CHAPTER I

INTRODUCTION

Water being a natural resource, its total supply is fixed. Apparently this supply is enormous; but it takes different forms through what is called the hydraulic cycle. In fact, though 70 percent of the world's surface is covered with water, nearly 99 percent of it is either unavailable or unsuitable for agricultural and other uses. So the real problem is that water is not available adequately in the kind needed or at the place it is required most. Therefore, humanity has to live with the scarcity of usable supply of water and the problem gets accentuated with the growth of population at a very high rate to be termed "explosion" indeed.

Rapid growth of population of human beings and livestock, expansion of industries and other sectors have resulted in a tremendous pressure on land and water resources. Between 1951 and 1991, the population of India increased from 361.1 million to 548.2 million, a rise of nearly 51.8 percent. During the same period the land under cultivation had increased from 97.32 million hectares to 124.32 million hectares, a rise of only 27 percent. From 1971 to 1980 the population increased from 551.3 million to 811.8 million, a rise of 47.25 percent, whereas the area under cultivation went up only to 127.06 million hectares, a rise of...
2.2 percent. Thus the rapidly growing demand for agricultural products has to be met, subject to the growing scarcity of arable land. Indeed the frontiers of extensive cultivation are closing in and so the future growth depends crucially on intensive cultivation of available land. In the mid-sixties, the Government of India inducted a number of new techniques into agriculture in order to increase production. The result was the Green Revolution, the success of which required application of fertilizers and plant protection chemicals, which in turn required an assured supply of water.

Realizing that the most important factor that helps significant increases in agricultural production is the availability of assured irrigation the Governments at the Centre and the States have accorded high priority for irrigation development from the beginning of the planning Era, in 1951. By 1980-81, about 57 million hectares (mha hereafter) of land had received irrigation (58 percent from surface sources and 42 percent from ground water sources). It marks an expansion by about two to three percent per annum in area of land irrigated.

Presently, the overall irrigated agriculture accounts for about 60 percent of the agricultural output in India. It was estimated that the increased production resulting from investment in irrigation had accounted for at least three quarters of agricultural growth since 1960. With the spread of the New Technology agricultural production did increase, but its future
prospects are threatened by the growing scarcity of water resources and the consequent uncertainty in its supply arising from fluctuating monsoons. Many of the existing irrigation system were planned to provide famine protection, and had limited or no storage facilities; these did not have sufficient water control structures. Hence water supply from these sources depend on rainfall. But rainfall in India is by and large not only low and fluctuating, but also ill distributed leaving a third of the country drought prone. At present more than 90 percent of the available water is used up by agricultural sector, which is very sensitive to variations in water supply.

UNCERTAINTY

India’s average rainfall is 120 mm on the face of it; this should be regarded as fairly good. But the year to year fluctuation and erratic seasonal distribution of rain are sources of uncertainty. It is concentrated within three to four months in a year. This is in sharp contrast to the condition prevailing in the United Kingdom, where the rainfall is more or less uniformly distributed throughout the year. Further the rains in India are distributed very unevenly among the regions. On the one hand, Cherrapunji in North Eastern India has the world record of 10,700 mm rainfall on the other, in Jaisalmer of Western Rajasthan the average rainfall is just 100 mm. As a result, in the net sown area of the country, about 34 percent lies in the low rainfall regions, 36 percent receives precipitation in the range of 750 mm to 1150 mm and 30 percent enjoys the benefits of high rainfall.
Coupled with uncertainties arising out of year to year variations, there are the disconcerting situations of frequent floods in some parts, with simultaneous severe droughts in other parts of the country.\(^{10}\)

As pointed out by Dhawan, floods and drought rage in rural India with the same frequency and ferocity. And so, water still continues to be an intractable problem—a problem of too much or too little—neither of which can be banished.\(^{11}\) The unfortunate part of it all is that four fifths of the country's cropped area depend on this gamble of monsoons. It is estimated that in the event of unfavourable rainfall, there may be a drop in production of 10 million tonnes (mt, hereafter) of food grains.\(^{12}\)

According to a report by National Commission on Agriculture, even after exploiting all the surface and ground water resources in the country for irrigation purposes, by 2025 AD, the net area irrigated will be just 52 percent of the cropped area, and 48 percent of the cropped area will still be rain-fed.\(^{13}\) Therefore, the urgency and importance of utilizing available water to secure maximum returns cannot be over emphasized.

