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Factors Affecting Adoption of KAU Rice Varieties: An Econometric Analysis

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Abstract

Being a major food crop, rice is consumed by more than 60 percent people on the world over. So, cultivation of rice depends on the choice of farmer based on its profitability. A study was conducted to assess the relative profitability and the factors affecting adoption of KAUvarieties (Jyothi and Uma) in comparison with local non-KAU varieties (MAHAMAYA and TKM 9) under Palakkad and Alappuzha districts areas of Kerala. Cost concepts and probit model were used to analyse the data. The average cost of cultivation (Cost C_2) of KAU varieties was found to be lower in Palakkad and Alappuzha districts (□73,213 and 81,915 ha^{-1} respectively) compared to non-KAU varieties (□83,634 and 94,526 ha^{-1} respectively). The gross and net income of KAU varieties were also found to be higher in Palakkad and Alappuzha compared to non KAU varieties. Organizational membership and an annual income of the farmers were identified as major factors affecting the adoption of KAU varieties.

Keywords: KAU and non-KAU rice varieties, net income, probit model

Rice is one of the major food crops for more than 60 per cent people in the world. It is regarded as the choicest staple food crop (Kumari, 2011). In India, rice was cultivated in an area of 30.81 million ha during 1950-51. The area has increased to 43.90 million hectares in 2013-14 along with the production enhancement of 85.96 million tonnes. The average yield was about 2424 kg ha^{-1} (Government of Kerala, 2015). India ranks first in the area followed by China; but production wise China is leading in the world. Rice production and productivity China had 207 million tonnes and 6744 $kgha^{-1}$ respectively. It reveals that China produces almost twice the quantity of rice than that of India and has nearly three times productivity (IRRI, 2014). This points out that to meet the food security of growing population in the country production and productivity of rice in India needs to be enhanced.

In Kerala, rice is the major staple food crop which accounts for a production and productivity of 5.62 lakh tonnes and 2837 kg ha^{-1}respectively in 2014-15. The area under rice has drastically reduced from 8.75 lakh ha (during 1970-71) to 1.98 lakh hectare (during 2014-15). The area and production during the last three decades showed a declining trend (73.6 and 54.2 per cent respectively). At present, rice occupies the third position regarding area after rubber and coconut (Government of Kerala, 2015). The reduction in area is mainly due to the conversion of agricultural land for rubber plantations and urbanization. As per the latest report of Commission on Agricultural Costs and Prices, the conversion is mainly attributed to the increased cost of cultivation such as high labour cost and a seasonal shortage of labour (Government of Kerala, 2015).The average cost of rice production is high in Kerala as compared

to remaining states in India ((Kumari, 2011). To make the rice farming profitable, productivity enhancement can be achieved through promoting the high yielding varieties (Kumari, 2011). The high yielding rice variety Uma (Mo 16) was released from Rice Research Station, Moncompu in 1998. Similarly, Jyothi (PTB 39) was developed and released from Regional Agricultural Research Station, Pattambi in 1974. There continue to be popular varieties among the farmers in Kerala. The present study was formulated to assess the relative profitability of the Kerala Agricultural University (KAU) varieties (Jyothi and Uma) in comparison with local non-KAU varieties and to identify the factors affecting adoption of KAU varieties in Kerala.

Materials and Methods

The study was undertaken in Palakkad and Alappuzha districts of Kerala. These are the major rice growing districts of Kerala accounting about 41.84 % and 17.37 % total rice growing area of the state respectively (Government of Kerala. 2015). These districts also contribute larger area under KAU rice varieties such as Jyothy and Uma. Therefore, they are considered as prominent in rice cultivation and were purposively selected for the study.About 20 farmers each cultivating KAU varieties at least one acre were randomly chosen from both districts separately and the similarly same number of farmers were also selected among cultivators of non-KAU varieties which made a total sample size of 80 farmers.The survey was conducted during January - May 2016. Data related to the yield, cost and returns from both the varieties, important reasons for adoption of KAU varieties were collected from selected farmers by using personal interview method using a pre-tested interview schedule.

