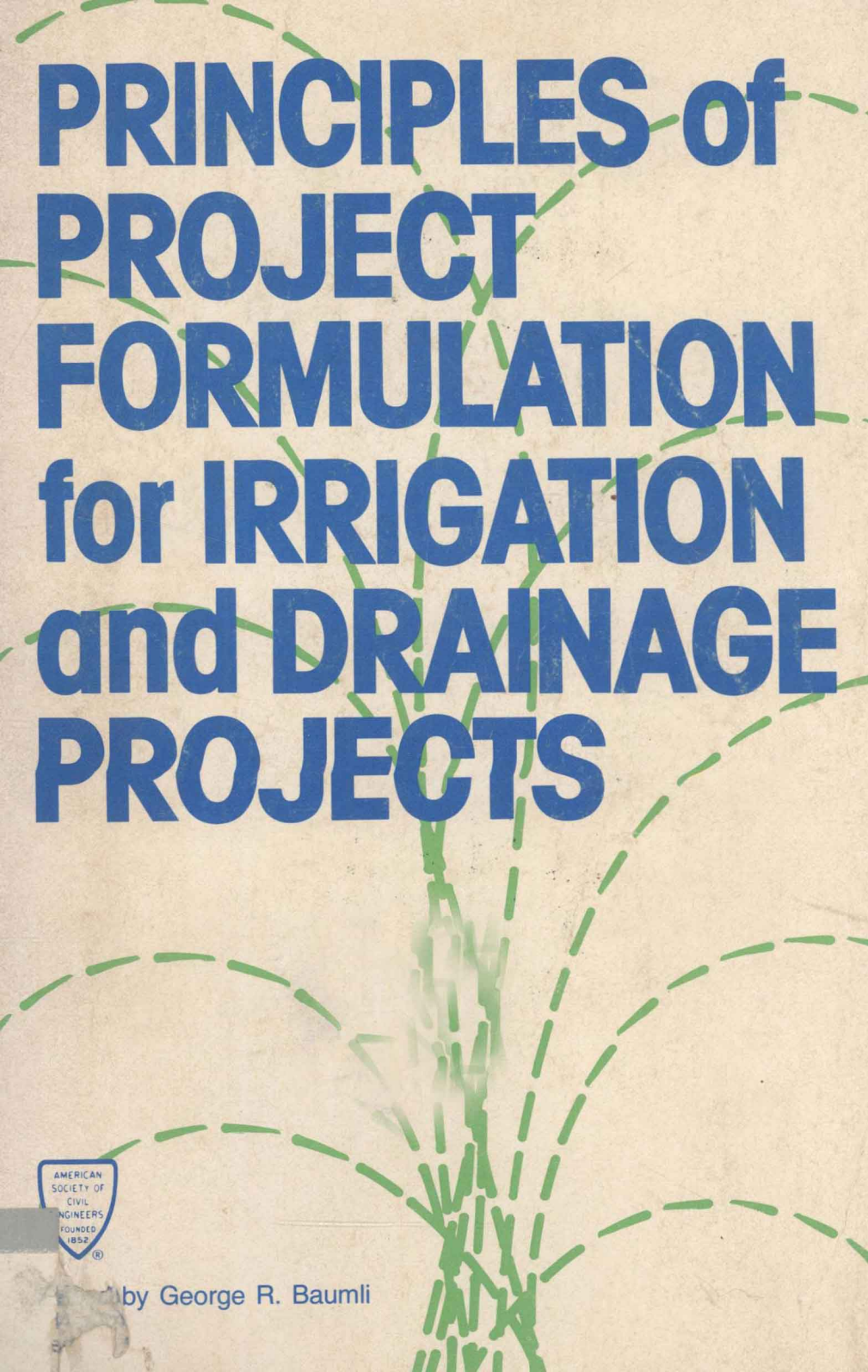
PRINCIPLES of PROJECT FORMULATION for IRRIGATION and DRAINAGE PROJECTS



by George R. Baumli

PRINCIPLES of PROJECT FORMULATION for IRRIGATION and DRAINAGE PROJECTS

A report prepared by the Technical Committee on Project Formulation For Irrigation and Drainage Systems of the Irrigation and Drainage Division of the American Society of Civil Engineers

