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An Economic Analysis of Irrigation Groundwater Scarcity indicators and Resource use efficiency in coastal blocks of Villupuram district in Tamil Nadu

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Abstract: Dynamic nature of ground water system in coastal area is evidenced in many studies. In agriculture this dynamism also cause absolute scarcity where expected irrigation water requirement could not be met from available ground water. Major indicators of groundwater scarcity are irrigation investment and irrigation costs which are economically analysed in this study in the two selected non-saline coastal blocks viz-Vanurand Marakkanam of Villupuram district in Tamil Nadu, the semi critical (SC) and over- exploited (OE) blocks of ground water use respectively. The OE block exhibited high investment in irrigation compared to SC block due to additional investments in bore well installation. The irrigation cost share in input costs was more in OE block than SC block and hence low economic returns in 'OE' block. The regression analysis of Resource Use Efficiency of irrigation ground water estimation also proved that the irrigation input had negative influence on gross income in OE block.

Keywords: semi critical (SC), over- exploited (OE), ground water system, coastal area.

INTRODUCTION

Ground water system is highly dynamic in coastal areas due to variations of many influencing factors like rainfall, recharge, space and time etc. Ground water extraction in agriculture leads to irrigation water scarcity when it exceeds the estimated availability share for use.

Hence studying and analyzing the indicators of irrigation groundwater scarcity is the problem focus of the study. Irrigation investment and Irrigation costs involved were found as major indicative measures to groundwater scarcity (Chandrakant et.al., 1998).

Estimation of investment cost on groundwater extraction including irrigation input cost analysis and Resource use efficiency were fixed as the objective of this study and presented in this research paper.

DATA AND METHODOLOGY

Due to the above mentioned problem focus of the study, selection of study area was done considering highest groundwater irrigated coastal district in the Tamil Nadu state for suitability to study groundwater scarcity.

Accordingly Villupuram district and particularly 'Vanur' and Marakkanam blocks in the district were selected the former being semi critical (SC) and latter being over-exploited (OE) of groundwater exploitation. Primary data were collected randomly from 90 samples in each selected block invariable of farm size as of negligible gross income variation among different sizes.

Estimations of data collected on the irrigation investment costs, Irrigation input cost share in various paddy seasons and Resource use efficiency of farms were done in this study with the following tools of analysis.

TOOLS OF ANALYSIS

Simple percentage analysis were done for irrigation investment costs and cost of cultivation of paddy in two seasons viz, sornavari and samba.

Resource use efficiency was estimated by regression analysis after finding suitability of fitting of cobb-douglas production function.

$$\text{Ln } Y_i = \text{Ln Ai} + a \text{ Ln SEED} + b \text{ Ln MH lab} + C \text{ Ln FM} + d \text{ Ln PPC} + e \text{ Ln IRRIGN} + u_i$$

where,

Y = gross income of the farm in rupees
SEED = value of seeds in rupees per farm
MH Lab = value of machinery and human labour in rupees per farm
FM = value of fertilizer and manures in rupees per farm
PPC = value of plant protection chemicals in rupees per farm
IRRIGN. = Irrigation water in rupees per farm
ui = error term

RESULTS AND DISCUSSION

Indicative measures of groundwater scarcity

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Table.1 Investment cost on Tube well irrigation in sample forms (Rs.)

S. No	Investment	7.5 HP Motor		10 HP*Motor
		SC block	OE block	SC block
1.	Motor + pump	37,000 (40.74)	37,000 (35.65)	39,500 (42.26)
2.	Pipe	10,000 (11.01)	15,000 **b** (14.45)	9,700 (10.37)
3.	Installation charges	30,000 (33.04)	37,500 **a** (36.13)	30,050 (32.15)
4.	Electric accessories	13,000 (14.31)	13,300 (12.81)	13,080 (13.99)
5.	Miscellaneous – Accessories (Repair – Maintenance)	800 (0.88)	1,000 (0.96)	1,120 (1.19)
	Total	90,800 (100%)	1,03,800 (100)	93450 (100)

Figure is parentheses are percentage to total.
a -inclusive of pebble cost mutt cost, **b** -inclusive of more distance of low land to high land pipe lining charges.***** 10 HP motor not used by OE block samples.

Investment costs on Tube well irrigation in the sample farms (Rs.)

Investment costs on tube wells among the sample farms in the selected blocks is shown in table-1. Among the components of investment costs involved in tube wells, in the two blocks, motor and pump cost had a major share of 42 percent of total investment costs in SC block and about 34 percent of total investment costs in OE block both calculated as weighted average. The difference was due to use of 10 HP motor in SC block as deep aquifer and only 7.5 HP motor in OE block as shallow aquifer.

The next high contribution of investment cost was found to be the installation charges with 32 percent of total investment costs in SC block and 36 percent of total investment cost in OE block. This difference was found to be due to presence of inclusive costs on mutt, pebbles and diesel fuel cost in installation charges in OE block .

The total investment in tube well among samples was found to be higher in OE block compared to SC block . This might be due to the higher amount in piping cost which was engaged as conveyance means so as to minimise the conveyance loss due to seepage and percolation in the porous alluvial soil.

Irrigation cost share in cost of cultivation in sornavari and samba paddy in samples of selected blocks.

The cost of cultivation of sornavarai paddy among samples of SCblock and OE block is shown in table -2. The weighted average revealed that the cost on groundwater irrigation was the second next highest share of input cost succeeding the labour cost and preceding the manures and fertilizers in both blocks. The cost of cultivation of samba paddy among the samples of both selected blocks is shown in table -2. The weighted average revealed similar results as that of sornavari season in samples of both selected blocks ie., the second highest contributing share of irrigation cost first being labour cost among all input costs in both blocks. Among the seasons naturally the irrigation cost in samba season was lesser than sornavari in both the blocks as this season coincided with North East Monsoon season. The table 2 showed that input costs vis-à-vis irrigation cost was increasing in absolute terms and percent terms in both the blocks. The fixed investment costs on irrigation was high among samples of OE block than that of SC block (Table2) and the variable irrigation cost per season was found lesser in OE (Table -2). In samba season the irrigation cost was marginally lesser in both blocks and it might be because of less extraction due to the locational advantage of coastal proximity with high rainfall.

