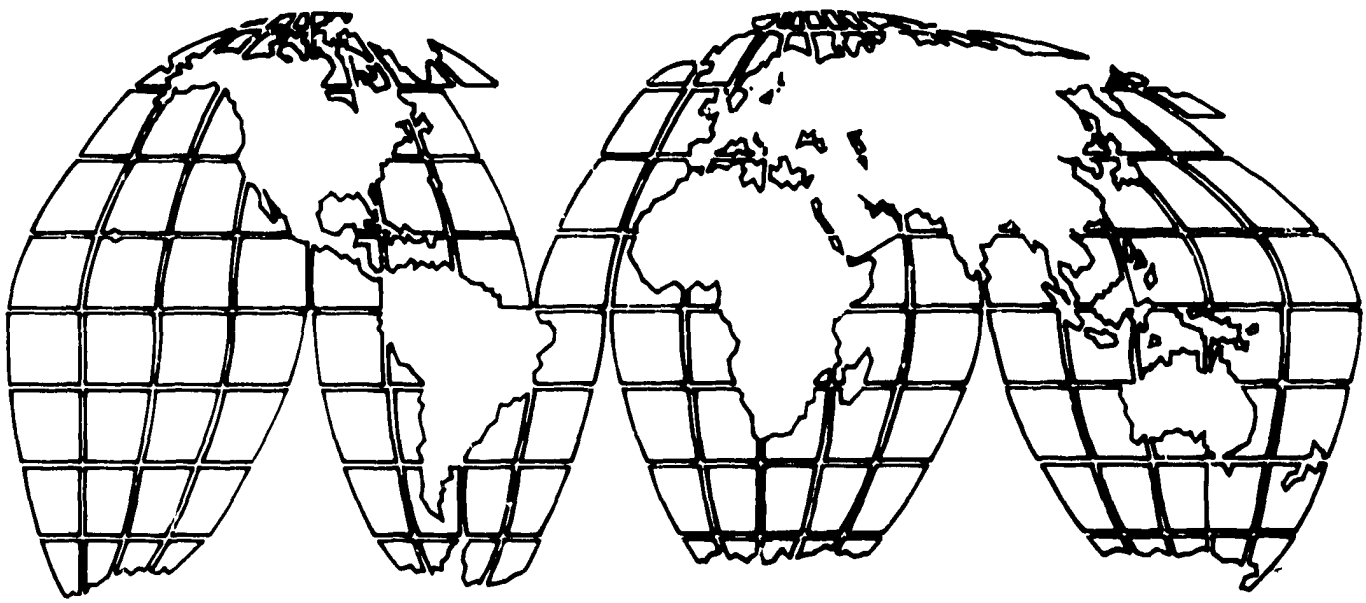
A.I.D. Program Evaluation Discussion Paper No. 9

The Impact of Irrigation on Development: Issues for a Comprehensive Evaluation Study



October 1980

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(continued inside back cover)

THE IMPACT OF IRRIGATION ON DEVELOPMENT: ISSUES FOR A COMPREHENSIVE EVALUATION STUDY

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A.I.D. Program Evaluation
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The Studies Division
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TABLE OF CONTENTS

		Page
Table of Contents		i
List of Tables		iii
Preface		iv
Summary		vi
Acknowledgements		xi
1. Introduction:	The Role of Irrigation in Meeting World Food Needs	1
1.1	Can Reality Match the Promise?	1
1.2	The Role of Evaluation	4
2. Irrigation:	Its Historical Evolution, Current Status, and Projections for the Future	6
2.1	Historical Evolution: Styles of Irrigation Projects	6
2.2	Status of Irrigation in Developing Countries	9
2.3	Trends of Irrigation in Developing Countries	16
3. Review of Existing Evaluations:		19
3.1	Existing Evaluation: Evaluation Policy	19
3.2	Existing Evaluations: Non-AID Reviews of AID Projects	26
3.3	External Evaluations: Evaluation Emphasis	28
4. Evaluation of Irrigation Projects:		35
4.1	Objectives and Special Characteristics of Evaluation of Irrigation	35
4.2	Evaluation Categories	36
4.3	The Case for Evaluation at Different Stages of the Project Cycle	40
4.4	Evaluation at Preparatory, Construction, and Operational Stages	41

TABLE OF CONTENTS

		Page
5.	A Program for the Evaluation of Irrigation with USAID	48
5.1	Regional Overviews	48
5.2	Routine Project Review	49
5.3	Selective, In-Depth Evaluations	50
6.	Materials Consulted	
6.1	Books	52
6.2	Articles and Papers	53
6.3	Government and International Organization Publications	55
6.4	Library Computer Systems Consulted	60

APPENDICES

APPENDIX I -	United Nations Development Program Project Compendium	62
APPENDIX II -	Environmental Considerations in Impact Evaluation of Water Resource Projects	66
APPENDIX III -	Criteria for Site Selection: When to Irrigate	68

LIST OF TABLES

Table		Page
I.	Distribution of Irrigation in the World	10
II.	Estimates of the World's Land Area Under Irrigation in 1970 and Ultimate Potential	17
III.	Evaluation Criteria for Irrigation Activities	37
IV.	Examples of Evaluation Questions at Different Stages of Project	42

PREFACE

This is one of a series of discussion papers issued by the Agency for International Development. This paper is sponsored by the Office of Evaluation.

The purpose of the A.I.D. Program Evaluation Discussion Paper Series is to stimulate thought and dialogue on development problems and to encourage experimentation. The authors of the papers are instructed to be critical in a constructive sense and to examine explicit or implicit assumptions that are usually taken as given, to look for unrecognized and often cross-sectoral linkages, to examine host country institutional factors, to examine how AID's organization, staffing and procedures affect its effectiveness, and to identify alternative approaches and policy options. Two key factors characterize the series: actual development experience is sought as a basis for opinion and opinion is directed towards policy issues. The papers are a mix of what is known (from experience and evaluation evidence) and what needs to be known from further evaluative studies.

Because the discussion papers are exploratory, they are not intended to be comprehensive in coverage, conclusive in their argument, or primarily technical in orientation. They are intended to help formulate additional hypotheses for testing and to assess what additional work needs to be done on the problem. We hope that the discussion papers will help stimulate innovative and more effective programming and project design in our overseas missions and that they will also be of interest to scholars carrying out research on development.

Most importantly, however, we hope that the papers will elicit responses from our readers--responses that will confirm or refute assertions, refine or add issues to be analyzed, and suggest case studies necessary to resolve issues.

The primary objective of the Office of Evaluation is to provide AID management with analysis of the intended and unintended impact of projects, programs, policies, and procedures. It is our intent that lessons gleaned from AID's past be made readily available to improve present planning.

The Office tailors its approach to suit the nature of a problem, its urgency, and the type of data available. After identifying a problem and ascertaining management interest in it, the Office's staff normally links up with or establishes a network of AID and non-AID experts. The staff also reviews information from the Agency's automated data base systems and assembles documents including project papers, project evaluations, and special

studies sponsored by other parts of the Agency. In conjunction with this, the Office commissions discussion papers by experts who are familiar with development problems. It may also hold workshops and conferences and, if necessary, carry out field studies of past projects and programs. The Office does not sponsor basic research on development but concentrates on analyzing available information.

Findings are issued in discussion papers, workshop and conference reports, circular airgrams, action memoranda, sector and subsector studies and case studies. These do not constitute formal guidance unless they are explicitly cleared and issued as such.

About This Paper

The Studies Division in AID's Office of Evaluation is coordinating an Agency inter-regional evaluation of small and medium scale irrigation projects as one of a number of current efforts. In order to provide the background to these activities, the author was requested to outline the issues which should be included in a comprehensive examination of irrigation's impact on development.

Leonard Berry is a recognized expert in many aspects of development but particularly in those interventions with probable environmental consequences. He created the Tanzania Bureau of Resource Assessment and Land Use Planning and served as its first head. He is currently co-director of the Program for International Development at Clark University.

SUMMARY

To some, increased irrigation appears to be the most effective way to feed the world's growing population. They emphasize the high yields that are possible using well coordinated sets of inputs, including "green revolution" packages, to meet the rapidly growing demand for food in the face of stagnating productivity.

Another viewpoint stresses the difficulties of operating truly successful irrigation projects. In most human and physical settings, irrigation technology is intrusive and disruptive to established natural and man-made systems. Irrigation creates new health, soil, water, socio-economic, and decision-making environments. Often, the potential gains of irrigation are offset or greatly reduced by one or another segment of this disharmony. Critics point to the increase in health problems or considerable losses of irrigable land through water-logging, salinization, and poor management practices.

Strong evidence supports both viewpoints. Irrigation can be a powerful factor in increased agricultural production; it can be shown that many irrigation projects have failed to achieve long run project goals.

Many developing countries and many donor agencies, including USAID, envisage irrigation as a significant component of development programs in the coming years. The FAO has called for an investment in irrigation of $40 billion from 1975 to 1985 though current ex-

penditures are considerably less than the necessary $4 billion a year. Despite the constraints of money, technical knowhow, and manpower, the extension of irrigation will continue to command considerable attention. The potential is considerable -- there may be one and one-half times as much irrigable land yet unirrigated as is now under irrigation. Land currently under irrigation could double its productivity using improved soil, water, and system management.

These two approaches-- (1) improvement of current irrigation, and (2) extension into new areas-- can only be worthwhile if they are based on a new kind of hard-headed assessment. If irrigation is to make its expected contributions, world-wide, the success rate needs to be substantially improved. Such improvement can only be achieved by a long term process of project selection, design, evaluation, monitoring, and feedback. The special commitment of USAID to problems of general rural development, health, equity, and the environment make the evaluation of irrigation particularly critical.

This report outlines issues that should be examined in any comprehensive evaluation of irrigation projects. It sets these issues against a background of previous evaluations of USAID projects. Recommendations are made for a schema for selection

of USAID projects to be evaluated.*

Five overlapping components are essential to any comprehensive evaluation:

... economic viability

... efficiency of resource use

... effectiveness of water delivery systems

... environmental quality (including health impacts)

... social soundness of the new social system

Table III (Page 37) sets out a more detailed taxonomy for these components.

Irrigation projects take a long time to design, build, and become operational. We therefore recommend that evaluation be a continuous process during the three main stages of the project cycle. Table IV (Page 42) suggests the different points of emphasis over time. It is also important that evaluation include a post construction analysis.

