Notes & Comments

'The Value of Irrigation Water Used For Land Reclamation: A Comment

by

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In their article on the economics of water use on saline and alkali lands, published in the Spring 1968 issue of the *Pakistan Development Review*, Ch. Muhammed Rafiq, M. Alim Mian, and R. Brinkman emphasize the very low economic returns from water used to reclaim saline and alkaline land. It is conclusively shown that where water is scarce it is far better utilized for raising the intensity of cropping on the existing cultivated area. The authors also contend that the reclamation of poor saline-alkali land for agriculture is uneconomic or marginal for the private person, even at concessional water rates. This is undoubtedly correct under the conditions of permanent water shortage, but where surplus water is available or additional supplies can be provided at a reasonable cost reclamation may well be justifiable from both the farmer's and the nation's points of view.

Before investigating this problem in more detail, it is worth reviewing the basic data available on reclamation. The authors' calculations on the reclamation of Class IV land are based on one example, from the Lower Bari Doab, while they state that they have had no opportunity to do the same calculations for Class III (moderately saline) land. During the course of the Lower Indus Project investigation in the former Sind between 1960 and 1965, extensive research on reclamation was undertaken [1]. Although conditions may not be identical to those of the former Punjab, they are sufficiently similar to allow the data obtained to be applied to both areas.

The investigations were based primarily on the monitoring of 39 farm sites where reclamation was in progress under normal farming conditions. Each site comprised 1¼ acre plots, from which watertable and crop-yield measurements and soil and water samples were taken. The soils were saline-alkali, with widely varying degrees of salinity and alkalinity. It was found that the

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time taken to reclaim land depended chiefly on its initial salt content and its texture. Where watertables are not high enough to encourage resalinization and subsoil drainage is adequate, medium-textured soils, which cover most of the area, normally take between 1½ to 3 years to reclaim under perennial irrigation, and 3 to 5 years when only *kharif* water is supplied. For perennial areas a rotation of rice—berseem—rice is the most suitable. During the reclamation period unfertilized rice yields could be expected to rise from 5 maunds initially to 10 maunds, while those of berseem would go from 50 maunds to 180 maunds. The addition of nitrogen and phosphate fertilizers would result in higher yields and an improved nutrient status in the soil. The total water supplied each year would be about 12 acre-feet at the watercourse-head, of which 8 acre-feet would be for rice. In no case did the application of gypsum prove to be neceassary, and a rise in alkalinity with heavy leaching did not occur. In most instances, a combination of heavy watering and a high intensity of cropping was sufficient to achieve successful reclamation.

In Table I social marginal returns to water used for reclamation have been calculated on the basis of these Lower Indus Project data, using the method of analysis employed by the authors. For rice, the locally recorded farm-gate price of coarse rice, 8.75 rupees per maund of paddy, has been used, while the value of berseem has been taken as 1.00 rupee per maund at the farm. A three-year reclamation period has been assumed and the costs of seed and fertilizers have been deducted to arrive at the total net returns. Water consumption is given in terms of acre-feet at the watercourse-head.

TABLE I

MARGINAL VALUE OF WATER OVER A THREE-YEAR RECLAMATION PERIOD

(*in rupees*)

	With fertilizer	Without fertilizer
Total net return per acre	899	597
Net return from *kharif* crops alone	168	162
Total water used	36 acre-feet	36 acre-feet
Kharif water used	24 acre-feet	24 acre-feet
Total value per acre-foot	25	16.5
Value per acre-foot of the *kharif* water alone	7	6.75

The value of the *kharif* water alone (*i.e.*, excluding the net output of berseem) is just over 0.5 rupee per acre-inch. It, thus, compares well with the authors' quoted figure of 0.5 rupee in spite of the differences in the assumptions made. The value per acre-inch would probably be slightly lower in the case of a nonperennial area, where the reclamation process would take one or two years more. It would still be well above that calculated by the authors for the Class IV land. However, it is doubtful whether the Class IV example is really representative of the saline-alkali soils of the Indus Plains. In view of the length of time it took to reclaim, the low output during reclamation, and the below average performance of the land even now, it would appear to be an unusually poor saline-alkali soil. Normally, one would not expect farmers to attempt the reclamation of such intrinsically poor land. Thus, the example given in Table I is probably more generally applicable. Even in this case, which has improved returns compared to those calculated by the authors, their main point, that far higher returns will be achieved by concentrating water supplies on the existing cultivated area, still stands.

However, the question now arises as to whether there is ever really any competition for water between the demands of intensification and land reclamation. It has been shown many times that the farmers in Pakistan are highly responsive to economic forces, and accordingly it is extremely unlikely that they would consider using their scarce water supplies for reclamation when they could still intensify. Reclamation will be undertaken only when the opportunities for intensification have been exhausted. Then, when the situation is reached in which surplus resources of labour, bullock-power, and water are available, reclamation of uncultivated land may be fully justified. During the reclamation period the returns to water, labour, and other resources are very low. But it may make good economic sense for the farmer to reclaim new land, because of the high returns per acre he will receive once the process is complete, and the fact that his water, labour, and bullock-power has no real opportunity cost anyway, because they are underutilized at present. In a sense, the reclamation period is the investment period, when the farmer does not expect to show a profit, although in fact his gross returns should even then be more than sufficient to cover his costs. But in the longer term it may be a highly profitable enterprise both for him and for the nation. The authors have shown that on fully productive land (Class I and Class II land) in Lyallpur District social marginal returns might be as high as 100 — 220 rupee per acre-foot of *kharif* water at the field. In most cases returns of this order could be expected from four to six years after reclamation begins, if a rehabilitation period is allowed after the initial reclamation takes place. With returns of this magnitude available after the end of this period, reclamation can be fully justified from the viewpoint of its contribution to national income.

