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ECONOMICS OF STRESSED LANDS AGRICULTURE WITH SPECIAL REFERENCE TO RECLAMATION OF SALT-AFFECTED SOILS

Bashir Ahmad, Muhammad Aslam Chaudhry, Muhammad Rafiq,
Muhammad Saleem Masood & Muhammad Nadeem
Faculty of Agricultural Economics & Rural Sociology.
University of Agriculture. Faisalabad

This paper represents an attempt at evaluating some soil amendment practices by using both the experimental and farm level primary data. Experimental data generated over the period 1980-81 to 1984-85 in farmer's fields by the University of Agriculture, Faisalabad and primary data for the year 1990-91 from 100 farm respondents from Sheikhupura district were analyzed using the partial budgeting technique. The results of the study with respect to controlled experiments showed that gypsum + subsoiling was the best practice for Gandhra soil series and gypsum alone for the Khurrianwala series. However, analysis of farm level data revealed that gypsum + subsoiling + green manuring was the best alternative in terms of field benefits.

Key words: agriculture. economics, reclamation, salt-affected soils, stressed lands

INTRODUCTION

Land and water are the basic resources of agriculture. In Pakistan, the limits to the expansion of the cultivated area are rapidly approaching a point of saturation, particularly of the more productive lands. There is, in fact, an increasing loss of productive agricultural land to non-agricultural uses such as urbanization, industrialization and highway construction. It follows that the future increases in agricultural production must come from increased land productivity(GOP. 1988). A closer examination of the farming conditions in the agriculture sector in Pakistan reveals that low crop productivity is attributable mainly to soil deterioration from the menace of salinity and waterlogging, lack of water supply. natural calamities. pests and plant diseases. inferior quality of seed. small and scattered holdings. etc.

One major cause responsible for low crop yields in Pakistan is unquestionably the problem of salinity .At present about 41 % of the salt-affected soils are saline in nature and 51 % are saline-sodic. Use efficiency of fertilizers and other inputs is very low on the salt-affected soils. The problem of soil salinity is becoming still worse. especially due to continuous and unchecked use of brackish tubewell water.. At present about one-third of the total farm-gate water availability is coming from tubewells. About 80 % of the tubewells are pumping water which is not suitable for irrigation. Thus, in future, the agriculture sector will likely face a serious threat from the salinity problem.

Sufficient experimental work has been done on the salt-affected soils by the soil scientists but without the active involvement of agricultural economists (Haider and Ali, 1972; Chaudhry, 1982; Chaudhry and Abaidullah, 1985 and DLR, 1985). Various amendments like gypsum, sulphur, farm yard manure. press mud, hydrochloric acid, calcium chloride, sulphuric acid. etc. have been tried over the years. Effect of simple leaching, deep tillage, subsoiling and green manuring with *Diplachne fusca* (Leptochloa fusca) was also studied. Similarly, various levels of leaching and amendments and combinations thereof were tried on saline-sodic soils and their effects were noted on various crops in terms of infiltration rate, electrical conductivity, sodium adsorption ratio (SAR) at different soil depths, pH of soil, ESP and yield of crops. However, the data generated through these experiments were not subjected to economic analysis, nor any recommendations extended to the farmers. Thus at present no worthwhile information is available about (a) the various reclamation practices that should be adopted to build up and maintain soil productivity for efficient and abundant production on a sustained basis, and (b) the effect of the reclamation measures on farmers cost and income.

The general objective of this paper is to present the economics of the use of various soil amendments based on experimental as well as on farm level primary data.

METHODOLOGY

In order to arrive at the real economics of the use of various soil amendments, experimental data generated

by 'the Department of Soil Science, University of Agriculture, Faisalabad during the period 1980-81 to 1984-85, were subjected to rigorous analysis. These experiments were conducted at the farmer's fields for two soil series i.e. Khurrianwala, district Faisalabad and Gandhra in Shahkot area of district Sheikhupura.

There were four treatments i.e.