In attempting to set this evaluation schema against existing evaluations, we found a complex situation. USAID evaluations focus almost entirely at the project level and range from detailed, large scale reviews to short commentaries. There appears to be more material on Asian and Near Eastern projects than on African or Latin

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*Our terms of reference did not call for a definitive survey of all USAID irrigation evaluations. For a comprehensive examination of AID evaluations and irrigation efforts, see "Patterns in Irrigation Projects: An Analysis of AID's Automated Data," IQC Bi. AID/ots-C-1377, prepared by Practical Concepts Incorporated, November, 1978. Two reviews currently underway are "Pattern Analysis of Small and Medium Scale Irrigation Projects," AID contract otr-C-1378, in preparation by Checci and Company; and "Synthesis of Irrigation Water Transport Practices," which the Consortium for International Development (CID) has underway.

American activities. We found no evaluations that looked comprehensively at the various stages of the project cycle and none that examined the full breadth of essential themes. We could not discern an overall rationale for evaluation nor did we learn of any effective mechanism for using the results of evaluation in project planning. Although several of the evaluations we reviewed identified critical problems in project management, we found very little explicit attention to formal mechanisms to use the evaluations to improve project management. Nor did we find any mention of systems to monitor project performances in ways which would improve project management.

We recommend:

... a clearer statement on the purpose of evaluation to include three objectives:

  a. assessment of project conformity with original goals;

  b. facilitating feedback for improved project management;

  c. defining lessons learned to improve design of future projects.

... evaluations to be targeted on the needs of the Agency, the host government, and the users of the system with appropriate feedback to each;

... a longitudinal study approach to evaluation;

... that evaluation should include both internal USAID evaluators and independent contractors with host country personnel involved in both.

Despite a comprehensive search, we found comparatively few non-USAID supported evaluations of USAID projects. Those we reviewed resulted either from an academic study or a "sector" review. The most important contribution of these non-AID evaluations is

that they were able to take a broad view of a particular problem. For example, one academic review studied the general impact of irrigation on a regional economy; other sector reviews analyzed the environmental or other effects of a number of projects. These studies are an important complement to USAID project evaluations, but are not numerous enough or comprehensive enough to significantly affect the need for Agency supported evaluation.

In designing a USAID program of evaluation, we recommend:

... that there be a regional review of the success and problems of irrigation projects (to include USAID and other projects) in each of the following regions:

India-Pakistan
Sri Lanka - Southeast Asia
Middle East (as defined by USAID)
Arid and Semi-arid Africa (Sahel, Sudan, East Africa)
Humid West and Central Africa
Latin America

... that all projects include a monitoring and evaluation component of a small number of significant variables;

... that in each USAID region in which there is significant involvement with irrigation, one project be designated for intensive evaluation and monitoring;

... that mechanisms be set up to facilitate the use of evaluations in project improvement and new project design

ACKNOWLEDGEMENTS

In preparing this report, we are indebted to a number of individuals for assistance. In particular, we wish to thank the following people at the Agency for International Development: Robert Berg and Daniel Dworkin, PPC; Gilbert Corey of the Office of Agriculture; Margaret Pope in the AID Information Library. We also appreciate assistance from Susan Vogelsang of Checci and Company. At the Inter-American Development Bank, Herman Barger provided background material for policies which IDB has recently adopted on irrigation efforts. M.G.C. McDonald Dow of the National Academy of Sciences; E. Walter Coward, Jr. of Cornell University; George Self of the Near East Bureau/AID; Dr. Hotes of the World Bank; and Donald Mitchell of AID's Asia Bureau also provided much appreciated assistance. We owe a special debt to loyal staff without whom the work could not go forward: Ellen Hughes-Cromwick, Shirlene McGrath, Linda Bressler, and Ruby Hunter.

THE IMPACT OF IRRIGATION ON DEVELOPMENT: ISSUES FOR A COMPREHENSIVE EVALUATION STUDY

1. Introduction: The role of irrigation in meeting world food needs.

1.1 Can reality match the promise?

World food production is rising steadily. To improve nutritional standards among the world's poor and to feed the world's rapidly growing population, food production must continue to expand. Bringing new land into production will achieve some gains. But the rate of expansion of new arable land is estimated at only 0.7 percent per annum, far below current population growth rates.[1] Thus, the more significant food gain must come through increasing productivity of land already under cultivation. Increased food supply requires efficient management of several variables, especially water, seed, fertilizer, pest controls, food storage, land management, and crop mixes. Better water utilization, usually through irrigation, is one of the most critical of these variables.

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[1] Population growth rates in Asia, Africa, and Latin America vary from 2.5 percent to 3 percent with some as high as 4 percent.

Irrigation is not a new methodology. In the humid tropical areas of southern China, Southeast Asia, and India, irrigation has long improved yields in areas with abundant labor through double cropping and careful crop management. In the drier parts of Asia, and in the Near East, Africa and parts of Latin America, irrigation is used somewhat differently. By lengthening the growing season, the reliability and quantity of crop production is improved; by introducing irrigation in areas of low or unreliable rainfall, protection against drought is assured.

Previous success with irrigation is causing planners in developing countries to expand the area of irrigated land. The current rate of expansion in developing countries is roughly 3 percent per annum. The FAO expects such investments to continue. FAO analyst C.E. Houston projected that 2.5 million hectares of newly irrigated land would come into production each year from 1975 to 1985 and approximately twice as many irrigated hectares would be rehabilitated or improved.[2] Houston viewed both increasing and improving irrigation as central to solving world food problems and argued that irrigation's previously significant share of agricultural aid must become even larger in the years ahead.[3]

Clearly, irrigation is capable of higher yields. In Asia, water control and other inputs on working farms result in rice yields up to five times higher than those in unirrigated areas. Scientifically managed irrigation does even better. On research farms, yields with irrigation can be as much as four to eight times higher than the yield

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[2] C.E. Houston, "Irrigation Development in the World," in Worthington, Arid Land Irrigation in Developing Countries, pp.425-432, 1977. Full References are cited in section 6, "Materials Consulted."

[3] Ibid. p. 426.

of irrigated working farms. Although these astounding yields are far from matched on regular farms, the 20 percent of the world's agricultural land which is irrigated, produces 40 percent of the world's agricultural output.[4]

Yet irrigation projects have experienced many difficulties. The FAO has estimated that roughly one-half of the world's irrigated land is afflicted with salinization with resultant serious declines in productivity. In individual nations, salinized or water logged soils cover more than 70 percent of the irrigated land in Egypt, Iran, Iraq, and Pakistan, ranging in severity from moderate to serious. In particular, 200,000 hectares of newly irrigated Egyptian land is affected; in Pakistan, 100 hectares go out of production every day because of salinity. India has about 12 million hectares affected.[5] Difficulties such as salinization result from many causes. In a few cases, these problems grow from faults in technical design. In many technically sound projects, however, objectives are not achieved because of improper management, unsatisfactory leadership and decision-making, or short-sighted local resource use.

There are other problems. Irrigation projects are expensive and grow more so as the easier opportunities are exploited. As a result, they increase debt burdens or become more difficult to justify as grants. The high capital outlay places strong demands on the new irrigation system to produce commensurate cash returns and therefore to grow crops for export. These expensive projects also increase the risk quotient should the system fail to achieve planned targets.

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[4] V.A. Kouda, "Arid Land Irrigation and Soils Fertility: Problems of Salinity, Alkalinity, and Compaction" in Worthington, Arid Land Irrigation in Developing Countries, 1977, p. 213.

[5] Houston, "Irrigation Development," p. 431.

In the face of what inevitably will be greatly expanded investments in irrigation, many questions emerge:

... Given limited resources, is increased irrigation the most effective response to world food needs?

... Is there enough water to meet irrigation needs as well as provide for other human needs?

... Do irrigation projects deliver what the planners plan?

... Is rehabilitation or new irrigation more realistic?

... Are current methods and technologies of irrigation sufficiently understood to be disseminated widely in the developing world?

... Are techniques for training irrigators and irrigation managers sufficiently perfected to deal with expanding personnel needs?

... Are the side effects of any irrigation efforts harmful to the point that they outweigh the gains in food production?

This short paper cannot provide answers to this formidable range of issues. However, it does set out a framework within which these questions can be answered, and suggests methods of evaluation to improve project design.

1.2 The role of evaluation.

The high promise that irrigation offers and the commensurately long list of risks and uncertainties place particular priority on careful project design and sound project evaluation procedures. Project effectiveness can only be improved through a clear analysis of the experience of existing irrigation activities.

Effective evaluation calls for a simple yet comprehensive evaluation design model. A recent SCOPE publication presents a helpful design format which implies five basic evaluation questions. They are:

(i) Is the proposed project economically sound?

(ii) Has adequate provision been made for drainage and leaching?

(iii) Has the full range of alternative measures for achieving efficiency in water use been appraised?

(iv) Has the project study examined the probable effects upon aquatic and adjoining terrestrial ecosystems of changing the hydrological and soil regime in the area?

(v) Has the study canvassed and assigned costs to the social and economic measures which would be required to assure that anticipated benefits from crop growth and social stability are realized?[6]

These five issues, generalized for all evaluations, become: economic viability, soil productivity, water use, environmental impacts, and socio-economic impacts.

If we judge existing irrigation evaluations on the simple criteria of whether or not they consider all these issues, most are lacking. Although AID and other agencies have made much progress in recent years, most evaluations are confined to the project construction and implementation stage; none looks at alternatives to investment in irrigation; and only a few involve post construction evaluation on a broad basis.

Most evaluations are still based on assumptions that the prime objective of a project is to increase the cash return on the investment; many seem to assume that the goals of governments take precedence over goals of the users of the irrigation system; few have addressed the environmental impact of such projects; and only recently have evaluations begun to address the managerial and operational issues which are so critical to the success of such projects.

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6 Derived from Martin W. Holdgate and G.F. White, Environmental Issues: SCOPE Report #10, 1977.

This paper addresses the issues that should be considered in different types of evaluations. We first review the extent of irrigation and plans for the future. We then examine project evaluations of USAID and non-AID projects, prepared both by AID and others. Based on these reviews, we present a scheme for project evaluation and for selection of projects for different levels of assessments.

2. Irrigation: Its historical evolution, current status, and projections for the future.

2.1 Historical Evolution: Styles of irrigation projects

Irrigation is almost as old as sedentary agriculture itself. In the great river valley cultures of the world's early civilizations, irrigation filled a basic need for productive farming in rain deficient areas. Later techniques of terracing and careful water management would enable Sabeans to prosper in Yemen, Nabateans to make the Sinai productive, and form the basis of the ancient Zimbabwean's civilization in southern Africa.

