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CONTENTS

Economics of paddy cultivation in the salinity affected regions of Alappuzha district, Kerala

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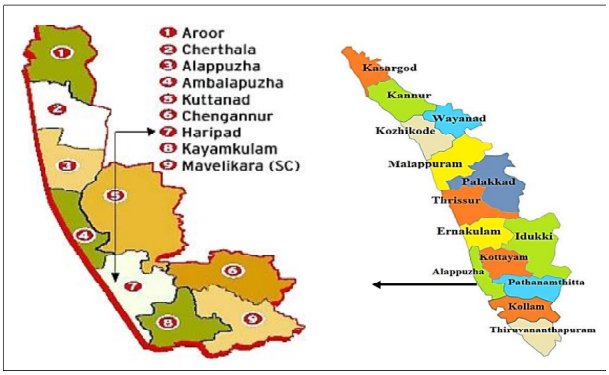
ABSTRACT: Rice, a staple in Kerala, is cultivated across diverse conditions in the region. Alappuzha holds the second position in terms of rice cultivation in Kerala. The district has consistently faced salinity issues stemming from saltwater intrusion, attributed to its distinctive geographical characteristics. The average annual cost of cultivation of paddy incurred by the salt water unaffected and the affected farmers was found to be ₹1,03,322 and ₹ 1,04,145 per hectare respectively. A significant increase in percentage share of the cost of soil ameliorants (4.70 %) was observed for salt water affected farmers. The average cost of production of paddy was ₹ 17,200 and ₹ 27,398 per tonne for salt water unaffected and affected farmers respectively. The yield of paddy realised from the affected areas was remarkably lesser than that of the unaffected areas even though the cost of cultivation was almost similar in both areas. The B-C ratio for paddy cultivation at cost C for the salinity- affected farmers stood at 0.98, indicating marginal losses to the farmer.

Key words: CACP cost concept, cost of production, Kuttanadu, salinity, salt water intrusion

Globally, rice is the foremost and principal food crop among cereals, grown in most of the countries and feeds more than four billion people primarily in Asia**.** The refrain "Rice is love, rice is life" is apt for India since it is the most commonly consumed grain crop and it also adds to the food security of the nation. Of the total rice production in the world, India accounts for 23.5 per cent thus, adding largely to the global food security (FAO,2022). Hence, enhancing rice productivity is a primary concern to the representatives and other stakeholders in the progress of agriculture sector. Among the income generating activities in India, food grain production is the most important one and provides employment to a larger section of the society. Rice is grown in two major seasons *viz.,* Kharif and Rabi in which Kharif accounts for 90 percent of total rice area, 87 percent of total rice production and rabi accounts for 10 percent area and 13 percent production (Samal *et al.,* 2018) in India. The estimated demand for rice will be 113.3 million tonnes and 137.3 million tonnes respectively, by the year 2022 and 2050 (Manda *et al*., 2009; Mohapatra *et al.,* 2013).

Rice is the staple food of Kerala which is cultivated under wide diversity conditions extending from regions situated three meters below mean sea level as in Kuttanad to an altitude of 1400 m level as in Wayanad. The three major rice growing seasons of Kerala are Virippu (April-May to September-October), Mundakan (September-October to December-January) and Puncha (December- January to March-April) (GOK, 2019). The area, production, productivity of paddy in Kerala in the year 2021-22



(Source: https://alappuzha.nic.in/map-of-district/)

Fig.1: Political map of Alappuzha district

was 1.94 lakh ha, 5.59 lakh tonnes and 2884 kg/ hectare, respectively (GOK, 2022). Alappuzha has a share of 18.8 per cent of area under paddy cultivation and it accounts to 36,506 ha in 2021-22. Mundakan crop is the main crop in the entire state, while Puncha crop is leading in Alappuzha district (GOK, 2022).