1. Tl Control (leaching with saline-sodic ground water)
2. T2 Subsoiling (SS) (50 cm deep, 150 cm apart crosswise furrows)
3. T3 Gypsum (GYP) (@100 % GRofindividual plot)
4. T4 Subsoiling plus gypsum (SS + GYP)

There were nine replications making a total of 36 plots each for Khurrianwala and Gandhra series. Rice-wheat rotation was practised during the period of experiment.

The farm level effects of various soil amendments, have been ascertained through primary data collected from 100 farm respondents of Sheikhupura district reporting more than 15 % of their farm area as salt-affected. The data pertained to the year 1990-91 . The following farm level practices were reported by farms on their salt-affected soil:

I. Without reclamation (farm fields on which no soil reclamation practices are followed by the farmers)
2. Subsoiling +green manuring
3. Gypsum
4. Gypsum + subsoiling + green manuring

The experimental data and the farm level primary data thus generated were subjected to economic analysis by using the partial budgeting technique as prescribed by CIMMYT (1988).

RESULTS

Experimental Data: The results obtained by analyzing the experimental data are presented in Tables I and 2. A cursory look at the results would show that economically the most feasible soil amendment for farmer's practice is gypsum (GYP) for Khurrianwala soil series and subsoiling +gypsum (SS+GYP) for Gandhra soil series. It is therefore concluded that subsoiling and gypsum were the most feasible amendments for the reclamation of salt-affected soil especially gypsum for the coarse (i.e. Khurrianwala) soils and subsoiling + gypsum for fine loamy (i.e. Gandhra) soils.

Farm Level Primary Data: On the basis of analysis of farm level data, it can safely be concluded that a combination of practices i.e. application of gypsum + subsoiling + green manuring represented the best option for the reclamation of salt-affected soils in the rice-wheat cropping system. However, the analysis of experimental data generated over time without the inclusion of green manuring showed that subsoiling + gypsum was the best soil amendment for Gandhra soil series and Gypsum alone for Khurrianwala soil series. Thus the package of amendments that proved the most ecoriomical varied with the nature of soil..

It should also be noted that· the net field benefits attributed to a given package of soil amendments in this study reflect only those benefits which wen: obtained during the period of experimentation at the farmer's fields. Similarly, in the case of farm level data, the benefits of following a given soil management practice, !is reported by the farmer respondents, represented only those benefits which accrued to them during the specific crop rotation period. The long term positive effects of the above soil amendment practices on crop yields and farm incomes in both the cases are hopefully substantially higher than the benefits identified in this study.

Policy Suggestions

1. Since Pakistan is located mostly in arid and semi-arid region of the world, salinity and sodicity shall remain the major threat to agriculture in the country. Moreover, the reclamation of saline and saline-sodic soils is a difficult, time consuming and an expensive process. It is therefore very important that the farming community is made fully aware of the possible amendments/practices that can be profitably used to overcome this menace. For this purpose, the mass media can play an important role in educating the farmers.
2. Although,the Government of Pakistan has been subsidizing the use of an important amendment i.e. gypsum, but unfortunately, the major bottleneck in the use of this important amendment has been its non-availability to the common farmers. Immediate steps need to be taken to ensure its availability on regular basis. In this connection the existing crushing capacity of gypsum stone should be substantially enhanced.
3. As the results of the study have clearly shown that green manuring combined with subsoiling and gypsum is the best alternative for adoption at the farm level, it is high ,time that these practices are popularized among the farmers through the provincial extension services in the country.
4. The available empirical evidence shows that a significant proportion of irrigation water supplies comes from tubewells, which mostly pump out hazardous water, adding both to salinity and sodicity. It eventually

Table 1. Partial budget for the project period (1980-81 to 1984-85) Khurrianwala soil series

