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WATER MANAGEMENT MODELS IN PRACTICE: A CASE STUDY OF THE ASWAN HIGH DAM

DALE WHITTINGTON and GIORGIO GUARISO

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In his classic 1952 study, *The Nile*, H. E. Hurst observed that conservation is the fundamental principle on which investigations of water are based: water is neither created nor destroyed; if it disappears in one place, it reappears in another. "The rest," he said, "is largely ordinary arithmetic." This observation is true, but not the whole truth. The management of water has both technical and institutional dimensions. For this reason, it has been the basis of much important applied research in the social sciences. It has been intimately tied to the development of benefit-cost analysis and, more recently, simulation and multi-objective programming methods.

This research attention may be traced in part to the analytical tractability of water resource problems, which require elements of both engineering and economics, inviting formal analysis and treatment. Yet, water use has also fascinated students of institutions: its allocation is a matter of property rights and distributive justice as well as economic efficiency. Unfortunately, what is often missing in the analysis of water resources is a balance of analytical and institutional sophistication. Nowhere is this balance more important and more difficult to achieve than in developing economies, where key technical and institutional characteristics are often missed (or ignored) by outside researchers.

This balance is successfully achieved in the Whittington and Guariso study of the Aswan High Dam. Respectively an economist-planner and an engineer, the authors synthesize the various dimensions of water use in the Nile Valley. There, it goes almost without saying, water management is as old as civilization. For several thousand years, the people of Egypt have confronted the same issues: (1) how to change the seasonal distribution of annual water discharge in order to have more for agricultural use during spring and summer; (2) how to save water from years of high floods for use during years of drought. Over time, efforts to control mean flow and the uncertainty associated with variations within and between seasons have resulted in a variety of technical and institutional innovations. The Aswan High Dam is perhaps the most monumental of modern efforts.

The volume begins with a very well-written introduction to the fascinating hydrology and history of water management on the Nile, leading

up to construction of the Aswan High Dam in 1960. Despite criticisms directed at the project, due in part to Soviet involvement in its construction, the authors point out that in the 1950s Western experts favored the proposed High Dam. A project evaluation completed for the World Bank in April, 1955, found the project technically and economically sound (a February 1956 World Bank report estimated an internal rate of return of 28.5%). However, after the proposed Western financing package fell apart in 1956, it was left to Soviet engineers to execute what, at least from an engineering point of view, remains a skillfully designed structure. But as students of water policy in this country know, engineering per se is but one dimension of water resources management. What distinguishes this volume from many similar studies is its sensitivity to the relationship between engineering, history, and policy.

The authors note a variety of institutional innovations which were spawned by the High Dam, including the 1959 Nile Waters Agreement and a Permanent Joint Technical Committee to implement cooperative actions in Egypt and the Sudan. In the Sudan, the Khashm el Girba Dam on the Albara and Roseries Dam on the Blue Nile stemmed from this agreement. Despite these technical and institutional innovations, economic and population growth in the Nile Basin have increasingly dictated more complex river basin management objectives, defined in terms not only of water quantity but water quality as well. It is in the context of these "second generation" management issues that the volume makes its major contribution.

With the completion of the High Dam, Lake Nasser has effectively become the source of fresh water for all water users in Egypt. If, as planned, some 1.2 million hectares (about 3 million acres) of desert are reclaimed between now and the turn of the century, a major water shortage could result. The pricing of this scarce resource according to its various uses is thus an economic case study of broad relevance. Utilizing a series of increasingly sophisticated linear programming, simulation, real time, and multi-objective models, the trade-offs between maximization of agricultural water, hydroelectric power, and water quality are explored and developed. Each type of model is employed to draw out a particular dimension of the overall problem. It is concluded, quite unlike some previous studies, that the trade-offs between water use for agriculture and hydropower generation may soon be more apparent than real. The agricultural value of water is predicted to dominate its use as a source of power in the short run, as demands from new land reclamation projects grow. But urban and industrial development are predicted to displace agriculture as the highest value water users over the longer term. Utilizing a multi-objective model, the authors argue that this shift will increasingly emphasize the importance of water quality. The possibility of shortage

of both water quality and quantity also points to potential tensions between riparian states and the need for a new round of institutional innovation in the form of a renegotiated Nile Waters Agreement.

The book concludes with some specific recommendations for action, and a call for the type of integrated policy analysis of which it is an example. As the authors note, the assumption that large sophisticated models lead to better policy analysis is often incorrect. In order for modelling efforts to contribute to the formulation and analysis of policy options, they must provide insights which can be explained and understood by nonspecialists, and must permit managers and administrators to understand the sensitivity of model solutions to data quality and assumptions. For these purposes, the use of a series of scaled down models which fit with different dimensions of water resource problems will be more accessible and comprehensible than complex and cumbersome modelling efforts which attempt to capture everything in a single system of relationships. Whittington and Guariso's approach provides a series of clear and well integrated analytical insights into various facets of water resource management, representing a level of applied policy analysis to which other studies would do well to aspire.

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