INTRODUCTION

Chapter I

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The irrigation potential of India has been developed to 56.60 million hectares by 1979-80 (Swaminathan, 1982). Ninety five per cent of this area is irrigated by surface methods with an average application efficiency of less than 30 per cent (Sarkar and Pal, 1974). The irrigated acreage may be doubled if only the application efficiency is increased to 60 per cent with the existing developed water resources. In a particular soil the irrigation application efficiency may be enhanced by designing optimal length, selecting proper flow rate, controlling irrigation time and using cutoff inflow or multiple inlet system (Wu and Gitlin, 1975). However, to establish some general principles for the application of irrigation water, there is an urgent need for more basic information of field irrigation efficiencies under different climatological, topographical, soil, agricultural and socio-economical conditions. These information on irrigation efficiencies may also act as guidelines in planning and designing new irrigation system and studying deficiencies in the existing systems (Bos and Nugteren, 1978).

Wheat is conventionally irrigated by flooding, border and check basin methods of irrigation. In flooding method, which requires considerable labour to conduct water on higher knolls and to prevent undue accumulation in lower

areas (Thorne and Peterson, 1954), the application efficiency is very low and the distribution of water is highly uneven. With border strip the inflow rate should be large and grading along the length is very essential (Bishop et al., 1967), especially in levelled rice fields, for ensuring even distribution of water over the entire length of the border. The check basin method, which also usually requires large inflows and extensive land grading, is suitable for soils having moderate to slow intake rate. The optimum size of the basin is related to cultural practices, location of delivery channel, advance time and labour requirements (Kovda et al., 1973). Moreover, low discharge of the low cost shallow tubewells preferred usually by the farmers with small land holdings, and slow advance of water front in fine textured soils do not permit larger sized check basins, borders and long run furrows.

Under these limitations of the conventional surface irrigation methods, the sprinkler system with high irrigation efficiency is though desirable but rarely been adopted by the farmers with small holdings because of high initial investment. Hence, it becomes necessary to design an improved surface irrigation system that has higher application efficiency than the conventional ones. The flat ridge and furrow system is one of such potential alternatives. Taking advantage of the seepage property of the clayey soils the ridges may be flattened and broadened to accommodate most of the crop rows on flat ridges. One of the

important advantage of the flat ridge and furrow system over the conventional furrow system is that crops which are sensitive to crusting are managed well as water is kept away from flooding the soil surface near the plants and soil surface is kept friable and open for aeration (Thorne and Peterson, 1954). However, in this system furrows should be spaced such that water spreads horizontally from their sides into the flat ridges before too much water moves down below the root zone (Kovda et al., 1973).

The importance of an efficient irrigation method is greatly manifested when available water resources are limiting the cultivation of crops. Such is the situation that prevails presently over the alluvial plains of eastern India during dry winter and summer months. In these plains though wheat is increasingly adopted as the second crop following 'Aman' rice, it's extensive cultivation is a challenging problem because of low efficiency of irrigation by the conventional free flooding method and reduced discharge from the shallow tubewell during the peak water demand period. A little is known about the irrigation efficiencies of alternative surface as well as sprinkler methods for wheat crop in shrinking clay soil of this alluvial plain. The significance of flat ridge and furrow system in irrigation of close row crops is though realised but rarely adopted for wheat in these clayey soils. The efficiencies of this system as related to spacing between the furrows is

not well defined. The viability of an irrigation method under a particular socio-economic condition not only depends on its efficiency but also on its benefit-cost ratio. The information on cost analysis for various irrigation methods for wheat is scarcely available especially in eastern India. In planning an alternative irrigation system it is essential to acquire these information through field investigations in representative areas. Field investigation in irrigation management, often called 'action research' or 'operational research project', which is carried out in farmers' fields under farmers' conditions is an important tool for addressing problems in irrigated agriculture. It focusses on identifying, testing and evaluating alternative irrigation system for improving water supply and related agricultural practices in a very limited pilot area considered to be representative of the over all region under consideration (Lenton, 1980).

The yield potential and water use efficiency (WUE) of wheat may be greatly increased if the choice of irrigation method is made within the physical limitations in relation to soil properties (infiltration, seepage, swelling and shrinkage), irrigation scheduling and crop water requirement. With this in view a comprehensive field investigation was carried out on a farmer's field at village Ashutia, in block Debra, Midnapore, West Bengal, India, to establish the most suitable method for irrigating wheat on a shrinking clay soil in terms of irrigation efficiency, water use efficiency, and benefit cost ratio for the cultivation of the crop.

The investigation was undertaken during wheat growing season of 1979-80 and 1980-81 with the following specific objectives :

i) to define the phasic water use rate and crop water requirement of wheat grown in alluvial clay soil under humid subtropical conditions,

ii) to design and fabricate a low cost simple mechanically weighing type lysimeter for field measurements of evapotranspiration,

iii) to evaluate the application and distribution efficiencies for different irrigation methods namely, check basin, ridges and furrows spaced at 40 cm, flat ridges and furrows spaced at 80, 100 and 160 cm and sprinkler,

iv) to assess the irrigation efficiencies for different methods as affected by stage of crop, frequency and depth of irrigation,

v) to characterise the water use pattern, yield and water use efficiency of wheat as influenced by method and scheduling of irrigation, and

vi) to assess the benefit-cost ratio for the cultivation of wheat with different methods of irrigation under shallow tubewell conditions.