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Equity Issues Relating to Irrigation-induced Soil Degradation under Left Bank Canal of Tungabhadra Project Area, Karnataka

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Abstract

The equity issues concerning soil degradation and soil reclamation have been analysed for Tungabhadra Project Area of the Karnataka state. The study is based on primary data obtained from 325 respondent farmers. The data gathered by survey method have been analysed using conventional and simple tabular method of analysis, Gini ratio, and Lorenz curve. The study has revealed that the small and marginal farmers are worst affected by soil degradation. The large farmers have also experienced the brunt of soil degradation but the effect has been marginal since they have alternative sources of livelihood. The study has further indicated that the extent of inequity is higher on degraded than normal soils. However, this can be reduced to a great extent by launching land reclamation programmes. Therefore, the study has suggested that the government should initiate land reclamation programmes on a large scale on long-term basis so that the fruits of land reclamation technologies could reach the vulnerable sections of the society.

Introduction

In India, the problems of soil salinity and waterlogging are more common in the irrigated tracts of arid and semi-arid regions. The soil salinity is estimated to occupy an area of about 7 million hectares in the country (Bhumbla, 1971). Not much information is available on the extent and nature of these problems as no survey of the problem soils has been conducted in the country since long.

In Karnataka, most of the salinity-affected area is in the irrigated commands. The extent of damage in the state is reported to be 10 per cent

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of the total irrigated area. The severely-affected command is the Tungabhadra Project (TBP) Area (26,018 ha), which alone accounts for over 61.4 per cent of the total saline lands in the state. The excessive use of irrigation water in this command area has led to the problems of salinity and waterlogging. This is also due to several such factors as type of soil, presence of salts in the soil, unscientific water management, cropping pattern and drainage. The problem is more pronounced in the Tungabhadra Command Area due to vertisols; and there also, it is alarmingly severe under the Left Bank Canal of the TBP Area. The area under irrigation-induced soil degradation in the Left Bank Canal command increased by 68.86 per cent between 1971 (6127 ha) and 1981 (10346 ha) and by 160 per cent between 1971 and 1991 (15971 ha). Based on this increasing trend of soil degradation during the past 30 years, it has been projected that by 2047 AD, the Left Bank Canal command area may become completely degraded due to salinity and waterlogging. The Left Bank Canal has 106 distributories, and of these, the 76th distributory had maximum area of 7000 ha of saline and waterlogged soils (Anonymous, 1991).

The irrigation-induced soil degradation has severely impaired the productivity, posing threats to sustainability of the irrigated agriculture and the livelihood of small and marginal farmers. On one hand, the land-base for agriculture has been shrinking and on the other, the productivity levels of land have been declining, causing concern to all the stakeholders. The state government is initiating several measures to address these critical issues. In an attempt to augment land resources for productive use, sizeable investments are being made. How far these investments are beneficial needs to be evaluated. This helps in prioritization of investments in land improvement. It is against this back drop that the present study was undertaken to analyze the equity issues of soil degradation and soil reclamation.

Methodology

Of the five command areas in the state, the Tungabhadra Project Area had the highest concentration of soil degradation due to twin problems of soil salinity and waterlogging (54,000 ha), accounting for 55 per cent of the total irrigated area in the state. Hence, TBP area was purposively selected for the present study. The TBP has four branch canals taking-off from either side of the dam site. The Left Bank Canal has the highest area under soil degradation (34,500 ha), accounting for 64.55 per cent of the canal command. Accordingly, the Left Bank Canal was considered for the purpose of present investigation. It was decided to restrict the study to one distributory of Left Bank Canal which had the maximum area under soil degradation. Apparently, the 76th distributory accounted for the maximum area of soil

degradation (7000 ha), accounting for 24.2 per cent of its command and hence the study pertains to this distributory, in particular and TBP in general.

From the list of affected villages obtained from the Command Area Development Authority (CADA), two villages under the 76th distributory, namely Byagwat and Hirekotnakal, representing the head and mid regions, respectively were selected on the basis of maximum concentration of area under salinity and waterlogging. Further, from the list of affected farmers obtained from CADA, 50 farmers for salinity and 50 farmers for waterlogging under the head-region were chosen. Another sample comprising 50 farmers for salinity and 20 farmers for waterlogging was chosen under the mid-region. An equal number of farmers (100) having normal soils under the head and mid regions (50 each) was chosen as control. The land reclamation schemes through sub-surface drainage technology have been implemented by the state government in collaboration with CADA to ameliorate the affected soils in the selected villages. The beneficiary farmers of land reclamation schemes, numbering 55, were also included in the sample for study. Finally, 325 farm households constituted the sample size for the present study. The data were collected by the survey method and included costs, returns, general information, cropping pattern, landholdings, reclamation methods, etc. The sample was post-stratified into large, small and marginal farmers. The data were analysed using simple tabular method, Lorenz curve, and Gini ratio.