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COMMITTEE ON PROJECT FORMULATION
FOR IRRIGATION AND DRAINAGE SYSTEMS

The purpose of the Committee on Project Formulation For Irrigation and Drainage Systems is to carry out technical activities relating to project formulation, including consideration of: 1) the objectives and need for projects, 2) physical resources available, 3) engineering, economic, social, environmental, legal, and financial aspects, and 4) interrelationships with other water uses.

The Committee held its first meeting in September 1972. In 1974, the Committee concluded that there was a need for a manual on the Principles of Project Formulation For Irrigation and Drainage Projects and initiated discussions of how to proceed. In April 1977, the Committee Chairman presented a detailed outline of the manual at a technical session of an ASCE conference in Dallas. At the National Convention in Chicago in October 1978, drafts of some of the manual chapters were presented as technical papers by the Committee member authors. At the July 1979 I&D Specialty Conference in Albuquerque, papers on the remaining chapters were presented at one of the technical sessions by other Committee member authors. The individual chapters were revised, considering the comments received at the technical sessions; and in April 1980, the first complete draft of the manual was compiled. That draft was reviewed by the Committee members and by other individuals with expertise in project formulation. Based on those comments, preparation of a revised edition was undertaken. At their March, 1981 meeting, the I&D Executive Committee decided that it would be preferable to publish the document as a special report rather than a manual, which would have required prior publication in the I&D Journal. In August 1981, a revised edition of the report was completed and submitted to Committee members and to the I&D Executive Committee for final review. Additional revisions were made in 1982 and with the approval of the Executive Committee, the document was submitted for publication as an ASCE special report.

It is intended that after the report has been in circulation for a few years and subjected to peer group review, it will be revised and published as an ASCE Manual.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the direct and indirect contributions to this report by a number of agencies and individuals. In particular, the cooperation of The World Bank is acknowledged for permitting publication in Chapter 5 of some of its methodology and examples of economic and financial analyses. Also, acknowledgements are due the U.S. Water Resources Council, Bureau of Reclamation, and Soil Conservation Service for their development of some of the methodology and procedures referred to in this report. This report would not have been possible if professionals involved with irrigation and drainage projects throughout the world had not taken the time to prepare the numerous documents which are referred to.

Special thanks and appreciation go to Mrs. Cynthia G. Erivez who typed drafts and final copy of the report and assisted with organization and editorial review.

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FOREWORD

Large increases in food production are necessary for the world's increasing population. Much can be obtained by improving operations and management of existing irrigation systems and by placing more lands under irrigation. Irrigation and drainage projects are one of the more effective means of closing the gap between world demand for food and fiber and supply.

Irrigation and drainage projects should be formulated to accomplish their intended purpose with full consideration of physical, economic, social, and environmental factors. It is to this end that this report "Principles of Project Formulation for Irrigation and Drainage Projects" has been prepared. The objective of the report is to provide guidelines to ASCE members and others who are engaged in the formulation or irrigation and drainage projects. There are numerous common elements in the formulation of irrigation and drainage projects regardless of their size, scope and location. Some projects have been successful, some have not. This report sets forth the generally accepted and proven principles of project formulation and provides a guide and checklist for the planning and review of irrigation and drainage projects.

Project formulation involves a series of steps starting with determination of objectives by the decision makers, identification and definition of problems and needs, evaluation of available resources, development of alternative means of resolving problems and meeting the needs, evaluation of the alternatives and selection and implementation of the recommended plan. It is an orderly and systematic process which permits the interested public and decision makers to become aware of the assumptions made, data used, rationale and methodology employed, alternatives considered, cost, benefits, impacts and consequences of the alternatives and throughout the process to play a role in the decision making process.

