, and even for the larger society. What weight if any will be given to considerations like improved water and land productivity in the aggregate?

This benefit may not be a strong consideration if it must be achieved the

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10 See Uphoff (1986), Chapter 3, for a more complete presentation of this analysis which integrates most of the irrigation activities discussed in the literature into a single framework.

expense of individual costs. But if it can be achieved in ways compatible with individual benefit, where there are no or few tradeoffs, such collective benefits can become additional factors that motivate cooperation and collective action. These considerations take us into the realm of thinking and valuation, not just responding to incentives that are provided by the structure of the situation that people find themselves in.

Within social science, "structural" approaches are ones that seek to explain, predict or manipulate behavior for *average or typical persons*, by designing roles, rules, precedents and procedures that pattern behavior in certain ways. There is little or no consideration given to individuality or individual differences. What is of most interest is general or "normal" performance; there is no interest in what specific persons would do. The people in structural analysis are abstractions, not individuals (Uphoff, 1996: 330-336).

Converse approaches can be variously described as behavioral, cognitive or normative. They are concerned with the perceptions, interests and capabilities of individuals, not as *abstractions* in the way that structural analysis treats them, but as thinking, feeling, caring persons with different values, needs, energy levels, networks of affinity, aspiration, etc. (Uphoff, 1996: 336-352). While incentives are considered important, there is a recognition that real people value a great many different things. Their interests are not simply or usefully subsumable under the broad heading of "*self-interest*." What motivates people is not just *material rewards* but also family and group connections, self-respect, religion and culture, and a host of other considerations.

In particular, I could see in our program in Gal Oya (and to a lesser extent in Sirsia-Dudhaura, where I spent less time and got less personally involved) that understanding what brought about changed behavior among farmers for more participatory (and more equitable) irrigation management required consideration of more factors than those dealt with in terms of structural analysis. There were important cognitive and normative elements in the process of changing thinking and actions regarding water allocation and distribution that could not be adequately accounted for in terms of roles, rules, precedents and procedures. These are real but instrumental, unemotional elements of organization that apply to everyone and have no special connection to people as individuals, as unique personalities. This becomes particularly important, for example, when engaging in system "turnover" to farmer management, looking only at visible structures and not at the human resources and networks that animate and control these.

This is a difficult subject to discuss because we have not developed social-scientific language and concepts that address "idiosyncratic" and "subjective" factors in rigorous, commonly-agreed terms. A good demonstration of this is the concept and phenomenon of *friendship*, a very critical factor in successful irrigation management.[11] In fact, the most systematic analysis of friendship was done over 2,000 years ago by the Greek philosopher Aristotle in *The Nichomachean Ethics*. It has been ignored largely because it is idiosyncratic and subjective, even though it is a universal phenomenon.

Considering Friendship as a Factor in Irrigation Management

In contemporary social science, friendship is considered traditional, even somewhat atavistic and thus unmodern, being classified as "particularistic" in the theorizing of Talcott Parsons. I would like to propose, however, that we can not understand and improve irrigation management without an appreciation of the contribution of friendship to social organization. It is a factor the remains exogenous to structural analysis.

Friendship can be operationalized as a rigorous concept in social science terms by using the economics concept of *utility functions*. Economists assume that people's motivations, decisions and actions can be understood and explained in terms of their trying to achieve things that they think have utility, and are thus desirable, and by avoiding things with disutility, i.e., undesirable.

The things that motivate people can be aggregated and represented in terms of a utility function, a set of things that are desired (being utilities, with positive signs) or disliked (disutilities, with negative signs). People, as rational actors, are said to seek to maximize their respective utility functions, composed of things that they wish to have because of positive satisfactions (or to avoid because of negative assessments): U = (*f*) A, B, C, -D, -E. -F,…..n, meaning utility (U) is a function (*f*) of more A, B and C and less D, E and F, etc..

Most economic analysis assumes, for the sake of simplicity, that people

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[11] This is related to the concept and phenomenon of *trust*, which has received in recent years somewhat more systematic consideration thanks to the growing interest in social capital, e.g., Fukayama (1995).

have *independent* utility functions, i.e., each person seeks to maximize his or her own net utility, irrespective of others' welfare. The justification for current economic thinking, derived from the classical economic analysis of Adam Smith, is that total aggregate well-being will be maximized by allowing (encouraging) each person to maximize her or his own respective welfare (represented by his or her own utility function), not trying to enhance that of others. Each person should use his or her own resources to achieve as much well-being as possible, implying that everyone is deciding, acting and evaluating essentially in isolation from others.

This concept of reality and human nature *regards people essentially as strangers*. It reflects a basically Hobbesian view of the society as characteristically "a war of all against all." In fact, many irrigation schemes in this world are some of the best arguments for the validity of Thomas Hobbes' thesis. Certainly this is how the Gal Oya irrigation scheme in Sri Lanka was viewed before the organizing effort began in 1981. Recall the remark, reported above, of the Ampare district official made to the young organizers as they were about to begin their work, cited above. He thought they would be lucky to get even 10 or 15 farmers to work together.