Irrigation has been a persistent tool for improving productive capabilities in many parts of the world. In the twentieth century it has assumed great importance for many nations in Asia, and for some in Africa and Latin America. India, Pakistan, China, Mexico, Sudan, and Egypt are obvious examples. Irrigation as a means to increase productivity and promote development, continues to play a large part in plans for the future of many developing countries.

The history of irrigation in the developing world can be viewed in three phases or styles: a colonial style, an export promotion style, and a community promotion style. These phases are related to an evolution of

ideas through time, but they also reflect contemporary variations of style and approach. They provide a perspective for the examination of irrigation activity over the last fifty years.

Colonial Style: A number of large scale irrigation projects predate World War II when many of the current LDC's were colonies of European powers. Projects built during this era attempted to produce crops important to the mother country. They incorporated little or no indigenous input into the planning or managerial process and were built exclusively with foreign capital. Projects of this kind were found in Indonesia, where the Dutch irrigated large tracts for rice production;[7] the Indus Valley of Pakistan where the British extended irrigation to produce grain for their empire;[8] in the Gezira scheme in Sudan where cotton was produced for Lancashire mills in England; in the Office du Niger in Mali, as an attempt by the French to reproduce the Gezira; and in Somalia where Italian managers grew bananas for export to the home market. Many of these projects have been substantially modified since their inception. Some, such as the Indonesian rice production project, have fallen into disuse. Others such as the Gezira are turning to a greater variety of crops including food crops. Management of these enterprises is now mainly by nationals, but the systems of management are not greatly changed.

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[7] Leonard Cantor, A World of Geography of Irrigation, 1967, p 117.

[8] Aloys A. Michel, "The Impact of Modern Irrigation Technology in the Indus and Helmand Basins of Southwest Asia," in Farvar and Milton, The Careless Technology, p. 262.

Export Promotion Style: These projects are typical of the period between World War II and the late 1960's. Their objective was increased production of cash crops for export. The direct priorities of mother country needs gave way to interest in cash income derived from the world market. Large scale activities assumed priority as economies of scale were maximized, and it was assumed that "trickle down" effects would distribute the economic gains to other parts of society.

Although projects were mostly under the control of host country governments, foreign aid played a major role. Examples include Afghanistan's Helmand Valley for cotton and grains,[9] Mexico's innumerable projects for cotton and tomato production,[10] and Sudan's "Managil extension".

Some of these projects have met with relative economic success, especially in terms of achievements measured at the national level. However, a large number are no longer functioning as designed, due either to environmental, social, or managerial complications. The projects have tended to remain islands of production with only limited impact on the surrounding communities. Despite these significant drawbacks, many new or expanded export promotion projects are under consideration, including the Mahawele Ganga in Sri Lanka and the expansion of the privately financed efforts of Budd-Senegal.

Community Promotion Style: Projects in this category have become more common since the early 1970's. Understanding that expected multiplier effects from large projects were not occuring, newer projects were designed to increase income to the rural poor through numerous small-scale projects. AID's Basic Human Needs Policy and its focus on the rural poor

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9 Ibid., p 258.

10 Adolfo Orive-Alba, La Irrigacion un Mexico, 1970, p. 218.

is part of this trend. The primary goal for these projects is production of an agricultural surplus for local consumption. Emphasis is placed on food crops instead of cash export crops. Where possible, traditional methods of cultivation are reinforced rather than replaced. Foreign capital is usually involved, but local managerial skill is also a vital ingredient. Examples of community promotion projects include the Nam Tan project in Laos,[11] the small-farmer system in the Philippines,[12] the Lam Pao project in Thailand,[13] the Sederhana project in Indonesia,[14] and the On-Farm-Water Management project in Pakistan.[15]

At present (1980) both export promotion and community promotion styles are common types of irrigation efforts.

2.2 Status of Irrigation in Developing Countries.

Table I summarizes the distribution of irrigated land in the developing world. The FAO estimates that in 1976 there were 230 million hectares of irrigated land, 78 percent located in developing countries. In the period 1961-76 irrigated farmland increased by 30 million hectares (20%) in developing countries, compared with 12 million hectares (30%) in developed countries.

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[11] Fred Tileston, Jimmie Green and Montha Narisk, Evaluation Study of the Nam Tan Irrigation Project, 1974.

[12] Daniel W. Bromley, William Merrill and Sarah K. Boys, Program Evaluation: Philippines Small Scale Irrigation, 1978.

[13] R.C.Y. Ng, Land Use and Socio-Economic Changes Under the Impact of Irrigation in the Lam Pao Project Area in Thailand, 1978.

[14] Sederhana Evaluation (USAID), 1978.

[15] On-Farm Water Management: A Joint US-Pakistan Evaluation, 1978.

TABLE I

Distribution of Irrigation in the World

(in thousands of hectares)

Region/Country	1961-65	1976	% Growth 1961-1976
WORLD:	189,085	230,556	21.7
All Developed Countries	38,666	50,242	29.9
All Developing Countries	150,419	180,314	19.9
AFRICA	5,873	7,697	31.0
NORTH/CENTRAL AMERICA	19,582	23,174	18.3
SOUTH AMERICA	5,403	6,730	24.6
ASIA	138,753	163,637	18.0
AFRICA	5,873	7,697	31.0
Algeria	259	330	27.4
Benin	1	5	500.0
Botswana	2	1	0.0
Burundi	4	5	25.0
Cameroon	3	8	66.7
Cape Verde	2	2	0.0
Chad		1	0.0
Egypt	2,548	2,826	10.7
Ethiopia	48	55	14.6
Gambia	12	25	108.3
Ghana	11	20	81.8
Guinea	4	6	50.0
Ivory Coast	5	25	500.0

Region/Country	1961-65	1976	% Growth 1961-1976
AFRICA (continued)			
Kenya	14	42	300.0
Liberia		2	0.0
Libya	123	135	9.7
Madagascar	306	430	40.5
Malawi	2	5	150.0
Mali	43	90	109.3
Mauritania	3	3	0.0
Mauritius	10	15	50.0
Morocco	199	470	136.1
Mozambique	46	68	47.8
Nambia	4	7	75.0
Niger	4	6	50.0
Nigeria	11	15	36.4
Reunion	4	7	75.0
Rhodesia	27	55	100.0
Rwanda		1	0.0
Senegal	77	127	64.9
Sierra Leone	1	4	400.0
Somalia	165	165	0.0
South Africa	850	1,017	19.6
Sudan	925	1,500	57.6
Swaziland	20	26	30.0
Tanzania	33	55	66.7

Region/Country	1961-65	1976	% Growth 1961-1976
AFRICA (continued)			
Togo	2	3	50.0
Tunisia	74	130	75.6
Upper Volta		2	0.0
Zambia	2	4	100.0
NORTH/CENTRAL AMERICA	19,582	23,174	18.3
Belize		2	0.0
Costa Rica	26	26	0.0
Cuba	456	730	60.1
Dominican Republic	113	135	17.5
El Salvador	18	33	83.3
Guadeloupe	1	2	100.0
Guatemala	38	62	63.2
Haiti	38	70	84.2
Honduras	60	80	33.3
Jamaica	23	32	59.1
Martinique	1	2	100.00
Mexico	3,700	4,816	30.2
Nicaragua	18	70	88.8
Panama	15	23	53.3
Puerto Rico	39	39	0.0
St. Lucia	1	1	0.0
St. Vincent		1	0.0
Trinidad	11	20	81.8

Region/Country	1961-65	1976	% Growth 1961-1976
SOUTH AMERICA	5,403	6,730	24.6
Argentina	1,587	1,820	14.7
Bolivia	74	120	62.2
Brazil	546	980	79.5
Chile	1,084	1,280	78.1
Colombia	231	285	23.4
Ecuador	446	510	19.3
Guyana	100	122	22.0
Paraguay	30	55	83.3
Peru	1,041	1,150	10.5
Surinam	14	30	100.0
Uruguay	32	58	81.2
Venezuela	218	320	46.8
ASIA	138,753	163,637	18.0
Afghanistan	2,208	2,460	11.4
Bahrain	1	1	0.0
Bangladesh	501	1,420	183.4
Burma	681	984	44.5
China	77,200	85,200	10.4
Cyprus	95	94	0.0
Hong Kong	9	6	-33.5
India	25,523	34,400	34.8
Indonesia	4,100	4,840	18.0
Iran	4,800	5,840	21.7
Iraq	1,150	1,150	0.0

Region/Country	1961-65	1976	% Growth 1961-1976
ASIA (continued)			
Israel	142	187	31.7
Jordan	57	60	5.3
Kampuchea	72	89	23.6
Korea DPR	500	500	0.0
Korea Republic	682	936	37.2
Kuwait		1	0.0
Laos	13	11	-15.4
Lebanon	49	85	75.5
Malaya Penisula	224	310	58.4
Malaya Sabam	8	15	87.5
Malaya Sarawak	1	3	300.0
Nepal	77	190	146.7
Pakistan	11,139	13,600	22.1
Philippines	896	1,430	59.6
Saudi Arabia	270	390	44.4
Sri Lanka	361	530	46.8
Syria	579	547	-5.5
Thailand	1,729	2,448	49.7
Turkey	1,336	3,000	49.7
U.A. Emirates	3	5	66.7
Viet Nam	992	980	-1.2
Yemen (Sana)	175	230	31.4
Yemen (PDR)	4	5	25.0

Source: FAO Production Yearbook: 1977. Table 2, p. 57.

Some Asian countries have greatly increased already high levels of irrigation. It is claimed that China quadrupled irrigated land from 1950 to 1960.[16] Bangladesh increased its irrigated area from 500,000 hectares to 1,400,000 hectares between 1961 and 1976. India, Pakistan, and the Philippines all showed significant increases.

In the Caribbean and South America, Mexico, Cuba, and Brazil showed strong growth rates in irrigated land. Mexico has by far the largest irrigated area with nearly five million hectares, partly a result of national and regional priorities.[17]

Except for Australia, Africa has the least land under irrigation of any continent. This can partly be explained by the fact that, except in the Nile Basin, there have been only local indigenous traditions of irrigation. Egypt, South Africa, and the Sudan are the only countries with more than a million hectares currently irrigated.

Table I estimates 230 million irrigated hectares. Other estimates of total irrigated land are somewhat lower, ranging from 204 million hectares[18] to 224 million hectares.[19] National estimates tend to be higher than actual figures as they also include land that has low levels of productivity due to water logging, salinity, or other problems.

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16 Cantor, World Geography, p.103.