Table -2. Irrigation cost share in the cost of cultivation of paddy (Rs/ha)

S.no	Particulars	SC block		OE block	
		Sornavari paddy	Samba paddy	Sornavari paddy	Samba paddy
1.	Seed	2,336	2257	2,468	2,363
2.	Machinery &bullock labour	1,860	1619	1,877	2,755
3.	Human labour	6,067	4,128	6,970	4,952
4.	Manures and fertilizer	5,547	4,419	5,821	4,677

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5.	Plant protection chemicals	1000	1100	1,128	1,130
6.	**Irrigation**	**7400**	**7120**	**7740**	**7,323**
I.	**Total input cost**	**24210 (100)**	**20643 (100)**	**26,004 (100%)**	**22,200 (100%)**
7.	Interest on working capital	700	680	798	769
8.	Depreciation	379	357	388	375
9.	Land revenue	50	50	50	50
II	Cost 'A'	25339	21730	27,240	23,394
10.	Inputed rental value of own land	3796	3731	4186	4180
11.	Interest on owned fixed capital	403	458	467	450
III.	Cost 'B'	29538	25919	31,893	28,024
12.	Inputed value of – family labour	511	603	684	698
IV.	**Cost C**	**30049**	**26522**	**32,577**	**28,722**
13	**Output per hectare(Qtl)**	**29.91**	**29.80**	**28.45**	**28.13**
V.	**Cost of Production(per Qtl)**	**908.50**	**793.52**	**1044**	**918**

Table. 3 Economic returns and input cost share in paddy among samples

S. no	Particulars	SC block		OE block	
		Sornavari paddy	Samba paddy	Sornavari paddy	Samba paddy
	Returns:				
1	Output per hectare(Qtl)	29.91	29.80	28.45	28.13
2	Gross income*	38763	38620	36871	36456
3	Cost C	30049	26522	32,577	28,722
4	Net income (s.no2-3)	8714	12090	4294	7734
	Cost share in Gross income(percent):				
5	Share of Cost C	77.51	68.67	88.35	78.78
6	Share of Total input cost	62.45	53.45	70.52	60.89
7	Share of Irrigation cost	19.09	16.40	20.99	17.01

Note: * Farm harvest price is Rs.1,296 per quintal of paddy (source: season & crop report 2014-15

Economic returns and Inputs cost share in paddy among samples of study blocks.

The economic returns and inputs cost share of paddy in sornavari and samba seasons among samples of study blocks is presented in table 3. Among the components of returns it was found that though the gross income was almost equal in both seasons in SC block, the net income was comparatively more in samba and less in sornavari season. This was due to comparatively lesscost of cultivation as of low input cost share in samba than sornavari season. The share of irrigation cost particularly was found prominently contributing to other input costs, hence shown in the table 3.

Similar above trend of costs and returns of SC block could be seen among the results of OE block (table 3), in both seasons. But the values and hence the share percent of irrigation cost was comparatively more in OE block than SC block in both seasons. Hence the gross and net returns in both seasons among the samples of OE block was found lesser than the SC block.

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Table. 4.Resource Use-efficiency of sample farms in study blocks

	Particulars	SC block			OE block		
		Coefficient	P-value	Mean value in Rs.	Coefficient	P-value	Mean value in Rs.
1.	Y=Gross income of the farm			132346			1,21,495
	Intercept	1.80	0.20		1.01	0.19	
2.	Seed	0.22	0.25	9588	0.28	0.18	10704
3.	Machinery and human labour	0.30*	0.01	36381	0.13*	0.08	39916
4.	Fertilizer and Manure	0.25*	0.01	18481	0.291	0.20	19498
5.	Plant Protection Chemicals	0.18	0.36	3388	0.285	0.30	3692
6.	Irrigation	0.28**	0.08	21,411	-0.03**	0.40	26856
7.	Multiple $-R^2$	0.76			0.68		
8.	Number of samples			90			90

** 5% level of significant *10% level of significant

Resource use efficiency of sample farms in study blocks

The resource use efficiency analysis showed that among the explanatory variables influencing gross income, machinery and human labour, fertilizers and manures as well as irrigation costs were found to be statistically significant in SC block and in OE block except fertilizer and manures all other variables vizlabour and irrigation were found to be statistically significant.

Among the variables in Resource use efficiency analysis next to labour, irrigation was the most influencing variable in SC block and in OE block the irrigation input had negative influence on gross income but with lesser magnitude.

CONCLUSION

The total investment in tube well among samples was found to be higher in OE block compared to SC block. This was found to be due to presence of inclusive costs on mutt, pebbles and diesel fuel cost in installation charges in OE block. Among the seasons, naturally the irrigation cost in samba season was lesser than sonavari in both the blocks as this season coincided with North Eat Monsoon season.

In samba season the irrigation cost was marginally lesser in both blocks and it might be because of less extraction due to the locational advantage of coastal proximity with high rainfall.The share of irrigation cost particularly was found prominently contributing to other input costs. The values and hence the share percent of irrigation cost was comparatively more in OE block than SC block in both seasons. This may be due to over-exploitation. Among the variables in Resource use efficiency analysis next to labour, irrigation was the most influencing variable in SC block and in OE block the irrigation input had negative influence on gross income but with lesser magnitude.

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