The report was prepared by the Committee on Project Formulation For Irrigation and Drainage Systems of the Irrigation and Drainage Division. Helpful comments were received on draft sections of the report when they were presented as papers at technical sessions of the Society's conferences. Accuracy, clarity, and usefulness of the report were enhanced by the constructive suggestions of a panel of expert reviewers.

Hopefully, the first edition of this report will serve as a foundation on which to build a more comprehensive and complete reference manual. Your comments are invited.

W. Martin Roche

W. Martin Roche, Chairman
Committee on Project Formulation
For Irrigation and Drainage Systems
August, 1982

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CHAPTER 1. INTRODUCTION

It is the purpose of this report to provide guidance to those individuals who have the responsibility to formulate irrigation and drainage projects and to review formulation studies prepared by others. It is recognized that regardless of the unique nature of a specific project, the formulation process has many common elements and the experience gained from one project is applicable to another project to a significant degree. The report, on the one hand, attempts to set forth generally accepted principles of project formulation and, on the other, to provide a check list for the planning and review of irrigation and drainage studies.

The general procedures set forth herein should be viewed in relation to the particular physical, temporal, and economic setting of the project under consideration.

Irrigation is man's application of water to land for growing plants. Measures to reduce soil moisture content are called drainage. Irrigation and drainage are complementary processes to maintain soil moisture required for optimum plant growth.

An irrigation project generally consists of a storage dam and reservoir or a diversion dam or pumping plant on a stream, a system for conveying the regulated water to the farmer's headgate, an on-farm distribution system, and a system for collecting the unused water and returning it to the stream system for subsequent use by downstream diverters. Groundwater can be used in lieu of or in conjunction with surface water. Drainage facilities can consist of subterranean tile collector pipes, and deep surface ditches to collect the excess water. Pumps are frequently required for both the delivery of irrigation water and for the disposal of drainage water.

The varying degree of success of existing projects indicates the need for thorough and realistic formulation studies. History can provide us examples of projects which are successful, others which have fallen short of achieving the goals which were envisioned, and others which were failures. Although, not always well documented, the knowledge of success and failure is available to project planners and it only remains for such knowledge to be diligently sought out and applied to the project at hand. However, as resources become scarcer and the demands for them become greater and more diverse, it becomes increasingly necessary to improve our ability to formulate effective, efficient, and acceptable projects. It is toward this end that this report is presented.

The report is organized to discuss each of the steps of the project formulation process.

Steps of the Project Formulation Process

The six steps of the project formulation process which are intended to be carried through in increasing detail for each level of study are:

1. Determine objectives of the decision makers.
2. Determine need for project.
3. Inventory available resources.
4. Develop alternative plans.
5. Evaluate and compare alternative plans.
6. Select and implement plan.

Step 1. Determine Objectives of the Decision Makers

Irrigation and drainage projects can be formulated in different ways to meet different objectives. The manner in which projects are formulated, constructed, and operated is determined by the decision makers. The success of the project depends upon the reasonableness of the objectives and availability of resources to formulate, construct, and operate and maintain the project. Objectives of irrigation and drainage projects may include improving living conditions by increasing employment, increasing personal income, and improving social conditions; improving national economic efficiency; improving foreign exchange balances; and improving the distribution of population.

Step 2. Determine Need for Project

The need for an irrigation and drainage project can best be determined in the larger context of the need for food and fibre. The economic need for a specific irrigation and drainage project is usually expressed in terms of market demand for a product or service provided by the project. In a multiple-purpose irrigation project, one or more of the following purposes may be included: drainage, flood control, hydroelectric power, municipal and industrial water supply, navigation, and recreation.

Step 3. Inventory Available Resources

The success of an irrigation and drainage project depends on a thorough inventory and analysis of available physical, financial, and human and institutional resources. An assessment of their quantity, quality and constraints is a necessary precondition to developing alternatives. The physical resources which should be evaluated include climate, land, soils, water, plants and animals, energy, transportation, aquaculture, man-made facilities, archeological and historical resources and aesthetics. In addition to the physical resources, it is important to consider financial resources, which are the tangible assets needed to plan, design, construct, and operate and maintain a project to fulfill its intended objectives.