17 David Barkin and Timothy King, Regional Economic Development: The River Basin Approach in Mexico, 1970.

18 Allan M. Strout, World Agricultural Potential: Evidence from the Recent Past, 1975.

19 FAO, Report of the United Nations Water Conference, 1977.

2.3 Trends for the Future

Irrigation will continue to play a prominent role in the plans for the developing countries. In 1974, the World Food Conference called for an increase of 23 million hectares of irrigated land by 1985, representing an investment of nearly 40 billion dollars (1975 prices!).[20]

The world's potential irrigable land is sometimes enthusiastically estimated as 1 billion hectares.[21] Table II provides a more realistic picture of potential world irrigation (494.3 million hectares plus 100 million in the USSR), though even this suggests a possible increase of 114 percent (1976 base) or 140 percent (1970 base). Over half of the potential for expansion is in the developing world.

But "potential," even in these estimates, includes only land and water potential. Many problems are involved achieving such potentials. Some of the issues are managerial. Others involve trade-offs with alternative land and water use, especially since many of the better opportunities for irrigation have already been taken. Still others involve effectiveness under the current international economies.

Despite these constraints, the extension of irrigation will assume a large role in the future. Even so, a greater potential for increased food production from irrigation probably lies in the improvement of existing systems. Much of the irrigated land now in use produces at levels far below potential capacity. The World Food Conference (1974) set a goal to improve or rehabilitate 45 million hectares of existing irrigated farmland.[22]

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[20] Houston, "Irrigation Development," p. 430.

[21] E. Barton Worthington, ed., Arid Land Irrigation in Developing Countries: Environmental Problems and Effects, 1977, p.3.

[22] FAO, Report of the United Nations Water Conference, 1977, p. 71.

TABLE II

Estimates of the World's Land Area Under Irrigation
in 1970 and Ultimate Potential

Region	Land Under Irrigation	Ultimate Potential	Potential Increase	Ultimate Potential as Percentage of 1970 Base	Regional Potential Increase as Percentage of Total
	(millions of hectares)				
				%	%
Developed Countries	47.9	175.3	127.4	366	44
*USSR	*(11.0)	*(100.0)	*(89.0)	*(909)	*(31)
Latin America	10.3	27.9	17.6	271	6
Middle East/Africa	13.7	36.2	22.5	264	8
Centrally Planned Asia	77.8	123.1	45.3	158	16
Asia (Other)	55.9	131.8	75.9	236	26
TOTAL	205.6 **	494.3	288.7	240***	100

Arranged from Data in Strout, World Agricultural Potential: Evidence from the Recent Past. M.I.T. and Resources for the Future, Inc., Cambridge: 1975.

* USSR estimates are not comparable with the others. The figures in parentheses are not included in totals.

** Table I, page 10, shows 230.6 millions of hectares for 1976.

*** = 214 percent over 1976 level reported on page 10.

These twin approaches, the improvement of existing projects and the careful selection and design of new initiatives, both demand a new level of hard-headed assessment and evaluation. If irrigation is to make its expected contribution, the success rate needs to be substantially improved. This can best be achieved by a commitment to a long term process of project selection, design, evaluation, and feedback. As Nelson and Tileston emphasize,

> "...the lure of technical feasibility should not blind us to the financial, environmental, managerial, and social obstacles which must be overcome."[23]

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[23] Gary Nelson and Fred M. Tileston, "Irrigation: A Paradox for Sahelian Development," Mimeographed Paper. p. 22.

3. Review of Existing Evaluation

Our terms of reference called for a review of existing evaluations in order to prepare a schema for the selection of projects for detailed assessment. This schema is presented in Chapter 5. It is based on categories of questions and stages in the project cycle described in Chapter 4. In the process of reviewing these evaluations, a number of evaluation-related issues have emerged. Three sets of these issues are treated in this chapter and include:

... policy issues which AID should clarify with reference to goals and objectives of evaluation;

... ways in which non-AID evaluations of AID projects have influenced policy and planning in the past·

... points of emphasis in project review deserving special mention in the context of evaluation.

3.1 Existing Evaluations: Evaluation Policy

USAID assessments of irrigation focus almost entirely at the project level. In scale, they range from a detailed and long review of irrigation in part of Pakistan to short commentaries on a project in Latin America. They appear to be imbalanced regionally with considerable documentation on Asian and Middle Eastern projects, less on Africa, and very little on South America and the Caribbean. The imbalance in AID is reflected by a lack of documents for past AID financed projects in Latin America. But this same imbalance is found in other agencies and is the result of their doing less in Latin America. For example, Appendix I indicates that little of the UNDP allotments for irrigation are being spent in South America and the Caribbean.[24]

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[24] Evaluation documents which we consulted are listed under "Materials Consulted" which begins on page 52.

These evaluations cover a considerable period in the life of AID and reflect the agency's different emphases over time. Yet no AID evaluation we examined looks comprehensively at the preparatory, construction, and operational stages of an individual project. Nor does any evaluation encompass the breadth of themes set out in Chapter 4.

We also found enormous variation in purpose, style, and final product of existing evaluations. Each seemed rooted in the needs of the immediate situation rather than guided by a long term rationale or policy for evaluation. We found no overall guidelines or instructions for evaluating irrigation projects. We did examine a helpful AID guide to evaluating potable water projec [25] and have included portions of its approach in recommendations in this paper.

Although AID has no explicit irrigation evaluation guidelines, we found there were a number of implicit assumptions which informally guided these evaluators in these studies. Four issues seemed particularly important to clarify for future evaluation guidelines.

3.1.1 Issue 1 - What is the Prime Purpose of the Evaluation?

Three different purposes are common, the first two already appearing in a number of USAID evaluations:

conformity to original project goals

... an assessment to determine whether funds have been invested according to original plans. This approach is essentially an audit to ascertain whether short-run goals have been achieved.

or

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[25] Practical Concepts Incorporated, "An Evaluation Plan for Rural Water Supply Projects," 1978, pp. III-1, IV-5.

Feedback for improved project management

... a review to gather data and feed it back to project managers for improved operation of the individual project.

or

Evaluation to improve future projects

... a study which is part of a general evaluation program to improve design of future irrigation projects, world-wide.

3.1.1.1 Evaluations to Determine Project Conformity with Original Goals.

Most USAID evaluations focused primarily on whether funds were expended consistently with original project goals.[26] They were concerned with whether the number of hectares intended for irrigation had actually been irrigated or whether the engineering, local management, water flow, crop production, land leveling, or land distribution had been carried out as originally designed.[27] Host country personnel were frequently used to gather evaluation data with very good results. These studies were concerned primarily with measuring initial performance; they do not evidence attention either to assessing success of the project's operation or to passing lessons along to designers and users for future projects.

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[26] Bromley, Daniel W., William Merrill. and Sara K. Boys., January, 1978. Program Evaluation: Philippines Small Scale Irrigation. Draft report to USAID; Grav. Clive, John Duewel, and Henry Gembala., June, 1978. Sederhana Evaluation: Irigasi/Reklauasi/Sederhana. Report to USAID; "On-Farm Water Management: A Joint US-Pakistan Evaluation." May 8, 1978. USAID/Islamabad, Pakistan.

[27] Ibid.

3.1.1.2 Feed-Back for Improved Management

A few evaluations were explicitly concerned with assessment to adjust the operation of the project.[28] In such an approach, project users not only provided data to evaluators but also commented on why particular policies worked the way they did. In some cases, evaluations included a mechanism whereby the information from users was shared among several sets of users and also with project managers.

For example, the Lowdermilk study[29] showed that over-watering by users was frequently a problem. At first, it was thought that the problem was poorly trained farmers who needed education in improved practices. The evaluation revealed a different cause. Over-watering came most frequently from skilled farmers who were trying to compensate for the irregularity and unpredictability of supply from central management authorities. The Lowdermilk study attempted to pinpoint why this management problem is taking place and suggests a means to provide information to those who control the necessary decisions.

3.1.1.3 Evaluation for Improvement of Future Projects

This third style of evaluation was represented by only one document among those we reviewed.[30] It was a very helpful, though

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[28] Engineering Consultants, Inc., "The Ghardimaou Irrigation Perimeter: An Evaluation." 1975, Nam Tan Irrigation Project (Laos).

[29] Max K. Lowdermilk, Alan C. Early, and David M. Freeman, "Farm Irrigation Constraints and Farmer's Responses: Comprehensive Field Survey in Pakistan, Volume I: Summary, 1978; Nam Tan Irrigation Project (Laos); Joseph Desousa, "AID's Experience with Irrigation and Irrigation Type Projects," 1977; Philippines Small Scale Irrigation.

[30] Richard Boudreau, "Irrigation: Training/Planning/Execution," 1978.

brief, memo from DS/DIU/DI which offered an example of the kind of review of previous experience which can guide design teams for new projects, in this case, a design effort underway in Niger. Apart from this memo, guidance to new project planners, managers, and users, based on evaluations of previous experiences, was in short supply. Moreover, we could find no requirement or procedure which insures that design teams look at evaluation documents, even from the country or region in which a new project is being considered.

It is recommended that attention continue to be paid to the achievement of immediate project goals but that much greater emphasis be given to use of evaluative data for improved project management and for improved project design.

3.1.2 Issue 2 - What Should be the Target Audience for Evaluation?

Evaluations may focus primarily on the needs of the donor agency, the priorities of the host country governments, or the needs of the users. It is recommended that evaluation targets should explicitly include all three. Approval of this policy would have implications for style, content, and language of evaluation reports. Although most of the USAID evaluations were focussed on the needs of the donor agency, we did find examples where all three target groups were served.

3.1.2.1 Donor Focus

Many evaluations set out to review the performance of the contractor or the local government managing agency. Others were undertaken because a particular project may have been in trouble and was

under review for possible termination. In both cases, these approaches are examples of evaluation primarily for the benefit of the donor agency.

3.1.2.2 Host Country Focus

Although none of the studies we reviewed was either commissioned by or directed primarily to a host country government, some included a range of data which would benefit host country agencies. These data provided long-term production trends and base-line information for a continuing monitoring system which could assist the host country managers to operate the system in efficient ways. Although the documents themselves made no formal mention of follow-up with host country institutions, other references noted that mission directors and other AID personnel have met with host country officials and suggested ways that monitoring of such data can assist in more effective management.

3.1.2.3 User Focus

A final potential audience for evaluations are the users themselves. Farmers, peasants, herdsmen, health workers, and local officials are the ones whose actions will have the greatest influence on the success of the project. One intriguing[31] study prepared for potable water review suggests that evaluations will be more meaningful if the study organizes its procedures to help the project users manage their individual or small-scale units more effectively.

In reviewing audiences for existing evaluations, we found considerable emphasis on needs of the donor agency, some attention to host country needs, and only slight reference to ways in which user needs might be served. We recommend that this imbalance be adjusted in future evaluation efforts.