Items	Treatment			
	Control	SS	GYP	SS+GYP
I. Gross Field Benefits				
a) Wheat grain				
i) Gross output (kg/ha)	7146	10349	14112	12579
ii) Adjusted output (kg/ha)	6074	8796	11995	10692
iii) Gross field benefits @ Rs. 84 per 40 kg (Rs./ha)	12755	18471	25189	22455
b) Wheat bhusa (Straw)				
i) Gross output (kg/ha)	20443	29099	34295	33291
ii) Adjusted output (kg/ha)	17377	24734	29151	28297
iii) Gross field benefits @Rs. 12 per 40 kg (Rs./ha)	5213	7240	8745	8489
c) Rice grain				
i) Gross output (kg/ha)	5071	7890	7361	6148
ii) Adjusted output (kg/ha)	4310	6707	6258	5225
iii) Gross field benefits @Rs.124 per 40 kg (Rs./ha)	13361	20792	19400	16201
d) Rice bhusa (Straw)				
i) Gross output (kg/ha)	21495	30029	23123	24482
ii) Adjusted output (kg/ha)	18271	25525	19655	20810
iii) Gross field benefits @Rs.4 per 40 kg (Rs./ha)	1827	2553	1966	2081
Total gross field benefits (Rs./ha)	33156	49056	55300	49224
II. Total Costs That Vary				
i) Gypsum @ 188 bags per ha in treatment GYP @ Rs. 29 per bag (Rs./ha)			5452	
ii) Gypsum @ 138 bags per ha in treatment GYP @ Rs. 29 per bag (Rs./ha)				4002
iii) Subsoiling once (Rs. per ha)		741		741
iv) Labour cost for gypsum application (10 days @ Rs. 35 per man day in treatment GYP			350	
v) Labour cost for gypsum application (7 man days @ Rs.35 per man day in treatment SS + GYP)				245
Total costs that vary (Rs./ha)		741	5802	4948
III. Net Field Benefits (Rs./ha)	33156	48315	49498	44236
IV. Average Annual Benefits (Rs./ha)	8289	12079	12375	11059

Table 2. Partial budget for the project period (1980-81 to 1984-85) Khurrianwala soil series

Items	Treatment			
	Control	SS	GYP	SS+GYP
I. Gross Field Benefits				
a) Wheat grain				
i) Gross output (kg/ha)	2598	3374	8543	8518
ii) Adjusted output (kg/ha)	2208	2890	7262	7240
iii) Gross field benefits @ Rs. 84 per 40 kg (Rs./ha)	4637	6069	15250	15204
b) Wheat bhusa (Straw)				
i) Gross output (kg/ha)	7644	7988	18727	21552
ii) Adjusted out put (kg/ha)	6497	6790	15918	18319
iii) Gross field benefits @Rs. 12 per 40 kg (Rs./ha)	1949	2037	4775	5496
c) Rice grain				
i) Gross output (kg/ha)	5964	5966	10434	11670
ii) Adjusted output (kg/ha)	5069	5072	8869	9920
iii) Gross field benefits @Rs.124 per 40 kg (Rs./ha)	15714	15720	27494	30752
d) Rice bhusa (Straw)				
i) Gross output (kg/ha)	15677	15977	24377	31478
ii) Adjusted output (kg/ha)	13325	13580	20720	26756
iii) Gross field benefits @Rs.4 per 40 kg (Rs./ha)	1333	1358	2072	2676
Total gross field benefits (Rs./ha)	23633	25184	49591	54128
II. Total Costs That Vary				
i) Gypsum @ 376 and 455 bags for treatment GYP and SS + GYP @ Rs. 29 per bag (Rs./ha)			10904	13195
ii) Subsoiling once (Rs. per ha)			741	741
iii) Labour cost for GYP application 19 man days in treatment GYP and 23 days in SS + GYP @ Rs. 35/man day (Rs./ha)			665	805
Total Costs That Vary (Rs./ha)		741	11569	14741
III. Net Field Benefits (Rs./ha)	23633	24443	38022	39387
IV. Average Annual Benefits (Rs./ha)	5908	6111	9506	9847

