

was selected. Then, setting  $x = .1S$ ,  $y = 0$ , and solving equation (1) for  $b$ , a value of  $b = 1/0.81S^2$  results. The assumed response curve then becomes:

$$y = M \left[ 1 - \frac{1}{0.81} \left( 1 - \frac{x}{S} \right)^2 \right] \quad (2)$$

Only the maximum yield parameter,  $M$ , remains to be estimated. Although yield data,  $y$ , are available, as mentioned above, there are no historical records of the corresponding water supplies,  $x$ . Let us assume, therefore, that the farmers have historically allocated their water among crops in, approximately, an optimal fashion. An optimal allocation is one such that a small increment in irrigation depth,  $dx$ , applied to an acre under the  $i$ th crop would increase the value of output neither more nor less than that same increment applied to an acre under the  $j$ th crop. If  $p_i$  and  $p_j$  denote the prices per maund of the  $i$ th and  $j$ th crops, this requires that

$$p_i y_i'(x_i) = p_j y_j'(x_j),$$

for every pair of crops,  $i, j$ . Carrying out the work we find

$$\frac{p_i M_i}{S_i} \left( 1 - \frac{x_i}{S_i} \right) = \frac{p_j M_j}{S_j} \left( 1 - \frac{x_j}{S_j} \right) \quad (3)$$

In addition to equations (2) and (3) an efficient allocation requires that all water available be used, or

$$\sum_i a_i x_i = \text{total water supply}, \quad (4)$$

where  $a_i$  is the total acreage under the  $i$ th crop, available for each year and district from patwari records. Equations (2) (one for each crop), (3) (one for each crop except one), and (4) (one equation) are just sufficient to determine simultaneously the unknowns,  $M_i$  and  $x_i$ , for all crops. From these equations the yields at saturation are obtained and the estimation of the water response curves is completed.

*No! The yields obtainable with all available water are obtained. This is probably less than saturation.*

These calculations have been carried out for ten major crops in eleven canal systems for five crop seasons. The results are summarized in Table A.5.1.

### Sources of Data

It was seen that these computations require the following data;

1. Total supply of water (in acre-inches per acre) for each canal system studied in each crop season studied;