Apart from the social value of reclamation, it should also prove a good

investment for the private farmers, provided, of course, that water is not in short supply. It is assumed that those who undertake reclamation will generally be landowners rather than tenants. When reclamation is complete and the land is fully productive, the farmer can either lease it out at a rent of up to 200 rupees per acre, or can cultivate it himself. If he follows the latter course his additional profit per acre-foot of *kharif* water will be between 68 rupees and 186 rupee per acre-foot using the authors' calculations of incomes from Class I and II lands. These figures exclude any deduction for land rent, since this will not be a cost to the owner-farmer. Marginal returns of this magnitude from reclaimed land should certainly be attractive enough to stimulate reclamation.

REFERENCES

1. Hunting Technical Services Limited, *Lower Indus Report.* Main Volume and Supporting Report: Volume No. 21: *Reclamation.* (Lahore: West Pakistan Water and Power Development Authority, 1966).

REJOINDER FROM THE AUTHORS

The above comment on our article about the economics of water use is very welcome, and we are grateful especially for the additional data. These fit very well with our conception of Class III land. The two main points of the comment are perfectly valid for Class irIII (moderate irrigated land with salinity-alkali problem). The reclamation of such land is economical beyond any doubt but is feasible only where excess irrigation water is available. It is regretted that this point was not made clear in the article.

The article, however, dealt specifically with the poor saline-alkali land (irIV) which forms a considerable percentage of saline land in the semi-arid plains which extend about as far as the Sahiwal-Multan boundary.

It is regrettable that the 'restricted' classification of our soil survey maps and reports prevents a wide distribution beyond government or semi-government

officials, because our data and maps indicate well-delineated and well-described areas of specific soils. To-date, we know the area and percentage of each kind of saline-alkali soil by actual soil survey for most of these plains. How representative is the example of poor saline-alkali land within the semi-arid former Punjab plains? This is most easily demonstrated by a few examples, tabulated below.

Area approximate extent	Approximate extent in sq. miles and (percentage) of different land capability subclasses		
	irIIa	irIIIa*	irIVa*
Sheikhupura area, including a small part of Lyallpur District, 2,400 sq. miles.	110(5%)	320(13%)	530(22%)
Lyallpur area, including most of Lyallpur and a small part of Jhang District, 3,400 sq. miles	220(7%)	80(2%)	190(6%)
The floodplain area of Jhang within Rechna Doab, 1,600 sq. miles	190(12%)	80(5%)	65(4%)

*Part irrigated, part unirrigated at present.

These figures are approximate, but they are representative of the conditions. It is easily seen that the poor saline-alkali Class IV soils range from about 22 per cent of the total area (more than half of all saline soils) in the eastern part of the former Punjab to 4 per cent (less than 20 per cent of all saline soils) near the western limit of the area discussed in the article. This decreasing trend is expected to continue southward.

A comparative field study has also shown that poor, dense and impervious saline-alkali land is of limited extent in the former Sind and Class III moderate saline land is more extensive. The salts in the saline soils of this area are largely chlorides, with locally a high percentage of calcium and magnesium chlorides. This makes reclamation relatively rapid and prevents alkalization during leaching. On the other hand, even the moderate Class III saline-alkali land of the semi-arid plains contains no appreciable amounts of calcium or magnesium salts, but contains largely sodium carbonate and sulphate in addition to exchangeable sodium. When these salts are leached, there is considerable alkalization, which makes reclamation without gypsum a slow and expensive process. Writing this, we are also reminded of the gypsum present in many soils of the Lower Indus Plains (for example near Sujawal and Jati), which makes reclamation of these saline soils very much easier.

In the second part of the comment, a very appropriate statement is made on the probable action of the farmers under a well-specified set of assumed conditions. One of these conditions is that of excess irrigation water.

In the former Sind area, for example in Gudu left bank, there are some local areas with irrigation water in excess of the present requirements of the currently cultivated land. On the other hand, in Lyallpur District for example, the current *kharif* (summer) cropping intensity is about 30 per cent, half of the probable optimum intensity. Until the *kharif* supplies are doubled, therefore, the condition of excess irrigation water does not apply. Since the ground water in much of this area is marginal or unfit for irrigation, there appears to be no cheap or short-term way to increase supplies. In spite of this, some *kharif* water is allotted, at uneconomically low (concessional) rates, for reclamation of poor saline-alkali soils. Unofficial but fairly dependable rumour mentions that part of this water is diverted to very good land. This would be a good example of the farmers responding to the true economic forces.

To summarize, we agree with the author of the comment that his example is probably an irIIIa soil; that the typically dense alkali irIVa soils are of far smaller extent in the Lower Indus area than in the semi-arid plains of the former Punjab, and that in the former Sind there are temporary local surpluses of irrigation water. Except perhaps in areas with abundant good ground water there are no excess irrigation supplies in the former Punjab area at present, and this is not expected to be the case until major new sources of irrigation water are brought in. Areas of poor dense saline-alkali soils should therefore, as stated in the article, be left alone at present.