

Economic Analysis of Spacing of Tubewells in the Northern Plain

The cost analyses summarized in Table 7.5 show that the ratio of capital costs and operating costs can be varied over a wide range by changing the spacing and number of tubewells per million-acre project. When the spacing is increased, capital costs are reduced both because fewer tubewells are required and because of economies of scale in equipment and installation costs. On the other hand since the ground water must travel longer distances to the wells, friction losses and power costs are increased. The three designs of Table 7.5 may be compared on the basis of the present value of the time stream of initial and future costs

$$C = c_c + vc_m$$

where  $v = r^{-1} [1 - (1+r)^{-T}]$

With a 6 percent ( $r = 0.06$ ) discount rate and a time horizon of 30 years, this ranking function for economic efficiency indicates that the intermediate design of tubewell-spacing (7350 feet; 1239 acres per tubewell) has the lowest cost. However, it is not possible on the basis of data presently available to ascertain the optimal distance between wells. The proper average spacing for individual projects must be determined from detailed investigation of local aquifer characteristics and of regional costs of canal enlargement and drainage. A substantial difference may be expected in the optimal spacing in the final designs of different projects. While the data of Table 7.5 cannot be used to estimate the optimal spacing definitively, the calculation is important in that it shows that a high degree of flexibility inheres in our plan for adjustment between capital costs and deferred operating costs. This design flexibility may be exploited to accord with interest rates and economic time horizons set by the national planning level.

Costs of Tubewell Systems in the Former Sind

As stated in item IE of the Water Budget, it appears on the basis of present information that extensive use may be made of tubewell systems in Former Sind to augment the water supply. While sufficiently detailed field data are not available to estimate costs precisely, it is probable that the overall cost of tubewell water per unit of irrigated area in the southern plain will be 25 to 40 percent larger than in the northern plain. This is true because of the shallow depth of the aquifer (mining is generally not possible), the poorer quality of the ground water, and the length of drainage channels needed in several areas. In the major part of Former Sind, where the underground water is salty a combination of tubewells and conveyance channels to return saline water to the Indus is necessary. Here the size of the project