

minimize the amount of fresh water discharged annually to the Arabian Sea. At this time it is assumed that mining of the aquifer will be stopped or reduced.

In discussing the first level of development it is pertinent to describe briefly the role of tubewells since these constitute an essential part of the water management system. Three separable kinds of beneficial effects can be expected in greater or less degree from installation and operation of tubewells: washing-out of accumulated salt; increase and stabilization of irrigation water supplies; and lowering of the ground water table.

For the area presently under irrigation, the amount of available canal water per acre of irrigated land is insufficient for maximum agricultural productivity and it is insufficient to reverse the rate of salt accumulation in the root zones of the crops. In the large areas where the ground water is not too salty, water pumped from wells can be used for leaching out accumulated salt. It can also be used to supplement canal irrigation water, and thereby to increase the amount of irrigation water per acre or to irrigate a larger area during either or both growing seasons. Furthermore, this water can be available for irrigation at any time during the year, and therefore during seasons when river and canal flow are low. Finally, with continued pumping, the water tables can be lowered so as to provide storage space within the aquifer and to permit regulation of flow between wet seasons and dry seasons, and wet years and dry years.

#### Limitations of Surface and Subsurface Drainage:

Surface and subsurface drains are used in controlling the water table and the build-up of salinity in many agricultural regions elsewhere in the world. It would be possible to use them on the Indus Plain in place of tubewells. In the Former Punjab, however, our calculations show that such "horizontal" drains are not only much more expensive than tubewells for eliminating waterlogging and salinity, but they do not provide the outstanding advantages of the latter - the increase and regulation of the irrigation water supply. In parts of the Former Sind, and a few other zones where "vertical" drainage by tubewells may not be practicable, recourse must be had to horizontal drainage by surface and subsurface drains. With the installation of tubewells, some surface drainage will be needed in the Former Punjab for export of excessively saline ground water, but the amount required will be relatively small.

### I. First Level of Development

A. The following assumptions are made for the entire region (See Figure 7.3):