

This is only 65 per cent of the water requirement of 13.4 MAF in June, the critical month, so that under these conditions the entire program would have to be scaled down by 35 per cent. This scaled-down program would use only a total of 41 MAF of canal water at the water courses in *kharif* (59 MAF at the canal heads). On the other hand, if tubewells capable of providing 4.7 MAF per month (equivalent to a total well capacity of 80,000 cusecs) are available and suitably distributed over the cultivated area, then the required 13.4 MAF can be delivered to the water courses in June. The total delivery capacity of the canals can be utilised for irrigation from May through September, and 49 MAF of canal water can be delivered usefully to the water courses, corresponding to a diversion of 70 MAF at the canal heads. The tubewells not only supply 14 million acre feet in *kharif* but they make it possible to use 11 MAF of river water that would be wasted without them.

Similar calculations can be made for other assumed canal capacities, and they show in each case that the volume of beneficially usable river water during *kharif* can be increased by supplementing canal flows with sufficient pumping at the proper times. The same utilization of surface water could be attained by enlarging the canals. But by coordinating canal and tubewell operations, investments for enlarging and modifying the canal system can be minimized. Even more important, difficulties of silting and erosion, and of inadequate check structures on distributaries and water courses can be at least partly avoided. With the "regime" canals of the Indus Plain, these difficulties arise from large differences in canal flows during different months.

This calculation, naturally, somewhat overstates the case. An accurate computation would have to take account of the differing canal capacities and patterns of monthly irrigation requirements in the different canal systems, of the need for surface water to dilute saline groundwater, and of other complications. And, of course, perfect coordination cannot be attained. But the moral is clear that a closely integrated operation of tubewells and canals greatly increases the efficiency with which surface supplies can be used. This close integration can be more easily attained where government wells are installed than where private ones are. But it may be possible to integrate private wells with the canal operations through wide dissemination of information about planned canal operations and economic pricing policies for both canal and tubewell water. Even before adequate well capacity is installed throughout the Northern Zone, sufficient capacity may be developed in certain canal commands to test the scheme outlined in Table II, particularly the effectiveness of the incentives for the private operators.

One reason for the superior integration of government tubewells with canal operations is that this integration will require some changes from the historical