PN-AAZ-349

ISN 54893

USING EVALUATION TO IMPROVE MANAGEMENT PERFORMANCE

SOME PRELIMINARY THOUGHTS

Nancy St. Julien
City & Regional Planning
Cornell University

and

Michael F. Walter
Agricultural Engineering
Cornell University

March 25, 1988

This paper was prepared for the Water Management Synthesis Project, USAID Contract DAN-4127-C-00-2086-00, to the Consortium for International Development.

PREFACE

This working paper is one product of a Water Management Synthesis II Special Study on Improving Management Performance. Other reports in this series include an evaluation of some common measures of irrigation system performance and water supply by Toti Moya and Michael F. Walter (WMS Report 92) and a classification of gravity systems and their operation by Roy Steiner. Nancy St. Julien and Michael F. Walter's contribution to this study is an examination of the evaluation process and its effect on irrigation system management.

They outline three reasons why evaluations have failed to contribute to the improvement of irrigation system management. The first is that evaluation methodologies have not adequately recognized the multiple and conflicting objectives of irrigation projects. This often means that evaluations do not correctly specify project problems and pitfalls. St. Julien and Walter suggest that evaluators begin by evaluating the incentives associated with particular irrigation behaviors. They also urge professionals to take the "bottom-up" view seriously and use criteria suggested by farmers in developing measures of project performance.

The second problem is associated with data collection efforts. St. Julien and Walter find on the one hand a paucity of data relevant to evaluation and on the other quantities of statistical data that shed little light on significant problems. They warn that data collection is costly and urge evaluators not to overreact to data shortfalls by overcollecting. To maximize the utility of data they suggest that data collection efforts for evaluation, monitoring, and research be dovetailed. They also offer some quicker techniques for data collection and suggest indicators of overall system performance that incorporate risk and change.

Third, St. Julien and Walter identify some factors that hamper the analytical process and make it difficult to learn from project evaluations. In this section they focus on the evaluation team and present suggestions for team composition and deployment. They also discuss problems associated with dissemination of and generalization from the findings of evaluations.

This paper is preliminary in nature. The authors welcome comments, criticisms, and directions for further study.

Barbara Lynch
Water Management Synthesis II Project
Cornell University

INTRODUCTION

This paper focuses on how we as contributors to irrigation development can learn from our past mistakes and how can we apply this learning to future efforts. Evaluation is required for most projects. It is a powerful mechanism for improving management at three levels. At the system level, evaluation can provide feedback to aid in improving operating procedures. Evaluation itself can establish and reinforce patterns of information flow and communication. At the planning level evaluation can determine what works and why it does. This information can be applied in planning for future projects. Properly framed, an evaluation can contribute to a better understanding of the interrelationships among the determinants of irrigation system performance and project processes at a more theoretical level as well. Unfortunately, irrigation system evaluations rarely accomplish these objectives.

If evaluation is to be made more useful to the irrigation studies community, what should change? In this paper, we discuss three important factors that make it difficult to learn from evaluations and therefore to improve management: 1) inability to establish cause and effect when there are multiple and conflicting objectives in operation; 2) lack of adequate data; and 3) difficulties in translating complex realities, observed through less than perfect means, into applicable and relevant "lessons" or "learning." After defining a particular problem area, we offer insights gained from case studies, from the literature, and from structured and unstructured interaction with colleagues. In conclusion, we summarize our observations on how evaluation methodologies can be changed to aid the learning process.

PROJECT EVALUATION IN CONTEXT

Evaluation is an adjunct to planning. Traditionally, planning is viewed as the rational process of gathering information, defining and assessing alternative courses of action, and selecting and perhaps overseeing the implementation of the best course of action. The purpose of evaluation is to review this process and point out deficiencies. In donor-assisted irrigation projects around the world, planning usually follows this traditional pattern. On the basis of economic, financial, administrative and technical feasibility assessments, projects are formulated and negotiated, and detailed schedules are drawn up for implementation. Evaluation is the last step in this long process, meant to improve future planning in similar areas. In the traditional process then, evaluation does not contribute directly to improving the current project because it is already too late. Timing difficulties can also severely limit the possibility that insight from evaluations can be applied to future project planning because it is unlikely that a single review will be able to capture anything of an explanatory nature. Further, the mechanisms that facilitate the transfer and application of learning from one project to the next are weak.

Most irrigation system/project evaluations are supposed to answer the question: "Has performance met the stated project objectives?" Yet most end up as audits of expenditure patterns and lists of short-term goal achievements. Somewhere along the line, the focus shifts from the achievement of major goals ("Did the project accomplish what it was supposed to accomplish?") to petty administrative issues ("Was the project kept within its administrative constraints?"). Evaluations usually do not explain the shortfalls or success) in performance, and when they do, responses are invariably couched in terms of implementation problems. The planning process itself is never questioned: "Are the

objectives originally set forth good ones or has planning failed?"[1] This subservience of the evaluation process to planning in the traditional approach has limited its effectiveness for learning and other useful purposes.

Many theorists and practitioners now question the validity of the traditional planning model in complex situations and in development planning in particular.[2] Korten's (1980) summary of the reasons why we need a more iterative, interactive, "learning process approach" is probably the best-known treatise on the subject. The "learning process approach" accords considerable importance to evaluation and similar feedback devices in the planning process. It starts out with the premise that no planning process is perfect, all difficulties cannot be predicted, and planners and implementors are going to make mistakes. Planning must be flexible enough to anticipate needed change and projects cannot be imposed on the beneficiaries without their active participation.

Nonetheless, the blueprint model of project planning and implementation, with all its inadequacies is still the framework for donor assistance. Government restrictions and accountability guidelines are the stones and mortar which keep this edifice strong. How then can we operationalize an adaptive, learning process mode of planning in the face of this resistance?[3] "Learning" in and from irrigation projects can be significantly increased if

---

[1]When a project fails to meet its targets, it is usually assumed that the project implementation has failed. Perhaps, in fact, the targets were totally unrealistic from the outset, or maybe the situation has changed enough to make the originally reasonable, (but inflexible) targets now unattainable. We cannot discern between these explanations by merely noting, and perhaps measuring, how far performance is from target.

[2]This started coming out in the academic literature through Lindblom's (1965) incrementalist notion of *muddling through* , in Simon's (1965) *bounded rationality* or *satisficing,* in Friedmann's (1973) adaptive or transactive planning. Hirschman's (1970) *Development Projects Observed* is a classic description of the problems of rational planning approaches in development. Practitioners in the late 1970's were coming around to the same notion. Korten's (1980) Learning Process Approach paper, which probably got the most play outside the small and rather immature field of rural development, captured in writing the consensus that was being reached by people in several corners of the development world. Many other papers have been released since echoing and elaborating these sentiments.

[3] Korten (1980) and others describe isolated, small scale efforts in the Learning Process Approach mode. Uphoff (1984) and St.Julien (1983) examine it in Gal Oya, a relatively large AID-funded project.

we first make learning a more explicit objective of evaluation activity and then bring evaluation methods more into line with this objective. Properly harnessed, evaluation can 1) help improve the operation of the local system being evaluated, 2) provide insight useful in the planning, operation and problem solving of other systems, and 3) contribute to theoretical understanding of irrigation systems (in the broadest sense) and the process of development intervention.

DIFFICULTIES FOR LEARNING FROM EVALUATION

This paper points out some of the weaknesses and confusion in current irrigation evaluation methodology especially as related to learning and suggests ways that get around or beyond those problem areas, but it does not tell the reader how to do irrigation evaluation properly. There probably is no perfect formula.

We examine three clusters of problems for evaluation. First, the system performance is the result of complex interactions between actors with different interests. When an evaluation methodology does not recognize the multiple and often conflicting objectives under which a system operates, inadequate or wrong specification of problems and performance shortfalls result. Second, limited timeframes and budgets severely constrain data gathering and processing. This leads to some dysfunctional "shortcuts." Third, there are weaknesses in how data are interpreted and passed on as learning.

Problem #1: The multiple and often conflicting objectives a system operates under are not adequately recognized in the evaluation methodology, leading to inadequate or wrong specification of problems and performance shortfalls.

An evaluation should relate performance to project objectives, but whose objectives? The list of objectives printed within the first few pages of a project document often gives the impression that the project represents the activities of many bodies and agencies all working together toward one end. In fact, this list bears little resemblance to the list that would be written if we enumerated all the objectives and agendas that shape project choices and actions. Many parties are involved in irrigation system projects: one or more donor agencies, one or more national government agencies, local government, farmer participants -- each with interests in how the system functions, each with its set of competing uses for the same limited resource pool, and each with its own set of constraints that define an acceptable solution space. To complicate matters further, these conditions

may change over time for any or all of these "groups." Even within "groups," individual interests differ. Farmers are not a homogeneous interest group. Likewise gatekeepers and design engineers do not share the same "irrigation department" outlook. Beyond one shared objective, that irrigation should increase production, there is not necessarily any convergence of opinion on what the irrigation system should look like, what it should accomplish, or how it should be built and maintained.[4]

At any one point in time, irrigation policy objectives are likely to be multiple. The objectives given primary emphasis reflect the political forces in power at the time. An irrigation project can contribute to the achievement of various national policy goals: positive balance of trade, adequate and cheap food supply, reducing regional disparities in income base or ethnic balance; pacification and counterinsurgency; finding a niche for unsettled, unemployed populations, and creating some good press. For example, Rukuni (1987) reports that the initial thrust of the Rhodesian government investment in irrigation was famine relief, but after the Second World War irrigation schemes were expanded to move peasant farmers from areas designated white to African reserves. Although political goals are important and frequently mentioned in internally-circulated project justifications, they are rarely translated into explicit performance objectives. Every decision made at the national level about an irrigation system and its operation (project site selection, who will benefit, what technology will be employed, etc.) requires simultaneous consideration of political, economic and security concerns. The long-term ramifications of specific decisions regarding the system for the system's potential success are not the only

---

[4]The literature provides numerous illustrations of the layered and varying nature of irrigation development objectives. The Mwea scheme in Kenya, for example, began as a work camp for the Kikuyu freedom fighters captured by the British colonial government during the Mau Mau war (Chambers and Moris, 1973). By contrast, the initial objectives of irrigation development in Mexico was to increase production so that the railroad system, object of heavy investments, could be more fully utilized (Greenberg, 1970). In India, the British colonial government linked irrigation at the policy level to "famine protection, revenue stability, the settling of unruly tribes, expansion of cultivation, enhanced taxable capacity, and political stability" (Stone, 1984: 9).

consideration. When political concerns are dominant, the party in power is likely to opt for short run payoffs, with little regret for the forgone longer term benefits of another course of action. These political pressures have a distorting effect on system design and operation which evaluators must understand in order to correctly diagnose problems and offer suggestions for improvement of performance.

An irrigation project is often seen as a way to take care of several problems at once. The original Gal Oya scheme, for example, spanned three administrative districts and included plans for a wildlife preserve, a major hydroelectric plant, a parastatal sugar plantation, resettlement of marginally employed excess population from the towns into irrigated paddy cultivation, better irrigation for minority-group farmers already in the region, and plans for the development of spin-off industries, as well as the usual social amenities like schools, dispensaries, post offices, etc.[5] Projects can get bogged down when they are designed to meet too many objectives. Implementation and coordination requirements exceed the administrative capabilities of the agencies involved.