Salinity or sodicity are the major problems affecting 15 per cent of the total cultivated land around the world. It affects the crop production and productivity negatively by limiting the economic usage of existing resources along the coastal line (Mandal *et al*., 2013; Kumar *et al.,* 2022). At present, rice is the only crop cultivated in coastal saline soils of south India during the rainy seasons. This area is left uncultivated in remaining part of the year due to high salinity and lack of good quality water for irrigation. Salinity induced losses in agricultural production is about US $12 billion and if necessary measures are not taken to mitigate the salt stress, losses may considerably increase in the next few decades (Shabala, 2013; Ashraf and Munns, 2022). Kerala state has a coastline of about 569.70 km long with nine districts viz., Kasaragod, Kannur, Kozhikode, Malappuram, Ernakulam, Kollam, Thrissur, Alappuzha and Thiruvananthapuram adjoining the Arabian Sea, which account for 65 per cent of the total geographical area and 84 per cent of ground water resource of the state. Salt water intrusion is a common phenomenon occurring in these districts and had a significant impact on the state's agriculture sector. The main salt distressed ecological units are Kuttanad, Pokkali, Kaipad and Kole lands (Jayan and Nithya, 2010). Estuaries and network of backwaters operates as pathways for sea water to intrude in to these areas and causes salinity (Swarajyalakshmi *et al.*, 2003). Salinity induced by salt water intrusion was being frequently reported from these areas, and in turn, the rice production was severely affected with increased costs of production and huge yield losses to the farmers. Inefficient use of resources has negative impact on food production and also on the cost of cultivation, leading to low revenue among the farmers (Khatun *et al.,* 2019). Even then studies on the economics of salinity- affected paddy in India are yet to be explored. Hence the present study was conducted with the overall objective of assessing and comparing the different economic aspects of rice production in salinity affected and not affected areas of Alappuzha district in Kerala and to propose improvement strategies applicable to comparable conditions in the other parts of nation.

MATERIALS AND METHODS

Sampling and data collection

The selection of Alappuzha district for the micro-level study was deliberate, given its significant role in paddy cultivation within Kerala. Alappuzha holds the second position in terms of rice cultivation, encompassing a substantial area of 38,623 hectares, with a production of 1,28,560 tonnes and a productivity rate of 3041.18 kg/ha (GOK, 2019). Additionally, the district has consistently faced salinity issues stemming from saltwater intrusion, attributed to its distinctive geographical characteristics and the practice of rice cultivation below Mean Sea Level (MSL) (MSSRF**,** 2007). Haripad block was purposively selected based on its status as one of the leading rice producers among the 12 blocks in Alappuzha district. Furthermore, the block is confronted with significant challenges related to saltwater intrusion issues. The political map of Alappuzha district was shown in figure 1. For the present study paddy fields affected by salinity due to salt-water intrusion and those unaffected from salt-water intrusion were meticulously selected. The water salinity levels in the salt-water affected paddy fields and the unaffected fields were tested and it varied from 12.10 - 18.36 dS/m and 0.14 – 2.10 dS/m respectively. The method of sampling adopted was simple random sampling. The farmers in the study area were categorised into two groups *viz.*, salt-water affected and unaffected. The farmers were selected based on the discussions with the officials of Department of Agriculture as well as *Padasekharasamithis* (paddy farmers group). Initially, a pilot study was conducted. For the main study, 25 farmers each from salinity-affected and unaffected fields were selected; thus, the total sample size of the study was 50. The data was collected through formal interviews from February to March, 2020.

Table 1: Cost concepts used in paddy cultivation

Costs	Components
Cost A_1	Cost of seeds Cost of hired labour Cost of machine labour Cost of bullock labour Cost of manures and fertilizers Cost of plant protection chemicals Value of soil ameliorants Land revenue Depreciation on machineries & farm implements used Interest on working capital Miscellaneous expenses
Cost A_2	Cost A_1 + Rental value of leased-in land
Cost B	Cost A_2 + Interest on the fixed capital (excluding land) + rental value of owned land
Cost B_1	Cost A_1+ Interest on value of owned fixed capital assets
Cost B_2	Cost B_1+ Rental value of owned land less land revenue + Rental value of leased in land.
Cost C	Cost B + Imputed value of the family labour
Cost C_1	Cost B_1+ Imputed value of family labour
Cost C_2	Cost B_2+ Imputed value of family labour.