**PROSPECTS**

In the above described scenario of growing demand for agricultural products in general, and food grains in particular, confronting the country along with the deepening scarcity and the uncertainty of irrigation resources, the increase in agricultural production is possible only by the application of appropriate technology that helps to manage water, making it
available through good irrigation methods. Further, irrigation induces a higher degree of stability in yields per hectare and reduces fluctuations in production levels. So it needs to be recognized that the available water must be efficiently managed. Otherwise the desired stability in production levels may not be achieved.

**IRRIGATION: A STATE SUBJECT**

Though water is a national resource, irrigation is a State Subject. The development of irrigation is looked after by the States. Tamil Nadu has a land area of 13 m.ha and the population as per 1981 census was 48.41 millions. The per capita availability of water was about 860 m$^3$. Tamil Nadu has a net sown area of six million hectares, with an average cropping intensity of 118 percent. The net area irrigated varied in the eighties between 2.5 m.ha and 2.8 m.ha; of which 35 percent was irrigated by wells, 35 percent by surface flows and 30 percent by tanks. The average irrigation intensity was 135 percent.

According to the Irrigation Commission, the annual surface flow in rivers of Tamil Nadu was estimated at 3.18 million hectameter (mhm hereafter) and the ground water recharge was 1.42 mhm, excluding evaporation and sub-surface run off losses. The Tamil Nadu Planning Commission estimated the surface water potential at 3.36 mhm, and ground water potential at 1.81 mhm. Besides this there is also some flow of water from the States of Karnataka, Andhra Pradesh and Kerala.
At present the requirement of water for non-agricultural use is low, but it is expected to rise appreciably in the future. By 2000 AD, the requirement of fresh water for non-irrigation purposes may be around 27 percent of the available water. The average use for domestic purposes may go up to 150 litres per day per head. On the other hand, the requirement of the agricultural sector also is increasing due to increase in the area under crops, and its intensity of cultivation.

Foreseeing the irrigation development in Tamil Nadu, it is clear that by 2025 AD the percentage of irrigated area to the net sown area can be increased to a maximum of 58 percent. The total surface and ground water potentials of the State are 4m.ha and 1.5 m.ha respectively. Of this, 95 percent of the surface water and 75 percent of ground water have been harnessed already.

THE PROBLEM

It is a known fact that Tamil Nadu has attained the highest level of utilization on its irrigation potential (see Appendices II and III). No large scale surface water resources remain undeveloped. At this point, it is useful to recall Peter Drucker's statement, that "The key task of management is not to find the right way of doing things, but it is an art of finding the right things to do." There is, therefore, considerable pressure on water sources; for, water is not only a limited resource, but also a limited resource needed for the growth of the economy. Therefore,
increasing the efficiency of water use in existing irrigation systems and developing suitable technologies for water deficit management are the best ways to increase agricultural production. Allocation among regions and years must be managed most wisely to avert disastrous consequences.

Therefore, the governments have attempted to improve upon the natural distribution of the precious resource through dams and distribution systems. The concept of water management as the process of allocating available water among competing uses to achieve the best possible return for it, has gained currency and priority in policies. The recent (1989) drought with its devastating impact on the economy has served to emphasize the seriousness of water supply management and policy. Hopefully the present experience will contribute to better management decision making in the years to come.

Given the high variability of the weather and water supply, it is only over a period of time that full range of possibilities would be experienced and any new information about the extremes of possibilities (either of droughts or of floods) would be available; and further adjustments can be made to maintain management plans as close to the optimum as the given information allows.

It is in the dry period that the water managers are confronted with a dilemma. The dilemma is between meeting all the current pressing needs of the thirsty ayacuts, and ensuring
adequate supplies for the next year, when it is realized that available supplies are limited and the next water year also might prove to be dry. Releasing deficient water to meet all the current demands may mean disaster for the following year. But an outlay conservative approach of holding back too much water wastes the value-in-use of the resource. What is needed is a systematic decision procedure to find an answer to the dilemma. The present study is such an attempt in a selected irrigation system, viz., Tambaraparani irrigation system of Nellai Kattabomman district (N-K district hereafter).

OBJECTIVES

The overall objective of the present study is to make a comprehensive study of the irrigation potentials, method of distribution and use of water, and the nature of organization that controls the distribution. With the help of data generated, an attempt would be made to prepare optimal plans for most efficient management of Tambaraparani River System. Optimal plans have to take into consideration not only productivity of water, but also equity in distribution. The specific objectives are—

i) to evaluate the present system of management of water supply in Tambaraparani river system;

ii) to assess the productivity and equity in water use;

iii) to prepare an optimal plan for efficient use of water in Tambaraparani river system; and
iv) to suggest policies for efficient management of the system.

