

be expected to have a lower salinity and ESP than that predicated in the constraints of the water budget. As we showed above in discussing the distribution of salinity in the saline zone, the best half of this zone should overlie water with an average concentration of 3350 milligrams per litre.

On the basis of presently available water quality data, it is not possible to specify mixing ratios and irrigation rates or times in the various project areas with any degree of certainty, and the Panel made no attempt to do this. Any practical irrigation scheme depends on several factors. A water supply of a given salinity and alkalinity suitable for one soil type may be unsuitable for another. A given irrigation time or leaching rate appropriate for one blend of surface and groundwater may be inappropriate for another. A program of water management for sugarcane may be unsatisfactory for pulses. It may be expected that practices will vary over a wide spectrum in the various canal commands and project areas of the Plain, depending upon local conditions. In the Northernmost Zone, for example, the diluting effect of rainfall should be taken into consideration.

In spite of these uncertainties, the Panel Report did conclude, we believe reasonably, that integrated use of groundwater and canal water for irrigation can be safely undertaken throughout most of the cultivated area in former Punjab and Bahawalpur. Consequently, major investments to construct many large, deep tubewells are justified. In the following sections, further justifications for this conclusion are derived.

#### **Salinity Control with Mixtures of Groundwater and Surface Water**

The amount of irrigation water required to maximize crop production and control salination depends not only upon the consumptive use by crops but also upon the chemical quality of the water. The higher the salinity and/or the ratio of sodium ions to calcium and magnesium ions, the more water is needed. An extra amount, over and above the consumptive demands of the plants, must be allowed to percolate through the root zone. This will make it possible to maintain the concentration of salts in the soil water at a level such that growth will be sustained and excessive sodium absorption on the clay lattices will not occur. The critical period occurs at the end of the irrigation cycle just before watering, when the soil moisture is low and its salt concentration is high. The concentration at this time should be maintained at or below the tolerance level, which depends upon the particular crop and upon the type of soil. Two parameters are important in achieving salinity control: *i*) the total depth of water applied per crop or per year; and *ii*) the irrigation time, that is, the period between waterings.