Method of Estimation of Cost

Cost concepts used by Raju and Rao (2015) for farm management studies classified costs as cost A_1, A_2, B and C. These concepts were used in the present study in order to estimate the cost of cultivation and returns from paddy cultivation. The important cost concepts are elaborated as follows in Table 1.

Returns

Gross return

It was worked out as the product of total quantity of paddy produced per year by the respondents with its unit price. The government procurement price for paddy during the study period (2020) was ₹ 26.95 per kg.

Net return

Net return was calculated by deducting the annual maintenance cost of paddy from the estimated gross returns

Benefit- cost ratio

It was worked out as the ratio of the total benefits to total expenditure incurred for paddy production in the selected locale.

RESULTS AND DISCUSSION

Economics of paddy cultivation

Economics of paddy cultivation was used in order to compare the relative performance of the salt water unaffected and the affected farmers in the study area. Cost of cultivation of paddy for the salt water unaffected and affected farmers were estimated using the ABC cost concepts *viz.,* cost A_1, cost A_2, cost B and cost C.

Cost of cultivation of paddy for the salt water unaffected farmers

The average annual cost of cultivation for the salt water unaffected farmers was found to be slightly lesser when compared to that of salt water affected farmers. The average annual cost of cultivation for the salt water unaffected farmers was furnished in Table 2. The difference in the costs was mainly due to the comparatively lower usage of inputs in the salt water unaffected areas. The total cost of cultivation at cost C worked out for unaffected farmers was ₹1,03,322.85 per hectare. Cost A_1

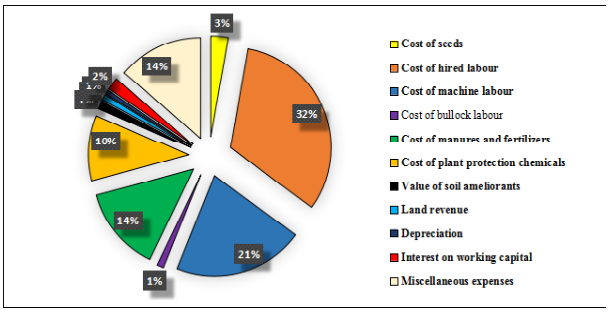


Fig. 2: Per cent share of each component at cost A_1 of the unaffected farmers

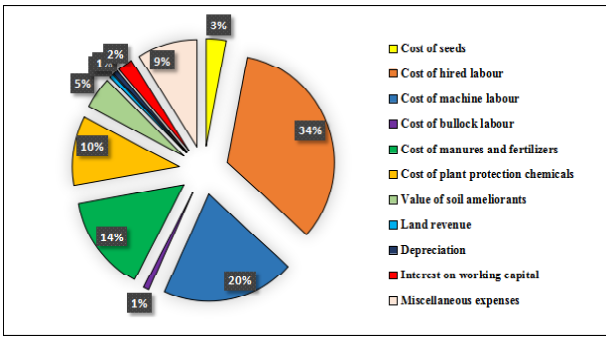


Fig. 3: Per cent share of each component at cost A1 of the affected farmers

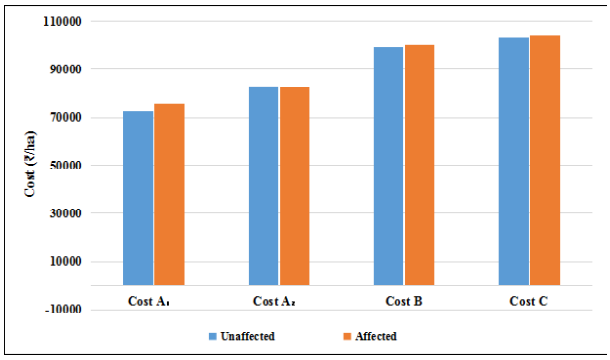


Fig. 4: Comparison of cost of cultivation of the salt water unaffected and the affected farmers