Yet the organizers managed to get a thousand times that many farmers participating in problem-solving organizations that have lasted now for two decades. After one year of organizing effort, one farmer-representative told me, "There used to be lots of fights among farmers here over water, even murders. You can check the records of the police if you don't believe me. Now there are no more." (Uphoff, 1996: 10). In March 2001, when I visited Gal Oya and talked with several dozen farmer-representatives, all agreed that conflict and inequality in water distribution are things of the past. The language that farmers used in referring to each other and even to their relationship with officials was that of friendship, something unheard when we became acquainted with that system more than 20 years earlier.

Raising System Productivity through Reoriented Social Relationships

Indicators of the increased effectiveness, efficiency and equity of water management in Gal Oya were reported above. To me, as a social scientist, what is more impressive is how thousands of farmers living in "a war of all against all" could join together in cooperative, even altruistic endeavors, especially in such a short period of time. We do not have similar statistics to cite from Sirsia-Dudhaura, but farmers there reported similar improvements in channel cleaning and water distribution within about three months of the start of efforts to establish organizational capacities.

How such changes could be introduced and maintained is one of the most interesting challenges for applied social science. I think this experience also pushes us to think more deeply and revise some "basic" understandings of social science, the preference for *structural* analysis to the neglect of other modalities. This is not to reject structural approaches. They are the bedrock of social science and are important for explaining "what is." They are, however, less useful, I now believe, for understanding and creating "what could be."

This is a *both-and* world where taking one perspective to the exclusion of the other is almost always going to be suboptimal. So the following argument is not a rejection of structural analysis but rather the presentation of an alternative, not really antithetical, perspective. I believe that taking idiosyncratic and subjective factors into account in a serious, systematic way can expand upon and improve our present social science approaches to irrigation management, and indeed, to most social subjects that we try to explain, i.e., develop theory for.

Using the Concept of Utility Function

While much of human behavior can be accounted for in terms of independent utility functions, when it comes to irrigation management, I want to suggest the importance of having -- or fostering -- *positively interdependent utility functions*. This means that individuals are including in their definition of their own welfare also, to some extent, others' welfare. This is, indeed, a good technical definition of *friendship* -- that people value each others' well-being, and are willing to make some sacrifices for each other because they consider others' benefits as a fulfillment of their own desires. (The technical definition of an *enemy* would be the converse, negatively interdependent utility functions, where any improvement for one's enemy detracts from one's own sense or reality of well-being.)

Friendship is a matter of degree, not simply of kind, so that there are friendships where people are willing to incur large costs for others' sake, while other friendships are moderate, having definite circumscription of the costs that would be borne for others' benefit. Such calculations are of course synchronic, at a particular point in time. Over time, we know that where people are willing to help, support and protect each other, the net benefits for both are usually greater than in the absence of such cooperation.

This willingness to benefit each other can be prompted by a social norm of *reciprocity*, by pragmatic calculations of *net utility*, by affective bonds of *love, empathy and mutual regard*, or by some combination of these. Where there are net benefits for both friends, or a credible expectation of net benefits in the future, the sense of *obligation* that espoused friendship entails and the *emotional attachments* which represent the most exalted but ethereal aspects of friendship will be *reinforced by individual payoffs*, present and/or future.

Dealing with a Variety of Motivations

Reductionist social scientists try, literally, to reduce friendship just to the latter -- individual benefits. But this is a simplistic and largely barren way to understand friendship. Benefits are clearly important, but they are more a result than an entire cause. I say this because from my discussions with farmers in Gal Oya, when I tried to account for the transformation in social relations that had taken place -- not just between and among farmers but also with officials and engineers -- I was struck by how often farmers talked about the cognitive and normative dimensions of what had occurred.

Farmers would say that they now cooperated in regimes of water allocation and water saving because previously they had not thought about the consequences of their actions (water stealing, structure breaking, or simply water waste) on others, whom they now knew through their associations Upstream farmers had felt no bond with downstream farmers, which they now had. It was most intensive with farmers who got water from the same field channel and who formed the field-channel group, the organizational 'building block' for a larger system of farmer organization. But through their representatives, they became aware of the larger number of farmers who were interdependent on a single, limited source of water. This included for Sinhalese farmers in the upper reaches, taking account of Tamil farmers downstream. If thought about before, these others were abstractions. Through the system of farmer organization, these were now real persons, with personalities, with families, with legitimate needs.