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[31] Practical Concepts Incorporated, "An Evaluation Plan for Rural Water Supply Projects," 1978.

3.1.3 Issue 3 - Longitudinal Evaluation or Control Group Approaches?

Data gathering for evaluation is time consuming and can be costly. Control group assessments are the most complex and given the myriad of variables involved with irrigation projects, are not recommended here. Longitudinal studies based on a good base line are feasible. A basic grid of analytical questions or evaluation criteria would greatly help comparability between evaluations. Longitudinal studies can develop a profile of data for a village, district, or project area, before project activity begins and then monitor, on a regular and selective basis, the nature of change and what influence the project activity may have in bringing about such change.

3.1.4 Issue 4 - Who Does the Evaluation?

There are two main issues involved in this question: (1) Who is the prime organizer of the evaluation; and (2) To what extent do host country personnel and/or users participate in the evaluation?

We suggest that evaluation include both internal USAID reviews and independent contractor work. For the foreseeable future, the prime organizer of external reviews should probab y be a US contractor but organized in such a way that host country nationals play a prominent role. We commend the existing AID policy which requires that host country individuals participate in such studies. Yet this policy does not go far enough. We urge that AID use local institutions (in the public and private sector) to play an important collaborative role in the review. Such participation strengthens the ability of local institutions to engage in similar evaluations themselves. It also makes

an experienced institution available to the AID mission for related work such as preparing initial environmental examinations. Perhaps most important, use of host country institutions assures that host country governments will have available institutional resources which can assist them in the continued monitoring of the impact of irrigation.

3.2 Existing Evaluation: Non-AID Reviews of AID Projects. Evaluations of USAID projects by other agencies are scarce. Generally, such evaluations are undertaken as part of an academic study or to "prove a point" by an interested external party. Evaluations of USAID or of other agency projects are usually carried out under the auspices of the particular agency involved. It is not surprising that this should be so as evaluations are costly in scarce resources of time and personnel.

There is of course a general literature which is well summarized in Worthington's "Arid Land Irrigation in Developing Countries."[32] In addition to this material and a search of academic literature and recent institutional reports,[33] we used several computer data bank analyses in an attempt to find lesser known material. A search of relevant systems[34] brought little

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[32] E. Barton Worthington, Arid Land Irrigation in Developing Countries: Environmental Problems and Effects, 1977.

[33] World Bank, Annual Report, 1978. FAO, Annual Report, 1978. United Nations Environment Programme, Annual Report of the Director, 1978.

[34] See Section 6.4 of Materials Consulted on page 60.

more than a dozen references, some of which were already known and others not properly classified as evaluations.

Three papers illustrate the kinds of evaluation of irrigation projects undertaken by external groups. A report, "Land-Use and Socio-Economic Changes under the Impact of Irrigation in the Lam Pao Project Area in Thailand" is a study undertaken by a group at the School of Oriental African Studies of the University of London.[35] As the title indicates, it is concerned with the impact of the project on the local and regional society, on the economy, and on land use practices. It is not concerned with physical aspects of irrigation, water management, or environmental issues. Its particular virtue is its methodology which, at low cost, breaks away from a narrow project context and, instead, looks at irrigation impact in a broad social context.

Hanson's "Case Studies on Environmental Assessment of Foreign Donor-Supported Projects in Indonesia" provides a unique country analysis on one aspect -- the environment -- of irrigation.[36] He includes the resource impact aspects of two USAID projects in his review and suggests that while in both cases environmental concerns were addressed, there was in each case too little involvement of local scientists, and too little awareness of local circumstances.

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[35] R.C.Y. Ng, 1978.

[36] Hanson, 1978.

In both instances, significant reassessments of the projects were necessary after the case studies identified these issues.

At a different scale of approach, Peter Freeman[37] reviewed the impact of large dams on the environment and included a detailed program for the evaluation of water resources projects, the irrigation component of which is reproduced in Appendix II. **Freeman's** evaluation criteria are helpful in designing future evaluations.[38]

These three different examples illustrate some gains available from outside evaluations such as a different approach or helpful and fresh insights. But most often, the outside evaluations are restricted, focussing on a limited number of variables in a project. Our review of non-AID assessments of AID projects also indicates that AID cannot rely on others for evaluation. The high cost, long time span, and intricate number of variables associated with irrigation evaluation require that AID should take primary initiative for funding. Although non-AID reviews provide insight into useful guidelines and approaches, AID itself must take primary responsibility for evaluation, simply because no other organization or agency has motivation to do so.

3.3 External Evaluations: Evaluation Emphasis

The review of evaluations identified a number of issues dealing with the substantive dimensions of irrigation. These issues are identified and briefly discussed here as a further means of sharpening

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[37] Peter H. Freeman, "Large Dams and the Environment: Recommendations for Development Planning," 1977.

[38] Summarized in Appendix II of this report.

the most important topics to be dealt with in evaluation. The three most frequently recurring themes in need of special attention are:

... management as a critical variable,

... environmental issues, and

... further responses to perceived risk.

3.3.1 Management as a Major Dilemma

Management has already been mentioned several times in this paper as a critical issue in the success or failure of irrigation projects. Four distinct sub-categories within the issue of management are discussed below.

3.3.1.1 Water User, Farmer and Government Associations, and Corporations as a Management Tool.

Several evaluations found that farmer organizations were the best means to insure success of irrigation projects but that they were frequently the least successful parts of projects.

A review of the Philippine small scale irrigation effort[39] identified the project's first three major problem areas as (a) whether Irrigator Service Associations (ISA's) could properly manage the complexities of an irrigation system; (b) whether the Farm System Development Corporation (FSDC) would be able to retain its trained personnel and adequately monitor the project; (c) whether ISA's and the FSDC could work together in distribution of water. In other problems areas, the Philippines evaluation cited an organization or association problem on virtually every point.

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[39] Philippines Small Scale Irrigation, USAID, Bromley. 1978.

Similarly, an assessment of on-farm water management[40] noted that the project's technical design was excellent. However, it found that too little attention had been given to formal recognition, support, and legal recognition of the Water User Association (WUA). The evaluation found WUA's to be the "key to the effective use of the system" but that they were, unfortunately, a neglected part of the original project design. Other evaluations carried similar institutional recommendations.

3.3.1.2 Local Leadership and Training

Emphasis on training and leadership grew from the concern for institutional capabilities. The Pakistan evaluation found that training standards were presently too high and too rigid and that ineffective job security caused poor morale in the leadership cadre of local management bodies.

A review of small irrigation work in Indonesia[41] found that the most important variable in the success of many of its efforts lay with the effectiveness of local leadership. Properly prepared, the Indonesian village and hamlet leaders could manage water rights disputes, planning and allocation issues, and maintenance tasks. The report, emphasizing the role of local leadership, noted "the hamlet is probably the primary and most effective village unit for corporate action -- given its close kinship, residential and reciprocal labor-sharing bonds."

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[40] On-Farm Water Management, Pakistan, USAID, 1978.

[41] Sorenson, V. and T.R.Thompson, 1976. Sederhana. Irrigation and Land Development Program, USAID.

R.C.Y. Ng and the SOAS evaluation team in Thailand[42] concluded that there were few incentives, especially for small farmers, to invest in or borrow money for fertilizer or equipment to use the new irrigation system. As a result, farmers were drifting increasingly into non-agricultural activity. The team found that the greatest need was for training/education programs that would "pursuade farmers to adopt modern agricultural practices."

3.3.1.3 Operation and Maintenance

Physical operation and maintenance are other crucial management issues. Reports abound with examples of weed build-up in canals, pump malfunctions, seepage, over-watering, water-logging/salinity build-up, terrace breakdowns, siltation, weir collapse because of improper diversions, etc. Others could be cited.

Another set of operational issues involves availability of credit, marketing, transportation, and local pricing practices. Coordination of these factors is crucial to the success of irrigation projects, though not always addressed in project aims.

3.3.1.4 Flows of Information

A final issue focuses on the way information moves from planner to user and back again. One study found farmers woefully misinformed about the timing and volume of water required for maximum yield. Another noted that need for levelled plots for increased production was not understood.

Lack of information on the part of system operators is an equally great management problem. An Indonesian review found it difficult for local farmer interests and technical needs to be transmitted up the chain of authority to the managers and designers of the system.

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[42] R.C.Y. 1978 Ng, Land Use and Socio-Economic Change in Lam Pao.

Of equal concern is the need for a means to incorporate "interim" information into project amendments or modifications. At present, there seems to be no well functioning mechanism to collect technical data from operational projects on a regular or systematic basis and feed it back into the managerial dimensions of the project. Although such monitoring systems may exist, none was reported in any of the evaluations we examined. Lack of feed-back of monitoring data and lack of a functioning project modification mechanism limit the success of existing irrigation efforts.

In future evaluations, we recommend that major attention be given to management issues and ways in which the evaluation can improve the management dimension of all projects.

3.3.2 Environmental Issues

The evaluations we examined were mostly based on projects designed in the early and mid 70's. In most cases, project design predated the current USAID environmental review procedures. Perhaps for this reason, most paid little direct attention to environmental impacts or resource degradation issues. Hanson's[43] review of Indonesian projects provides a case where environmental issues were examined. In one example, he shows that a poorly conceived and executed environmental impact statement (EIS) resulted in a major misconception of the potential project impacts. Because of the energy of local scientists, the issues were reexamined and after a revised EIS was prepared the project was abandoned. In another Indonesian case, environ-

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[43]Arthur J. Hanson, "Case Studies on Environmental Assessment of Foreign Donor-Supported Projects in Indonesia," 1978.

mental health issues were at first thought to be important. On more detailed study, they were found not to be a major danger for the project.

There has been much vocal opposition, in the name of the environment, to large water resource development projects. Mixtures of valid and exaggerated claims of adverse environmental impacts have been published.[44] Irrigation projects do have impacts on both the physical and human environment, and it is essential that environmental concerns be given direct attention at each stage. Good evaluation is the best tool to guide future designers. Peter Freeman's guidelines, found in Appendix II, provide a useful conceptual framework for such a task.

We recommend that future evaluations be conscious of the need for special attention to the question of resource degradation, both in human and social terms.

3.3.3 The Importance of Risk Perception by Farmers

A brief note is appropriate on the risk factor in irrigation projects. Several evaluations noted that large farmers benefit more from irrigation than small.[45] There are many reasons why. Primarily, small farmers are less able to protect themselves should adverse circumstances develop. They insulate themselves by adopting low risk strategies. Small farmers, therefore, are frequently less

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[44] Richard Odingo, An African Dam, 1979.