Donor agencies like USAID operate within a political mandate and are guided by economic development theories fashionable in government circles.[6] Beyond this there is a

---

[5]Many of the assertions in this paper are based on St.Julien's reflections on the implementation and evaluation of the Gal Oya Left Bank Water Management Project in Sri Lanka. She is grateful to Norman Uphoff for keeping her abreast of every new development, and to the Cornell/Agrarian Research and Training Institute Water Management Group for the opportunity to participate in project analysis at the field level on three separate occasions.

[6]Berry (1980) observes an historical pattern to AID's objectives for irrigation, which I think reflect broader changes in the theories of economic development and planning. The earliest projects reflect a **colonial style** wherein irrigation investment is meant to produce crops important to the mother country. Little indigenous input is required, and system management is largely centralized. Some examples of this project style are Indonesia, Indus Valley, Gezira, Office du Niger, and Somalia. Irrigation projects in the **export promotion style** are to advance the production of cash crops for export (for cash income derived from the world market). These tend to be large scale activities, ostensibly in order to take advantage of economies of scale, which create isolated islands of high- tech production. Many of these projects, such as the Helmand Valley project in Afghanistan and the large cotton and tomato producing schemes in Mexico have relative economic success, but fail due to environmental, social or managerial problems. More recently, the emphasis has been on **community promotion**. These projects have tended to be small scale, for the production of agricultural surplus for domestic consumption, though the community

substantial gap between what donors espouse as policy and what they find themselves pressured to do by their own political and bureaucratic imperatives (Korten, 80:484). The project director is the one whose objectives for the project most closely mirror those in the project paper: it is his or her job to see that the project succeeds in terms of predictable efficient implementation.[7] He/she is beset by constraints however. USAID missions have the difficult assignment of designing and implementing projects, many of which by their nature will require a high level of coordination and cooperation rarely found across line agencies of the host government bureaucracy, while simultaneously contending with U.S. administrative red tape. These cooperative efforts require a lot of oversight to be workable. But there is an unspoken tension between the parties involved when the donor exceeds the bounds of "partnership" by spending too much time in the overseer role. Project quality control and administrative reporting requirements that derive from a faceless bureaucracy are less threatening than ordinary supervision mechanisms.[8]

It is not surprising that capital-intensive irrigation projects have been so common in AID portfolios. Host country irrigation counterparts recommend large-scale projects (because the projects are highly visible, because they will bring a little professional excitement into the engineers' lives and perhaps a little money to their construction industry friends, because it is what they have been trained to do), and that is what AID is set up to do best. It is easiest for AID to spend large lump sums on a project with relatively few separate line items. These large projects: (1) absorb large amounts of money in short periods of time (Korten 1980: 474); (2) involve lower ratios of staff time per unit

---

promotion and farmer participation themes are being applied in larger scale irrigation projects as well. Management, institutional development and training, environmental issues, and analysis of perceived risks are now considered to be of importance, though frequently a paragraph or two are all the consideration they really get because we don't know how to operationalize the concepts.

[7]The AID logical framework, which is used at the project development stage to define project goals, objectives and criteria, rather unrealistically assumes a foreknowledge of problems and solutions.

[8]There is evidence that AID's "conditions precedent" and "conditions of acceptance" are largely ignored, however. Perhaps they are too unobtrusive.

expenditure (Tendler 1975: chapter 7); (3) are more amenable to complex techniques of feasibility analysis (Rondinelli 1983: 77); and (4) are concentrated in one place, facilitating donor supervision and control (Tendler 1974: 105).[9] Farmer participation, institutional development, small-scale systems, and other "nickel and dime" project components now in vogue accentuate the conflict between ideals and administrative reality. While it is satisfying to be associated with a project deemed successful in terms of achieving ideologically-based development objectives, moving money and internal rate of return remain major, if unspoken, concerns of the agency. Banks are more blatant in defining success in terms of money, but will entertain -- even encourage project components of ideological interest if they contribute towards the generation of a capturable surplus, local resource mobilization, fee payment, etc.[10] Banks usually depend more on solutions they can buy or easily set up. There is less integration into the day-to-day workings of the host country bureaucracy; less patience with its many fits and starts.

Different groups have different objectives for the project and for the system. By asking what interests groups are likely to have in terms of project implementation and system performance, we can see how conflicts can arise and how these can adversely affect observed performance. For example, if a government sees the goal of irrigation as famine relief and has a policy of spreading some benefit of water to as many people as possible, this will mean more work for engineers and farmers. When there is a shortage of water, there will be conflict between the two objectives of giving every claimant his share and maximizing total system production. (Since water control is usually not adequate, this choice is academic.)

Gal Oya farmers broke canal structures when water was needed, but not forthcoming. Irrigation department efforts at water rotation (to achieve the objective of

---

[9] See Schmidt (1987).

[10] This is not a judgmental statement. Economically sound projects are more likely to endure though the emphasis on the bottom line (particularly over a relatively short project life) has been dysfunctional in numerous cases as well.

spreading the water further) were undermined because farmers would break the bunds to get water out of turn. If we stopped the analysis here, we would probably treat the symptoms through a program of educating or better controlling farmers. Taking the analysis one step further, we might determine that farmers do this because the rotations are not systematic enough to make water predictable. This would suggest that the irrigation department make more systematic deliveries and/or to increase communication of schedules with the farmers. But we have not determined why rotational deliveries are not systematic. For one thing, national needs for electricity generation determine the schedule of water releases from the reservoir, not any rationality of water needs of the irrigation system. In addition, legally-defined rights to generous, set water allocations for the sugar corporation must be followed, even when, in water-short seasons, these apportionments seem unfair, and wasteful vis-a-vis others in the system.

There are a least two dimensions to any group's objectives for an irrigation project. The first dimension takes a more immediate view of the project as an activity that brings with it numerous opportunities and resources that can be exploited. Irrigation projects bring construction jobs, opportunities for overseas training, increased irrigated acreage. Many benefits are up for grabs. The second dimension looks at system performance from a long-term perspective. Thus far, we have not adequately distinguished between the project and the irrigation system the project is meant to assist. Projects are born out of the necessity to spend money in politically acceptable and significant ways. Their defined limitations include arbitrary deadlines for money to be spent, having to use certain suppliers and technologically-advanced methods, etc. Project definitions may preclude implementation in a manner likely to ensure success. Evaluations are usually linked to a project; therefore, staying within the constraints of project definition often becomes a major evaluation theme. Furthermore, evaluation is seen as a project activity, represented as a line item in the budget. The final evaluation occurs when the money or the calendar runs out. This may be a poor time to evaluate how well a system functions since the final flurry

of project activity may skew the evaluator's perception of the system's functioning. Also, all systems need to be "debugged" before they can be usefully evaluated. It takes some time for farmers to learn how to optimize their use of the resource even if they want to. We have to get at the long-term effects of project choices and innovations on the potential and sustainability of the system,[11] but cannot do this *ex ante*.

The success of an intervention in terms of helping a segment of the population improve their livelihood or reduce their vulnerability or gain something that they consider valuable and that they will endeavor to sustain, may not at all be reflected in the project-level criteria of success. The project view may not coincide with the bottom-up view (whomever the persons looking up from the bottom may be). A successful project may not be successful development intervention. The converse is also true.

How evaluations can deal with multiple and conflicting objectives.

What can be observed at the local level of the functioning system is the result of complex interaction between the multiple, conflicting objectives within the constraints of that setting. By analyzing both the incentives and the constraints at work in a given

---

[11]What is it about the way evaluations are done that gets in the way of learning? I reflected on my experience in 1985, when I went to ARTI (Sri Lanka) to help the Water Management Group prepare for and go through the AID evaluation of the Gal Oya project. When the evaluators came in, how did I feel? We were as cooperative as possible, providing data and manpower as they required. We did not set out to deceive them , but we were more prepared to answer their questions than we would have been on an average day, because we knew they were coming. I am sure they got an earful of the party line, but no attempt was made to hide problem areas from them. We then held our breath to see what they would say -- hoping they liked us, and would say good things about our work. They were judging our past performance. When their preliminary analysis came out, my response was this: either what they said, we already knew, and had in fact carefully pointed out those problems to them, or what they said was wrong, a misinterpretation of data. In other words, we felt that we knew what was wrong already, and to some extent, didn't need their input. However, the evaluators were one place (a sounding board) where we could discuss what worked and what were the pitfalls of such issues as working with/through an agency not accustomed to project implementation, of having overseas training for the project's key people, just when we needed them most at the site, etc. These concerns were also discussed with the AID project director beforehand, but to him, they are problems over which he likely has little control, and are therefore a source of frustration.

situation, evaluators can shed some light on why things are the way they are, and perhaps on how improvements can be made as well.

Analyze incentives. When system performance assessment proceeds on the assumption that the printed project objectives are the actual objectives of project participants, the influence of the multiple competing interests on project format and system performance is ignored. This leads to misspecification of problems and bad advice. The Lowdermilk *et al* (1978) study which helped pinpoint the causes of overwatering by farmers in Pakistan illustrates the point. The initial hypothesis was that farmers needed education in improved practices, but investigation revealed that by overwatering, farmers compensated for the irregularity and unpredictability of the water supplied them by the central agency. The evaluation served to provide information on the cause of this management problem to those controlling decisionmaking.

Better understanding of the system, its problems and potentials, can be gained through deliberate examination of the various interests and the relative harmony or discord between them. What are the incentives and the contraints to action at the various levels of system management? The literature provides some insight.

Many studies of small scale irrigation systems highlight farmers' objectives for irrigation and document how the technology choice and rules of water distribution serve to reinforce good system performance. For example, although water use efficiency is a frequently used measure of system performance, system-level water-use efficiency would not be a goal of any one individual, unless his supply of water or its cost to him, depends on system-level efficiencies. This is accounted for in many farmer-managed systems; rarely in state-initiated schemes. Several mechanisms exist to encourage individual farmers to be concerned with system-level water-use efficiency:

* In some small systems in Sumatra, Indonesia, those responsible for distribution of water are systematically assigned plots at the end of the system. This ensures their putting forth a good effort at distributing water the entire length of the system (Ambler, 1988). This same arrangement is found in the Philippine zanjeras (Siy, 1982).

* In the Diaz Ordaz system of Mexico, a farmer's total acreage is divided into pieces spread throughout the system. This spreads risk, and ensures that the persons distributing water will do a good job (Downing, 1974).

* In Somalia, siltation rates are very high. Headenders depend on help from the tailenders to keep the channels clear. This dependence serves as a check on headenders' water use, for they must keep the tailenders happy enough to get them to help in maintenance.[12] Similarly, in the hill systems in Nepal, water must be routed great distances through landslide-prone areas to get from the source to the command areas. The task of patrolling and repairing these canal-lengths requires every irrigator's cooperation. Thus, headenders are dependent on tailenders' continued satisfaction with the system (Martin, 1986).

* The point may be brought out most clearly by Martin and Yoder's (1986) comparison of Chherlung and Argali, two small hill systems in Nepal. In Chherlung, a farmer's right to sell any excess of his proportional allotment water creates the incentives to maximize water use efficiency through market mechanisms. Farmers in effect get paid for the extra care they take in using water efficiently. Argali farmers on the other hand each have a proportional claim to water in the system, and although water available has actually increased, the rules do not allow others to buy in, temporarily or permanently. Unless the rules change, or unless water availability conditions change, the most rational thing for farmers to do is to let the water run.