Now it helped the organizing process immensely that through cooperation, this scarce resource of water could be, in effect, increased, so that water distribution became positive-sum rather than zero-sum (or negative-sum when structures were broken and seepage and conveyance losses were increased). The remedial actions planned and implemented by field-channel groups to solve their own water shortage problems aggregated to large water savings, ultimately to roughly a doubling in water-use efficiency.[12]

The unspoken rule of thumb in improving irrigation management in Gal Oya and Sirsia-Dudhaura was "Pareto optimality," where in terms of water distribution, no farmers who had previously received water should be made worse off, i.e., deprived of the minimum of water needed to grow a crop. Farmers in privileged locations were expected to agree to redistribution of all water above this minimum with the assurance that if the minimum proved to be inadequate, some supplemental issues would be made. Farmers in less advantaged geographic positions were willing to make such an accommodation because they were now getting more water than before.

Thus, one might say that there were no costs to such a system. But in fact, there were: the labor and time required to clean channels and maintain structures and to operate an equitable, efficient system of distribution. Why should farmers at the head-end who had been getting a surfeit of water (and wasting that which flowed through their fields into drainage canals) cooperate in planning meetings, channel cleaning, etc. when with their locational advantage they could get sufficient water by doing nothing?

I once asked this question of a group of organizers. One answered: "It's hard to be selfish in public." By catalyzing field-channel groups, there was now a public space in which farmers were expected to meet regularly. In such situations, consensus on efforts to remedy the problems of those in need was usually very quickly reached. Why did head-end farmers participate? one might ask. From my discussions in the field, I think because of the multi-stranded relationships that farmers had even in a settlement scheme, where for the previous 20-30 years, there had been no evident social cohesion and an abundance of conflict and strife.

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12 Cleaning channels speeded up water flow and reduced seepage and evaporation losses; rotating water deliveries among fields rather than supply small amounts continuously to all fields did the same; monitoring deliveries to cut them off to fields and to channels as soon as the minimum water requirement had been met redistributed water from areas that had previously gotten a surplus to areas where even small amounts of water would have high agricultural productivity payoff (Wijayaratna, 1986).

Farmers who wasted water were evidently engaging in "anti-social" behavior, felt keenly by those affected by it. Their wives were likely to be regarded less favorably by other women in the community. Possibly their children would be less welcome in the groups that kids form. If a water buffalo happened to break into their rice fields, the most attractive ones in the area, neighbors were unlikely to come tell the privileged farmer or to chase the beast out themselves.

In a situation where there was what Sinhalese call *ekamutakama*, a spirit of unity or oneness, this would be very different: all women would feel more solidarity, as would children, and fields would be more secure. The extra effort by head-end farmers to participate in an efficient and equitable scheme of water distribution was compensated by kinds of security and satisfaction that only show up in very inclusive utility functions, not just yield and income as credits and time and money spent as debits.

But from discussions with farmers, there seemed to be still more than this (still utilitarian) set of considerations motivating their new-found spirit of cooperation. There was a sense of solidarity and an appreciation of the *ekamutakama* which now animated their communities, providing many psychic as well as material benefits.

Channel cleaning in Gal Oya and Sirsia-Dudhaura was done usually by *shramadana*, an ancient tradition common in most of South Asia where people engage in voluntary community service such as irrigation improvement, road repair, temple maintenance, etc. This is thought to confer merit on participants in Buddhist and Hindu traditions, but this benefit is much deferred and rather intangible. *Shramadana* occasions are usually enjoyable social events, despite the hard work done. There are refreshments partaken and a spirit of camaraderie as everyone engages in the labor. (Actually, this is an idealization, since often the richer members of a community "participate" by providing funds for the refreshments.)

I mention this because we found that *shramadana* was important not just for the greater efficiency and predictability in water distribution it enabled, but for the canalization of community solidarity. This was reinforced by meetings, committee work, delegations, etc. where farmers got to know each other, initially and then better. Especially traveling together to other places was important for building solidarity, since it heightened a sense of common identity and interdependence.[13]

INTEGRATING STRUCTURAL AND OTHER KINDS OF ANALYSIS

The farmer organizations introduced in Gal Oya and Sirsia-Dudhaura could be analyzed from a structural perspective. They introduced *roles*, particularly that of farmer-representative, which were essential for facilitating (lowering the transaction costs of) decision-making, resource mobilization, communication and coordination, and conflict resolution. There were also a variety of *rules* that were formulated by the farmers themselves once the group process was underway.

For example, to prevent the associations from becoming politicized and used for partisan purposes, it was agreed that any farmer chosen to full an irrigation management role should resign any positions he or she held in local party organizations. There were also rules about membership eligibility and responsibilities. *Precedents* were set for work obligations, reaching consensus, resolving conflicts, etc., and various *procedures* for collecting and accounting for funds, for informing farmers about any changes in the water distribution schedule, etc.

There were thus established a set of socially-constructed relationships -- obligations, expectations, sanctions, etc. -- that enabled farmers to engage in collective action to improve their irrigation management. Most of these were informal, at least in the initial period, when farmers were trying to determine what would be the most effective and least-cost ways to make improvements.