Table 3. Partial budget of wheat based on farm level primary data

Item	Practices followed			
	Without reclamation	Subsoiling + green manuring	Gypsum	Gypsum + subsoiling + green manuring
I. Gross Field Benefits				
a) Wheat grain				
Average yield (kg/ha)	441.64	1218.20	1482.00	1712.2Cl
Field price (Rs.lkg)	2.38	2.38	2.38	2.38
Gross field benefits (Rs.)-	1051.08	*i899.34*	3527.16	4075.06
b) Wheat straw				
Average yield (kg/ha)	441.64	1218.20	1482.00	1712.2Cl
Field price (Rs.lkg)	Cl.37	0.37	0.37	Cl.37
Gross field benefits (Rs.)	165.61	456.83	555.75	642.08
Total gross field benefits (Rs.)	1216.70	3356.16	4082.91	4717.13
11. Variable Costs (Rs.Iha)				
Cultivation	617.50	617.50	988.00	617.50
Fertilizer		504.97	504.97	504.97
Plant protection			113.62	165.49
Farm yard manure	123.50			247.00
Harvesting	176.36	587.86	705.43	705.43
Threshing	105.10	289.93	352.72	407.50
Gypsum			1230.80	738.48
Subsoiling			592.80	395.20
Green manu ring			308.75	308.75
Total variable cost	1022.46	2901.81	3895.54	3387.75
Net field benefits (Rs.zha)	194.24	454.36	187.37	1329.38

results in hardening of soils. It is therefore very important to realize the long-term implications of the use of brackish water, especially from the point of view of sustainability of agriculture. Immediate steps should be taken to add to our canal water supplies by building additional capacity reservoirs at appropriate places. This would not, only greatly help in substituting the underground brackish water with good quality canal water but would also help improve the conjunctive use of canal and tubewell water.

REFERENCES

Chaudhry, M.R. 1982.Role of Inorganic and Organic Amendments in the Reclamation of Saline-Sodic Soil.. Directorate of Moria Reclamation Experimental Project, Publication No.124, Mona Colony, WAPDA, Bhalwal.

Chaudhry, M.R. and Abaidullah.1985. Efficiency of Biological and Chemical Methods of Soil Reclamation. Mona Reclamation Experimental Project, Publication NeU 45', WAPDA Colony, Bhalwal.

Table 4. Partial budget of rice based on farm level primary data

Item	Practices followed			
	Without reclamation	Subsoiling + green manuring	Gypsum	Gypsum + subsoiling + green manuring
I. Gross Field Benefits				
a) Rice paddy				
Average yield (kg/ha)	448.55	1302.18	1521.52	1742.83
Field price (Rs./kg)	3.325	3.325	3.325	3.325
Gross field benefits (Rs.)	1491.44	4329.76	5059.05	5794.92
b) Rice straw				
Average yield (kg./ha)	897.10	2604.37	3043.04	3485.66
Field price (Rs./kg)	0.07	0.07	0.07	0.07
Gross field benefits (Rs.)	62.80	182.31	213.04	244.00
Total gross field benefits (Rs.)	1554.24	4512.07	5272.09	6038.92
II. Variable Costs (Rs./ha)				
Cultivation	864.50	988.00	1235.00	988.00
Transplanting	370.50	382.85	395.20	395.20
Fertilizer		504.97	504.97	504.97
Plant protection				
111.15				
Farm yard manure	123.50			247.00
Harvesting/threshing	149.14	432.97	505.91	579.49
Irrigation			255.82	255.82
Gypsum			1230.80	738.48
Subsoiling			592.80	395.20
Green manuring			308.75	308.75
Total variable cost	1507.64	3210.33	4374.69	4277.05
Net field benefits (Rs./ha)	46.60	1301.74	897.40	1716.87

CIMMYT. 19H8. From Agronomic Data to Farmer Recommendannng:... An Economic Training Manual, Mexico.

DLR. 19H5. Directorate of Land Reclamation, Government of Punjab. Irrigation and Power Department. Coordinated Research Programme on Saline Agriculture. Fourth Annual Report.

GDP. 1988. Government of Pakistan, Ministry of Food, Agriculture and Cooperatives. Report of the National Commission of Agriculture, Islamabad.

Haider, G. and T. Ali. 1972.Economics of Reclamation of Saline Alkali Gypsy Ferrous Soils. Mona Reelamation Experimental Project, Publication No. 16, WAPDA Colony, Bhalwal.