As main system management becomes a more important research topic, we will see more analysis of incentives and decisionmaking at the agency-level as well. Murray-Rust (1983) describes an agency's processes of decisionmaking for water distribution. Moore (1980) shows how irrigation department personnel performance incentives and career advancement opportunities in Sri Lanka do not reinforce concern for local system performance. Wade (1982) analyzes administrative and political corruption in India. Lack of administrative capacity at the local level is often cited as a cause of performance shortfalls, but Garces (1983) is one of the first to articulate the characteristics of a responsive local level agency. National government and donor agency incentives and constraints are addressed by political scientists.[13]

Take the bottom-up view seriously Bottrall (1978) provides a long checklist of information that would be useful in evaluating irrigation system performance, running the gamut of physical and agronomic conditions. In an Overseas Development Institute

---

[12]Seminar by Tom Weaver on WMS II Shebelli Project, to Cornell Irrigation Studies group, 1987.

[13]See Tendler (1975) , Bryant (1980), and Cohen *et al* (1975).

irrigation network newsletter discussing this checklist (Bottrall, 1980), Slabbers criticizes its apparent "top-down" management assessment approach, suggesting instead that additional insight into the performance of an irrigation project could be gained by a "bottom-up" approach, taking into account such factors as the target group at the time of project initiation, how the project has promoted cooperation and solidarity among this group, was its dependency (and therefore risk) increased or decreased? What was the effect of the project on family dynamics? Bottrall concludes that, ideally, evaluation of system design and operation should be taken from two directions and on two time-scales: a quick one from the top to the bottom to establish the nature and dimensions of major constraints present and future and another "from the bottom up" which examines all the various design and management options feasible within the constraints identified.

In order for an irrigation project to become a sustainable irrigation system, it not only has to perform acceptably in terms of cost, and reliability and predictability of water deliveries, irrigation and the whole package of changes that it implies has to fit within a context over which project activity has little or no control. Therefore, farmer assessment of system performance, using farmer-suggested criteria, is a critical component of system evaluation. The bottom-up view might point out areas where a minor adjustment in irrigation practice or in a non-project factor (such as where the government crop-buyers are posted), would make a significant difference for the system's future.

Problem #2: It takes time and money to collect data. This leads to dysfunctional practices.

Data collection and analysis is costly and time consuming. Accurate data for even the most basic system performance indicators, such as average yield or total irrigated area, are often hard to come by. Even after almost a decade of irrigation project activity and research on the Gal Oya system in Sri Lanka, we do not know its irrigated area. When an irrigation project is more strictly geared for programmatic accomplishment, these data are even less likely to be available.

Evaluators coming in at the close of the project frequently face a paucity of data. A good project manager will have collected the types of figures with which one can easily construct project efficiency measures, such as number of persons served, length of canals relined, dollars expended, man-hours, etc. Of limited use for explaining system performance and or project effectiveness, these data are available and easily assimilated, hence the preponderance of project-progess reporting statistics in evaluative reports. The evaluation task is too frequently defined as the application these measures.

Given the limited timeframe within which a product must be produced, the evaluator must rely on easily available data. We must be careful not to let these data drive the process of evaluation or exert undue influence on its conclusions. The harried evaluator may be happy to find in the Irrigation Department files what appear to be regular readings from which system performance measures can be devised. These data provide a basis for action, and when the data are quantitative, the evaluator may feel a sense of security. Caution must be exercised however, for these numbers or ratings depend on data, and data are socially generated and politically relevant. Ramamurthy (1986) provides evidence from an irrigation system in Andhra Pradesh of a tendency known to exist in systems all over the world: there are incentives for Irrigation Department personnel at the headend of the system to underestimate the area not zoned for irrigation so that water rations to the offtake level will be high. This lessens the need for management or provides

additional portions of water -- payments for which reward officials for their careful management practices. Before accepting the recorded command area or cultivated hectarage at face value, one must consider what resources are distributed based on this data? Agency figures usually overestimate agency-irrigated hectarage and underestimate indigenous system performance and potential.

The process of selecting performance criteria is influenced by data availability. There are sound reasons for using criteria used in the past or for other purposes, including increased comparability across systems and increased complementarity to diverse research endeavors. However, data are usually used because they are available and not necessarily because they are good or appropriate. This can be dysfunctional. The team sociologist for the Gal Oya project final evaluation was to answer questions on the number and strength of farmer organizations formed. ARTI had last systematically collected numbers (on number of shramadanas (group labor parties) and number of meetings at the field channel level) early on in the project. These indicators were appropriate when the organizations were young, as a measure of vitality. The sociologist requested that ARTI put together the data on these same indicators for more recent years. Though we knew these were less appropriate measures of organizational health in a more mature system, and thus had not analyzed these data, we had not articulated the fact that our definition of a healthy organization had been revised to include a maturation factor. The data collection apparatus had not kept pace with our changing notions of what an appropriate indicator would be. It still collected the data it had collected from the beginning. The baseline was there and it was very tempting to use this as a before /after comparison. Some numbers, any numbers, are better than none aren't they? So the observed trend was reported: farmer organizations were no longer meeting regularly for shramadana labor (ISTI,1985, p. B-13). One familiar with the situation would shrug this off. If organizations have no need to meet regularly, why should they waste their time doing so? The unwary reader of the evaluation could

easily come away with the wrong impression however, because available data were used because they were available.

The use of design standards as the performance criteria is a more pervasive example of reliance on convenient though perhaps inappropriate performance criteria. Design criteria are written down, and hence what evaluators ask to see even years after the system has been built. This poses several problems. First, design is based on pre-project assumptions (e.g., predictable water supply or farmers' willingness to conform to new distribution procedures) that are often grossly exaggerated or wrong. Second, using design standards to gauge performance ignores incremental changes that occur in the interim between design and evaluation. These changes can be in response to new problems or new information or changes in performance criteria. Some changes may be systematic; others may be rapid adaptation to the new situation that the irrigation creates, i.e., though water layout may be done by design in a basically non-political manner, the land-tenure system quickly adapts so that certain people benefit . Third, professional norms provide the notions of performance from which the design criteria are derived. The few design firms in this business (in 1982, there were about ten)[14] tend to repeat their design principles and mistakes on many projects. How do the standard design objectives compare to those of the users? For example, assured subsistence may be a much more important gauge of performance to them than conveyance efficiency[15] Fourth, design standards-based evaluation uses canal appearance as an indicator of performance, but in farmer-designed and -operated systems particularly, professional appraisals with their bias toward neat, orderly, sturdily-built systems may not be appropriate. The permanence of structures is an important gauge. Yet in some situations, farmers have learned that it is better to built dams that will wash out.

---

[14]Gil Levine, lecture at Cornell, Course on Sociotechnical Aspects of Irrigation, 1982.
[15] Chambers suggests farmers have a hierarchy of needs which affects their system performance criteria: 1. survival; 2. not being vulnerable (strengthen their coping mechanisms) 3. self-respect.

Evaluations take place at a point in time. It is difficult to extrapolate trends from one data point. This observation period is usually at the end of a project, when it is too late to make significant changes in the project, but it is too early to judge its impacts. Another weakness of one-shot evaluations is the undue emphasis on what is observed at that time. Team visits are often scheduled to correspond to a point in the project cycle or when travel is convenient. How does the view one gets at this time of the season compare with the rest of the year?

How to address the problem.

It is important to avoid overreacting to the normal paucity of data on system performance by collecting any and all data because it could be useful. A questionnaire or a daily data sheet can cause its own ruin by including too much. Respondents lose interest or focus, data collectors begin to save effort by marking down "reasonable" values without verification. When the amount of data required is so voluminous that the intelligent and interested data collector cannot figure out how it is going to be used, and is therefore not intellectually engaged him/herself, there is a greater chance that he will make errors both in rote work and in situations requiring a judgment call. When data collectors are somehow kept isolated through non-participatory, alienating supervisory situations, the evaluator who is farther removed from the facts and details is likely to get a bogus picture from the tabulated data, even if the data collectors are conscientious and have done their work in good faith.

The duration and intensity of data collection are discussed further here. Certainly there are tradeoffs between massive longitudinal studies and short term impression-takings. Perhaps a hybrid system of less intensive data collection for the duration of the project, monitoring really, would be more workable in more cases. Indicators, which integrate several variables of concern or which integrate over time, are also a promising area for further work. Garces (1983) raised the issue that there can and should be various levels of

intensity of analysis. He delineates three: the consultant level, the agency level, and the research level. To Garces, an increase in intensity of analysis means more detail of the same data (filling in more of the data cells). We suggest that different jobs or selected levels of analysis intensity require different data and or different approaches, and not just more or less of the same data and activity. What we want to know is how to do the best job of data collection possible under various circumstances. (Most evaluations cannot be a full-scale research project and evaluators should not have to make apologies for this.) There may be critical or optimal times to do a one-shot evaluation, for example, at the tail end of a gravity flow system in the dry season. Recognizing that data is a luxury whose cost-effectiveness should be maximized, we suggest that data gathering for evaluation could more explicitly complement or piggyback on system performance monitoring or research-oriented data collection throughout the life of the project. We also discuss irrigation system management assessment techniques that efficiently and effectively focus in on problem areas.

Increase emphasis on monitoring for management. Performance monitoring need not be based on many, complex, technical variables, nor must it be computerized to be effective. Regular readings of the water level in a key canal may suffice. The distinctive feature of monitoring data is that it is regularly taken information intended to help managers keep performance with accepted boundaries -- suggesting incremental changes to keep performance within range. Data from computerized models of system regulation, water balance and the like are useful in system appraisal, and interactive monitoring/modelling offers us the unique opportunity to see the expected results of a change in one or more system parameters. This broadens the basis for evaluation considerably. There is the danger that as data analysis capabilities become more sophisticated, the central irrigation department offices will put more pressure on local and district level offices to collect data for the center's purposes. These data may not relevant at the local level. Data still take a lot of time to collect, and adding yet another reporting requirement to the local officals' list

of things to do will not help system performance. Management information systems should be geared to help local people understand and operate their system better. Knowledge alone will not suffice to make things better, but it is a start.

Sometimes a mid-project evaluation is commissioned when system management already faces a serious problem. The evaluation may be a last-ditch effort to save the project or may be part of the review for termination. More frequent evaluation/analysis would be useful in avoiding these crises, at least to the extent that there is the ability to control the critical variables, or in situations where lack of information and understanding have been the culprits of poor performance. But information alone cannot solve a problem. Continual system performance monitoring[16] will be getting more attention as computerized simulations of water flow through a system's canal network proliferate. This should help water managers in decisionmaking about water allocation and distribution, particularly in large schemes.[17] But management of irrigation systems is not only hardware manipulation. Regular reports of farmer activities, suggestions and complaints might prove as useful to system management as the latest numbers from a computerized water balance model. So far, our discussion has ignored the question of who is managing and who should be receiving the management information. We must be careful not to assume that only agencies manage irrigation systems. When the project is finished, the patterns of information flow for water management established during its life must continue to support the irrigation system. Evaluations that seek to encourage and support better management at the local level should involve and target the managers, farmers as well as agency staff. Evaluators should ask what managers need to know to do their job better. Farmers can assume much of the responsibility for water management, but they need both information

---

[16] Monitoring is the collecting of periodic data readings to make sure performance is "within range." Evaluation examines trends and patterns in those readings, and how they relate to performance objectives.