One of our program's hypotheses was that we would be more successful by initiating the program on an informal basis rather than start by forming an organization -- approving a constitution, electing officers, etc. Our motto was 'work first, organize second,' meaning organize *formally* only after people have demonstrated for themselves the value of working together. This creates a 'demand' for organization instead of starting off by providing a 'supply' of organization (see Uphoff, 1985, for this and other

13 This was important not just for farmers. The USAID project in Sri Lanka provided funds for groups of central government officials, members of parliament, and irrigation engineers to visit the Philippines, to observe the NIA program which was more advanced than ours in terms of participatory management. The personal relationships cemented during such tours were probably more important for the progress of our program than the knowledge that was gained.

program 'hypotheses').

This dynamic was reinforced by another hypothesis, that we should start the organization process at the field channel level, where there would be 10-20 farmers all getting their water from the same source. These field-channel groups became the 'building blocks' for the system of organization. Their small size made friendship and caring about others more feasible as people met and interacted with each other frequently in day-to-day activities.

This approach was basically structural, and I would make no criticisms of or apologies for this. It was fundamental for creating *capacities* for mutually-beneficial collective action. At the same time, it was not, as I reflect on our experience, sufficient for success, as this was not by itself *motivating*. There were many material, indeed individual benefits that could be produced by such cooperation. But overcoming the previous selfishness, indifference, suspicion, even antagonism required more than just opportunities. There had to be elements of trust and solidarity to get the process going and to sustain it.

The young organizers who were deployed into the villages in Sri Lanka and Nepal to catalyze these processes of change were not trained to be "change agents" in the conventional sense. We did not expect to change the farmers in these communities so much as to give them new opportunities and to evoke from within these communities *existing potentials* for cooperation and innovation. This was why we used the word 'catalysts' to describe the organizers, rather than the common term 'change agents.'

There were two particular values that animated our program, and the organizers who represented it in the field, in addition to the obvious value of efficiency that the USAID project emphasized: participation and equity. These were values that the organizers, having a lot of youthful idealism, could feel strongly about. There were farmers in each community, not always a large number to begin, who shared these values, even if they had not been able to give any public expression to them in the past, when the prevailing social scene was better described as anarchic than cooperative.

Probably many of the farmers, even a large majority of those who came forward to work with the organizers, were motivated by desires to improve the efficiency and productivity of water management for their own families' benefit. But those who moved into leadership positions and who set the semantic and moral tenor of discussions were persons who had a greater sense of idealism and community spirit than the average farmer. They were willing to invest their own time and money in getting the organization process moving. They took the lead during the first phase when everything was done informally, organizing work parties, leading delegations to the Irrigation Department, keeping records, etc. They were the obvious and natural choices to assume formal leadership roles when these were established by consensus after some months.

What was interesting to watch was how these more altruistic farmers set the tone for an organization which was more other-regarding than if we had approached the organization process purely on the basis of incentives, emphasizing what was 'in it' for each individual. Even more interesting was to watch how persons who had been farmer-leaders in the community before had to adopt more community-centered approaches and rhetoric to maintain their leadership status. (Some examples are given in Uphoff, 1996: e.g., 80-85).

In irrigation management, it is fortunate that there are material payoffs from idealistically framed cooperation. By increasing the effective supply of water, by reducing seepage and conveyance losses, the expressions of empathy for tail-end farmers given expression through better O&M had the effect of 'increasing the pie.' In such an environment, the criterion of Pareto optimality led to a conflict-reducing situation, feasible because the 'pie' was now bigger.[14]

The situation in Sirsia-Dudhaura was not that encouraging today: The cultural and economic conditions were less favorable for these values in that part of Nepal, effectively an extension of the caste and class system of Bihar, and we had less time to work with farmers to reinforce these values. However, we can see in Gal Oya that 20 years after participatory irrigation management was introduced, there is an indigenized and institutionalized commitment to equity and participation.

This commitment is not perfect or total, and the advantages of political and economic power as well as geographic locational advantages surely

[14] There were also non-material payoffs, such as the often-cited benefit that with a reliable and equitable distribution scheme, "We can now sleep at night." Farmers no longer had to stay up all night in their fields during their channel's turn for water issues, guarding the trickle of water allocated to them, and maybe encroaching on their neighbors' supply. There were many reasons why they would rather be back home in bed.

influence outcomes. But I would argue, the norms of equity and participation are stronger and more operative -- *with concomitant outcomes of efficiency and productivity* -- than if we had proceeded purely with structural thinking and with an emphasis on individual, material incentives as is common in the social science literature.

My suggestion is that we engage in the best possible *structural* social science analysis and practice but regard this as just one part of the task. Beyond structural approaches, if we want improved irrigation management in either AMIS or FMIS that is equitable and sustainable, as well as efficient and productive, we should think and act in terms of the *cognitive* and *normative* dimensions of social structures.

Norms, values, attitudes and beliefs that are inside people's heads (and hearts?) are not just reflections of individual, material interests. They are shaped by people's culture and religion as well as by their personal experiences and convictions. These are influenced by family and community interactions to produce unique individuals with a sense of self-interest but also of fairness, legitimacy, justice, and solidarity.

