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BOOK REVIEW

Design of Water Resource Systems

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ARTHUR MAAS, MAYNARD M. HUFSCHMIDT, ROBERT DORFMAN,
HAROLD A. THOMAS, JR; STEPHEN A. MARGLIN,
GORDON MASKEW, *and others.*

Harvard University Press, 1962: pp. XVIII, 620.

Design of Water Resource Systems, a joint effort summarizing the research of the economists, engineers and political scientists participating in the Harvard Water Program, is an auspicious beginning toward a professional treatment of the *mal pais* between economics and engineering which each discipline has tended to relegate to the other. Robert Dorfman's discussion of the economic and technological concepts of water planning will be especially helpful to engineers and others who wish to learn how economists reason. Social scientists and planners, on the other hand, will find this volume helpful in understanding the engineering approach. Both groups might well stand ready to review some mathematics as they read.

The basic approach of the Project involved erecting quantitative models of the relationships pertinent to water planning and using the models to determine optimum levels of project construction and the best operating procedure for the facilities. The first part of the book deals with general model-building in the water resources area with emphasis upon objectives and related economic factors. The principal element in their objective function is the maximization of net economic benefits, *i.e.,* the excess of the amount beneficiaries would willingly pay for the particular project over the value of goods given up in order to construct and operate it. An effort was made to allow for the effects of income redistribution as an objective, but much work remains to be done in this area. When a number of time periods are considered, the present value of the net economic benefits is maximized. In computing present values, however, the authors would reject market interest rates on the ground that some individual preferences cannot be expressed even in a purely competitive marketplace. On page 197 they write "The range of private interest rates has no normative significance for public investment." It is somewhat doubtful whether all economists will agree with this view. The complications caused by limitations upon the investment budget or levels of expenditure are discussed masterfully.

Part II presents two primary techniques of analysis—mathematical programming and simulation. Since non-linear relations are likely to appear in water design, the simpler linear programming techniques could not be used. Some

knowledge of linear programming, however, would aid in understanding these chapters. Water design problems are often so complex that non-linear programming is ruled out. In this case the streamflow is simulated by a digital computer and the response of net economic benefits to changes in design or operating procedure is determined by analysis and sampling. Part III of this book is concerned with the political process and water system design, especially the methods of reaching a consensus upon objectives.

Although *Design of Water Resources Systems* is a valuable pioneering effort, one serious omission is apparent. No attention is paid to the problems of pollution and waste treatment. Consider, for example, this statement from page 183: "an increment (of water) devoted to municipal water supply . . . cannot be employed for irrigation water since both are consumptive uses." If waste treatment were included in the model, a considerable portion of municipal waste could be used, after treatment, for other purposes. Actual water consumption resulting from evaporation and transpiration is rather low in municipal use. During 1960, 121,901.1 million gallons of water were withdrawn in Philadelphia but 120,078.8 million gallons were returned to the sewage plants. Even in the arid Southwest about 40 or 50 per cent of municipal withdrawals is returned. This analysis is confined to power and irrigation systems but recent developments indicate that perhaps changes in salinity due to irrigation should be included in design considerations also.

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