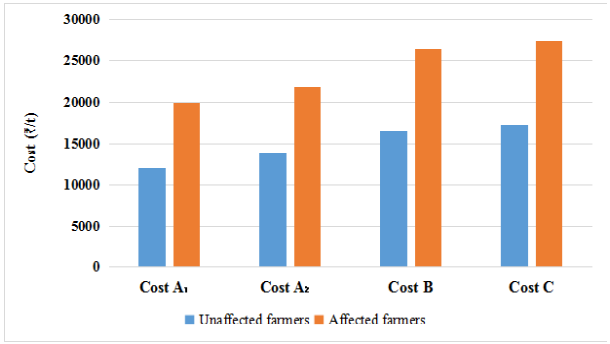


Fig. 5: Comparison of cost of production of the salt water unaffected and the affected farmers

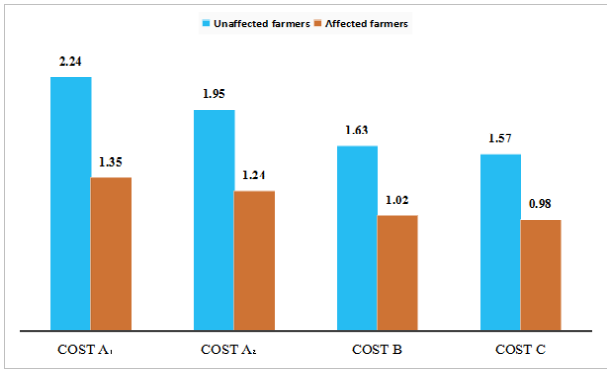


Fig. 6: B-C ratio of salt water unaffected and affected farmers at different cost levels

constituted ₹72,389.79 per hectare, of which cost incurred for the hired labour stood highest and accounted for more than one fourth of cost A_1. It was estimated at [1] 23,380.22 ha^{-1} and was 32.30 per cent of cost A_1. Since paddy cultivation is labour intensive cost incurred for wages was also more. Wages paid to the labourers for each farm operations were different in the area and it included the rent paid for implements also. Many farmers have used their own farm implements in the fields. Following the labour cost, cost incurred for machine labour (20.99%), cost of manures and fertilizers (13.70%) occupied in the second and third positions respectively. Costs of plant protection chemicals accounted for 10.49 per cent of cost A_1. Cost of seeds, cost of bullock labour, value of soil ameliorants, land revenue, depreciation, and interest on working capital all together constituted 8.74 per cent of cost A_1 and the remaining costs were classified under miscellaneous cost.

The diagrammatic representation of components of cost A1 for the unaffected farmers was given in Figure 2. Cultivation in the leased in lands was predominant in the study area resulting in demand for leased in lands was more. Consequently, the rental value of land in the unaffected areas was higher when compared to affected areas. Cost A_2 and cost B was found to be ₹82,923.14 and ₹99037.91 ha^{-1}, respectively.

Cost of cultivation of paddy for the salt water affected farmers

The average annual cost of cultivation for the salt water affected farmers was given in Table 2. The total cost C estimated from the affected area was more than that of unaffected farmers and was [1] 104145.13 ha^{-1}. Cost A_1, cost A_2, cost B accounted to ₹75,873.25, ₹82,788.65 and ₹1,00,426.77 ha^{-1}, respectively. Among the components of cost A1, the cost incurred for hired labour was the maximum, constituting 33.76 per cent followed by cost of machine labour (20.99 %). The cost incurred for fertilizers and for plant protection chemicals together constituted 31.48 per cent of cost A_1. A significant increase in cost of soil ameliorants (4.70 %) was observed in the affected areas, but it remained to be of very less amount in the unaffected areas. Cost of seeds (3.01%), cost of bullock labour (0.86%), land revenue (0.59%), depreciation (0.71%) and interest on working capital (2.29%) accounted for minor shares in the total cost A_1. The rental value of leased in land was comparatively lesser in the affected areas comparing to the unaffected areas. As a result cost A_2 was less in the affected area. The rental value of leased in land was found out to be ₹6,915.40 per

hectare. The diagrammatic representation of components of cost A_1 for the affected farmers was given in Figure 3.