CONCLUDING THOUGHTS

A fuller appreciation of this broader set of factors that motivate and reward people would require another paper, or several. I have discussed these issues analytically in Chapters 12 and 13 of *Learning from Gal Oya* (1996), exploring the contributions of ideas and ideals as well as of friendship to the establishment of sustainable capacities for mutually-beneficial collective action, which are essential for long-term improved management of irrigation systems.

A desire for rigorous and parsimonious analyses can reduce the relevance and realism of our conclusions. This paper is not disputing the existence and importance of incentives and 'rational choice' but rather questioning their adequacy for understanding and improving irrigation performance. The 'soft' side of 'software' -- values, norms, attitudes and beliefs -- may be less tangible than are the material interests and resources that we see in individual incentives and physical payoffs. But its consequences can be very real and concrete.

Indeed, the significance of these 'softer' aspects of management decisions and activities is enhanced by their softness, in that they are not subject to the same limits of physical scarcity that material factors are. If people decide to become and act as friends, including others' welfare within their own utility functions, this subjective act is just a matter of choice. It will have some material consequences, and certainly some costs. But it can also produce multiple benefits, magnified because a benefit for any one among friends produces satisfactions for all of them.

The world will not be freed from the reality of many zero-sum constraints, where tradeoffs are unavoidable, and one person's gain represents another person's loss. This is part of the human condition. But it is not the entirety of the human condition.

The irrigation sector is probably unique among domains of human activity in that it holds out many possibilities for escaping the limits of zero-sum relationships. Unfortunately, when we view it through the zero-sum assumptions of neoclassical economics and rational-choice theory, we cannot see these possibilities. This is why I think we need to expand our social science horizons to give equal footing or billing to these 'softer' factors which can produce many 'hard' and very desirable results.[15]

[15] This has also been elaborated in Uphoff (2000a).

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FARMER MANAGED IRRIGATION SYSTEMS AND SUBSISTENCE AGRICULTURE IN NEPAL

ROBERT YODER[1]

INTRODUCTION

Much of the irrigation research emphasis for the past few decades has focused on technical, management, and governance issues related to operation and maintenance of irrigation systems. Less emphasis has been placed upon the agricultural production outcome that motivates Nepal's farmers to invest their labor and cash to access and control water for their fields. For many farmers in Nepal's remote areas, the most evident change they face is a growing population and its impact on their community's limited forest, land, and water resources. Close to cities and for fields near the ever-increasing network of rural roads, however, urbanization and the global economy compete for land and labor that have long supported household food production. This paper briefly examines the origins and characteristics that distinguish Farmer Managed Irrigation Systems (FMIS) in Nepal. It then examines the impact and choices farmers with access to irrigation may have as their landholdings shrink and they face new circumstances.

SUBSISTENCE AGRICULTURE AND IRRIGATION

Nepal's irrigated agriculture system appears static when viewed from only a few decades of observation. A bit longer time-slice, however, suggests dramatic change over the past two centuries. Myths of the Gurung hill tribe in central Nepal suggest that only a few hundred years ago they were shepherds who practiced limited cultivation by shifting fields each year (Hodgson, undated). Horses are mentioned, but never plough animals. As cereal crops became more important to them, they moved lower into the valleys and in the past 150 years began growing rice. Valley bottoms that could sustain multiple crops were malaria infested and settled only after the hilltops could no longer support the growing population. Land scarcity became a serious problem in the last half century. Population growth turned an expansive economy, where resources of land, fodder, timber, grazing, and wildlife were abundant, into a labor-abundant economy where

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natural resources limit growth.

While most hill slopes in Nepal remain dependent on rainfall for crop production, springs, streams and rivers have been diverted on a massive scale to supplement rainfall for more reliable agriculture production. The story told by a farmer in Chherlung of Palpa District may represent many communities in Nepal that built irrigation systems in the past 100 years. Chherlung is in a favorable location with several areas of gently sloping, fertile fields and a mild climate. However, by the 1920s the community could no longer grow enough rainfed crops to supply subsistence food needs. Most households sent members to work in India to supplement their income. Migration to the Terai or other less populated locations was a possibility but malaria posed a serious threat in the Terai and less populated locations in the hills also had fewer resources. Some concluded that building an irrigation system provided the best alternative for increasing food production in Chherlung. Growing more subsistence food was the driving force that enabled a group of 27 households to mobilize cash and labor to construct a long and difficult canal.

Without financial assistance from outside the community, the Chherlung farmers contributed their own labor to complete a small canal. They hired local experts in canal building to survey the alignment and construct the channel through difficult sections. They reportedly sold jewelry and some land to pay for this assistance. When a small trickle of water was successfully delivered after four years of work it confirmed the alignment and proved to skeptics in the community that irrigation was possible.

