# DIGITAL SIMULATION OF WATER RESOURCES SYSTEMS

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**THIS BOOK CONTAINS NUMEROUS PAGES WITH DIAGRAMS THAT ARE CROOKED COMPARED TO THE REST OF THE INFORMATION ON THE PAGE.**

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# CHAPTER I

## INTRODUCTION

The progress of civilization has increased the importance of water resources engineering. This importance is reflected in the need for planning, design, construction, and operation of facilities for regulation and efficient utilization of water. The prime objective of a public water project is the maximization of the national welfare, that is the national income. This goal cannot be reached unless the various alternatives of the system are investigated. The first step in design is to determine which of these alternatives reflect the needs of the society interested in the development of efficient water utilization. Once the objective has been defined, the employed methods must lead to a combination of these alternatives which will best achieve the objective. In order to estimate the available water, accurate hydrologic methods have to be applied. An efficient use of this available water must be attained in order to reduce the associated cost, and hence the water system becomes economically feasible.

### 1.1 DEFINITION OF THE PROBLEM:

A water resource system may include reservoir(s), dam(s), and power plant(s) which are discribed in terms of their physical characteristics such as capacity of reservoir storage, effective water head, and power plant capacity. The primary function of reservoirs is to provide a water storage for the various purposes such as, irrigation, power generation, water supply, flood control and recreation. A compromise takes place

between the cost of project construction, which is a function of its capacity, and its expected benefits resulting from the output resources produced. Power plants are utilized for the generation of hydro-electric power. The amount of energy generated depends on both the effective water head, which is a function of the reservoir content, and the actual water flow through the turbines. The function of a dam is to keep certain required water level in the reservoir so that a water supply and/or a water head are provided.

In general, the resources employed by water projects are, available water (inflows), site, construction materials, manpower, and equipments for which costs are incurred. The resources produced (outputs) are water at time, place, and quantity required for, irrigation, hydro-electric energy, urban supply, and a variety of recreational facilities. Both of these resources have to be interrelated by a model which controls the system operating policy. Accordingly, the main function of the study conducted in this paper is to develop such a model so that an optimal design is reached.

Since the inflow to any real world water system behaves stochastically, some stochastic parameters which describe this behavior have to be included in the developed model. Because of the existence of these stochastic factors, benefits are evaluated in terms of expectation. These expected benefits can be considered as a criterion on which the selection among various combinations of the system variables is based.

Due to the large number of variables involved in water systems and the wide combinations of these variables, operations research techniques, as a tool to provide optimal decisions, have been employed in the design of water resources systems. These techniques can be promising when a high