[17] Farmers in the Gal Oya system have thus far been happy to send up their water level readings to the system model, and to receive more information or have a greater sense of control in exchange.

the authority to make decisions and implement decisions. We have not been in the habit of asking farmers for their analysis of how and why a system works as it does. Including representative farmers on the evaluation team, as equal partners may strengthen the evaluation as a tool for local management.[18] Beyond participatory evaluation would be locally designed evaluation activity.

Dovetail research and project activities. Project implementation, appraisal and research data needs could be complementary, especially when there is explicit cooperation between the two ends. The costs of more intensive or extensive data collection could be spread over both purposes.

Project implementation and research are explicitly linked in the Ford Foundation's action research experiments in the Philippines. The reports, diaries, and findings of participant observers learning about the process of organizing farmers are regularly fed into the management decisionmaking process. This may be a special case, as their claim of employing a learning process approach implies.

Gal Oya reveals some of the difficulties of dovetailing research and project activities. Research activity has its own tempo which is determined in part by the cyclical nature of its object. It is hard for a research agency to implement a project . Its structure allows the individual research projects to operate autonomously, but it cannot handle widespread activity with accountability, or respond quickly through its administrative channels (St.Julien, 1983).

Though the dynamics differ across labs and research institutions, in the Sri Lankan case, traditionally data belongs to the researcher. Turf boundaries are guarded and the

---

[18]The DA practice of including local officials in the evaluation exercise is great for training those officials in our techniques of interdisciplinary analysis. The surpressing effect of their presence on farmer responsiveness has been reported, casually, time and again however, and should be considered seriously. Translators and other intermediaries often perform a similar function of screening information given, so that the evaluator hears only what he is supposed to/is presumed to want to hear.

researchers do not want to divulge preliminary findings or release the data until satisfied that it is true and that all that is valuable has been wrung from the data. Research produces one defensible end product. But this isn't what project implementors need or want. They need feedback along the way -- not just monitoring data but analysis.

The tendency to overcollect and hoard data only compounds the problems of inadequate facilities for data analysis and the untimely release of findings. Researchers want to produce publishable pieces. Usually then, this requires that an esoteric or technically complicated data analysis technique or research question be involved. Data oriented to research community interests may not contribute particularly to management decisions. Project management and project evaluation ends are best furthered by data on project progress and impacts. The less "professional" data contained in participant observer reports were too unstructured to be useful. In the Gal Oya case, there never was much of an attempt to link to socioeconomic research component to the engineering side of project implementation.

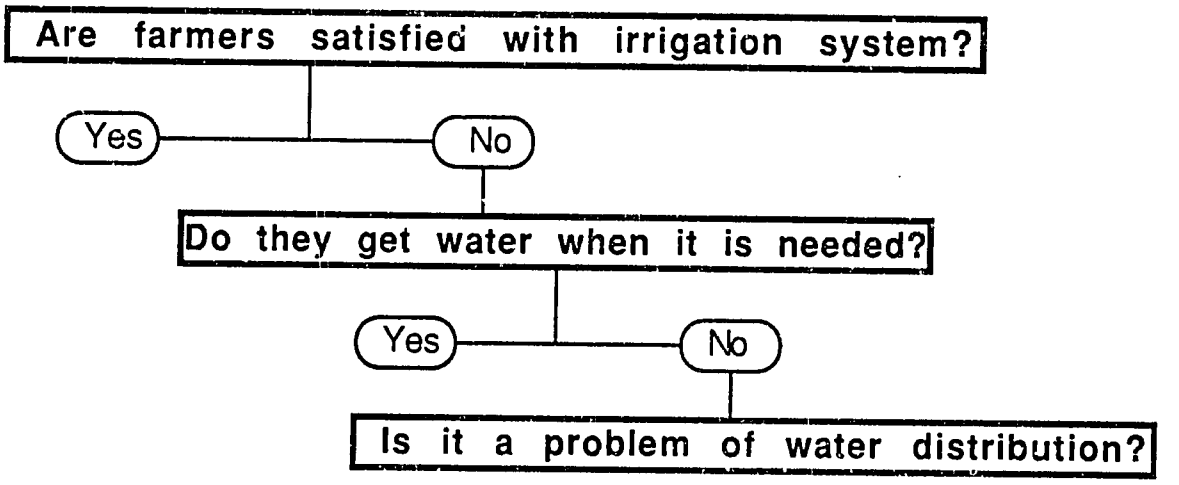
Use techniques that efficiently and effectively identify problem areas. We are interested in minimizing the data and time required, and still have a reasonably confident assessment (Bottrall, 1980: 18). One way to quickly observe and assess management performance is to observe the system under stress. The fact that the crises occur should not necessarily reflect poorly on operational performance; what is telling is the manner in which they are handled. Analysis of critical events or crises could be used to delve into how well the system handles randomly occurring crises as well as the more predictable critical periods, as when the water reserves reach a certain low point. How does the system perform in terms of being prepared for and managing crisis situations (information availablility, information transmittal, response times, etc.) and how sensitive are service flows to crisis (i.e. how is distribution affected by drought?)? This kind of analysis benefits greatly from alert observation of the event as it unfolds. To use this methodology

the evaluator must either be lucky enough to be there himself, have informants trained and ready to observe or else he must reconstruct the events after the fact.

Rather than even attempting to find the answers to all the questions on a comprehensive data checklist such as the one produced by Bottrall (1981), Carey-Jones suggests that

> "(i)t might be useful if you could pick out some vital questions, which, if answered favorably, would avoid the necessity of a comprehensive investigation but, if answered unfavorably, would require further specific investigations into other questions -- rather in the form of a "logical tree." If the farmers are doing all right, no further questions. If they are not, then why, and proceed to question 2, 3, 4 until one finds the answer. This would be more practicable, as a continuing management process, than your (Bottrall's) checklist." (Carey-Jones, in Bottrall, 1980: 3)

The logical tree might look something like this:



The above example demonstrates how this method quickly zeroes in on a problem. Persons with experience in irrigation can set up discriminating questions at each level that quickly get to the heart of the matter. The binary response pattern of the logical tree narrows down the search universe quickly. This is useful when we are looking for a problem, trying to maintain a certain level of performance or to keep on target. Persons

who know a particular scheme know where the problems areas are likely to be and can tailor a list of "key questions" or can establish a "red flag" method of problem detection and identification. A red flag might be raised if the number or severity of complaints coming in to the irrigation department has significantly increased, or if water does not reach field x at the tail of the system[19], or if water is overflowing its banks. These indicate that the system is not working properly.[20]

Numerous people have worked on finding quick, bias-free indicators of rural development. This work, including that specifically geared toward irrigation, falls under the rubric of rapid rural appraisal. Though frequently employed in comparative case study work, the methodology is useful in single case evaluations as well. Certainly, having only one week in the field as a project evaluator is an exercise in rapid appraisal. Carruthers and Chambers (1985: 54) provide a sampling of some of the "key questions" one might put to a system under evaluation:

#Is surplus, spill and drainage water used and by whom, and with what benefits?

#Do crop changes, staggering, zoning and/or rotations improve performance?

#Would headreach farmers do as well or better with less water?

#Do farmers influence their water supply?

---

[19]In the warabandi systems with precision canal design and highly regulated operational patterns, the gauge at the tail has a more exact meaning. "...the system is so designed that one foot (30 cm) depth of water at the tail is an index of the correct performance of all the watercourses of distributary." (Maholtra, 1982; 34)

[20] It should be remembered that each perspective has its strengths and weaknesses however. Persons in the system have a set of red flags based on a set of assumptions about the manipulatability of the system, with current conditions assumed to be givens. These conditions are unchangable at that level of power, resource availability etc. As the perspective moves above the immediate field level, and opportunities increase to address some of the constraints, the set of questions will differ. A broader scope for action will be assumed. Sometimes this puts everything into focus, and problems are simply solved with a simple intervention. Frequently, the simple solution is unrealistic however.

#Is the reservoir managed? On what basis, subject to what pressures, and by whom, are distribution decisions made?

#Is there a labor constraint?

#How do managers know about what is happening on their systems?

#What do tailenders get?

#How do tailend farmers know about what they will get and when it will come?

#What happens to ground water?

#What happens to water at night?

#What happens when water is scarce?

#What happens when it rains?

#What is the control capacity of the system and how much of it is used?

#What political interests are involved in water allocation and distribution?

#How much water is available for distribution?

#Which staff are permanent, and which are transferred and how frequently?

#Do some farmers not irrigate at all?

These questions, like the red flags, mark problem areas and indicate issues for further investigation.

Others, such as Bottrall (1981) and Diagnostic Analysis teams, deal systematically and exhaustively with documentation and measurement of system performance. This type of exercise has its place, but frequently, we need to move quickly from the measurement of performance shortfall to explanation. Unfortunately, a set of answers to a list of predetermined questions does not necessarily bring us to understanding, nor does having a multidisciplinary team guarantee a holistic view. The logical tree, "red flag," and rapid rural appraisal methods improve observational efficiency by focusing attention on critical issues, which may be embedded in a mass of extraneous detail. The efficiency is that not every question has to be asked. After identifying the problem areas, our investigation will branch out again, tracing the interconnections of variables, to ask questions such as what if and why.

Toward better measures--that integrate over time and incorporate risk

The system performance evaluation methodologies currently employed are not only costly, but also woefully inadequate for explaining how water affects people's existence or even for describing system performance accurately. At present, most of our measures inadequately incorporate facets of irrigation system performance, such as the reliability and predictability of water and the probability of crisis, which are most certainly part of a farmer's decisionmaking calculus. This makes it harder to explain observed behaviors. Variables used to describe and define system performance are aggregated to the point that they miss significant spatial and temporal variations.

Measurements taken at only a few points in time, such as canal flow, or that aggregate or average over time, such as water use efficiency often lead to erroneous conclusions because they fail to detect extremely adverse situations that can occur for short periods of time. If soil moisture reaches the permanent wilting point for only a short time, the crop dies regardless of the average canal flow or crop water demand to supply ratios. One example of a measure that accounts for extreme variations over time is water quality testing by using types of biological indicators, rather than direct measures of constituents in water. Aquatic plant and animal life can be a more critical indicator of overall environmental quality than chemical or other constituent water quality measures *per se* taken at a few points in time and space. Specific species of animals and plants are differentially sensitive to various types of water pollution. Therefore the monitoring of aquatic life at any point in time indicates the water quality not only at that time but also conditions that existed in the past as well. The aquatic community of a stream indicates integrated conditions including any short but critically important event. Some indicators might be useful to assess seasonal problems while others might be more appropriate for long term analysis of a system These indicators that integrate the conditions over time are important to identify.

Measures need to incorporate farmers' sense of risk, and the probability of crisis. Farmers' investments of time, labor, and other inputs into irrigated agriculture are decided upon based on perceived risks. We also need to gain an historical perspective on system performance to know its effects on system-level management and farm-level decisions. Not only risk that water will not be there, but also that the water schedule is at all practical given the farmer's need for other inputs (tractors for land preparation, labor, etc.).

