CHAPTER I

INTRODUCTION

1.1 General

Irrigation has been considered by far the most important input for increasing the agricultural production. The average annual rainfall of India is 1200 mm though rainfall varies widely from place to place. About 75 per cent of the total annual rainfall is received during the south-west monsoon in the months of June to September. The rest of the months are practically dry with exception in some parts of the country. Even during the monsoon, droughts are experienced due to the erratic and uneven distribution of rainfall and crops require irrigation for stable production. Due to vulnerability of India's agriculture on account of the vagaries of the monsoon, the water resources have become very important for irrigation. According to the Irrigation Commission 1972 (India, 1983, and Bose, 1984) the utilizable water resources of the country have been estimated as 66 M ha m from the surface source and 27.5 M ha m from the ground water source. Of this, about 27.0 M ha m from the surface source and 14.5 M ha m from the gound water source have been utilized by the year 1983-84. As a result about 55 M ha out of the total gross sown area of 178 M ha has been brought under irrigation. By the year 2000, the gross irrigated area would be about 84 M ha. It has also been

estimated that on the full development of the irrigation projets, perhaps by the year 2025 it will be possible to bring about 110 M ha under irrigation. This would account for 52 per cent of the total gross sown area of about 210 M ha expected by that time. This indicates that the country's water resources are insufficient to meet the irrigation requirement of the arable land.

Further, there has been considerable pressure of population on agriculture. According to the National Census 1981, the population of India is 692 million which is expected to reach to 920 million by the year 2000. The estimated quantity of food required for this population will be 225 million tonnes. The present production of the food grains (1985-1986) is 150 million tonnes. This means that the food production has to be increased by 50 per cent in the next 14 years. This is a difficult task but is possible by careful planning and management of the available resources.

The present causes of low production in the country are mainly related to the weaknesses on the supply side such as the lack of the inputs like better seed, fertilizer, pesticide, availability of water at the right time, credit facilities, etc. With the existing practices, the intensity of cropping has been estimated as 123 per cent and the average production of food grains is about 1.5 t/ha/year againstthe reasonable target of

production of 3-4 t/ha/year of the major crops from the irrigated lands. All these problems suggest the need to develop an institutional frame work capable of dealing with them. It is in this context that the Government of India has set up 76 Command Area Development Authorities (CADA) which are spread in 16 states of the country, each covering more than one lakh hectares of the culturable command area (CCA). They have concern with the conservation of water, water distribution, land shaping, land drainage, supply of inputs and services including credit and selection and introduction of suitable cropping pattern, etc. In West Bengal, three major irrigation projects, namely Damodar Valley Corporation, Mayurakshi and Kangsabati have been included in the CADA program since 1976.

Due to the scarcity of water greater attention is being paid in the recent years for the better utilization of the water resources with due emphasis on the social, economical and employment aspects of the region. The 'Systems Approach' to water resources management has become the important tool in decision making. The model developed has also the provision to make it applicable to other areas.

The present study utilizing 'Systems Approach' to water resources management for crop planning has been taken up in Division 4 of Kangsabati Command Area in Midnapur district, West Bengal, India. This area has been selected because of the

fact that some developmental programmes including the integrated Rural Development Programme (IRDP) and the Kangsabati Command Area Development Authority (KCADA), are functioning in the area for promoting the agriculture. There appears to be an ample scope for the implementation of the results of the model.

1.2 Problems and Objectives

The area selected for the study, the Division 4 of the Kangsabati Command Area Project with the population of 7,17,328 persons and a culturable command area (CCA) of 73,577 ha is characterised by the tropical climate with hot summer and cold winter. The area receives on an average, annual rainfall of 1,580 mm, mostly concentrated in the 4 months from June to September. The soils are light in texture with a plain topography. The major crops of the area are paddy, wheat, potato, vegetables and few pulses and oilseeds. Paddy is the predominant crop of the area. The prime sources of water in the area are surface water and ground water. The irrigation developments are mainly through the public sector while in the private sector liberal loans and subsidies are granted to the farmers to develop their own water resources. Agriculture is the main source of the income for the majority of the population. Most of the farm families are poor with 75 per cent having land holdings of less than 2 ha. About 20 per cent of the population belongs

to the labour class and remains unemployed during the major portion of the year. The existing cropping pattern followed by the farmers is not based on the scientific lines. The cropping intensity is about 114 per cent. The returns per hectare are low (Rs. 1,340 per ha). The water resources have not been utilized to a satisfactory level. Water is applied at a level which results in low irrigation intensity of about 40 per cent only. The existing cropping pattern needs some change to utilize the available water resources efficiently. The goal of 'maximum good to maximum number' has been preferred over the goal of net benefit maximization. No scientific crop planning has ever been done in the past in the command area. Hence, it has been considered necessary to review the working of the irrigation system and suggest a crop plan which would be ideal to the people as well as make optimum utilization of the available water resources. Keeping this in view, the research project entitled 'Multiobjective Irrigation Planning for a Command Area' has been undertaken with the following objectives:

1) to study the socio-economic status and attitudes of the people in the command area and assess various water resources potential;

2) to develop a linear goal programming (LGP) model for optimal allocation of area under different

crops with available resources and for maximizing irrigated cropped area, net benefits and production; and

3) to develop alternate solutions by changing the goal priorities, select an optimal model and carry out a sensitivity analysis, with changing assumptions of ground water availability in the command area.

1.3 Procedures

The data for the study have been collected from various organizations within and outside the command area through personal inquiries and progress reports. All the necessary computer work has been done on HP 1000 system.

The input-output data of the different crops at the existing and the improved levels of management have been collected from the Principal Agricultural Officer, Midnapur, West Bengal to get an insight into the existing economics of the command area and to develop the input parameters for the proposed goal progamming model. The data on the population, the labour availability and the land holding pattern in the area have been collected as per the available census of West Bengal, 1981. The population of the command area and the labour availability have been projected for 1987, the year chosen for planning,

considering an average growth rate of 2.2% per annum. The food production requirements for the projected population have been worked out based on the recommendations of the Indian Council of Medical Research, New Delhi (Gopalan et al., 1984). The irrigation potential of the existing surface and subsurface water resources in different seasons have been estimated by collecting the records of the canal discharge, the storage analysis of the irrigation ponds, and collecting the discharge data of the river lifts, the shallow and the deep tube wells and the dug wells. The weekly pan evaporation and the weekly rainfall data of the command area have been analysed to estimate their magnitudes at various probabilities using the analytical methods. The weekly net irrigation requirements of the different crops have been estimated on week basis considering the pan evaporation at 40 per cent probability and the effective rainfall at 60 per cent rainfall probability as per the guidelines given in 'A Guide for Estimating Irrigation Water Requirements (1971)'. After making the necessary assumptions regarding the relevant factors, a multiobjective linear goal programming model has been formulated to find out a suitable cropping pattern for the area. The three objectives, viz., (i) maximizing the irrigated cropped area, (ii) maximizing the net benefits and (iii) maximizing the crop production have been considered in a hierarchical order within the constraints of land, water, fertilizer and food requirement of the area. The other

constraints like farm power availability, credit supply and management practices though relevant to the study have not been considered, since the reliable data pertaining to the factors to be used as inputs to the model, are not available in a systematic fashion. The model comprises a planning period of one year divided into three crop seasons and emphasizes on cultivation of crops at the improved level of management. Alternative solutions by changing the goal priorities have been obtained and the sensitivity analysis performed to see the effect of changes in ground water availability on the optimum results.

The results of this study can be taken as a guiding tool to effect irrigation planning on scientific lines in similar situations elsewhere.