Efficient Utilization of Water in Irrigation

E. SHMUEL

Owing to the rapid growth of world population and the resulting development of industry and agriculture, there is a constantly increasing demand for fresh water. At the same time, the quality of the available resources is being affected by salinity and pollution (MARSHALL, 1972). Consequently, the problem of water supply, which is directly related to the supply of food, is gradually becoming one of the crucial issues facing mankind.

FRAMJI and MAHAJAN (1969) have estimated that there are in the world about 500 million hectares of land suitable for irrigation from the standpoint of water availability; for social, political and economic reasons, however, less than one half of this potential is currently being exploited (Fig. 1). Moreover, the irrigable area could be increased considerably beyond the present potential if fresh water could be made available by desalination (CLAWSON and LANDSBERG, 1972). At present, the cost of desalinating sea water is still very high, which rules out the use of such water under field conditions. Future technological developments may permit the economic use of desalinated water in agriculture (CLAWSON and LANDSBERG, 1972).

![Fig. 1. Irrigated area of the world, from 1800 to 1969. Sources: 19th century – HAGAN et al., 1967; 20th century – FRAMJI and MAHAJAN, 1969](image)

If the future is promising, as indicated by the vast potential of irrigated agriculture in supplying food for the growing world population, the current situation is not very encouraging. Some countries with arid conditions are already seriously short of water and this problem will become more acute in the future. This leads us to the question whether successful agriculture indeed requires such large quantities of water as are applied today. The answer is that the present level of application of water in irrigation is, to some extent, wasteful (HAGAN et al., 1967; JENSEN, 1972; VIETS, 1965).

Although the subject of rational use of water in irrigation is of worldwide interest,
we shall restrict our discussion to the U.S.A. and Israel. In the seventeen western states of the U.S.A. the area under irrigation increased from 14.0 million acres in 1910 to 30.7 million acres in 1960. This was achieved by using mostly open irrigation methods and was made possible by the abundance of cheap water as well as much research on water-soil-plant-atmosphere relationships. This research has produced an extensive literature of much theoretical and practical interest (see “Irrigation of Agricultural Lands.” Agronomy Monograph No. 11, 1967), but there has been almost no improvement in the efficiency of water application in U.S. agriculture over the past 30 years (JENSEN, 1972).

In Israel, the amount of irrigation land has increased considerably over the last 25 years (Fig. 2). Because of water shortage, the development of Israel’s irrigated agriculture was accompanied by continuing attempts to minimize the amount of water applied per unit area, or per unit yield. As a result of research and Extension Service activities, sprinkling is widely used and less water is now applied, but yields are higher than they used to be.

**Terminology and Some Basic Assumptions**

In the last 100 years many terms have been introduced to describe various aspects of water use in irrigated agriculture. Some of these terms are mentioned in Chaps. 5.4 and 7.1. Here we shall restrict ourselves to terms referring to water supply and consumption by plants.