While we would like to see intensive data collection and analysis for system performance evaluation, for purposes of the following discussion, we assume that evaluators will continue to work under financial and timing constraints. We suggest several indicators, of overall system performance, and of water management practices, which are relatively easy to gather and show particular potential. Granted, each indicator has its alternative explanation, and can be misleading. Proper interpretation depends on a knowledge of the context. Taken together, however, they should say something about system performance. Indicators should point out areas for further work. We are not at this point seeking to separate and calculate the effects of various factors on system performance, and thus covariance isn't so bothersome. We can live with it, so long as we recognize them for the amalgams they are.

Some possible indicators of the overall results of irrigation system performance are

Crops grown are an indication of farmer's assessment of water availability. Vander Velde (1980) indicates he could measure historical performance in terms of the percentage of the crop land planted to irrigated crops. Barker (1986) similarly has suggested that the types of crops planted in an area are the single best indicator of area farmers' assessment of system performance. Crops known to have a very sharp water-yield response function are planted only when water is expected to come reliably. Where these crops are in evidence, the system is most likely functioning well (though we cannot distinguish between whether the system functions predictably or its own accord or whether

the farmers have confidence in their powers to intervene). Where the water-responsive crops are absent, it is harder to draw conclusions. This measure assumes that farmers have the freedom to select the crops grown. A rigorous study would go beyond *ceteris paribus* assumptions to include consideration of conditions controlling comparative expected profits (yield, price, risk, marketing, labor, subsidies, etc.), but the simplicity of the indicator as a first approximation of farmers' trust in water deliveries is appealing.

Crop insurance taken out by farmers may also be an indicator of presumed risk, though if there is doubt as to the likelihood of collecting on legitimate crop failures, as there frequently is in Sri Lanka, the indicator loses power.

Planting method. Paddy can be seeded in nursery beds and transplanted, or the seeds or sprouts can be sown directly on the fields. Transplanting requires much more labor than broadcasting and is generally associated with higher yields. If water is reliable (or if it is unreliable only early in the season) and if there is labor available, transplanting is the preferred method. Broadcasting seed takes less labor and other inputs and usually results in lower yields. Therefore, if farmers perceive an irrigation system as being unreliable they will typically risk loss of less inputs by broadcasting. Farmers will venture more inputs by transplanting if they view the system as reliable.

These indicators work well in indigenous systems or where farmers have freedom of choice in their farming practices (freedom in decisions about what, how and when they plant) and have only to deal with the vagaries of nature. Government interventions cause distortions. In many settings, government mandates, in effect or in fact, the planting of certain crops, such as tomatoes or tobacco. Government-enforced paddy cropping calendars andwater delivery schedules which require land preparation and seeding to take place within a narrow timeframe render obsolete the traditional practices of shared labor, and effectively raise the price of scarce resources (animal and mechanical traction and hired laborers) beyond that which some farmers can pay. If he cannot afford the labor for

transplanting, a farmer will resort to broadcasting methods. In these cases, the indicators are less suitable.

Land development or field preparation. If farmers haven't put much effort into land levelling and development of an in-field water application system, then either water is not expected, water is abundant, household labor is scarce, or the land is not controlled by the person who farms it.

Farmer inputs and other farming practices also give some indication of water. Investment in fertilizer is an indication of predictable water. If one suspects that water may not be available and the crop lost or producing low yields, it is unlikely that there will be heavy investment in labor, fertilizer, seed, pesticide or other inputs.

Farmer satisfaction. Most simply, we could ask a cross-section of **farmers** if they are **satisfied** with their irrigation situation. Do the responses differ across the system? What is it that they like or don't like? Opinion surveys have their biases, but this does not mean we should avoid using them. In order to gain the most insight from interviews with farmers or officers, it is important to take the extra time required to keep the questions open-ended. What was the system like before? What noticeable changes have occurred, improvement or decline? Gal Oya farmers recall specific seasons when water shortages caused very specific types of problems. Generalized, even judgmental variables (which have so many covariants, and are hard to deal with in research because it is difficult to disentangle their separate effects) may be just what we need in exploratory analysis for management and problem solving.

Rate of fee payment as a measure of farmer satisfaction with irrigation service has been used in several different studies in the Philippines but the validity of the measure depends on the context. Garces found no apparent link between willingness to pay irrigation fees and yields or satisfaction (1983: 299). Rate of fee payment may correlate most highly with the number of tax collectors in the area. Indeed, in a study of the performance of communal irrigation organizations in the Philippines, Tapay *et al.* (1987)

found that fee collection increases with an increase in the authority network within the farmer organization. Payment also depends on the perceived fairness of the prices, the validity of the concept of paying for services, whether or not the money is plowed back into that system's operation and maintenance, etc. In some political contexts, such as in Taiwan or Korea, farmer non-payment may not be an option. In any one situation however, fee payment may be used internally as an indicator of satisfaction. The agency will get the message that something is wrong if farmers who ususally pay now refuse.

Yield figures describe overall performance, though certainly yield is determined by many other factors in addition to water. It has interactive affects with input use, etc. In areas with similar crops and cropping patterns, yield can be a good indicator or relative performance. As mentioned earlier, mean yields and yield variation taken spatially can be used to identify system problems.

Housing quality. There is certainly no good substitute for household production level analysis, but a quick and simple alternative which may be better than nothing is to look at housing quality as an indicator of overall prosperity within the system area. Farmers who consistently have good yields and/or make a profit will be likely to invest it back into the farm, perhaps reducing some of their constraints by buying a tractor. Those who do well will also probably have improved their house somewhat, or else have purchased some goods such as a furniture set, a petromax lamp, or a clock. Housing structures with floor, walls and roof made of permanent materials such as concrete and tile indicate prosperity and security of tenure, whereas those of temporary materials such as cadjan, and wattle and daub suggest poorer or more temporarily settled people or else newly-established households (ARTI 1980 Yearbook, ARTI Mid-term Assessment, ARTI Final Impact Assessment, 1986). Comparing project area to non-project area, one can get a gross sense of the economic impact, direct and indirect, of the project. Comparing head to tail areas might give some insight into distributional equity. If good housing is evident throughout the system, the system is probably performing pretty well. Conversely, if all

the housing is poor, poor system performance may be indicated. Using housing quality as a performance indicator is obviously based on many assumptions which may only be true in general -- that the houses in the head belong to farmers who farm in the head (that farmers live near to their fields, that farmers live in the houses, not the landlords).

Amount of land under mortgage arrangement is interesting information that may come up in farmer interviews. The tenancy situation in an irrigated area compared to neighboring non-irrigated areas is likely to give an indication of how well farmers are doing because of the irrigation system, and who benefits. In Gal Oya prior to rehabilitation, many tailend farmers were badly in debt, and had been forced to mortgage their land to creditors. Though they usually still farmed the land and had the possibility of redeeming it, there was little likelihood of that happening since they only had one, rainy season crop per year, and had to pay rent as well as their variable costs of production out of that single crop's yield. Other questions we could ask, given time, are: Who were these creditors, how much land did they amass? Have tailenders been able to redeem the land now that better water conditions allow for two crops a year, or does this added value (because of the irrigation project) accrue to the big men through higher rents, or outright dispossession of the land?

How do the **land values** in irrigated areas compare to nonirrigated areas or even throughout the irrigated command area? If the value of land in a tail section of an irrigated command is little higher than in an unirrigated area, the system is probably not very reliable at least at that spot.

Income is a variable much like improved housing quality, but harder to measure. This variable is more removed from water *per se* than many other indicators, but can be used to indicate equity or development impacts. To the farmer, irrigation water is just one input, in a perhaps complicated set of social and economic costs and benefits. Increased yields may result in increased income, but not necessarily. Philippine tenant farmers appeared to be going into debt despite of higher production and double cropping, because

of high rents, the cost of amortization of the pumps, expensive electricity, increased fertilizer costs , and the low price they got for their rice when sold to merchants, (who would buy the rice that the government rejected at the guaranteed price because the rice did not meet international market quality standards)(Steinberg, 1983: 25).[21] Likewise, the more intensive cultivation practices require more labor, in a concentrated time frame. This additional labor must be hired or else family members and friends must be pressed upon, a practice which also has its opportunity costs.

The differential effects of the technological package associated with irrigation development on farmers of differing means (tenants versus owners for example) also provide insights into equity. For example, in a rice area, an enforced cropping calendar which requires all farmers to plant simultaneously, makes the system of water delivery much easier to plan and administer because every farmer has similar water needs at the same time. Simultaneous planting has the additional benefit of reducing pest problems and making the needed pest erradication campaigns more effective. But, simultaneous planting also eliminates the possibility of exchange labor arrangements, because everyone needs help at the same time. This can drive up the cost of temporary hired labor dramatically. Similarly, tractors and ox-driven plows cannot be shared among as many people, which makes labor availability an even more important issue. Those who own the means of traction and those who can pay the highest price for labor are least affected. Whether the tractor owners and field laborers do better to serve fewer people at a higher price than more at a lower price, or whether this market adjustment even takes place at all is an empirical question. Who are the tractor owners and laborers? Are they the poor, landless? Do the

---

[21] In Gal Oya, there has also been a problem with getting the guaranteed price for rice. It is hard to get access to an agent , and then he rejects the rice for not meeting quality standards. The local merchants were accessible, frequently coming to the farm gate, they would buy the paddy at some price at least, and would also "arrange" for credit to be extended to this farmer during the planting season. This is an important service as many of the farmers have been blacklisted(for nonpayment of credit extended during a 1970's program over which there was a great deal of misunderstanding over the credit terms) and cannot get credit through official means.

changes required by the irrigation technical package, including the simultaneous planting, spread benefits further or concentrate wealth?

Do water charges, system taxes, required labor contributions etc, coincide with the normal terms of a tenancy agreement? Someone who will probably only farm field x for this season is not likely to spend much time improving the canal to it or join the farmer's organization to work toward long-term agreements with neighboring canal groups or the agency.

Indicators that specifically address water management practices are

Waterlogging or abandoned areas indicate overwatering, and/or poor drainage. Waterlogged areas are sometimes found outside the official command of a system but still suggest the system is producing adverse environmental effects in addition to the production and equity problems. The adverse effects of waterlogging on production are obvious. Usually waterlogging occurs in tail areas as a result of over-irrigation in headend areas so in addition to production loss, the equity of the system suffers.

Ground water levels fluctuate naturally around an average level during the year and from year to year, but irrigation systems can radically alter the stability of ground water levels. The most common impact of surface irrigation is for water tables in the command area to rise if water use is excessive. Ground water levels are not as visible as areas abandoned due to salinity, but the rate of rise (in meters per year) can be estimated by talking to well owners about water table depth. The product of the rate of rise and the area affected indicates the extent of excess water use. As ground water approaches or reaches the surface, waterlogging or salinity problems begin to appear. Irrigation systems can also deplete (or mine) ground water by overpumping. This however is usually due to a number of well systems in a region and not to a single scheme.

Wells at the tail end of a system suggest that canal water is not reliable at the tail or that headenders are overwatering their crops, thus indirectly providing the source of

ground water for tailenders. The spatial density of wells throughout the command area indicates relative access to canal water. Farmers with reliable access to canal water will use it in preference to relatively costly ground water. Sims'(1983) research comparing irrigation practices in the Indian and Pakistani Punjab revealed that farmers were willing to pay the higher cost of groundwater in order to avoid the hassles and problems of unreliability associated with government-provided canal irrigation water.