From the analysis it was found that the cost of cultivation of paddy in salt water affected area was slightly higher than that of the unaffected area. The major share of the cost was incurred for the hired labour, machine labour, manures and fertilizers, respectively for both affected and unaffected farmers. The comparison of cost A_1, cost A_2, Cost B and cost C of paddy cultivation by salt water affected and unaffected farmers was given in Figure 4. The result of the study conducted by the Government of Kerala (2016) regarding the cost of cultivation of paddy in Alappuzha district was in close proximity with the results of the current study. As per the report the average annual cost of cultivation incurred for the paddy farmers was ₹95,929ha^{-1}.

The average cost of production per tonne of paddy by the salt water unaffected and the affected farmers is given in Table 3. The average cost of production of respondents from the unaffected area was less when compared to that of affected farmers. The average cost of production at cost C for the unaffected and the affected farmers was ₹17,200 and ₹27,398 t^{-1}, respectively. Even though the cost of cultivation was almost close in both the areas, the yield realised from the affected areas was remarkably lesser than that of unaffected areas and, in turn, led to the increased cost of production of paddy in the affected areas. The cost of production of paddy for the unaffected and the affected farmers showed a difference of around ₹10,000 t^{-1} at cost B and cost C. This could be attributed to the enhanced yield potential of paddy in unaffected areas. Comparison of cost of production of paddy cultivation by the salt water unaffected and affected farmers are given in Figure 5.

Effect of salinity on farm income of farmers

Net returns

Net returns obtained by the farmers from paddy production were worked out to evaluate the profit from rice cultivation. The procurement price of paddy fixed by the state government was ₹26.95 per kg. The gross returns obtained by both the salt water unaffected and affected farmers were worked out and net returns at cost A_1, cost A_2, cost B and cost C were found out separately. A remarkable difference was observed in average returns between salt water unaffected and affected farmers and is shown in Table 4.

Average yield obtained by the unaffected and affected farmers was 6.01 and 3.80 t/ha. Salt water intrusion had caused a drastic impact in yield obtained by the farmers. A significant difference of 2.21 t/ha of average rice yield and ₹59,440.31 per hectare in gross returns existed between the salt water unaffected farmers and the affected farmers. Even though the cost incurred for inputs and agricultural operations of both farmers was marginally different, the salt water affected farmers faced major downfall in returns due to decreased yield and poor quality of the grains. Five kilogram per quintal of paddy was considered as *Kizhivu* (reduction in weight) in the salt water affected areas. As a result, in order to obtain the returns from one quintal of paddy, farmers from the affected areas had to forego 105 kg of paddy. Hence the average price obtained by the farmers from 1kg of paddy was ₹25.66. This attributed to the lower returns from paddy for the salt water affected farmers.

The gross returns obtained by the salt water affected farmers was ₹1,02,443.05 per hectare. The net returns at cost A_1, cost A_2, and cost B were ₹26,569.80, ₹19,654.40, ₹2,016.27 per hectare respectively. There were no net returns for farmers in the saltwater affected area at cost C and also, they faced a monetary loss of ₹1,702.08 per hectare. The gross returns obtained by the salt water unaffected farmers was ₹1,61,883.36 per hectare. The net returns at cost A_1, cost A_2, cost B and cost C for salt water unaffected farmers were worked out to be ₹89,493.57, ₹78,960.22, ₹62,845.45, ₹58,560.51 per hectare respectively. Two kilograms per quintal of paddy was considered as *Kizhivu* in the salt water unaffected areas. Thus, the average price obtained by the farmers for 1 kg of paddy was ₹26.42.

Table 2: Cost of cultivation of paddy for the salt water unaffected and affected farmers