[45] Small Scale Irrigation, Bangladesh, II, 1975; Sederhana Evaluation, 1978; Philippines Small Scale Irrigation, 1978; and Nelson and Tileston, "Irrigation, A Paradox for Sahelian Development," 1977.

flexible in experimenting with new technologies or new methods and are reluctant to commit themselves wholly to a new venture such as irrigation. They frequently reduce risk by maintaining part or all of their previous activities. For example, part of the family will continue to herd animals while others work in irrigation. In other cases, farmers will only use the irrigated land for some crops, preferring traditional methods for others. This response may be thoroughly rational from the farmer's point of view, but it may create problems if the project design has not taken it into account. The mixed economic strategy of the small farmer needs to be recognized, especially when evaluating the impact of the project on farmers' social and economic well being. Evaluation offers an interesting means to explore precisely what and how risks are perceived by small farmers in irrigation projects.

We recommend that evaluations examine the question of risk in irrigation and consider policies which will minimize risk in the design and implementation of future irrigation projects.

4. Evaluation of Irrigation Projects

4.1 Objectives and Special Characteristics of Evaluation of Irrigation

Evaluation of irrigation projects is a complex task for several reasons. First, although evaluation serves a number of purposes, two are of particular importance:

... judging an individual project's performance against its stated objectives;

... improving the success rate of new projects.

Both are important. Yet they are slightly different processes and require that data be managed and assembled in a slightly different form.

Problems also arise in evaluation precisely because of the complex impacts which irrigation can have and because of the extended time period often necessary before a project becomes fully operational.

By definition, irrigation modifies natural water systems. It creates new aquatic environments for water weeds, insects, and bilharzia-carrying water snails. It changes soil conditions, water tables, and siltation patterns. Irrigation often alters the farm production and land context of the farmer, the pattern of decision making, and the hierarchy of management. It almost certainly modifies the economy of the area.

Because of these complex impacts, comprehensive evaluation can be an intricate and costly task. Unless the parameters of evaluation are carefully defined, evaluation may become an all consuming task involving a cumbersome array of social and engineering sciences and producing an unmanageable product. In this chapter, we suggest ways of dealing with the many dimensions of irrigation projects without becoming bogged down in overwhelming detail.

Section 4.2 suggests five categories for evaluation criteria; Section 4.3 presents a rationale for evaluation at three different stages in the project cycle; Section 4.4 elaborates on each of the evaluation categories for each of the three project cycle stages.

4.2 Evaluation Categories

Previously, (pages 4-5) we recommended an evaluation design based on five components. They were economic viability, efficiency of resource use, effectiveness of water delivery systems, environmental quality, and social soundness of the resulting social system.

Table III provides details of each of these components and offers a sampling of categories from which analytical questions can be constructed.

TABLE III

Evaluation Criteria for Irrigation Activities

Suggested Categories for Analytical Questions

A. ECONOMIC VIABILITY: An irrigation scheme should contribute significantly to agricultural output. Qualitatively and quantitatively, how does the project contribute to the household, local, and national economies? How does its performance square with the projections?

1. On Farm:
   - ... levels of output achieved;
   - ... levels of output projected;
   - ... pattern or composition of cropping.

2. Project-Wide:
   - ... pre-project benefit cost ratio achieved;
   - ... projected and realized output;
   - ... impact of project products on project itself.

3. National:
   - ... impact on national food budget;
   - ... contribution to gross national product;
   - ... influence on foreign exchange situation;
   - ... the economic impact on non-project areas within country.

B. RESOURCE USE: An irrigation project represents a significant commitment of resources-both nationally and internationally. How are the following resources employed? Does the project represent the optimal use of those resources? What are the relevant opportunity costs?

1. Land:
   - ... land use;
   - ... cropping patterns;
   - ... alternative sites or new sites opened;
   - ... alternative uses of land because of irrigation;
   - ... alternative methodologies or patterns of resource use.

2. Water:
   - ... volume used;
   - ... source;
   - ... alternative uses;
   - ... alternative sources.

3. Capital Inputs:
   - ... use of capital inputs;
   - ... initial investment of funds;
   - ... mechinery and fertilizer inputs;
   - ... credit availability and use;
   - ... payment for water;
   - ... financial viability of the system.

B. RESOURCE USE: (continued)

4. Labor:
... employment data, particularly emphasis on seasonality;
... source of labor.

C. WATER SYSTEM: With each irrigation project, a physical system for the delivery of water to farmers is designed and built. How well is it built and does it function as it was intended?

1. Performance:
... construction abide by plan;
... design efficiency;
... water promised and water delivered;
... excess water adequately drained.

2. Management Decisions:
... maintenance;
... rotation;
... conflict resolution;
... local input;
... adaptability and related organizational considerations.

3. Appropriateness of System:
... suitability of system for local social conditions;
... environmental conditions;
... proper maintenance by local efforts.

D. ENVIRONMENTAL QUALITY: Irrigation projects are artificial means of applying water to land. Thus, they represent a technologically-induced environmental change. What are the effects of this change, and what becomes of the newly-created or destroyed ecological niches?

1. Health:
... existing disease patterns;
... changes in disease patterns;
... increase of water-born diseases;
... change in sanitation situation;
... nutrition, especially of children.

2. Soils:
... types of soils;
... increased fertility;
... negative complications such as increased erosion, salinization, alkalinization, etc.

3. Pests:
... existing pests and weeds;
... new pests and weeds;
... types and effects of pest control used.

D. ENVIRONMENTAL QUALITY: (continued)

4. Fertilizer:
   ... previous fertilizer used;
   ... impact on crops themselves;
   ... side effects in stream build-up, run-off area build-up, etc.

E. SOCIAL SOUNDNESS: Any irrigation system must be used by people. What is the society like that uses the system? How does society change because of the project?

1. Pattern of Production:
   ... indigenous mode;
   ... induced shifts;
   ... group relations;
   ... newly emergent classes.

2. Social Unit:
   ... indigenous household unit;
   ... changes in that unit and its function;
   ... changes affecting primarily one portion of that unit.

3. Cultural Integrity:
   ... traditional patterns;
   ... changes;
   ... loss of skills/knowledge.

4. Wealth Distribution:
   ... shifts in income or land ownership;
   ... changes in patterns of land ownership or income;
   ... major shifts as an indicator of class polarization;
   ... poor farmers helped;
   ... risk minimized, as much as possible, for small farmers.

5. Management Decisions:
   ... changing framework for decisions;
   ... change in local control;
   ... effects of shifting decision base.

6. Role of Women:
   ... status enhanced or decreased because of project;
   ... family viability change;
   ... shifts in responsibility related to food production, marketing, household management, etc.

If the categories recommended in Table III or a selection of them are used to meet particular circumstances, it is important to determine when and how these questions are to be asked.

4.3 The Case for Evaluation at Different Stages in the Project Cycle

The project cycle involves three major stages: (i) a preparatory stage involving the decision to irrigate and project planning; (ii) the construction stage including design, construction, and experimental operations; and (iii) operational stage, including production, maintenance, and management within the project's stated goals.

The preparatory stage begins with the decision to investigate the possibilities of irrigation in a region. It may take several years; it will inevitably involve large numbers of government, funding, and user organizations. The construction stage, for small projects, may take up to five years. Larger projects will take much longer. Operation of a project usually begins in phases and may include a substantial adaptation as farmers adjust to new cultivation techniques. It may be a number of years before a project operates on a full and regular basis. Thus, the full project period, from the beginning of the preparatory stage to the formal and full-scale operational stage may vary from 8 to 25 years. During this extended time, there may be substantial changes in both external and local conditions.

Given this time span, it is important to establish evaluation procedures at different points in the project cycle. The emphasis of evaluation will change from one stage to another. Table IV provides illustrations of some of the different points of emphases in questions which might be asked at different stages.

4.4 Evaluation at Preparatory, Construction, and Operational Stages

The sets of questions **offered** in Table IV indicate a change in the balance of attention given to particular topics at different stages of evaluation. This suggests general orders of priority and is not meant to imply that some topics can be disregarded at any stage of the project review. The rationale for the differing emphasis is set out below.

4.4.1 Preparatory Stage

An important evaluation stage comes early in the project process. When the decision has been made to irrigate and project planning is well advanced,[46] a review is frequently undertaken in connection with the funding process. A major problem in the past has been that evaluation at this stage is not linked with later parts of the process.

Economic viability, resource use, and social soundness issues are vital questions at this stage and environmental considerations may be important in some areas. Economic viability is important at household, community, project, and national levels. These issues are most often considered at household and project levels. Resource use questions relate to optimal employment of land, water, and capital. At this stage, alternative resource-use issues should be raised and evaluated, thereby increasing chances of a rational

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[46] A discussion of issues related to the decision of when to irrigate is found in Appendix III at the end of this paper.

TABLE IV

Examples* of Evaluation Questions at Different Stages of Project

	Preparatory Stage	Construction Stage	Operational Stage
1.	Economic Viability: Is irrigation economically justified?	1. Economic Viability: Is approved plan being followed?	1. Economic Viability Is the system producing at levels which justify its operation?
2.	Resource Use: Does project fit into the optimal picture of resource use?	2. Resource Use: Is construction hampering resource access or long-range resource activity?	2. Resource Use: Are the committed resources used in the most efficient manner?
3.	Water System: What are the traditional uses of the water and land systems?	3. Water System: Is construction maintaining or cutting off access to water or is construction adversely affecting water quality?	3. Water System: Does the system perform as designed?
4.	Environmental Quality: Can the local environment absorb pressures which the project may bring?	4. Environmental Quality: Is construction undertaken in ways to minimize adverse impact?	4. Environmental Quality: What are the environmental changes that have taken place?
5.	Social Soundness: Is the social system likely to adapt well to irrigation?	5. Social Soundness: Are relocations involved, and if so, are they sensibly and effectively managed?	5. Social Soundness: How has the social system changed because of the project?

*Only one question per category is offered here, simply as example. Specific and detailed questions would depend on the particular project to be evaluated.

decision for or against irrigation as an option. Social soundness issues are vitally important at this early stage. Basic issues here include the availability of knowledgeable farmers, experienced managers, and a receptive community as well as questions about who might be displaced and issues of potential conflict and disruption. Another social soundness issue to consider at this stage is whether mixed or integrated development options might have more positive social impact.

4.4.2 Construction Stage

In the design/construction stage, all five sets of questions are important.

4.4.2.1 Economic Viability

Economic viability issues are similar to the cost/benefit issues raised in the preparatory stage as well as specific checks to determine whether the proposed plan is being followed.

