

tively in evapotranspiration by the crops. To minimize this fraction, to postpone investments for drainage, conveyance channels, and to reduce the ultimate costs of drainage structures, it is necessary to use the underground reservoir as an integral component of the drainage system. Any ultimate tubewell system should be designed to accommodate both irrigation supply and drainage.

THE BUDGET OF IRRIGATION WATER

In a steady state, rivers and rainfall are the only sources of supply for water in the Indus Plain. While there are significant fluctuations from year to year, the average annual volume of river flow is about 136 MAF (million acre feet), and the "effective" rainfall perhaps another 10 MAF. Of the total, say 145 MAF, only about a third was available in 1960 for beneficial use by crops. A large part of the remaining two-thirds flowed to the sea unused during the months of the summer monsoon; a smaller part was lost in non-beneficial evapotranspiration from rivers, canals, and water courses, and their soggy banks, and from field ditches and edges. More than a third of the water diverted from the rivers into canals seeped into the ground, as did a small part of the river flows. A major fraction of the seepage was ultimately lost in non-beneficial evaporation from waterlogged and saline areas, where the watertable stood close to the surface.

A principal objective of water development in the Indus Plain is to contribute to increasing agricultural production by increasing the fraction of the total water supply that is beneficially used. Most of the beneficial use will be in evapotranspiration by crop plants, which, from the standpoint of water transfer, behave much like little evaporating pans. But part of the beneficial use—ideally 10 to 15 per cent of the water applied to the fields—will be in achieving and maintaining a low salt content in the soil. This portion of the water will be used to wash away the salts already present or carried onto the fields with the irrigation water.

In the ultimate water development, the water running to the sea will consist very largely of these irrigation return flows. They will be needed to carry salt off the fields and out of the Plain. The principal device for increasing the usable supplies will be water storage during the monsoon months, either in surface reservoirs or underground, and the use of this stored water during the remainder of the year. As much as possible of the seepage water will be recovered, chiefly by pumping from wells. Part of the seepage enters the ground in areas of high groundwater salinity such as characterize the Southern Zone. It will not be recoverable for beneficial use, and will have to be wasted to the sea or to desert