The presence of wells within an irrigation command but not outside it would suggest that the source of the well water was percolation from excess surface irrigation. In situations where the management and structural costs necessary to bring water through canals to the tail of a system are very expensive, the use of natural water conduits may be the most cost-effective option. However, conjunctive use does raise questions of access to public versus private resources,which often have different subsidies.

Water in the drains indicates adequate water and perhaps wastage, especially in systems that haven't had time to develop elaborate reuse system. In most cases non-official irrigators use the drainage from those in the system, and there may be pressure for those in the system to let a little water go that way. Water pouring out a drain pipe does not necessarily indicate wastage if that water is tapped by someone else. Cross checks in the drainage canals indicate drainage reuse. We need to look at water balance. "Water losses" through canal seepage and excess field irrigation feed the wells used for domestic water in the Gal Oya system, where there is no other source. Domestic water issues are not supposed to be part of the Irrigation Department's decisionmaking calculus, but both human empathy and political expediency require water releases for nonagricultural purposes.

Other more data-intensive indicators which incorporate temporal or spatial differentiation have been discussed at length by others. We refer the reader to Moya's (1988) summary and comparison of several indices of relative water supply and water adequacy. Wijayaratne (1986) and Svendsen and Wijayaratne (1982) make interesting use

of a (rice-system) water availability index which is easy to understand, but which requires daily observation of field conditions.

Problem #3: There are factors that hamper the analytical process, and thus make learning from project evaluation difficult.

We discussed how the multiple and conflicting objectives associated with irrigation development make it difficult to evaluate performance and to analyze why the system functions as it does. Next we discussed some of the problems associated with the data used to represent and model complex and changing systems. In the following section, we discuss a few factors that can hamper the analytical process of transforming data to understanding. Some of these stem from what the analyst brings to the task: disciplinary training and technique, experience, personal biases and qualities. These may limit the quantity and quality of what is learned through evaluation. Other problems affect higher order learning: translating one experience into a contribution to a generalized understanding of irrigation systems. Is the case accurately portrayed in common language? Is there a forum for sharing information and a method for synthesizing this knowledge? What are the scientific community's rules of evidence?

Experience both aids and constrains our ability to observe and draw inference. Experience teaches us what is likely to be important; it guides our observational strategy. When a person faces a series of situations that are repetitive or at least similar, experience is extremely valuable, because the observations made about relationships and effect from one case are likely to be applicable to another. Knowledge accumulates, and people become more efficient and effective in diagnosing problems.

The problem comes when situations are too dissimilar for transferability, but we attempt to generalize anyway. Experience in arid area irrigation of perishable cash crops

will not translate very directly to a system providing supplemental irrigation for paddy. When we do not recognize the differences between cases, we can jump too easily to an erroneous, but familiar conclusion. Experience teaches us what avenues of exploration are most likely to be fruitful, but if we are too keen to find a particular set of indications, we may not see the others. We can get locked into one way of investigating and interpreting a situation. Someone accustomed to operating in a whirlwind consultant mode is unlikely to shift smoothly and easily into slow tedious field analysis.

Disciplinary training and technique both aids and constrains the evaluator's ability to observe and draw inference. A disciplinary framework suggests and limits researchable questions and methodologies. The discipline provides boundaries on what the specialist from that discipline is expected to know and deal with. It suggests a first and perhaps major line of inquiry.Engineers, agronomists, economists and sociologists may pick up different, but overlapping cues from observing the same plot of land planted in sugar cane. The agronomist draws inferences about soil , water and pests, the engineer about soil-water delivery schedules, reliablity, the economist about the integration of the locals in to the larger economy, marketing arrangements and price subsidies for non-subsistence crops, world prices, and the sociologist about who provides the labor for this labor-intensive, dirty work, why do they grow something they cannot eat, do people have a choice in what they plant, etc. But this is dysfunctional if the specialist allows his/her disciplinary orientation to restrict his or her view of the larger panorama.

These disciplinary interests and variables limit and orient our view of the system. Chambers (1987, Chapter 2:3) illustrates this by listing a variety of occupations and their most likely first criterion of good system performance :

landless laborer	increased labor demand, days of working and wages
farmer	delivery to his/her farm, at low cost, of adequate, convenient, predictable and timely water for preferred farming practices
irrigation engineer	efficient delivery of water from headworks to outlet
agronomist	creation and maintenance of "the optimum moisture regime for plant growth and in particular (maximizing) production of that part of the plant which is harvestable product
agricultural economist	high and stable farm production and incomes
general economist	a high internal rate of return
political economist	equitable distribution of benefits especially to disadvantaged groups
sociologist	participation of irrigators in management

We generally see the project goals and performance problems in light of the variables and the data sources we use.

Both formal education and experience serve to hone our observation and problem-solving skills. Higher education in the U.S. is specialized and narrowly focused, though the degree of this narrowness depends on the discipline itself and even more so on the particular university's philosophy. Actually the American universities are more interdisciplinary at least in terms of their requirements than those in the European system, where there are few out-of-discipline requirements, especially at the graduate level. Given their colonial heritage, a majority of the developing world's university systems and bureaucratic structures also foster discipline-based, professional brotherhoods. Asian engineers have reported that when they were sent to the US for additional training, they learned little about engineering, but they did come away with a much greater appreciation of

the legitimacy of the contributions that social science people can make in understanding a situation. [22]

Short term means to address these problems

There are several ways to minimize the negative aspects of disciplinary training and technique as they affect evaluation quality. The scope-of-work should specifically request a discipline-integrated product, and at least some of the "questions to be addressed" should reflect the priority given to this orientation. Careful formation and deployment of the evaluation team are further considerations.

1. Evaluation Team Composition. Having reviewed the possible negative effects of disciplinary bias on irrigation problem solving, let us now state that the advantages of disciplinary training outweigh the hindrances. We have never met a successful irrigation jack-of-all-trades. In principle then, we agree with the trend toward interdisciplinary teams. The evaluation team should be made up of persons capable in their respective disciplines who are also sensitive to other concerns and willing and able to get help.[23] Donors, acting from a need for a prepackaged, predictable evaluation device, frequently hire one representative of each discipline: minimally, an agricultural engineer, an agronomist, a sociologist and an economist, to wage a frontal attack in their respective areas. But the problem at hand may call for a different mix. A predetermined list of questions for each

---

[22] This increased permeability of their disciplinary walls is key to developing the capacity to manage the irrigation *system* and not just the water conveyance apparati. Foreign training is one of the plums offered to irrigation officials participating in a project. The value of this for achieving short-term project goals is debatable, particularly if their leaves are scheduled right in the middle of critical stages of project implementation. Highly technical state-of-the-art sessions may not help them in their job any, but it does give them a morale boost (because if nothing else they are now more marketable in the private sector). If the training can help expand their repertoire of approaches, either because it offers them new skills, or just the chance to stand back and get a different view of the situation, then the training has been an investment in the future.

[23] Coward (1987) discusses issues in team composition for project design.

discipline to address may keep the multidisciplinary teammembers so busy that they have no time to wrestle with the more difficult, more elusive interdisciplinary questions.

People and personalities in large part determine the success of an interdisciplinary venture. Being a team player is wholely independent of excellence within one's discipline, and skills in both are desirable for the evaluation team, but personality is a difficult variable to select for or control without crossing the line into unacceptable hiring practices.

Local counterparts have their pluses and minuses. They probably know the whole milieu better, but especially if they are associated with the agency involved, they may have strong biases. Participation on the team gives them experience, and builds institutional capacity. We should experiment with the idea of including one or more clients of the system as full-fledged members of the evaluation team, though this idea is probably unworkable in many cases because of the language barrier between the external expatriate consultants and a representative farmer.

2. Deployment of the evaluation team. How the evaluation is set up and how it gets done, given the team makeup, has a definite impact on the quality of the product. Usually the teamleader arrives a week before the others to get the lay of the land. The whole team is usually in-country a maximum of three weeks.

If the scope-of-work or list of questions to be addressed in the evaluation is compartmentalized by discipline, there is likely to be little interaction. If team members can divide up and come and go to the research site as they please, (having the car, the necessary permissions, and the relative ease to do so) an individualized effort is even more likely. The team will pool their separate chapters in the last day or so of their TDY. Conditions such as lack of transport, great travelling distances, etc., which require the team to move about together, can be very aggravating, but do provide greater opportunity for team interaction. The most interesting interdisciplinary work usually gets done in informal interaction in an unstructured setting. Team members should live in the same quarters and share a common an office. The distractions of family and/or other outside interests may

keep an evaluator from participating in this invaluable informal interaction between team members.

This brings us to a discussion of the pitfalls of the team approach. First, tired and grumpy people may not interact positively. Team members need a break from one another on occasion. Each should have ample time to do a good job guided by his disciplinary instincts. The interdisciplinary interaction should be complementary, and a cause for inspiration, not grumbling. Second, the presence of a delegation of foreigners can be overwhelming. It is good to visit farmers and local officials in pairs or even individually. Official government escorts can be helpful in some settings. They have some idea what data are kept by whom, and can help expedite your requests and the response, but they are usually a big liability to getting real answers to questions of opinion. Their presence may intimidate respondents. Do not take them with you when you visit the farmers. Facility in the local language is a tremendous asset for the evaluator, but when translators must be employed, they should be instructed to not answer for the farmers or to modify responses.

Longer-term means to address these problems

In the long run, the best way to avoid allowing disciplinary training to put blinders on us is to legitimize and make valuable those other views. Experience, incentives and training are key interacting factors. Changes in curricula to include a broader basic knowledge of irrigation development issues are important in this legitimation process. But requiring the budding irrigation specialist to take one course in each field may not achieve the goal. Students need to be able to see the disciplines in interaction; what each provides to the total picture.[24] When people in decisionmaking positions are also convinced of the

---

[24]The Sociotechnical Aspects of Irrigation course at Cornell, which is jointly sponsored by four departments, offers this experience. Professional, academic and in-training engineers, sociologists, agronomists and economists, and political scientists interact together on a given irrigation problem or case.

value of the contributions other disciplines can make, changes in curricula and perhaps in incentives will follow.

Problems for generalizing from evaluations.

Other difficulties for translating observed reality into learning stem from the fact that we are dealing with an inexact, immature field of study. The rules of acceptable evidence are not adequately defined. How do we recognize a "lesson learned" when we bump into one? How can the valuable wheat of experience be separated from the chaff of personal bias? When are lessons from specific cases generalizable?

There is a general uneasiness with the trend that, in action research and espoused learning process approaches especially, a good deal of the literature describing and appraising the results has been written and promoted by participants and other "true believers." An upbeat attitude and the ability to adjust to each turn of fate to maximize potential are excellent traits for an advocate. But an advocate's ability to contribute objective analysis of project performance is suspect, regardless of his good faith motivation. In the Gal Oya case, Norman Uphoff generously shared his field notes and opinions on project problems and progress with many people in many forums. This kind of progress journal made it an open experiment. The possible negative aspect of this is that this well-documented case may be given more weight than it actually merits <u>because</u> it is well-known.

Outside observer/evaluators, though not without their own problems, are a necessary component of credible evaluation, particularly evaluation which is supposed to contribute to planning and knowledge-building. We need to examine more carefully what we do with these data and case studies.