To estimate the costs, the cost concepts (CSO, 2008) such as cost A1, A2, B1, B2, C1, C2 and C3 were used. A probit model was fit to determine the important factors affecting the adoption of KAU varieties. To explain this model, the decision of i^{th} farmer to adopt the KAU rice varieties (Jyothi or Uma) or not, depends on an unobservable utility index I_i (also known as a latent variable), that is determined by the number of explanatory variables X_i included in the model in such a way that the larger the value of the index I_i, the greater the probability of a farmer adopting a variety. It is given as

$$I_i = \beta_1 + \beta_2 X_{i;}$$

Where, X_i = explanatory variable(s)

Model specification for KAU rice varieties growing farmers

$$Pi = P(Y=1/X_i) = P(I^*_i \leq I_i) = p(Zi \leq \beta_1 + \beta_2 X_{2i} + \ldots\ldots + \beta_6 X_{6i} + U_i) = F(\beta_1 + \beta_2 X_{2i} + \ldots\ldots + \beta_6 X_{6i} + U_i)$$

$$Pi = P(Y=0/X) = P(I^*_i > I_i) = p(Zi > \beta_1 + \beta_2 X_{2i} + \ldots\ldots + \beta_6 X_{6i} + U_i) = F(\beta_1 + \beta_2 X_{2i} + \ldots\ldots + \beta_6 X_{6i} + U_i)$$

Where, $P(Y=1/X_{ni})$ indicates the probability of i^{th} farmer adopting a KAU rice variety at given values of the explanatory variables.

$P(Y=0/X_{ni})$ is the probability of the i^{th} farmer not adopting a KAU rice variety at given values of the explanatory variables.

I^*_i = threshold level of index of i^{th} farmer

I_i = utility index or latent variable of i^{th} farmer

X^{2i} = represents education of i^{th} farmer in years

X^{3i} = represents age of i^{th} farmer in years

X^{4i} = represents area of i^{th} farmer in hectare

X^{5i} = represents member of the farmer's organization of i^{th} farmer (dummy)

X^{6i} = represents annual income of i^{th} farmer in Rupees

U_i = error term

Z_i = is the standard normal variable, i.e., $Z \sim N(0, \sigma 2)$.

F is the standard normal CDF.

Results and Discussion

Socio-economic characteristics of the sample farmers

The majority of the respondents were from age group of 40-50 years in both KAU and non-KAU varieties cultivation (Table 1). This showed that younger generation was less interested in paddy cultivation. The literacy rate of farmers growing KAU varieties and non KAU varieties was about

97.5 and 87.5 per cent respectively. Among 80 respondents, 59 respondents had an experience of more than 25 years in paddy cultivation. Organizational membership was more in farmers' group cultivating KAU varieties (95%), and it was less in non KAU varieties growing farmers group (65%).About 25 per cent respondents growing KAU varieties and 12.5 per cent respondents growing non KAU varieties were having an annual income of more than 2,00,000. In case of KAU varieties, more than 42 per cent farmers were depended on Krishibhavan as source of seeds.

Table 1: Socio-economic characteristics of the sample farmers

Variables	Categories	Kerala	
		KAU varieties	Non KAU varieties
Age	<30 years	2(5)	0(0)
	30-40 years	2(5)	1(2.5)
	40-50 years	5(12.5)	15(37.5)
	>50 years	31(77.5)	24(60)
	Total	40(100)	40(100)
Education	Illiterate	1(2.5)	5(12.5)
	Upto 9th	0(0)	8(20)
	SSLC	7(17.5)	17(42.5)
	Plus two	20(50)	7(17.5)
	Graduate	12(30)	3(17.5)
	Total	40(100)	40(100)
Experience in paddy cultivation	<10 years	2(5.0)	1(2.5)
	10-25 years	4(10.0)	14(35)
	>25 years	34(85)	25(62.5)
	Total	40(100)	40(100)
Organizational membership	Yes	38(95)	26(65)
	No	2(5)	14(35)
	Total	40(100)	40(100)
Annual income	<50000	5(12.5)	10(25)
	50000-100000	15(37.5)	17(42.5)
	100000-200000	5(12.5)	8(20)
	>200000	10(25)	5(12.5)
	Total	40(100)	40(100)
Access to seed source	Seed corporation	15(37.5)	0(0)
	Krishibhavan	17(42.5)	0(0)
	Local exchange	0(0)	28(70)
	Farm saved seeds	8(20)	12(30)
	Total	40(100)	40(100)

Note: Figures in parentheses represent the per cent to total

It is mainly because of subsidized rate for seeds and fertilizers whereas in the case of non KAU varieties more than 70 per cent of farmers depended on local exchange. This is mainly because the important non KAU varieties like MAHAMAYA and TKM 9 presently grown in the state belonged to other states and hence seeds are brought from other states and are distributed to farmers. A larger number of respondents depended on local exchange as their source of seeds.