The distribution of income among sample farmers was examined with the help of Lorenz curve. In this study, the income referred to the total income less total variable costs. The Lorenz curve was obtained by plotting the cumulative percentage values of income on the vertical axis and those of decile groups on the horizontal axis. The Lorenz curve gives only graphical solution and does not furnish a precise estimation of equity numerically. It was overcome by computing the Gini ratio using Equation (1) :

$$GR = \sum (X_i Y_{i+1}) - \sum (X_{i+1} Y_i) \quad \ldots(1)$$

where,

X_i = Cumulative percentage of decile groups of population, and

Y_i = Cumulative percentage of income.

Results and Discussion

Soil Degradation

The distribution of farm households according to the size groups under soil degradation has been depicted in Table 1. It was found that about 46.6 per cent of the land belonged to large farmers, 55.89 per cent to small

Table 1. Distribution of landholdings under normal and degraded soils in Tungabhadra project area during 1999-2000

(ha)

Particulars	Saline soils				Waterlogged soils			
	No.	Total land	Saline soils	Per cent	No.	Total land	Waterlogged soils	Per cent
Head region								
· Large farms (LF)	25	114.00	53.20	44.67	21	91.20	38.40	42.10
· Small farms (SF)	5	6.80	3.80	55.89	15	24.60	14.00	56.91
· Marginal farms (MF)	20	14.20	13.80	97.18	14	7.00	6.80	97.14
Total	50	135.00	70.80	100.00	50	122.80	59.20	100.00
Mid regions								
· Large farms (LF)	29	159.50	69.80	43.76	12	67.40	23.20	34.42
· Small farms (SF)	7	11.20	6.80	60.71	3	4.40	2.40	54.55
· Marginal farms (MF)	14	8.40	7.70	91.67	5	3.80	2.50	65.79
Total	50	179.10	84.30	100.00	20	75.60	28.10	100.00

farmers and 97.1 per cent to marginal farmers. The distribution of total land under waterlogged conditions was found as follows : large farmers, 42.1 per cent ; small farmers 56.9 per cent, and marginal farmers 97.1 per cent.

The income distribution under normal and degraded soils (saline and waterlogged together) has been shown in Table 2. The net income was found higher under the normal soil group than the degraded soil group. The bottom most income groups I and II received 5.24 per cent of total income in the degraded soil group. The remaining 60 per cent of the population received about 37.21 per cent share. In the case of normal soils, groups I to III, located in bottom income group, received 18.88 per cent of the income. More than 50 per cent of the total income was shared by 20 per cent of groups. The top most income groups IX and X accounted for nearly 27.90 per cent of the income. Thus the top income groups enjoyed the major portion of the income. The Gini ratio for the normal soil was 0.17104 as against 0.32036 for the degraded soils. Therefore, it may be concluded that inequity was greater on the degraded than normal soils. The Lorenz curve used for measuring inequity in the income distribution graphically, depicted the curve for normal soil nearer to the egalitarian line throughout. It indicated that equity was greater on the normal than degraded soil group. Attaining intergenerational equity is highly crucial for sustainable development. In the context of soil degradation, the proportion of land going out of agricultural use is an indicator of land irreversibility. This would affect not only the present generation but future generations also. Thus, transforming of degraded lands into normal lands is imperative to attain intergenerational equity.

Table 2. Distribution of income among the sample respondents of normal and degraded (saline and waterlogged) soils in Tungabhadra project area during 1999-2000

Decile groups	Normal soils		Degraded soils	
	Income (Rs/ha)	Cumulative percentage of income	Income (Rs/ha)	Cumulative percentage of income
I	99464	3.89	25680	1.21
II	277667	10.85	110910	5.24
III	483095	18.88	228597	10.79
IV	709292	27.72	382044	18.04
V	963038	37.64	577752	27.28
VI	1237505	48.37	788098	37.21
VII	1532380	59.89	1025020	48.41
VIII	1844730	72.10	1313271	62.01
IX	2178302	85.14	1686451	79.63
X	2558494	100.00	2117780	100.00
Gini ratio	0.17104		0.32036	

Table 3. Net returns from paddy cultivation on normal and degraded soils in TBP area

(Rs/ha)

Farm size	Head-region			Mid-region		
	Normal soils	Saline soils	Waterlogged soils	Normal soils	Saline soils	Waterlogged soils
Large	19911	-1350	2453	21917	1184	3079
Small	21911	-4077	1276	17193	2108	6059
Marginal	17300	-4360	-1873	14363	-4554	4695

The net returns of sample farmers from paddy cultivation on normal and degraded soils (Table 3) revealed that farmers under all the three farm-sizes had suffered losses on saline land under the head-region. The small and marginal farmers had incurred higher losses as compared to that by the large farmers. On the waterlogged soils, only marginal farmers had incurred a loss of Rs 1873/ha. Under the mid-region, only marginal farmers on saline lands had suffered a loss of Rs 4554/ha. On the waterlogged soils, the farmers, irrespective of farm-size, realized higher profits than their counterparts on the saline lands.

Data (Table 4) on the welfare loss in terms of net returns across soil types and regions revealed that the marginal farmers of saline lands were the worst hit, incurring a loss of Rs 1.25 in the head-region and of Rs 1.32 in the mid-region for every rupee of profit earned on the normal soils. The large and small farmers on saline soils under the head-region had also suffered losses. However, the large and small farmers of waterlogged soil group in the head-region could manage to obtain profits.

