

## INTRODUCTION

Of all the grave challenges faced by mankind today, the gravest and the most menacing is that of food. The world population is likely to exceed 6 billion by the year 2000. In India alone it is estimated to shoot up to 920 million. The rapid increase in population coupled with the low production and imbalanced intake of food poses a gloomy prospect. Moreover, most of the predictions indicate that the world food problem will become even worse if the highest priority is not given to assist farmers to produce more and more food from less and less land. To tide over these twin problems, some radical steps need to be taken.

Geographically, India has a slight edge over many other countries of the world in that the varied range of soil in the fields can support different types of crops round the year. India has an annual rainfall ranging from zero to 1300 cm, the climate ranging from temperate to tropical and the land elevation from the sea level to Himalayas. There is a wide gap between actual and potential yields, since the production under scientific management is four to five folds higher than the national average production. There is ample scope, therefore, to raise India's productivity by integrating package of production practices in the most optimal way.

The way to achieve this would be either to increase the land area or the production per unit area. Horizontal diversification of land having reached the physical limits, the most apt

strategy would seem to be vertical diversification for maximizing the productivity.

Some important factors contributing to the unstable crop yields in most areas are improper allocation of irrigation water between competing crops, irrational use of fertilizer, thoughtless allocation of land to different crops in different growing seasons and socio-economic bottle-necks. Therefore, there is an urgent need to stabilize crop production by drawing upon the information on recent trends in agronomic research and through efficient crop planning which includes maximum utilization of space and time with economic use of resources under different socio-economic conditions.

In many parts of the world adequate irrigation is either not available or is not used efficiently for maximum production. In India, about 24.5 per cent of the total cultivated area is under irrigation, of which 45 per cent is under rice. It is known that rice with a low water use efficiency needs more water. Attaining high water use efficiency through crop substitution while maintaining high productivity would also be worth attempting.

In general, any cultural practice that reduces the limitations on growth imposed by factors other than water is likely to increase the water use efficiency of a crop. However, among the inputs, water and fertilizer are the most crucial for the plant growth as well as from the point of view of cost. Levels of other inputs and technology remaining the same, scientific

management of water and fertilizer leads to rise the land productivity. Three problems involved in management of irrigation water and fertilizer are proper allocation among competing crops, proper scheduling and locating by calculating their response point where they attain their optimum, individually or in combination with each other.

The nub of this problem is not solely which crop or crops should receive the water, but also at which period of the growing season the water should be provided. According to Hukkeri et al. (1979) if the water resources are deficient in comparison to the cultivated land during the winter season, the major aim behind irrigation water management should be to harvest maximum possible yield or return per unit input of irrigation water. The strategy of efficient water management would, therefore, involve immediate decisions in respect of the choice of crops and varieties, scheduling of irrigations and application of the right amount of water at each irrigation, apart from other water management practices.

In the Kangsabati Command Area of West Bengal, rice-rice rotation has received predominance over other crop rotations, even though there are ample scopes and favourable situations for cultivating other crops. Being unaware of the recent production technology farmers of this area are hesitant, rather do not venture, cultivating crops other than rice. This shows a need to demonstrate the productive potential and also to work out the input requirements for other crops, in their own fields.

The farmers generally grow short, medium and long duration rice cultivars in up, medium and low land areas during 'kharif' season which meet their timely food requirements. The management also becomes easier for them. The sowing time and all other operations are staggered accordingly.

Due to high rainfall and lack of adequate drainage there is water logging, even if for short periods, which also is another factor that precludes the possibilities of successful cultivation of other crops during 'kharif' season. At present, after rice, the fields are mostly kept fallow or are followed by rice, wheat or potato. It would, therefore, be worthwhile to develop a profitable cropping pattern after rice for these types of land, so that the competition for water, labour and other resources are minimized even during the winter season. Since the fields are vacated by 'kharif' rice at different times the farm operational activity can be spread for longer time to avoid the competition at peak requirements.

Scientific information on scheduling of irrigation and fertilizers is available for individual crop in the country; but they can not be utilized as such due to variation in climate, sowing time and other management factors. Moreover, even the recommended scheduling of irrigation for individual crop may not give the maximum total profit from farms having different crops at the same time under limited water supply. Under such circumstances, scheduling of irrigation taking into account all the crops, their requirements and relative profit under each crop

may help in proper allocation of water or even crop area for the farm as a whole. Similarly, the optimum fertilizer allocation to the crops may be different from that required for obtaining the maximum profit/production for individual crop, when the farm as a whole is taken into account under limited supply of the nutrients.

The cropping pattern should, therefore, be restructured through field experimentation on different crops (cereals, oil-seeds, pulses and tubers) that will be reasonably consistent with agronomic needs and availability of resources at the farms. The requirement of food for farmers as well as for the country may also be taken into account while formulating the cropping pattern.

The national average holding size is less than 2 ha. Particularly in this tract 70 per cent of the farms are having less than 2 ha cultivating 44 per cent of the total land. Only 9 per cent farms are having more than 3 ha cultivating 23 per cent of cultivated land. Cultivated land is owned by small, medium and large farmers having different status, capital, labour as well as managerial and educational standards.

For efficient optimization of resources, the selection of crops, their management, water and fertility requirements and different crop-combinations suitable for farms varying in size are various factors which must be taken into consideration. All these together suggest the need to work out the cropping

sequence in relation to farm size having different resource availabilities, for maximization of profit.

Keeping these points in view, a set of nine field experiments were planned and conducted with the following objectives :

- i) to study the effect of irrigation scheduling and fertility level on rice, wheat, maize, mustard, chickpea and potato ;
- ii) to minimize the water requirement of crops in general, and rice in particular ;
- iii) to develop the rice-based cropping pattern under different resource conditions ; and
- iv) to maximize the profit of farms different in size by crop substitution.