Costs and returns from KAU and non KAU varieties in Palakkad and Alappuzha districts

In Palakkad, the total cost of cultivation at cost A_1 for KAU and non KAU varieties were ₹56691and ₹60017 respectively (Table 2). Hired labour cost accounted for larger share in the cost $A_1$of both KAU varieties (40.2%) and non KAU varieties (41.7%) and followed by machine labour charge (25.8 and 23.8% respectively in KAU and non KAU varieties). Cost C_2 for KAU and non KAU varieties were ₹73213 and ₹76031 respectively. In Alappuzha, the total cost of cultivation cost A_1 for KAU and non KAU varieties were ₹54729 and ₹59990 ha^{-1}respectively. As in case of Palakkad, here also hired labour cost accounted for larger share in cost A_1 for both KAU varieties (26.3%) and non KAU varieties (37.2%) followed by machine labour charge (23.8% and 22.5% respectively). Cost C_2 for KAU and non KAU varieties were ₹81915 and ₹85933 respectively.

Table 2: Comparison of cost of cultivation of KAU and non KAU varieties in Palakkad and Alappuzha districts (₹ha^{-1})

Variables	Palakkad		Alappuzha	
	KAU varieties	Non KAU varieties	KAU varieties	Non KAU varieties
Labour hiring charge	22796(40.2)	25037(41.7)	19887(26.3)	22344(37.2)
Machine labour charge	14646(25.8)	14311(23.8)	13046(23.8)	13521(22.5)
Nursery preparation	1024(1.8)	934(1.6)	0	0
Seeds	2482(4.4)	2410(4.0)	3408(6.2)	4648(7.7)
FYM	4767(8.4)	5586(9.3)	0	0
Fertilizers	4934(8.7)	5486(9.1)	4880(8.9)	5720(9.5)
PPC	1270(2.2)	1409(2.3)	1345(2.5)	1248(2.1)
Land revenue	100(0.2)	100(0.2)	200(0.4)	200(0.3)
Dewatering	0	0	3930(7.2)	3856(6.4)
Liming charges	0	0	4183(7.6)	4266(7.1)
Depreciation	964(1.7)	818(1.4)	271(0.5)	263(0.4)
Interest on working capital	3709(6.5)	3926(6.5)	3580(6.5)	3925(6.5)
Cost A_1	56691(100)	60017(100)	54729(100)	59990(100)
Cost A_2	56691.2	60016.89	54729	59990
Interest on the value of owned fixed capital assets	1352.77	885.93	118	104
Cost B_1	58043.97	60902.84	54847	60094
Rental value of owned land	15169.5	15128	27067.75	25839
Cost B_2	73213.47	76030.839	81915	85933
Cost C_1	58043.971	60902.84	54847	60094.29
Cost C_2	73213.47	76030.84	81915	85933

Note: Figures in parentheses represent the per cent to total

In both the districts, the larger share in the cost A_1 in both the varieties was due to hired labour cost; it is mainly because more dependence on hired labour for all other field operations except harvesting. Higher labour charge (₹572 day^{-1}) for land preparation existing in the state is another reason for higher share of the work cost (Government of Kerala, 2015). A comparison between the districts showed that the labour cost is found to be high in Palakkad compared to Alappuzha mainly because of adoption of transplanting method of sowing which is more manpower required. But in Alappuzha, less manpower was used through broadcasted method for planting and therefore the labour cost share was found to be less.

The cost of cultivation of non KAU varieties found to be higher than the KAU varieties in both the districts and this could be attributed to the fact that hired labour charges for weeding and plant protection were found to be more in non KAU varieties cultivation than KAU varieties.