Sl. No	Item	Unaffected farmers		Affected farmers	
		Cost (Rs/ha)	Percentage to cost A_1	Cost (Rs/ha)	Percentage to cost A_1
1	Cost of seeds	2,022.50	2.79	2,283.00	3.01
2	Cost of hired labour	23,380.22	32.30	25,611.83	33.76
3	Cost of machine labour	15,196.47	20.99	15,199.03	20.03
4	Cost of bullock labour	781.57	1.08	649.86	0.86
5	Cost of manures and fertilizers	9,916.15	13.70	11,013.08	14.52
6	Cost of plant protection chemicals	7,593.81	10.49	7,931.79	10.45
7	Value of soil ameliorants	942.75	1.30	3,567.33	4.70
8	Land revenue	657.70	0.91	446.29	0.59
9	Depreciation	492.62	0.68	541.27	0.71
10	Interest on working capital	1,433.26	1.98	1,735.66	2.29
11	Miscellaneous expenses	9,972.74	13.78	6,894.09	9.09
	Cost A_1	72,389.79	-	75,873.25	-
12	Rental value of leased in land	10,533.35	-	6,915.40	-
	Cost A_2	82,923.14	-	82,788.65	-
13	Interest on owned fixed capital excluding land	1,500.14	-	1,119.98	-
14	Rental value of owned land	14,614.63	-	16,518.14	-
	Cost B	99,037.91	-	1,00,426.77	-
15	Imputed value of family labour	4,284.94	-	3718.35	-
	Cost C	1,03,322.85	-	104145.00	-

Table 3: Cost of production of paddy by the unaffected and the affected farmers

Sl No.	Particular	Unaffected farmers	Affected farmers
1.	Cost A_1 (₹/t)	12,051	19,960
2.	Cost A_2 (₹/t)	13,805	21,780
3.	Cost B (₹/t)	16,488	26,420
4.	Cost C (₹/t)	17,200	27,398

Table 4: Returns from paddy cultivation in salt water unaffected and affected areas

Sl No.	Particular	Return	
		Unaffected farmers	Affected farmers
1	Yield (t/ha)	6.01	3.8
2	Price (₹/kg)	26.95	26.95
3	Gross returns (₹/ha)	1,61,883.36	1,02,443.05
4	Net returns at cost A_1 (₹/ha)	89,493.57	26569.8
5	Net returns at cost A_2 (₹/ha)	78,960.22	19654.4
6	Net returns at cost B (₹/ha)	62,845.45	2016.27
7	Net returns at cost C (₹/ha)	58,560.51	-1702.08

Table 5: B-C ratio of salt water unaffected and affected farmers

Sl. No	Cost	Unaffected farmers	Affected farmers
1	Cost A_1	2.24	1.35
2	Cost A_2	1.95	1.24
3	Cost B	1.64	1.02
4	Cost C	1.57	0.98

B-C Ratio

The returns generated by farmers per rupee invested in paddy cultivation was worked out for salt water unaffected and affected areas in order to evaluate the profitability. B-C ratio of unaffected and affected farmers from paddy cultivation is given in Table 5. From the results, B-C ratio of salt water unaffected farmers at cost A_1, cost A_2, cost B and cost C was 2.24, 1.95, 1.64 and 1.57, respectively. The B-C ratio of affected farmers at cost A_1, cost A_2 and cost B was 1.35, 1.24 and 1.02 0.98 respectively. Also, the results clearly showed that the unaffected farmers got more profit relative to the affected farmers. The B-C ratio at cost C for affected farmers was 0.98 which indicated the occurrence of slight losses from production. A similar study conducted by Radhika (2014) revealed that the relative profitability from saline affected Kaipad area of Kannur district was much less than the non-saline areas. The diagrammatic representation of B-C ratio of unaffected and affected farmers at different cost levels are depicted in Figure 6.

CONCLUSION

The farmers in areas not affected by salinity

experienced lower average annual paddy cultivation costs compared to those in the salinity-affected areas. Notably, there was a substantial rise in the percentage share of expenses related to soil ameliorants for farmers affected by saltwater. In addition to the rise in production costs, salinity also significantly impaired the quality of the harvested paddy. The heightened production costs in the salinity-affected areas were linked to yield losses caused by saltwater intrusion. Constructing bunds promptly and maintaining them appropriately are the most effective measures to prevent saltwater intrusion into the farmers' fields. Enhancing the effectiveness of institutional measures is crucial, as it represents the primary factor in addressing this issue. Effectively addressing the challenges encountered by farmers has the capability to enhance the profitability of paddy farming not only in Kuttanad but also in other similar areas grappling with salinity caused by saltwater intrusion.

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