The first objective requires an assessment of the supply of water—both normal and temporal variation in it, the pattern of distribution among different regions of the systems, loss in the distribution and the area irrigated net as well as gross. Equity criterion of the second objective places emphasis on that any fall in the supply of water in the system must be evenly shared by all the regions. But it is in conflict with the criterion of productivity. Some areas achieve greater productivity per unit of water used than others. Then, proportionately larger allocation of water to these higher productivity regions would increase agricultural productivity of the system as a whole. This trade-off between productivity and equity must be solved subject to the riparian rights conferred on various sections of the users. A single optimal plan may not be feasible. Therefore, the third objective includes development of alternative plans and contingent plans.

HYPOTHESES
The above objectives would require the following hypotheses to be empirically verified.

1. The present use of water in Tambaraparani River System leaves room for more efficient reallocation through optimal plans.
2. The optimal plan has not only to maximize productivity, but also to ensure equity in water distribution to be acceptable to the users, subject to their riparian rights.

3. Implementation of optimal plan may require specific policy action and support, and changes in organizational pattern of users with their consent.

These hypotheses suggest that a constrained optimization model is useful for the present study, particularly to take care of constraints imposed by the riparian rights of registered users. Optimal efficiency of the system (as a whole) is the goal; but it depends on two criterion of productivity of water and equity in its distribution, and there is a trade off. The hypotheses also imply, that there is scope for improving organization for management of the system by active involvement of the farmers in the decision making. Policy support in the form of educating and motivating farmers for their mutual co-operation in sharing available supply of water equitably is, therefore, an essential component of the management model.

SCOPE OF THE STUDY

The findings of this study would throw light on the existing pattern of water use in the study area. It would enable the farmers, planners, and government officials of the study area to take suitable decisions with regard to the allocation of water for the most efficient use of it. The study is useful to draw up policies on the use of water in future. Further the findings of
the study would provide useful lessons for future research, particularly in the use of optimizing models and ways to relax their restricting assumptions.

In the process of evolving optimal plans for various irrigation levels, the model simulated a situation for assured water supply also. This optimal plan will be useful in two ways. First, such optimal plans can be adopted to maximize the aggregate farm profit in normal years. Secondly it serves as a reference base to assess the loss of income at various levels of stress with and without the use of contingent plans.

In addition to these uses, better water management on the farm will enable the efficient use of other agricultural inputs and hence agricultural productivity can be improved as such. Evolved management strategies can be generalized for the areas wherein similar stress conditions occur.

However, there are a few limitations. First, the required primary data were collected only for one year i.e., 1990-91 by personal interview method. Since the farmers did not keep any records of the data, they furnished the information from their memory, and hence the fear of recall bias did not permit collection of primary data for earlier years. However, the response of the farmers was satisfactory for the current year data, and the recall bias was minimized due to their experience and by several cross checks made while interviewing them. The study, thus restricted to one year, and to one particular canal of an irrigation system
among selected branch canals; and the number of sample farms is limited. It must also be accepted that no two droughts-stress conditions can be compared either in their duration or in their intensity.²⁴ Hence one cannot expect the same situation to be repeated in all the years and in other branch canals. So, generalization has to be done with much care taking into account the differences in the basic conditions of the system. As far as the secondary data are concerned full co-operation of the officials was available. The period covered was twenty years and the data obtained were month wise. This empirical model is applicable for similar exercises elsewhere, with due care to identify and include location specific constraints.

PLAN OF THESIS

Chapter I  Introduction. The problem of the thesis is explained, the objectives of the study are defined and testable hypotheses are stated. Scope of the study and organization of the report are shown.

Chapter II  Previous work and concepts relevant to the study are reviewed to define concepts and scope of the present study.

Chapter III  A brief description of the Tambaraparani river system is presented.

Chapter IV  Design of the study and model formulation are described.
Chapter V Results of analysis are presented and discussed with reference to the specific objective to draw useful inferences, and hypotheses are tested.

Chapter VI Summary of findings, conclusions and implications of the results for policy and research are presented.

NOTES

7Ibid., p. 2.
13National Commission on Agriculture, Abridged Report, p. 64.


22 Indian Express, September 16, 1981.