Soil Reclamation

It has been observed that the resource-poor farmers were the largest beneficiaries (87.28%) of the land reclamation programmes (Table 5), while resource-rich farmers constituted a minor group (12.72%). The average

Table 4. Welfare loss in terms of net returns

(Rs)

Farm size	Head-region		Mid-region	
	Saline soils	Waterlogged soils	Saline soils	Waterlogged soils
Large	-0.06	0.12	0.05	0.14
Small	-0.18	0.06	0.12	0.35
Marginal	-0.25	0.11	-0.32	0.33
Mean	-0.14	0.22	0.04	0.22

Table 5. Beneficiaries of land reclamation programmes

Category	No.	Farm size (ha)	Area (ha)	Investment (in lakh Rs)
Resource-rich	7	1.41	6.60	0.68
Resource-poor	48	0.54	25.84	2.64
Total	55		32.44	3.32

farm-size was 1.5 ha for the resource-rich farmers and 0.5 ha for resource-poor farmers. Based on the farm size, the resource-rich farmers were small and the resource-poor were marginal farmers. The resource-poor farmers owned the major portion (79.66 %) of the total reclaimed land, while resource-rich farmers had only 20.34 per cent share in it. In absolute terms, the resource-poor farmers were benefited more than the resource-rich group. The land reclamation schemes of the government had enabled the resource-poor farmers to own better quality land. Their main source of livelihood was agriculture labour due to degradation of their lands, but now cultivation has become their primary activity. Thus, land reclamation schemes had positive impact on the income levels of resource-poor farmers.

The equity issue in soil reclamation was also examined by comparing the distribution of income among the reclaimed and unreclaimed farms. Lorenz curve and Gini ratio were used to analyse the equity concerning the income distribution. The analysis was carried out separately for the reclaimed and unreclaimed farms. The details of income distribution and Gini ratios are given in Table 6. The net income was found higher for the reclaimed than unreclaimed farms. In the case of unreclaimed farmers, about 30 per

Table 6. Distribution of income among unreclaimed and reclaimed farms of Tungabhadra project area during 1999-2000

Decile groups	Unreclaimed farms		Reclaimed farms	
	Income (Rs/ ha)	Cumulative percentage of income	Income (Rs/ha)	Cumulative percentage income
I	25680	1.21	53850	5.25
II	110910	5.24	118884	11.58
III	228597	10.79	206531	20.12
IV	382044	18.04	284402	27.71
V	577752	27.28	384075	37.42
VI	788098	37.21	473516	46.14
VII	1025020	48.41	597293	58.20
VIII	1313271	62.01	709886	69.17
IX	1686451	79.63	852626	83.07
X	2117780	100.00	1026275	100.00
Gini Ratio	0.32026		0.18268	

cent farmers shared 10.79 per cent of the total income, about 50 per cent farmers shared 27.28 per cent, while the remaining 62.79 per cent was enjoyed by the high income group. In the case of reclaimed farms, 50 per cent of the farmers received 37.42 per cent of the total income and 60 per cent of them received 46.14 per cent of it. The last two top income groups received 30.83 per cent of the total income. The Gini co-efficient of income distribution was 0.32026 for unreclaimed farms and 0.18268 for reclaimed farms. Undoubtedly, the land reclamation had led to enhanced income from crop production on reclaimed land for resource-poor farmers. On reclaimed lands, there was an improvement in the distribution of income ; the share of bottom 10 per cent farmers had increased from 1.21 to 5.25 per cent. Further, 50 per cent of the reclaimed farms had shared 37.42 per cent of the income, which was 10.14 per cent higher. This was a positive aspect of the land reclamation process. It clearly demonstrated that the inequity in distribution of income had decreased during the post-reclamation period.

Conclusions

The study has revealed that small and marginal farmers are the worst affected by soil degradation as they do not have any alternative source of livelihood. They are to relay upon their limited land resources which too are affected by either salinity or waterlogging. The large farmers have also experienced the brunt of the soil degradation, but the effect has been found marginal on them since they have better options. The extent of inequity has been found higher on the degraded than normal soils. The inequity can be reduced considerably by initiating soil reclamation programmes. The study has revealed that the reclamation programmes launched by the government have a positive impact on the income distribution during the post-land reclamation period. Hence, such programmes should be sustained on long-term basis so that the benefits of land reclamation technologies could reach the lower strata of the society.

References

Joshi, P.K. and A.K. Agnihotri, (1982) Impact of input subsidy on income and equity under land reclamation. *Indian Journal of Agricultural Economics*, **38** (3) : 252-260.

Abrol, I.P. and D.R. Bhumbla, (1971), Saline and alkaline soils in India: Their occurrence and management, *World Soil Resources*, F.A.O. Report No. 41, pp. 42-51.

Chinnappa, B., (2003) Valuation of irrigation-induced soil degradation in Tungabhadra project area, Karnataka : An economic analysis, Unpublished thesis, University of Agricultural Sciences, Bangalore.

Annonymous, (1991) *Annual Report*, Command Area Development Authority, Tugabhadra Project Area.