CONSTRUCTION AND OWNERSHIP OF FMIS

While many FMIS were built by community groups and may mirror the experience of the Chherlung community, other hill irrigation systems in Nepal are hundreds of years old and little is known about their initial design and construction. The Raj Kulo in Palpa District[2], for example, is said to have been constructed under the authority of Mani Makunda Sen, the first Sen Rajah of Tansen, which makes it over 300 years old. Likely, holders of birta land originally constructed many of the irrigation systems.[3]

2 There are a number of Raj Kulos in Nepal. The Raj Kulo referred to in this paper is in the village of Argali of western Palpa District.

3 Land could be given by the state as birta to individuals in appreciation of their services. The birta grants made to individuals were usually on an inheritable and tax-exempt basis. The recipients included priests, religious teachers, soldiers, members of the nobility and the royal family (Regmi, 1978).

Birta-holders were entitled to share the production of peasants who farmed the land, and they were granted the authority to exact unpaid or corvee labor from these tenants for various purposes, including the construction of irrigation canals (Regmi, 1972). The birta-holder could mobilize the labor needed for construction and secure the rights-of-way for the canal.

In 1959, the birta system was abolished and all the birta lands were converted into raikar landholdings by granting permanent rights to tenants who had records to show that they cultivated the land (ADB/HMGN, 1982).[4] There is evidence from the operation and maintenance rules of irrigation systems that ownership of the system is understood by farmers to be vested with the persons entitled to use water from the system. When tenants with land irrigated by the Raj Kulo system became landowners, they changed some of the operating procedures for the Raj Kulo. Instead of using the money collected from fines throughout the year for a feast at the end of the season, they began systematic investment in upgrading the irrigation system.

The national government was also sometimes involved in developing irrigation systems in the 18th and 19th centuries (Regmi, 1984). This was a period when increased agricultural production was needed to support a large standing army following the expansion and consolidation of a unified Nepal. There is little information about the ownership of these systems. However, in a law on reclamation of wasteland it is clear that the government recognized the efforts that farmers had made in developing irrigation systems. The law declares: "Water shall not be available for others until the requirements of the person who constructed the irrigation channel at his own expense with his own physical labor are first met" (Regmi, 1963).

CRAFTING FMIS INSTITUTIONS

Groups of farmers, if by dictate of a birta owner or on their own initiative as in Chherlung, recognized the value of irrigation and worked together to construct irrigation systems. By pooling their resources they accomplished much more than was possible by the labor of individual families. Though construction was often fraught with conflict, the incentive of reliable and increased food production motivated development of creative ways to

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[4] Both by law and tradition, land was the property of the state. As both sovereign and landowner, the state was entitled to the payment of a part of the produce of the land as tax or rent. This system of state land ownership is called raikar.

manage differences. The need to move ahead with construction in ways acceptable to all participants forces farmers to find ways to make collective decisions. They adapted the process of institution building to their socio-cultural experience in the same way that the structures built were tailored to fit the physical environment.

In the process of carrying out the construction of their irrigation system, Chherlung farmers discovered that they needed a leader with skills in organizing the work, a leader they all trusted to distribute the workload fairly and to keep records of each household's contribution. They found that they needed to hold frequent planning meetings where they could discuss and eventually agree on the details of the different tasks that needed to be done and determine who among them was best able to do the job. Because of the enormous amount of work to be done, they required cooperation from all members. They learned by experience that a working agreement was necessary before proceeding with an activity or else some members would not cooperate. Disagreements and misunderstanding over decisions reached earlier resulted in assigning one person to write a record of the discussion at meetings. Since many of the farmers were illiterate, they initiated the practice of reading the minutes aloud at the end of each meeting before asking those attending to sign. The institutions crafted by the farmers investing in the construction and early period of system operation in Chherlung still endure today, over 70 years later.

FMIS have evolved in many different ways in Nepal. Not all users of FMIS have gone through the process of constructing their own system or even necessarily had much responsibility for making physical improvements. However, in many cases, the construction and ongoing improvement processes provide both the incentive and the experience essential for establishing enduring institutions to govern FMIS enterprises.

Water Rights

The right to use water for irrigation is carefully controlled by FMIS irrigators. Although the state views the water resources of the country as a common good, it does recognize that those who worked to develop an irrigation system have the first right to use the water. To protect prior rights, a new intake cannot be established above an existing one if doing so will decrease the amount of water being diverted into an earlier canal (Mulki Ain, 1936).

The right to use water from an existing irrigation system and the amount of water that a user is entitled to is often fixed and carefully controlled by the FMIS organization. Persons gain entitlement to irrigation water by participating in the construction of a system or by buying or inheriting land that has been allocated the right to use water. In a few areas the entitlement is not tied to a specific parcel of land but is viewed as property that can be exchanged (Martin and Yoder, 1998). In both cases all the persons who cultivate land irrigated by the same canal are members of the organization that operates the irrigation system. The organization records the allocation of entitlements to water (the percent of the total irrigation supply for which each member has entitlement) and attempts to operate the irrigation system to deliver the water according to the allocation.