CONCLUSION

Evaluations can serve a vital function in the process of learning from irrigation projects. Evaluation is potentially profitable at three different levels: as feedback to project and system management at the local level, as evidence of what works and doesn't work to the project planning cycle, and as a tool for increasing our understanding of how irrigation systems and human and agricultural systems interact.

For evaluation to be useful as feedback to the local level, the exercises must come earlier in the project implementation cycle than typically has been the case, so that changes can be incorporated before the project is completed. Project implementation and system management concerns may require different evaluation emphases (different data, different people involved, different ways of going about the evaluation activity). Evaluations typically emphasize such project concerns as timeliness of construction, neglecting system management information needs. If evaluation is to promote system sustainability and develop management capabilities, it must place greater emphasis on the development of locally-relevant management information systems. The longitudinal view provided by accumulated system performance monitoring data is an information base for final evaluation, but even more important, the evaluation activity itself has served to build the social and physical infrastructure necessary for a functional monitoring system which will extend beyond the project's life.

Management information generated by evaluation/monitoring data-gathering systems should go to managers, but we need to ask, who manages, or more specifically, who manages at what level of the system? What are their data needs for day-to-day management? For analyzing system performance versus potential?

As we begin to realize that project planning and problem-solving processes need to be better grounded in reality, evaluation's potential as a feedback and learning tool becomes more evident. The focus and timing of current evaluation methods constrain its

ability to facilitate learning from project realities. However, relatively minor adjustments to evaluation's definition and methods can be expected to yield significant improvements in its ability to contribute to our understanding of what is really happening in this project and why. This kind of information allows us to make finetuning adjustments to the current project, and to alter our concepts and strategies for similar situations.

Evaluation can provide important feedback for system and project design, and implementation procedures. Alterations and adjustments can be made to the way projects are conceived and implemented, based on the experience of others as reported by the evaluations. This of course assumes that evaluations are read and their lessons assimilated by the persons responsible for project planning and implementation.

Evaluations of irrigation systems can also provide evidence and insight into numerous disciplinary-bound and cross-disciplinary study areas such as farmer's input use as a response to water predictability, or farming systems more broadly, or the problems and potentials of development interventions. Most evaluations are project-oriented and thus are not and should not be specifically geared for theoretical pursuits. They can yield interesting insights as a secondary benefit however. Irrigation studies is an immature field, without benefit of a theory, a vocabulary[25], or the rules and institutions for capturing, communicating, testing, accumulating and transferring ideas. Some of these amenities are needed before we can make much progress in learning about irrigation through evaluation, for though the terminology of "learning" is frequently employed, we are not so sure how learning actually happens.

We identified three important factors that inhibit or prevent learning from evaluation. Multiple and conflicting objectives at work in the project setting confound the evaluator's efforts to diagnose problems and to suggest strategies for improving performance. By identifying and sorting out the incentives of various parties involved, we

---

[25]Steiner's(1988) typology of physical characteristics of irrigation systems begins to provide a vocabulary.

can begin to see why things are the way they are. By "taking the bottom-up view seriously " and examining the farmer's/manager's perspective, we will gain a better understanding of how the irrigation system (in all its ramifications) fits within the parameters which govern their lives. Through this exercise, it is possible that we could identify minor modifications in system design or operation would make a significant improvement in the long-term viability of the system.

The limited time and resources that go into collecting and analyzing the data on which the evaluation is based dilutes its quality. We do not believe that more data are necessarily better, and in fact, more might be worse. Survey data that can be easily tabulated and quantified is often less useful and more expensive than simple conversations with those intimately involved with the system. We suggest use of less intensive data collection, emphasis on data that indicate changes in system performance over time, time saving data collection techniques.

These changes in evaluation strategies may require different field arrangements. Monitoring devices involving complex or very simple data collection can be used to generate an information base for project evaluation, and can provide the hardware and training for system performance monitoring to continue after the project is long gone. Monitoring makes midstream corrections possible, also provides the possibility to collect longitudinal data, that coupled with other data could provide much better insight into system performance. Monitoring emphasizes knowing the system, interacting with it. System managers will benefit most from the investment of time required, and should probably be included on evaluation teams.

We also discussed quick techniques for problem diagnosis and evaluation: red flags that will draw our attention to critical points, "key questions" that are likely to identify other problem areas so that we do not waste valuable time collecting data to answer irrelevant questions. More thought should be put toward the development of measures that incorporate concepts of risk, and that integrate over time.

The difficulties of translating observed phenomena into learning stem from two sets of problems: what skills and biases the observer brings to the task of observing, and how the observations made are then handled. Evaluation quality depends on the evaluators and their observation and inference capacities. Experience develops the powers of inference and deduction and suggests the critical connections between this observation and other bodies of knowledge. Discipline provides a theoretical framework and a method of analysis. Interdisciplinary evaluation teams are suggested with the warning that a prepackaged foursome (agriculturalist, economist, engineer and sociologist) may not be the appropriate mix for any and all situations. Also, interdisciplinary interactions among team members must be fostered if the evaluation is to take an integrated approach to problem identification and performance assessment.

What happens to an evaluation report after it is completed? How many of its observations or "lessons learned" are disseminated widely depends in part on the abilities of the receiver/sponsor to sift through the evidence, to recognize the valuable insights, to either store them in memory or to immediately make adjustments to practice, and to share the lessons with others. The means for transforming single observations into contributions to both knowledge and to theories of action are underdeveloped in the irrigation-sponsoring institutions and in irrigation studies. In spite of this, an evaluation which clearly and succinctly draws out the lessons suggested by the situation it has studied is bound to be widely read, for people are eager for this type of analysis. In fact, some particularly well-done case studies have had more than their share of influence upon our concepts.

REFERENCES

Abeyratna, Shyamala, and Jayantha Perera.
1984 Changes in Irrigation Management in Small Communities: A Tank and Anicut System in Moneragala District, Sri Lanka, "*Sri Lanka Journal of Agrarian Studies*, 5(1), pp. 71-84

Abeysekera, W.A. Terrence.
1986 *Experience at Mahavilachchiya Settlement*. Ph.D. Dissertation. Ithaca, NY: Cornell University

Agrarian Research and Training Institute.
1982 *1980 Yearbook for Sri Lanka Water Management Research: Initial Analysis of Pre-Rehabilitation Situation in Left Bank Gal Oya*. Colombo: Agrarian Research and Training Institute.

1985 *Gal Oya Water Management Project: Mid-Term Impact Assessment*. by A.S. Widanapathirana and J.D. Brewer, Research Study No. 63. Colombo, Sri Lanka: Agrarian ResearchTI

1986 *The Gal Oya Water Management Project: End-of-Project Impact Assessment*. Irrigation and Agrarian Relations Division, Colombo, Sri Lanka: Agrarian Research and Training Institute

Ambler, John.
1988 *Ecology and Management of Small Scale Irrigation in West Sumatra,ndonesia: Farmer-Managed and Government-Assisted Systems*, Ph.D.dissertation, draft. Ithaca, New York: Cornell University.

Asian Development Bank
1987 *Project Benefit Monitoring and Evaluation for Irrigation Projects: Guidelines for Bank Staff*. Staff of Executing Agencies and Consultants. Draft. Manila: Asian Development Bank

Barker, Randolph, and Les Small (workshop coordinators)
1985 *Proceedings of the Workshop on Research Priorities for Irrigation Management in Asia*. Held in Kandy, Sri Lanka, January 6-11, 1985. Sponsored by Water Management Synthesis Project, Contract DAN-1527-C-0086-00, and the International Irrigation Management Institute. Ithaca, NY: Cornell University

Barnett, A. S.
1977 *The Gezira Scheme: An Illusion of Development*. Frank Cass

Benedict, Peter *et al.*
1981 *Sudan: The Rahad Irrigation Project*. A.I.D. Project Impact Evaluation Report No. 31, Washington,D.C.: USAID

Berry, Leonard, Richard Ford and Richard Hosier,
1980 *The Impact of Irrigation on Development: Issues for a Comprehensive Evaluation Study* A.I.D. Program Evaluation Discussion Paper No. 9. Office of Evaluation, Bureau for Program and Policy Coordination, Washington, D.C.: U.S. Agency for International Development.

Bottrall, Anthony.
More On Evaluating Organisation and Management, Irrigation Management Network Paper 1/80/1 London: Overseas Development Institute.

1981 "Improving Canal Management: The Role of Evaluation and Action Research," *Water Supply & Management.* Vol. 5, pp. 67-79

1981 *Comparative Study of the Management and Organization of Irrigation Projects.* World Bank Staff Working Paper No. 458, Washington, D.C.: World Bank

Bryant, Coralie
1980 "Organizational Impediments to Making Participation a Reality: 'Swimming Upstream' at AID", *Rural Development Participation Review* Vol. 1. No. 3, Spring 1980, p. 8-10. Rural Development Committee, Cornell: Ithaca,

Campbell, Donald
1969 "Reforms as Experiments" American Pyschologist Vol. 24, No. 4, 409-429

Chambers, Robert
1978 "Project Selection for Poverty-Focussed Rural Development: Simple is Optimal" *World Development*

1983 "Shortcut Methods in Social Information" in *Putting People First: Sociology and Development Projects* Michael Cernea (ed) Washington, D.C.: World Bank

n.d. *In Search of A Water Revolution: Canal Irrigation for People.* Draft of book manuscript

Chambers, R., and Carruthers, Ian.
1985 "Appraisal to Improve Canal Irigation Performance: In Search of Cost Effective Methods", IIMI Evaluation seminar paper

Chambers, R., and J. Moris (eds.)
1973 *Mwea: An Irrigated Rice Settlement in Kenya.* Weltforum Verlag, Mucham

Cohen, J.M., Merilee Grindle and S. Tjip Walker
1975 "Foreign Aid and Conditions Precedent: Political and Bureaucratic Dimensions," *World Development* 13(12), pp. 1211-1230

Coward, E. Walter Jr. (ed.)
1980 *Irrigation and Agricultural Development in Asia.* Ithaca, NY: Cornell University Press

1987 *Designing Projects for Irrigation Development: Using External Consultants.* Water Management Synthesis Project. Professional Ithaca, NY: Cornell University.

Deuwel, John
1982 *Promoting Participatory Approaches to Cultivating Water Users Associations: Two Case Studies from Central Java.* Departments of Rural Sociology and Agricultural Engineering, Technical Report No. 11, Ithaca, NY: Cornell University

de los Reyes, Romana P.
1981 "Guidelines for Appraising Communal Irrigation systems" Overseas Development Institute Irrigation Network Newletter 1/81/1, London: Overseas Development Institute

de los Reyes, Romana, and Sylvia Ma. G. Jopillo
1986 *An Evaluation of the Philippine Participatory Communal Irrigation Program* Institute of Philippine Culture, Ateneo de Manila University: Quezon City.

de Wilde, J.C.
1967 *Experiences With Agricultural Development in Tropical Africa,* Vol. II and III, Baltimore: Johns Hopkins Press

Downing, Theodore
1974 "Irrigation and Moisture-Sensitive Periods: A Zapotec Case." in Downing T. and McG. Gibson (eds.) *Irrigation's Impact on Society.* Anthropological Papers of the University of Arizona No. 25. Tucson: University of Arizona Press. Pp. 113-122

Ellman, Antony
1981 "Rapid Appraisal for Rural Project Preparation" *Agricultural Administration* 8(1981) pp. 463-471

Farver, M. Tashi , and John P. Milton
1972 *The Careless Technology: Ecology and International Development.* Garden City, NY: The Natural History Press

Finin, Gerald , N.T. Uphoff and Suzanne Wallen
1985 *Strategies for Supporting Local Institutional Development.* Rural Development Committee, Cornell University: Ithaca, NY

Friedmann, John
1973 *Retracking America: A Theory of Transactive Planning.* Garden City: Anchor Press

Garces, Carlos Restrepo.
1983 *A Methodology to Evaluate the Performance of Irrigation Systems: Application to Philippine National Systems.* Ph.D. dissertation, Ithaca,New York: Cornell University.

