CHAPTER 1

INTRODUCTION

1.1 GENERAL

India being a developing country with its economy mainly based on Agriculture, efforts to increase productivity with possible methods and techniques has become inevitable to face population explosion and rapid industrialization. Extensive and intensive irrigation is emphasized to increase and stabilize productivity. Productivity is the outcome of judicious combination of large number of inputs involving nature, policies, procedures and farmers. In areas where there is potential, new irrigation projects are planned to utilize the available resources. On the other hand, in areas where the existing potential has been already developed, improving productivity by modernization and/or by scientific management is thought of. Lot of research activities are underway looking at exhaustively, the numerous factors responsible for productivity in different scientific communities such as Agronomists, Soil Scientists, Agricultural Scientists, Agricultural Engineers, Hydrologists, Irrigation Specialists, Water Resource Engineers, Sociologists and Economists. This work relates to effective and efficient management of existing water resources for irrigation. This can be achieved through scientific approach, adopting operations research techniques. Simulation and/or Optimization techniques are most widely used in irrigation planning, design, operation and maintenance.

Optimization models are frequently used for narrowing down the number of alternatives that are distinct in their performance in order to select the best from among these alternatives. Optimization techniques are most suited to identify "Starting Points" for further and more detailed simulation analysis, specially when there are many alternatives, none of which is obviously the best.
Linear programming, Dynamic programming and their variants are the optimization techniques normally used. As far as Irrigation Systems are concerned both supply to the reservoir and demand on the reservoir are stochastic. Since Dynamic Programming (DP) is more versatile in handling such conditions, it is most often used. Also DP is very much useful in estimating the risk and uncertainty involved in operation of water resource systems.

Simulation reproduces the essence of the system without reproducing the system itself. Mathematical simulation is a technique whereby the behaviour of a system is described using a combination of mathematical and logical relationships. Computer simulation techniques can be extremely useful in tracing changes in system performance through simulated time and under varying rules of operation. Through simulation, different parties in conflict can assess the extent to which any particular proposed design and operating policy will be feasible and acceptable under various scenarios of future demands and hydrologic conditions. Water resource systems simulation provides an opportunity to gain understanding of system apart from assisting to identify the best among possible development plans and operating policies. Simulation techniques bring down the mathematical intricacies associated with many of the other mathematical framework. The Planner or System Designer has to concentrate on measures of system performance as large information is generated through simulation modelling. Simulation has the ability to incorporate a high degree of detail although this increases the complexity of the relationships and the computer time needed for solutions. The desired balance between validity and complexity depends upon the objectives of the study (Loucks and Salwicz 1990).

In most cases water resources systems are so complex that the best alternatives cannot be obtained directly through the use of any mathematical optimization technique. In these cases, simulation methods are often employed. For irrigation systems planning and operation, combination of simulation and optimization is most appropriate.
This work relates to the development of suitable DP and simulation models for large scale South Indian irrigation systems and applying them to a real system to derive optimal operation plans and to evaluate the utility of the models. Some of the pertinent features of South Indian irrigation systems that need special attention are discussed briefly below.

1.2 FEATURES OF LARGE SCALE SOUTH INDIAN IRRIGATION SYSTEMS

Before the construction of large reservoirs across rivers, there were small irrigation reservoirs called tanks. Every tank has a catchment area and rainfall-runoff from their catchment is stored in the tanks for irrigation. These tanks irrigate around 20 ha to 200 ha according to the size of the tank. Later when large reservoirs were planned and constructed across the rivers and when command area was developed for the reservoirs, these tanks fell within the command area of the reservoirs. These tanks are now called system tanks and they receive additional supply from the reservoirs when necessary. These tanks significantly affect the demand pattern on the reservoirs.

The rivers in South India carry significant discharge only during the monsoons. The monsoons over India are highly varying from one year to another and so the inflow into the reservoir is highly varying. The inflow during dry seasons is very less. The serial correlation coefficients between monthly flows for several months are very less. The cropping intensity is high during years of good monsoons and is less in other years. So the cropping pattern keep changing from one year to another.

In this research work, for the conditions mentioned above, models are developed innovatively and applied to a typical large scale South Indian irrigation system namely Krishnagiri Reservoir Project (KRP).
1.3 ORGANIZATION OF THE THESIS

Chapter 1 is the introduction in which discussion is made on the importance, necessity and relevance of the research work carried out. In Chapter 2 the study area taken up for application of the models developed is described. In Chapter 3 the literature relevant to the models developed in this work are critically reviewed and the scope and the objectives of the study are presented. In Chapter 4 detailed development of optimal operation model wherein tanks exist in the command area is presented and applied to KRP and the results are discussed. In chapter 5 steady state SDP model for crop sequencing is developed and applied to KRP and the results are discussed. In chapter 6 steady state SDP model with mixed inflow process namely treating the inflow into the reservoir as first order Markovian for certain months and independent for certain months is developed. The utility of the model is discussed and the results are presented. In Chapter 7 conclusions drawn from this work are summarized and presented.