Rice Terraces

To grow flooded rice, fields must be leveled and bunds built to pond water. Tremendous labor has gone into reshaping hillslopes into bunded terraces. An individual cultivator's family usually does this work although a wealthy landowner may hire labor or have it done on contract. In the past, corvee labor may have been the major input for the construction of terraces. Terrace building usually does not begin until the irrigation channel is complete and it is certain that it will operate. Then year-by-year, in periods when labor is available, the terraces are built. Expansion of irrigated land continues as long as there is enough water to irrigate or until all the land available to those who have the right to use the irrigation water has been converted to terraces.

SUBSISTANCE AGRICULTURAL PRODUCTION

Most FMIS in Nepal were constructed to supplement rainfall in the monsoon season for growing rice. Maize was considered a bari (slopping usually unirrigated fields) crop. In the Raj Kulo maize was first introduced as an irrigated crop in the khet (level and bunded fields to pond water for growing rice) between 1910 and 1920 (Yoder, 1986). Prior to that the khet fields were used for grazing except in the monsoon rice-growing season. Wheat was first grown in the Raj Kulo khet fields in about 1960. It was possible to introduce wheat as a third annual crop only after short season variety maize became available. Even with shorter season varieties of rice, wheat, and maize, farmers must minimize the time between harvest of one crop and planting the next in order to maximize each growing season. By the late 1970s these three subsistence grain crops were grown in nearly all of the Raj Kulo khet each year. Most farmers had 300% cropping intensity in their irrigated fields year after year.

Bottlenecks to Increasing Subsistence Agriculture Production

For Chherlung, the controlled water supply enabled the addition of two irrigated growing seasons. Shifting from one to two or more crops per season has been critical in accommodating the growing population in many communities in Nepal. Increased annual production per unit of land, however, has been offset by the decreasing size of landholdings as family landholdings are divided among sons in each generation.

Land Constraint

In 1982, land holding of irrigated khet in the Raj Kulo, and in many other of Nepal's FMIS, averaged less than half a hector per household. With good water control and use of some fertilizer Raj Kulo farmers averaged about 7500 kg/ha annual cereal production (Yoder 1986). The average Raj Kulo family's half hectare produced sufficient grain for the subsistence needs of about 17 persons.[5] For the average household of six persons this level of production allows the sale of enough grain to purchase seed, fertilizer, and meet other household needs. Already in 1982 about a third of the households farming in the Raj Kulo command area were not able to grow sufficient grain to meet household consumption needs. In one or two generations only a few households will have enough irrigated land to grow all of their own food in the Raj Kulo command area.

Water Shortage

With few exceptions, the large snow-fed rivers are not available to FMIS irrigators. They are cut deeply into the valleys and require longer and more complex canals than can be built and maintained by a few farm families. Farmers use the streams and springs of smaller watersheds for irrigation. Intensification of rainfed agriculture in these watersheds removes the forest cover and increases runoff of rainfall. Less rainfall infiltration reduces the flow of springs and the base flow of the streams diverted for irrigation. Villages and towns use the same springs and streams for their

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5 Subsistence cereal needs for an adult are assumed here to be 220 kg/year. This is based on the National Planning Commission (1978) poverty line income level set at the daily intake of 2256 calories, which requires daily consumption of approximately 0.6 kg of cereal.

water supply and have higher priority for using the water than irrigators. As the demand for municipal water increases, the supply of fresh water available for irrigation near Nepal's towns and villages will decrease.

Temperature/Growing Season

The command area of the Raj Kulo is at about 600 m elevation but many of the fields irrigated in the hills of Nepal are at higher elevations where lower temperatures limit the growing season to two crops. In many hill areas and especially in the Terai, lack of sufficient surface water limits the extent of irrigation in the dry season. The intensive agriculture system of the Raj Kulo, while not unique, is considered close to the upper limit of production for cereal crops under irrigated conditions with the seed quality and fertilizer levels currently used.

Labor Constraint

The Chhattis Mauja system near Butwal and the systems of the Kathmandu valley are facing growing labor constraints. Since smaller landholdings do not support full family employment or production levels for subsistence as in the past, many household members have taken day jobs to supplement family income. These jobs require regular working hours that make it difficult to be available to carry out system maintenance as in the past. The Chhattis Mauja system allows members to pay for others to be hired to carry out maintenance. Kathmandu valley has a number of FMIS that are slowly falling into disrepair. Farmers say they can no longer mobilize labor for maintenance because of the high percentage of household members with off-farm employment.

In many communities, young people are leaving agriculture. Fewer of the younger generation have experience with canal maintenance and operation. There is growing concern that leadership as well as labor will soon not be available. Higher income from irrigated agriculture has enabled some farmers to send their sons and daughters to school, which has opened opportunities for higher paying, less demanding jobs outside the community. Unfortunately, few educated persons are choosing the agriculture profession and this contributes to FMIS leadership problems.