Step 4. Develop Alternative Plans

The development of alternative plans is necessary to insure that the most favorable solutions to the problems are considered. The alternative of improving an existing irrigation project as well as achieving

the objectives through non-structural means should be considered along with the alternatives involving construction of new facilities. There usually will be competition or conflict between objectives, as the achievement of one may reduce the achievement of the others. Other factors which contribute to the need for formulating alternative plans include limited resources, technical planning constraints, acceptability, legal, institutional and administrative constraints, and implementable stratagies. The initial list of alternatives should be developed without screening or ranking based on cost or other constraints. Even possibly nonviable proposals should be included if they have significant public interest and support. It is necessary to document that these plans were considered and justification given for not selecting them for further analysis. The economic costs and benefits and environmental and social effects should be developed on a comparative basis for each of the alternatives.

Step 5. Evaluate Alternative Plans

The plans must be evaluated to determine how well they meet the objectives. The differences among the alternative plans must be analyzed to show trade-offs among the specified components of the objectives. The beneficial and adverse effects of each alternative must be evaluated in terms of effectiveness, completeness, efficiency, and acceptability.

Steps 4 and 5 are iterative and may need to be repeated several times.

Economic, financial, and environmental and social analyses are critical elements in plan evaluation. Economic and financial analyses are closely related in the decision making framework, however, they have important differences. Economic tests are made to estimate total return, productivity or profitability to society as a whole from the viewpoint of a needed investment. Financial analyses are made to measure the ability of beneficiaries to meet their financial obligations, and when appropriate, to estimate returns to equity capital, labor, and management. Environmental and social analyses are made to determine beneficial and adverse effects of projects on the environment and society, to provide a basis for selection of the plan which minimizes adverse effects, and to provide a basis for mitigation of those adverse environmental effects which cannot be avoided. The above factors are then collectively analyzed to determine the best plan or if a project can be justified at all.

Step 6. Select Plan

The recommended plan should be one that meets the objectives, is publicly acceptable, provides maximum flexibility in meeting needs, and minimizes adverse environmental effects. Given such criteria, there should be no more economical means of accomplishing the purposes of the project and net benefits should be maximized. Total economic, environmental, and social benefits should exceed total economic, environmental, and social costs and each separable purpose should provide benefits at least equal to its cost unless there is a stated exclusion. In some cases, it may not be practical to meet all these requirements, but they are the goals for which to strive.

The six steps of the project formulation process are carried through in increasing detail for each of the following levels of study.

Levels of Study

Planning is an iterative process. That is, the process is carried out in a number of stages, each with more detailed data and analysis than the last. The stages or levels of study are continued until the desired level of definition is achieved, consistent with the established objectives and available resources. In some cases because of time and budget constraints, it may not be possible to complete each level of study, including the report, before moving into the next level.

The decision to study the project in more detail, to go to a more intense level of study, is based on the results of the previous level. If, for example, based on a reconnaissance evaluation, a proposed project shows promise it normally would be studied in more detail; if not, the project normally would be dropped from consideration.

Following is a brief description of various levels of study usually followed in the planning of irrigation and drainage projects.

Level I. Reconnaissance - (Sometimes called Preliminary Project Investigation, or Pre-Feasibility Study)

This is the first level of study. It consists of a preliminary appraisal of water and land resources problems and possible alternative solutions to determine whether further investigation and expenditure of funds for a more detailed study is warranted on the basis of existing conditions. Field work, research, and office studies are held to the minimum necessary to meet these objectives. Supporting economic data are preliminary in nature, but sufficient to enable identification of the most favorable solutions. Preliminary benefit-cost and financial analyses and environmental and social evaluations are included. If the results are favorable, a decision is made to carry the more promising alternatives to the second level of study, namely:

Level II. Feasibility - (Sometimes called Survey)

As the name implies, the purpose of this level of investigation is to determine engineering, economic and financial feasibility of a proposed project and to define environmental and social effects. A feasibility report, which is based on detailed field and office studies, includes definition of all project features and operations for a number of alternatives in sufficient detail to define approximate project costs, accomplishments and environmental and social effects. Economic and financial studies are carried to sufficient detail to identify project beneficiaries, and to determine the overall investment requirements and to identify sources of financing. The feasibility report and accompanying environmental documentation generally serves as the basis for the decision to commit the necessary resources to implement the project. Once the project is authorized or approved, evaluations shift to the third level of study, namely:

Level III. Implementation Plan - (Sometimes called Definite Plan, Work Plan, General Design Memorandum or Advance Planning)

The purpose of this level of study is to define the features of that selected plan in sufficient detail to further determine specific costs and accomplishments. In addition, many years or decades may have elapsed since the feasibility study was completed, and modifications are required to bring the project study up to date. Adjustments are made as necessary in the financial aspects to insure funding. The results of the implementation plan provide the basis for design, construction, and operation of the project.

Public Participation

At each step of the plan formulation process and for each level of study, it is important to consider public participation. Public participation in the formulation of irrigation and drainage projects is emphasized more in developed countries than in undeveloped countries. In developing countries, public participation may have only limited applications.

The primary objective of public participation in the formulation of plans for irrigation and drainage projects is to identify all alternatives and possible environmental and social effects. Public participation promotes citizen trust in the fairness and objectivity of the planning process. A public participation program should insure that government officials (local, state, regional, and national), influential and opinion leaders, and the general public are informed and involved in the decision making process. The program should provide a process by which the public can participate in a visible manner in the steps that lead to decisions which directly or indirectly affect those interested in the study, and should be initiated early in the planning process and incorporated in activities throughout the entire study.

Public participation involves two-way communication to:

- Keep the public fully informed regarding the status and progress of studies and the results and implications of planning activities.
- Obtain from involved interest groups their opinions and perceptions of problems, issues, concerns, and needs; their preferences regarding resource use and development of alternative managerial strategies, and any other information and assistance relevant to the plan formulation process.
- Use public input to influence the project formulation process and to assure that a full range of alternatives is considered.

Considerable effort must be devoted to the public participation effort in planning studies, particularly where serious conflicts in public desires and values are likely to arise. Early identification of such situations will allow time for the planning organization to more effectively design and conduct the public participation program most

likely to be successful in dealing with sensitive value-conflict situations. Care should be taken to avoid overwhelming the public with well-intended but unspecific efforts. The objective of each action should be clearly defined. Public participation meetings should essentially be scheduled in relation to the six steps of the project formulation process. However, if it is a highly visible project or there are significant conflicts involved, additional meetings should be scheduled.

There will often be competing demands for water resource use. To the extent possible, plans should be formulated that are responsive to the problems, needs, and concerns of the public involved in the planning process. To facilitate comparisons and trade-offs among alternative plans and comparisons of beneficial and adverse effects measured in non-monetary terms with beneficial and adverse effects measured in monetary terms, alternative plans should be formulated which emphasize each objective. Consideration should also be given to formulating non-structural plans for components such as flood or erosion control, and to describing future conditions without any plan of development. When considering alternative plans which reflect major trade-offs between conflicting objectives, the addition of complementary measures to serve several objectives may considerably enhance the plans.

There will be uncertainty as to what the public consensus may be regarding trade-offs and, indeed, decisions cannot be reached until the range of trade-offs is made available to the public and feedback obtained. Therefore, a variety of alternative plans may need to be developed initially which appear to represent the preferences of the various public interests. During subsequent iterations, the alternatives can be refined, and those which lack significant public support can be eliminated. The number of alternatives which are to be carried through to the end of the planning process is a function of both the diversity of public and professional expressions and the characteristics of the possible plans formulated to meet planning objectives.