4.4.2.2 Resource Use

There are a number of important resource use questions at this stage. What are the resulting land use patterns during construction and how do they relate to the larger project and national goals? Has construction revealed any new or previously unknown resources? Has temporary or even normal use of the partly constructed system given indications of longer run resource problems not anticipated in the planning stage?

4.4.2.3 Water Systems

Water system questions are most important in relation to appropriate design. The amount of water to be delivered and the type of distribution system to be used can both be readily agreed upon,

given environmental conditions and technical factors. Are these conditions being met in the construction process? Is temporary or longer range water diversion being sufficiently used or are there preliminary kinds of problems? Is water access being maintained? Are there any preliminary signs of adverse impacts on water quality?

Much more difficult to answer, however, are questions regarding the appropriateness of the system for the local population: does it still seem possible to be locally run, managed, and maintained? Is the local population playing a significant role in adapting to strains of construction? What organizational or other institutional responses might be anticipated?

4.4.2.4 Environmental Quality

Questions of environmental quality relate to the suitability of the local environment for irrigation and the impact of irrigation on the environment. Have any construction practices adversely affected existing yields or created problems not previously present. Have there been any adverse effects on the quality of water downstream? Is there any preliminary reading of changes in the local water table? Is there a chance that increased evaporation will affect the local climate? What is the likelihood of malaria or schistosomiasis becoming a health problem in some of the newly irrigated areas? Finally, does the project seem to be affecting vulnerability of local livelihood systems (crops, herds, artisan manufacturing) to destruction from natural hazards (flood, drought, plague, weeds)?

4.4.2.5 Social Soundness

The social soundness questions in the construction stages are difficult yet important to answer. Have trends already present in

the local society (e.g. weakened family ties, loss of traditional knowledge, increased involvement in the monetized economy) increased because of construction? What are the initial impacts on level and types of social services? Is any indication emerging of new services or institutions which may be needed? Social soundness questions at this stage should also reassess the ultimate acceptability of the project to the ultimate users.

4.4.3 Operational Stage

Evaluation has normally been undertaken at some point near the completion of construction. The overall questions for this stage are: Does the project fulfill its goals? If not, how can its operation be improved? Can future problems be avoided? Can lessons be learned to help design future projects?

4.4.3.1 Economic Viability

The analysis of economic viability at this stage is particularly important. Although such emphasis sounds self evident, strangely enough the abundance of pre-project benefit/cost analysis is not matched by post-project economic evaluations. Many studies of benefits of farmer and project level are calculated on the basis of experimental farms that have little or no bearing on production levels at working farms. The fundamental question for this component is whether the system is producing at a level which justifies its existence. This question needs to be asked at all levels of the economy. Do the farmers earn incomes that are or seem profitable to them? What sort of yields do they achieve? Can they pay back their debts? Will the achieved benefit/cost ratios match the projected ratios? Are the relevant communities stronger economically because of the project or has it merely increased their

reliance on outside sources? Does the project contribute significantly to national income, the national food budget, or foreign exchange earnings?

4.4.3.2 Resource Use

At this stage, resource use questions focus on specific land use practices and the use made of capital inputs (machinery, fertilizer, etc.). Does the adopted land use pattern conform to the projected pattern? How could the pattern be changed to improve attainment of project goals? Or alternatively, how should project goals be changed to accommodate the pattern? Are fertilizer, machinery, and credit accessible and effectively used or are extension efforts or policy changes needed?

4.4.3.3 Water System

Evaluation of the water system must include details of its functioning and its treatment by the farmers. Is water delivered to the farm plots as intended or do discrepancies exist between projected and delivered levels? Does seepage, evaporation, or leakage significantly detract from the amount of usable water? Is the excess water effectively drained? Does the local irrigation management system function sufficiently well to allocate water, maintain the system, and resolve inter-personal conflicts? Has the system been adopted by the local populace?

4.4.3.4 Environmental Quality

The environmental quality criteria are important as indicators not only of present project operation but also of trends that are likely to become important in future operation. For example, modest increases in salt composition in soils are important as indicators of future change. In the simplest form, the question to be asked is

what changes, both positive and negative, have taken place in the environment due to the initial operation of the project? What changes should be made to avert harmful impacts? Has incidence of malaria or schistosomiasis increased since the project began? What steps have been taken to monitor snail or mosquito populations? Does the system allow for adequate personal hygiene. Are the soils undergoing negative changes? Has the water drained from project land had an influence on biota downstream? Finally, have insects, weeds, floods, or other natural hazards increased intensity since project implementation?

4.4.3.5 Social Soundness

The social soundness analysis at the operational stage may provide both the most important and yet the most unpredictable information regarding the project. The focus of the questions should relate to what changes have occurred. Have the farmers become more involved in the monetized sector of the economy, and if so, have there been resultant changes? What changes have occurred in the elementary social (family, household, etc.) unit as a result of the implementation of the project and the induced changes in tradition, migration, patterns, and consumption patterns? Has a major shift in land or income distribution taken place as a result of the project? Have new social classes emerged since project implementation? Are social services adequate to serve the population?

Evaluation at these three stages in the project cycle, covering this range of issues, is a necessary task if planners are to learn what make irrigation projects succeed.

5. A Program for the Evaluation of Irrigation with USAID.

In this chapter, we propose three complementary approaches to the evaluation of irrigation with USAID:

... an overview of experience with irrigation in regions where USAID is planning significant involvement;

... a focussed, routine monitoring and evaluation program for every USAID irrigation project;

... a more detailed analysis of selected issues within a representative sample of projects.

5.1 Regional Overviews

We propose that USAID commission a generic study of irrigation in each major cultural/physical region in which it is currently supporting irrigation projects and/or has significant involvement planned for the future. This proposal is made for several reasons. First, there are relatively few USAID irrigation projects in any one area. An evaluation of only these projects will give an incomplete picture of the needs and potentials which irrigation can offer in that region. A wider perspective is needed. Second, there are wide differences between reception of irrigation technology from one place to another. Third, the physical conditions for irrigation differ widely and these can be most adequately addressed on a regional basis.

Issues to be considered in these regional overviews would include previous success with irrigation, potential problems to be anticipated in that region, merits of cash crops versus small farm management approaches, potentials for rehabilitation and/or opening of new lands, existing productivity, and experience of farmers with irrigation.

Global surveys of irrigation are underway already. For example, the Food Policy Institute under John Mellor is reviewing irrigation characteristics world-wide. This review may fill some of the need identified here.

The most important regional reviews for USAID are:

India - Pakistan
Sri Lanka - Southeast Asia
Middle East (as defined by USAID)
Arid and Semi-Arid Africa (Sahel, Sudan, East Africa)
Humid West and Central Africa
The Caribbean
Latin America

The review should include nationals of the region and all aspects of irrigation. The outputs of the reviews should be made available to all irrigation design teams which work in the region, regional bureaus, PPC, DSB, and individual missions.

5.2 Routine Project Review

It is important to monitor every project in a routine way, using a very selective list of criteria. The questions listed by Holdgate and White[47] provide a good initial framework. Existing mechanisms, mentioned elsewhere in this document, to build revisions into the project should be emphasized and linked to the routine monitoring. Moreover, monitoring should be established in ways which continue after donor activity has concluded and the operation is fully within the hands of local or national management institutions.

A most important evaluation stage for every project occurs something like five to seven years after the beginning of its full operation. It takes at least five years for agricultural, marketing, transportation, and managerial groups to "get into the swing" of any new system. So a five year review is extremely important to measure ultimate impact and benefit.

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[47] These questions appear on pages 4 and 5 of this report.

Yet we could find no reviews of projects at this stage. Thus, we further recommend that a regular review of economic, resource use, social soundness, and environmental information of each project should be made at this stage in its operation.

5.3 Selective, In-Depth Evaluations

In addition to routine monitoring, a representative sample of projects should be evaluated in more detail. A small number of projects can be identified and a select number of variables within a particular project examined. The selection process should take care that the sub-components reviewed in individual projects are selected in ways that complement any factors reviewed in other projects. Thus, at any given time in the world-wide evaluation effort, AID will be reviewing the major issues in irrigation, even though they may be distributed in several projects.

At least one project should be selected for detailed examination from each of the AID's four regional bureaus. Because there are substantial differences in environmental setting, marketing/economic practices, cultural characteristics, and productivity potential, each region should have at least one comprehensive review exercise. In addition, the issues of scale should be addressed in the comprehensive evaluations. Worldwide, it would be useful to include one large project, at least one medium-sized project, and several small ones. Beyond selection by size, the categories provided in Tables III and IV suggest a range of topics which should be covered in the comprehensive evaluations.

Translating this schema into concrete terms, AID might consider the following global evaluation plan:

a. In Asia:

(i) One rehabilitation project from Pakistan, Bangladesh, or India, including, if available, an evaluation of the original irrigation project. Such rehabilitation work will more than likely be on a large scale.

(ii) A smaller scale, modern, cooperative project based on goals for increasing food production in either Southeast Asia, Indonesia, or the Philippines.

b. In Africa:

(i) Small scale irrigation effort, ideally working with local farmers and local cooperative associations.

c. In the Near East:

(i) Review of a major project in Egypt, Jordan, or other Near Eastern nation.

d. In Latin America:

(i) A Caribbean project in, for example, Haiti, which deals with small farmers and is integrated into other sectors including health, nutrition, community development, roads, food production, potable water, etc.

(ii) A project working with small or medium-sized land units dealing with specific environmental issues such as soil erosion, salinization, health or declining productivity.

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Kimaro, Young, and Colin Bruce. October, 1978. "An Economic and Social Analysis of the Chao Phya Irrigation Improvement Project II." World Bank Staff Working Paper No. 299. World Bank.

Linn, Johannes. 1977. "Economic and Social Analysis of Projects: A Case Study of Ivory Coast." World Bank Staff Working Paper No. 253. World Bank.

The World Bank. 1974. Manual for the Compilation of Balances of Water Resources and Needs. United Nations Economic Commission for Europe, New York.

6.4 LIBRARY COMPUTER SYSTEMS CONSULTED

AGRICOLA

1970 - present, 1,265,000 records, monthly updates of the National Agricultural Library, Beltsville, Maryland. This massive file provides comprehensive coverage of worldwide journal and monographic literature on agriculture and related subjects.

BIOSIS

1969 - present, 2,265,000 records, monthly updates of Biosciences Information Service, Philadelphia, Pennsylvania. This file contains entries from both Biological Abstracts and Bioresearch Index, the major publications of Bio-Sciences Information Service. Contains reviews of 8,000 primary journals.