Urbanization

Urban sprawl has taken over much of what was productive agriculture land only a few decades ago in the Kathmandu valley and near other urban centers. Population growth and industry compete for the water supply and increase the pollution of water sources used downstream for irrigation.

INCREASING AGRICULTRE PRODUCTION

Three generations ago Chherlung residents faced a food crises that led them to building new irrigation systems. Even with the improvement and expansion of those systems, many households in Chherlung are again facing a situation where their current agriculture system cannot supply their needs. Nearly all the land commanded by Chherlung's canals has been converted to khet for growing rice and is under intensive annual three-crop cultivation. This situation is repeated in many FMIS in Nepal. To a large extent Chherlung is land constrained. Further improving the system to bring additional water will bring little change in the cropping pattern or the crop production.

The Raj Kulo in Argeli, Palpa is limited by its water supply. It commands land that is currently only irrigated in two seasons while there is potential for three cropping seasons. Water delivery efficiency could bring some additional land under three-season irrigation in water abundant years. However, Raj Kulo farmers will not allow system expansion because they are fully aware that in drought years there is not enough water for all the fields that are currently entitled to water. The watershed above the Raj Kulo is small and fully developed for rainfed agriculture. There is little potential for changing land use in the upper watershed to increase rainfall infiltration, which would increase the discharge of springs in the dry season. The Raj Kulo shares its water supply with the town of Tansen, which pumps most of its municipal water supply from a spring just the Raj Kulo intake diversion. Since municipal supply for drinking has priority over irrigation use, the Raj Kulo faces a decreasing water supply.

Shifting Emphasis to Agriculture Production

For the past few decades there have been programs for improving the water delivery performance of FMIS. Both the Asian Development Bank and the World Bank have sector loan projects that are designed to engage farmers in improving the diversion and canal structures for more efficient water delivery. In some systems this has increased the water supply delivered in the rainy season for growing rice. In others it has improved reliability of the systems and improved the performance in multiple cropping seasons. In most cases these programs have reduced the maintenance required to repair the diversion, which is greatly appreciated by the farmers. However, the expected expansion in irrigated area and cropping intensity has not been achieved. Fully evaluating existing and negotiating future water rights and better assessment of the available water supply are areas that require more attention from the assistance programs.

While a great deal of attention and assistance funding has been focused on physical improvements and to some extent on the governance and management institutions for improving FMIS, little effort has been made to improve the agriculture systems of FMIS. Agencies responsible to support irrigation and agriculture are under different Ministries and have a poor record of cooperation and coordination. FAO is providing support to the World Bank-funded Nepal Irrigation Sector Project for on-farm water management. This is based on FAO's Special Program on Food Production in Support of Food Security in Nepal (SPIN). SPIN has shown significant improvements in production that can be achieved by introducing on-farm water management improvements in combination with improved agricultural practices. Much greater investment and better coordination are necessary to promote research-based agricultural practices that will increase production levels of subsistence crops irrigated by FMIS.

Beyond Subsistence Crop Production

Recasting FMIS assistance programs to focus first on the agriculture system to ensure that green revolution technology is fully used, as in the SPIN project noted above, is an important step. However, with landholdings shrinking and water supplies increasingly diverted to drinking and municipal use, other measures are required to keep FMIS viable, especially near urban areas. Helping FMIS move beyond subsistence agriculture to access market opportunities should be made a priority. This requires addressing post-harvest handling and storage, processing, transport, and marketing issues. There are examples where individual farmers have discovered ways to move into higher value production but there has been little systematic effort in helping irrigation based producer groups develop strategies and institutions for effective market penetration.

In the Raj Kulo command area one family experimented with vegetable and fruit production in the 1970s. Even when transport required carrying produce 3-4 hr to a market and spending the day at the market to sell the produce, the family demonstrated higher returns than with subsistence crops. When a road was completed to the Raj Kulo command other farmers began experimenting with vegetable production and marketing. There was some success but without organized post-harvest storage, processing and organized marketing, the returns were limited.

Past experiments in trying new crops have not all proven as successful as expected. Coffee produced in Nepal is of high quality but does not have a strong domestic market and faces oversupply in the international market. Apples grown in Nepal are of high quality but due to transportation costs were not initially able to compete with lower quality apples from India in Nepal's domestic market. Market research and marketing expertise needs to be a part of the program as much as introduction of technology and information for production of new crops.

A significant segment Nepal's rural population currently searches for work in the cities and abroad. Opening productive, higher value agricultural enterprises could employ some of that labor in their home communities. Nepal has a wide range of climate and soil conditions, and capacity for excellent water control. There is considerable potential for growing higher value crops provided appropriate support structures are put in place. As transportation improves and international markets grow, there will be opportunities for Nepal's agriculture to fill labor-intensive niche markets. Individual farmers are at a disadvantage to establish such new enterprises. However, already established FMIS groups or new marketing organizations could be established to provide a level of production that can penetrate new markets

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