A perusal of table 3 revealed that, the average yield of KAU varieties (5644 kg ha^{-1}) was more compared to non KAU varieties (5629 kg ha^{-1}) in Palakkad. The gross income obtained by cultivating KAU varieties was more (₹121356 ha^{-1}) compared to non KAU varieties (₹121024 ha^{-1}). In Alappuzha also, the average yield of KAU varieties (5036 kg ha^{-1}) was higher compared to non KAU varieties (4807 kg ha^{-1}). The gross return obtained by cultivating KAU varieties was ₹108271ha^{-1} which is five per cent more than that of non KAU varieties (₹103355 ha^{-1}). It could be concluded that the average yield of non KAU varieties was lower compared to KAU varieties in both the districts. Net returns at C_2 was more for KAU varieties growing farmers compared to non KAU varieties growing farmers in both the districts; because of lower yield, higher cost of cultivation in both the districts. The B:C ratio at cost C_2 was found to be high for KAU varieties compared to non KAU varieties in both the districts because of higher gross income from KAU varieties and high cost incurred in the production of non KAU varieties. The cost of production of non KAU varieties was comparatively higher than KAU varieties mainly because of lower yield realised in comparison to KAU varieties and higher cost of cultivation involved in the cultivation of non KAU varieties in both the districts.

Table 3: Estimates of different income measures (₹ ha^{-1}) in Palakkad and Alappuzha districts

Particulars/category of respondents	Palakkad		Alappuzha	
	KAU varieties	Non KAU varieties	KAU varieties	Non KAU varieties
Average yield of rice (kg ha^{-1})	5644	5629	5036	4807
Average gross income (GI)	121356	121024	108271	103355
Net income at cost C_2	48143	44993	26356	17422
Benefit cost ratio (GI:C_2)	1.66	1.59	1.32	1.20
Cost of production at cost C_2 (₹ q^{-1})	1297	1627	1351	1788

Factors affecting adoption of KAU varieties in Kerala

The farmer's membership in an organization was found to have a positive influence on adoption of KAU varieties (Table 4). Among the 40 farmers growing KAU varieties, 38 (95%) were members of an organization called Padasekhara Samithi. This is an organization of the farmers for promoting paddy cultivation in the state.Majority of the farmers in each of the Padasekhara Samithis cultivate the same variety season after season because it is a government initiated programme where the seeds and fertilizers are distributed at subsidized rates through Krishi Bhavans. The farmers grow the same rice variety in a group to facilitate easy cultural and management practices. Since Jyothi and Uma are high yielding varieties in Palakkad and Alappuzha, (Kumari, 2011) most of the Krishi Bhavans distribute these varieties only to Padasekhara Samithis for cultivation. Therefore, it may be concluded that as

the farmer's membership in a Padasekhara Samithis increases, adoption of KAU varieties will also be increased. Annual income was another factor found to be have a positive influence on adoption of KAU varieties.Among 40 respondents growing KAU varieties 32 (80%) respondents were having an annual income of more than □50000.Awareness about variety is more among rich farmers compared to small and marginal farmers. Hence, we can conclude that farmers having higher annual income, have adopted KAU varieties faster than farmers having lower annual income.

Table 4: Estimates of the probit model for adoption of KAU varieties in Kerala

Variables	Unit	Co-efficient	Std. Error	Z-value
Constant	–	-3.008**	1.531	–1.965
education	Years	0.088	0.057	1.530
age	Years	0.012	0.022	0.525
area	Hectare	-0.023	0.058	–0.390
Annual Income	Rupees	0.001***	0.001	2.619
organizational membership dummy	=1 if member of any organization =0 if non –member of organization	1.079***	0.362	2.978
$X^2 = 0.771$ significance of $X^2 = 0.379$, N= 80				

*** denotes significance at 1 per cent level of probability, ** denotes significance at 5 per cent level of probability

Conclusion

In the cultivation of both KAU and local non KAU rice varieties, labour cost accounts highest share in the cost A_1 components in both the districts. In Kerala, mechanisation is not followed for various agricultural operations except field preparation and harvesting hence there is a lot of scope for mechanization in rice cultivation. Use of farm machineries such as rice transplanter for transplanting seedlings, row rice seeder for direct sowing, seed cum fertilizer drill for both direct sowing and fertilizer application and welder for weeding operation are to be undertaken on a co-operative basis for rice cultivation to overcome the problems like fragmentation and small holding size of land.The result also showed that the younger generation was least interested in taking up rice cultivation in the state. Therefore, initiatives have to be taken to attract the younger generation towards rice cultivation by providing skills through training programmes, conducting group discussions on mechanisation, adopting HYV and with innovative attitude towards rice cultivation thereby, making it a more profitable venture in the future.

In both the districts, KAU varieties overrated the non KAU varieties in terms of yielding potential and hence promotion of these high yielding varieties is necessary in order to create and develop awareness among the farmers by highlighting the high yielding ability of these varieties and for further expansion of area of these varieties in the whole the state.

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