CAB ABSTRACTS

January, 1973 - present. 890,000 records and monthly updates from the Commonwealth Agricultural Bureau, Farnham House, Farnham Royal, Slough, SL2 3BN, England. CAB Abstracts is a comprehensive file of agricultural and biological information containing all records of 26 main journals published by the Commonwealth Agricultural Bureaus. More than 8,500 journals in 37 languages are scanned.

CONFERENCE PAPERS INDEX

1973 - present, 670,000 records, monthly updates from Data Courier, Inc., Louisville, Kentucky. Conference Papers Index provides access to records of more than 100,000 scientific and technical papers presented at over 1,000 major regional, national, and international meetings each year.

ECONOMICS ABSTRACTS INTERNATIONAL

1974 to present containing 80,500 citations and monthly updates from the Learned Information, Ltd., London, England. The abstracts focus on coverage of the world's literature on markets, industries, country-specific economic data, and research in the fields of economic science and management.

SOCIAL SCIENCE CITATION INDEX (Social Scisearch)

1972 - present. 700,000 records and monthly updates from the Institute for Scientific Information, Philadelphia, Pennsylvania. It is a multidisciplinary data base indexing every significant item from the 1,000 most important social science journals throughout the world.

SSIE CURRENT RESEARCH

1976 - present, 253,000 citations and monthly updates from the Smithsonian Science Information Exchange, Washington, D.C. This is an index derived from a data base of reports of both government and privately funded scientific research projects, either currently in progress or initiated and completed during the most recent few years.

APPENDIX I

UNITED NATIONS DEVELOPMENT PROGRAM

PROJECT COMPENDIUM

Summary of Program Under
Agriculture, Forestry, and Fisheries

30 June 1978

Land and Water Use: 159 Projects costing $220,787,548	United Nations $84,427,412	Government Contributions $131,360,136

Country	Title	Cost ($ U.S.)
Afghanistan	Irrigation and Power Development	6,126
Bangladesh	Development of Winter Crops in N.W. Bangladesh through improved H_2O resources	744,891
Bangladesh	Development of Winter Crops in N.W. Bangladesh through improved H_2O resources	162,000
Benin	Small Irrigation Schemes in North Dahomey	706,837
Benin	Reinforcement de la Soniah et Development des Resources Hydro Agricoles du Benin	1,014,730
Botswana	Surveys & training for Development of H_2O Resources & Agricultural Production	1,175,245
Chile	Irrigation & Conservation of the Bio-Bio River Watershed	1,242,839
Costa Rica	Implementation of the Itiquis River Irrigation District	171,601
Cuba	Central Irrigation and Drainage Research Station	566,320
Cyprus	Paphos Irrigation Project	119,020
Kampuchea	Irrigation and Drainage Network of the Prek Thnot River	1,202,148
Kampuchea	Pilot Station for Irrigated Agriculture in Battambang (Phase II)	418,126

Country	Title	Cost ($ U.S.)
Ecuador	Strengthening National Extension Services and Increasing Agricultural Production in the Irrigation District	1,374,842
Egypt	Control of Waterlogging and Salinity in the Newly Reclaimed Area	1,305,323
Fiji	Irrigation and Drainage Engineer	314,126
Fiji	Senior Drainage and Irrigation Engineer	401,218
Ghana	Irrigation Development	544,948
Honduras	Contribution al Plan de Emergencia Nacional Para la Produccion de Arroz y Otros Cultivos Bajo Riego	73,997
Hungary	Irrigated Agriculture in the Tisza River Valley (Phase II)	1,187,507
Iran	Irrigation Practices	99,371
Iran	Training in Irrigation Farm Practices	7,000
Jordan	Irrigation	349,985
Jordan	Groundwater Irrigation in East Jordan	227,902
Kenya	Irrigation in Arid Regions	777,486
Lao Peoples' Republic	Assistance Au developpement hydraulique Agricole et L'Irrigation	705,340
Lao Peoples' Republic	Assistance a L'Irrigation Programme d'urgence	66,306
Lebanon	Irrigation de Koura-ZGharta	106,590
Lebanon	Relance des projets Hydro-Agricoles	85,021
Madagascar	Developpement des Peches Continentales et de L'Aquaculture	1,329,600
Mali	Hydroagricultural Studies Related to the Selingue Dam	423,040

Country	Title	Cost ($ U.S.)
Mauritania	Recherche Applique en Riziculture Irriguee	198,850
Nepal	Sikta Irrigation: Mapping Phase	130,000
Nepal	Major Irrigation for Western Region	859,730
Nigeria	Investigation and Feasibility Study of An Irrigation Project South of Lake Chad	942,945
Nigeria	Investigation and Feasibility Study of An Irrigation Project South of Lake Chad (Phase, II)	32,013
Pakistan	Preparation of a Revised Action Program and National Investment Plan for Irrigation Farming Development	3,070,000
Papua New Guinea	Village Level Irrigation Consultant	3,500
Philippines	Improvement of Irrigation Facilities Through Groundwater Development	2,090,344
Saudi Arabia	Irrigation Development in the Wadi Jizan	927,675
Saudi Arabia	Senior Irrigation Advisor	95,763
Saudi Arabia	Fellowship in Irrigation and Drainage	900
Senegal	Creation d'Ateliers de Reparation de Pompes D'Irrigation Dans La Region de Fleuve Senegal	45,230
Somalia	Pilot Farm for Irrigated Agricultural Development on the Shabelli River	106,167
Sudan	Hydro-Agricultural Investigations for Tokar Delta-Red Sea Hills Development	13,138
Thailand	Experimental and Demonstration Farm for Irrigated Agriculture, Kalasin (Phase II)	985,694

Country	Title	Cost ($ U.S.)
Thailand	Strengthening of the Programme for the Improvement of Irrigated Agriculture in Northeast Thailand	698,192
Tanzania	Irrigated Rice and Vegetable Cultivation, Zanzibar	912,220
Upper Volta	Experimental Center for Rice and Other Irrigated Cultures	1,269,013
Zambia	Small-Scale Irrigated Horticulture Development	628,256

Source: UNDP, Compendium of Approved Projects, No. 9. 30 June 1978.

APPENDIX II

Environmental Considerations in Impact Evaluation of Water Resource Projects

Impact	Consideration	Measure of Survey	Consideration	Evaluation	Related Goals
Irrigation Development	(Salinization danger)	Water table and likely movement with irrigation		Needs for preventive measures and costs	Water quality management
	(Siltation of canals)	likely sediment load of irrigation water, and erodability of canal bank soils	(canal bank erosion can be serious for sandy soils; dredging of lined canals can break lining)	special erosion control needs	
	(water weeds)	likely weed infestation of canal system	(weeds grow in sediments) (presence of free-floating weed species, Eichornia, Pistia, Salvinia) (weeds may be used as habitat by snail intermediate hosts of schistosomiasis)	possible needs and measures to control weed infestation	Control introduction of exotic plants and animals into the river basin

APPENDIX II

(page 2)

Impact	Consideration	Measure of Survey	Consideration	Evaluate	Related Goals
	(pollution)	likely extent pollution from agricultural chemicals, pollution by human and animal wastes		Possible damage to aquatic life and problems in downstream uses	
	(human values of water)	likely use of canal water for drinking, bathing and washing	(exposure to pollution and disease vectors)	needs for protected water supplies, public health education, pollution control	water quality-management
		—	(not usually considered as a benefit in project analysis)		

Source: Freeman, Peter H. Large Dams and the Environment "International Institute for Environment and Development" A Report in Preparation for the United Nations Water Conference Mar Del Plata, Argentina, (March, 1977).

APPENDIX II
(page 2)

APPENDIX III

Criteria for Site Selection: When to Irrigate

Although evaluation of irrigation is a difficult task, the larger question of how one ranks the priority for irrigation investments against other types of development investments is a fundamental and frequently unasked question. As this topic is not directly an evaluation topic, but something that is important to the success of irrigation activities, some comments are provided here in this appendix.

In practice, the ultimate decision to establish an irrigation project will be made by political leaders. However, undergirding the political dimension will be economic, social, environmental, and agricultural conditions. The selection, analysis, and application of these data are critical to the decision whether to irrigate or not and, if so, how to do it.

The decision to irrigate can be looked at with reference to three different decision making situations.

Projects initiated:

... as a self-evident "best way" of improving the realibility of food or other crop production in arid and semi-arid areas;

... as a complement to other water development projects, usually hydro-power of flood control schemes;

... as a well thought out decision to introduce or upgrade irrigation in an area.

The evaluations of USAID projects and more general experience with irrigation suggests that the following are the most important

considerations in early decision making.

a) Rehabilitation Projects. The easy, inexpensive, or readily adaptable areas for irrigation have, for the most part, already been irrigated. Projects which introduce irrigation into an area for the first time are almost certainly going to be expensive investments. The logic is to give priority to viable rehabilitation projects, or expansion of previous successful irrigation projects unless the activity is very carefully planned as a new initiative in the area.

b) Management. Management of irrigation systems emerges as the critical variable in determining success or not. Therefore, future decisions of when to irrigate should be based on a careful assessment of existing or potential management institutions, training capabilities and potential, and integration of the project into existing networks and sectors.

c) Small Farmers. Evaluations indicate that large projects tend to aid larger land owners and those with access to more capital more directly than small farmers. Therefore, AID decisions, in following its mandate of the "new directions" should focus on irrigation efforts which aid smaller farmers.

d) Previous Experience. Evaluations also indicate that projects introduced in areas where irrigation is already known or where farmers have had some experience with irrigation are dramatically more successful than areas where

irrigation has been previously known. Another priority for policy considerations suggests that AID give preference to irrigation projects where farmers know something of irrigation, unless much longer-term experimental efforts are envisaged.

e) Integration. Irrigation projects which function in isolation from other sectors in development or from other components within a particular project are less successful than those which integrate themselves directly into the local infrastructure. Thus, in project design for irrigation efforts, explicit attention should be paid to the factor of integration.

f) Environmental Compatability. The compatability of both the physical and social environment to the project plan is obviously a central issue. Although evaluations available to us deal predominantly with social, economic, and political factors, one must not overlook the technical issues associated with site selection. The Agency already has a series of policies and procedures on technical issues related to irrigation, and these were not included in the terms of reference for this paper.

SPECIAL STUDIES

No. 1: The Socio-Economic Context of Fuelwood Use in Small Rural Communities (August 1980)

No. 2: Water Supply and Diarrhea: Guatemala Revisited (August 1980)

PROGRAM DESIGN AND EVALUATION METHODS

Manager's Guide to Data Collection (November 1979)