Greenberg, Martin Henry
1970 *Bureaucracy and Development: A Mexican Case Study.* Lexington, MA: D.C. Heath Books

Hildebrand, P. E.
1981 "Combining Disciplines in Rapid Appraisal: The Sondeo" *Agricultural Administration.* 8(1981) pp. 423-432

Hirschman, A.O.
1967 *Development Projects Observed.* Washington D.C.: Brookings Institute.

Honadle, George
1982 "Rapid Reconnaisance for Development Administration: Mapping and Moulding Organizational Landscapes" *World Development* 10(8) pp. 633-649

International Science and Technology Institute, Inc.
1985 *Final Evaluation of Sri Lanka -Water Management Project* No. 383-0057, Washington, D.C. : ISTI

Johnston, B. F., and Clark, W.C.
1982 *Redesigning Rural Development: A Strategic Perspective.* Baltimore: Johns Hopkins University Press.

Jurriens, R. , A.F. Bottrall and others
1984 *Evaluation of Irrigation Design - A Debate.* Irrigation Management Network Paper 9b. London: Overseas Development Institute.

Korten, D. C.
1980 "Community Organization and Rural Development: A Learning Process Approach." *Public Administration Review* 40, No. 5, pp. 480-511.

Lenton, Roberto.
1980 "Field Experimentation and Generalization in Irrigation Development and Management" ODI Network Paper 2/80/81, London: Overseas Development Institute.

1982 *Management Tools for Improving Irrigation System Performance.* Paper presented at the course for Water Management in Irrigation Systems. New Delhi, India: Central Water Commission.

Levine, Gilbert.
1986-87 Comments at Seminars

1986 "The Challenge of Rehabilitation and Betterment". Paper presented at Water Management Synthesis II Conference on Rehabilitation and Betterment, October 27-31. Washington, D.C.

Lindblom, C.E.
1965 *The Intelligence of Democracy*. Free Press: NY

Lowdermilk, Max K., Alan C. Early, and David M. Freeman.
1978 *Farm Constraints and Farmer's Responses: Comprehensive Field Survey in Pakistan*. Water Management Technical Report No. 48-A. Water Management Research Project, Fort Collins: Colorado State University. September 1978.

Maholtra, S. P.
1982 *The Warabandi System and Its Infrastructure*. Central Board of Irrigation and Power, Publication No. 157. New Delhi: CBIP

Maholtra S. P., S. Raheja, and D. Seckler
1984 "A Methodology for Monitoring Performance of Large-Scale Irrigation Systems: A Case Study of the Warabandi System of Northwest India", *Agricultural Administration* **17** (1984) 231-259

Martin, Edward and Robert Yoder
1983 *Water Allocation and Resource Management for Irrigation: A Comparison of Two Systems in Nepal*. Paper presented at Nepal Studies Association Meetings, Madison, Wisconsin

1986 *Institutions for Irrigation Management in Farmer-Managed Systems: Examples from the Hills of Nepal*. Research Paper No. 5, Digana Village, Sri Lanka: International Irrigation Management Institute (IIMI).

1987 *A Study of Irrigation Management in Hill Irrigation Systems in* University Water Management Synthesis Project

Mayson, E.
1984 "Assisting Villagers to Build Their Own Irrigation Scheme--An Example from Thailand" *Irrigation Management Network Paper*. Overseas Development Institute: London

Michel, Aloys A
1972 "The Impact of Modern Irrigation Technology in the Indus and Helmand Basins of Southwest Asia," in Farver and Milton, *The Careless Technology*

Moore, M. P.
1980 "The Management of Irrigation Systems in Sri Lanka: A Study in Practical Sociology", *Sri Lanka Journal of Social Sciences*, 2 (2), pp. 89-111

Moya, Tolentino, and M.F. Walter
1988 *Irrigation Systems Operations and Relative Water Supply* Working Paper, Water Management Synthesis Project. Cornell University, Ithaca, NY

Murray-Rust, D. H.,
1983 *Irrigation Water Management in Sri Lanka: An Evaluation of Technical and Policy Factors Affecting Operation of the Main Channel System.* Ph.D. dissertation, Ithaca, New York: Cornell University.

Pant, Niranjan, (ed.)
1985 *Productivity and Equity in Irrigation Systems.* New Delhi: Ashish

Practical Concepts Incorporated,
1979 *Patterns in Irrigation Projects: An Analysis of AID's Automated Data* IQC No AID/otr-C-1377 Work Order #20, prepared for Studies Division, Bureau for Program and Policy Coordination, March 26 1979, Washington, D.C: Agency for International Development.

Plusquellec, Herve, and Thomas Wickham
1985 *Irrigation Design and Management: Experience in Thailand and Its General Applicability.* World Bank Technical Paper No. 40 Washington D.C.: World Bank

Ramamurthy, Priti.
1984 *A Report of the Conference on Community Responses to Irrigation in South Asia.* Sponsored by the Social Science Research Council, New York and the Indian Institute of Management, Bangalore, January 4-7, 1984 at Bangalore, India

1986 *Measuring Main Canal Performance: Productivity or Futility?* Paper presented at the Forum on Irrigation Systems: Research and Applications. May 13-15, 1986. Sponsored by Water Management Synthesis II Project, Ithaca, N.Y.: Cornell University.

Robinson, D.
1982 *Water Users' Organizations in Two Large Philippine Irrigation Systems: Constraints and Benefits of a Participatory Approach to Water Management.* Ph.D. Dissertation, Ithaca, N.Y. : Cornell University

1986 *The High Performance Sederhana Irrigation Systems Project.* Consultant Report to USAID/Jakarta. Jakarta, Indonesia: United States Agency for International Development.

Rondinelli, D
1983 *Development Projects as Policy Experiments: An Adaptive Approach to Development Administration* New York: Methuen

Rukuni, Mandivamba
1987 "The Evolution of Irrigation Policy in Zimbabwe: 1900-1986" in Research and Irrigation in Africa, Water Management Synthesis Project Report 63, Ithaca, NY: Cornell University

St. Julien, N.
1983 *Sri Lanka Trip Report*, consultancy report to ARTI/USAID, October 29, 1983. Colombo, Sri Lanka: Agrarian Research and Training Institute.

Schmidt, Greg
1986 "Foreign Aid and Institutional Development: An Analysis of Programmatic and Capacity-Building Approaches Employed by USAID in Peru" Paper for International Studies Association 27th annual convention, Anaheim March 26 1986

Schon, Donald A
"Organizational Learning, " in *Beyond Method.* Gareth Meegan (ed)., Sage Publications

Seckler, D.
1985 Irrigation Management Network Paper 11B, May 1985 London: Overseas Development Institute

Sims, Elizabeth Hollister
1983 *Rural Development and Public Policy: Agricultural Institutions and Technological Change in Indian and Pakistani Punjab.* Ph. D. Dissertation, Berkeley: University of California.

Simon, Herbert
1965 *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organization.* Second Edition. Free Press: NY

1971 "Decision Making and Organizational Design, " in *Organizational Theory,* D. S. Pugh (ed.) Penguin Books

Siy, Robert Y.
1982 *Community Resource Management: Lessons from the Zanjera.* Quezon City, Philippines: University of the Philippines Press.

Steinberg, David, with Cynthia Clapp-Wincek and Allen G. Turner.
1983 *Irrigation and AID's Experience: A Consideration Based on Evaluations* A.I.D. Program Evaluation Report No. 8, U.S. Agency for International Development,Washington, D.C. PN-AAL-019

Steiner, Roy
1987 *Operation Typologies for Surface Irrigation Systems.* M.S. Thesis. Ithaca, NY: Cornell University

Steiner, Roy and M.F. Walter
1988 *Classification of Gravity Irrigation Systems and Their Operation.* Water Management Synthesis Project, Cornell University, Ithaca. NY

Stone, Donald
1984 *Canal Irrigation in British India.* Cambridge: Cambridge University Press

Svendsen, M.
1983 *Water Management Strategies and Practices at the Tertiary Level : Three Philippine Irrigation Systems.* Ph.D. Dissertation, Ithaca, N.Y. : Cornell University.

1987 *Irrigation Research at IFPRI*, Handout and seminar, May 5, 1987, given to Cornell Irrigation Studies Group

Svendsen, M, and C.M. Wijayaratna.
1982 "The Spatial Distribution of Irrigation Water and Yield in Gal Oya Left Bank," *Sri Lanka Journal of Agrarian Studies*, 3(2) pp. 69-82

Tapay, Nenita E, Greg Simbahan, and Hammond Murray-Rust
1987 "Evaluation of Communal Irrigation System Performance in the Philippines: The Case of Farmer Irrigation Organization." *Agricultural Administration and Extension.* **25** (1987) 127-141

Tendler, Judith.
1975 *Inside Foreign Aid.* Baltimore: Johns Hopkins University Press

1979 *New Directions: Rural Roads* Aid Program Evaluation Discussion Paper No. 2 ,Office of Evaluation, Bureau for Program and Policy Coordination. Washington, D.C.: Agency for International Development

United States of America, Government Accounting Office.
1983 *Report to the Administrator, Agency for International Development.* GAO/NSIAD-83-31, August 29, 1983

Uphoff, N.T.
1985 "People's Participation in Water Management: Gal Oya Sri Lanka" pp. 131-178 in J.C. Garcia-Zamor (ed) *Public Participation in Development Planning.* Boulder, Colorado: Westview Press

1986 *Local Institutional Development: An Analytical Sourcebook with Cases.* West Hartford, CT : Kumarian Press

Valera, A. B.
1985 *A Comparative Assessment of Three Irrigation Systems at Central Luzon, Philippines.* Ph. D. Dissertation, Ithaca, N.Y.: Cornell University

Vander Velde, E. J.
1980 "Local Consequences of a Large-Scale Irrigation System in India." Pp. 299-328 in E. Walter Coward, Jr. (ed.) *Irrigation and*

Agricultural Development in Asia. Ithaca, NY: Cornell University Press

Vermillion, Douglas Lynn
1986 *Rules and Processes: Dividing Water and Negotiating Order in Two New Irrigation Systems in North Sulawesi, Indonesia.* Ph.D. Dissertation, Ithaca, N.Y.: Cornell University

Wade, Robert
1982 "The System of Administrative and Political Corruption: Canal Irrigation in South India. *Jounal of Development Studies.* 18 (3): 287-328

Wade, Robert, and Robert Chambers
1980 *Managing the Main System: Canal Irrigation's Blind Spot,* mimeo, Brighton: Institute of Development Studies

Wijayaratna, C.M.
1986 *Assessing Irrigation System Performance: A Methodological Study with Application to Gal Oya Scheme, Sri Lanka.* Ph. D. Dissertation, Ithaca, N.Y. : Cornell University