



OPTIMUM ALLOCATION OF DIFFERENT SOURCES OF IRRIGATION

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DISCUSSION

Discovery of agriculture was no doubt the greatest development in the history of mankind. Irrigation, being one of the most crucial input in the process of agricultural development, has been sought to be developed. In India, although significant efforts have been made to develop the irrigation potential through major and minor irrigation, yet there has been rather inadequate awareness of the economics of irrigation. Particularly, very few comparable attempts have been made to examine the rational allocation of water between different regions, crops and over time. Most of the studies that have been made in this field, have examined the different sources of irrigation in isolation from one another. In the present study, it is intended to examine the different sources of irrigation in an integrated manner and thus provide a macro-prospective as a guide to formulation of rational policies for irrigation management. In the present study, it is proposed to study the allocation of water by regions and crops and also over time. An attempt will be made to draw out policy implications and make some specific recommendations.

The work was done during 1999-2000. Fourteen normative plans worked out are given as under:

- A. Existing supply of canal water + tube-well water.
- B. Existing supply of tube-well water + 10 per cent increase in canal water.

- C. Existing supply of tube-well water + 20 per cent increase in canal water.
- D. Existing supply of tube-well water + 30 per cent increase in canal water.
- E. Ten per cent increase in tube-well water + 10 per cent increase in canal water.
- F. Twenty per cent increase in tube-well water + 20 per cent increase in canal water.
- G. Thirty per cent increase in tube-well water + 30 per cent increase in canal water.
- H. Existing supply of canal water + 10 per cent increase in tube-well water.
- I. Existing supply of canal water + 20 per cent increase in tube-well water.
- J. Existing supply of canal water + 30 per cent increase in tube-well water.
- K. Existing supply of canal water only.
- L. Ten percent increase in canal water only.
- M. Twenty percent increase in canal water only.
- N. Thirty percent increase in canal water only.

These fourteen solutions were obtained for six canal zones of western and central U.P. – Bulandshahar, Aligarh, Farrukhabad, Etah, Kanpur and Etawah. An attempt was also made to obtain a global overall solution combining all these six canal zones. This global solution which was obtained by assuming the canal and tube-well water supplies at their existing levels yielded optimum water allocation among different canal zones and different months of the year.

Normative cropping pattern and thus the normative water allocation was worked out by applying the Profit-Maximising technique of Linear Programming. To study the economics of minor irrigation Cobb-Douglas and Linear Programming Functions were fitted for different crops. Best fit was judges on the basis of R^2 value etc. Economics for private diesel engines, electric motors and state tube-wells were also worked out on the basis of per unit investment and cost per unit of water from these sources.

- A. In Bulandshahar Canal Zone, results show that there are significant changes between actual water utilization and its normative pattern over time. This is primarily due to misallocation of water between crops in the existing situation and there seems to be vast scope for improving the efficiency of water utilization by shifting the normative plan A, even without further augmentation of water from surface or ground sources. However, if canal water supply is augmented by 10, 20 and 30 per cents respectively, through saving in seepage losses, which seem possible through the undertaking of effective programmes for lining of water courses and other soil conservation measures, then normative plans B, C and D could be implemented. The MVP of canal water per acre feet in all the situations in this zone was much higher as compared to its estimated cost of Rs.8.98. In situations from K to N it is worth noting that when only canal water is available the MVP is significantly high. It varied from Rs. 1073 to Rs. 5300. The MVP of water from EM was of the order of Rs. 31.36 in all the corresponding situations as against its cost of Rs. 56.48 per acre feet. Further, MVP of water from DE could not be found to be surplus in all the situations to its per acre feet cost of Rs. 87.84.
- B. In the Aligarh Canal Zone, in situation K, due to shift in the cropping pattern in favour of crops requiring less irrigation, the surface water is utilized in full only in the month of August, September and February. In all the remaining months, a lot of water remained unutilized. By comparing the existing situation with the normative situation A, which is based on normative allocation of water in the profit maximization solution, whole of the surface water was fully utilized in all the months except January, April, May and June. Specifically in the month of April, utilization of surface water was only 181 per acre feet in Solution A, as against the adjusted canal discharge of 22436 per acre feet. By comparing the existing capacity of EM with the Normative Solution A, it was found that EM was used to its full capacity only in the months of August and October. The MVP of canal water per acre feet generally in all the solutions was much above its cost. When only surface water is available, the MVP of water was remarkably high.
- C. In Farrukhabad Canal Zone, in Solution K the surface water could be used to its full capacity only in the months of July, August and December, due to drastic change in favour of crops such as urd etc. which need less irrigation. A lot of water remained unutilized in all the remaining months. But in normative solution A with the existing canal and ground water use, whole of the surface water was fully utilized except in the months of September and May. The MVP of canal water per acre feet in all the situations was phenomenally high as against its estimated cost.
- D. In Etah Canal Zone, Solution K showed that like other zones, due to major change in the cropping pattern in favour of crops which require less water, surface water was fully utilized only in the months of January and June. In all the remaining months, most of the surface water remained under-utilized. However, when we shift to the Solution A and compare it with the existing canal and ground water situation, it was observed that surface water was fully utilized in all the months of the year except in July, October, November, March and April, when it was under-utilized. MVP of canal water was quite high in all the situations as against its cost per acre feet. However, The MVP of water from EM was of the order of Rs. 31.36 and Rs. 36.77 in all the situations as against its cost of Rs. 56.48. Similarly, the MVP of water from DE appeared in the month of May and which was too low, i.e. Rs. 5.41 as against its cost of Rs. 87.84 per acre feet. In other months of the year, the water from DE was found to be surplus.
- E. In the Kanpur Canal Zone, in the case of Solution K, the surface water was utilized in full only in the months of January and June due to change in the cropping pattern in favour of less water consumptive crops. However, when we shift to the optimum solution A, and compare it with the existing surface and ground water situation, the whole of the available surface water was fully utilized during the months of August, September, December, January, February, March and June except for the months of July, October, November, April and May, where it remained underutilized. To maintain the existing cropping pattern, scarce canal water has to be supplemented with water from electric motors and diesel engines. In the case of electric motors in situation A, this source was fully utilized in the months of August and January only. Similar was the case with diesel engines which remained totally unutilized for the whole year except for the month of August only where it was highly

under-utilized. From situation A to J, the marginal value productivity of canal water was phenomenally high. But only when surface water is available, the MVP of canal water was considerably high as against its per acre feet cost. The MVP of water from electric motor was even higher, which is astonishing.

- F. IN Etawah Canal Zone, in the case of Solution K, the surface water is utilized only in the months of August, February, March and April. In all other months, a lot of water remained unutilized. However, by comparing the existing canal and ground water use with normative plan A, the whole of surface is fully utilized in all the months except May where water utilization is dismally low as against the adjusted canal discharge. The MVP of canal water was much above its cost. When only canal water is available, the MVP of water is very high.

Canal water utilization in the global optimum in relation to the zonal optimum increased significantly in all the months of the year except for the months of April, May and June, where utilization decreased. In March, canal water was not utilized at all in the global optimum. The utilization of EM in the global optimum in relation to zonal optimum showed an increase during the months of July, August, October and March. On the other hand, during the months of September, November, December, January and February, its use decreased considerably. And in the months of April, May and June this source remained unutilized in the global optimum too. So far as DE is considered, its utilization increased in the global optimum to the zonal optimum during the months of September only while for the rest of the year this source remained totally unutilized as in the zonal optimum also. The MVP of canal water per acre feet in all the situations of global optimum (A) was much higher as compared to its estimated cost of all the canal zones combined together.