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INPUT USE EFFICIENCY IN COCONUT GARDENS OF KERALA

K. Muralidharan, C. Thamban, S. Arulraj, C. V. Sairam
Central Plantation Crops Research Institute, Kasaragod
U. C. Sud, D. C. Mathur and H. V. L. Bathla
Indian Agricultural Statistics Research Institute, New Delhi

ABSTRACT

Influencing the farmers in making right input management decisions is vital for enhancing the productivity of coconut. Efficiency of inputs varies from location to location. On the basis of data on inputs and output from a total of 600 holdings selected by following a three stage random sampling design, the input use efficiency in coconut gardens of three districts viz., Kozhikode, Ernakulam and Thiruvananthapuram was analyzed. The yield differences for variable levels of inputs were described as the incremental yield over the average yield of the region without adopting any technology.

The results of this study indicate that the often assumed effect of input use on yield may not be realized uniformly under varying field situations Application of manures (organic and inorganic) has a decisive role in productivity in Ernakulam and Thiruvananthapuram districts which is substantiating the relevance of manurial recommendations for root(wilt) disease management by CPCRI. Irrespective of irrigation status, application of chemical fertilizers results in higher yields.

INTRODUCTION

The low productivity of coconut in Kerala State is a serious subject for discussion among farming community, planners and policy makers and coconut research workers, as it remains a grave concern for planning for agricultural development in the state. Research work has yielded a substantial number of production technologies to suit the divergent coconut farming situations in the State. The state is also having a strong agricultural extension network operating up to the Grama Panchayath level. In spite of these favourable environment, coconut growers have not been able to effectively utilize the technologies for enhancing productivity of the crop owing to many constraints (Rajagopal, *et. al.*, 2001). Enhancing the productivity by exploiting hybrid vigor is a very slow process in the case of coconut for reasons of low multiplicative rate and very low per cent of replanting practiced by the farmers. Population improvement by selection is also not a viable option, as it assured only 0.5 nuts per annum for a selection pressure of best 10%. Effectiveness of chemical control of pests and diseases is a debatable issue since the crop is grown under homestead conditions and also the State has many inter connected water bodies across. Hence, to achieve increased productivity within a reasonable span of time, the emphasis should be on management of natural resources on a sustainable basis. This argument also derives support from the fact that coconut is grown for many centuries in Kerala and unlike other cultivated crops, its life span is more than 60 years that calls for maintaining congenial soil health for sustained productivity.

Management of soil nutrients and water are the key components of resource management in coconut holdings, besides optimum spacing and growing of suitable inter/mixed crops. Obviously the resource management by farmers will not be the optimum as the decisions at farm level are influenced more by the socio-economic characteristics than the relative advantages of production technology options. This in turn indicates that influencing the farmers in making right input management decisions is vital for improving coconut scenario in the state. A pre requisite for facing this challenge is the analysis of the pattern of resource utilization at farm level itself. Besides time, man power and resources, methodological issues are also need to be sorted out in such studies.

In this background, a study was carried out with the specific objective to analyze the input use efficiency in coconut gardens of Kerala State.

MATERIALS AND METHODS

Locale of the study: The present study use the data generated from a survey conducted during 2001 in three districts of Kerala viz., Kozhikode, Ernakulam and Thiruvananthapuram to work out the cost of production of coconut in Kerala. These

districts are belonging to the North, Central and South agroclimatic conditions of the State respectively. The average productivity of coconut in these districts is above the state average. The per cent share of area under coconut cultivation in Kozhikode, Ernakulam and Thiruvananthapuram is respectively 10, 9, 13 and contributing 11, 10 and 16 % respectively to the State's coconut production.

Sampling design: A three stage random sampling design was adopted for the study. The first stage units were community development blocks. From Kozhikode district, 4 blocks were selected and from other two districts 5 each. The second stage sampling units were the panchayats. From each selected block, 2 panchayats were randomly selected. The coconut holdings with an area of more than 0.05 ha and having at least 10 coconut trees formed the third stage sampling units. The sampling frame was constructed by enumerating the house holdings (approximately 50%) in the selected panchayats. Holdings were stratified on the basis of area under coconut i.e. small (0.05 - 0.20 ha), medium (0.20 - 0.80ha), and large (>0.80 ha). Proportional to the number of households in each holding size class (i.e. small, medium and large), 20 households were selected from a selected panchayat. Further, the palms in the selected holding were post-stratified on the basis of age group i.e. up to 1 year, 1-3 years, 3-8 years and more than 8 years.

Data collection: Quarterly data on input/output was collected from the selected house holds during the year 2001 by employing field investigators belonging to the respective panchayat itself. They were identified in consultation with the Agricultural Officer of the panchayat. Specific interview schedules were used for data collection. Adequate training was imparted to the investigators prior to the start of the field survey and also after the second round. The work of the field investigators was supervised by the scientists in the project from time to time by cross checking of data in 3 to 5 holdings in each panchayat.

Analysis: Holding wise data on quantities and cost of inputs and yield for the four quarters of the year 2001 was compiled. Input quantities were apportioned to different growth stages in a holding. To overcome the variability of palm population across holdings, the values were expressed on per palm basis for each holding. SPSS procedures (SPSS, 1999) were used for data analysis.

RESULTS AND DISCUSSION

The material inputs of importance in the bearing stage of palms are the organic and inorganic fertilizers. Organic requirements are met by the application of cow dung and green leaf manures. Few holdings reported the application of compost, neem cake and branded organic fertilizers. Ash was also applied in many holdings. Different organics applied in a garden was converted to a single cost for comparison. Similar is the case with chemical fertilizers. To establish the influence of material input on yield, coefficient of correlation (both parametric and non-parametric) was employed (Table 1). Significant positive correlation between yield and organic and inorganic input was observed in Ernakulam and Thiruvananthapuram districts. However, no such association was noticed in Kozhikode district. As anticipated, the plant density had significant negative correlation with the yield in all the three districts.

The possibility of interaction of irrigation with material inputs resulting in non-significant correlation in Kozhikode district was examined in Table 2. In both the situations (i.e. rainfed and irrigated), no significant correlation with yield was noticed in the Kozhikode district. It is interesting to note that application of chemical fertilizers had positive correlation with yield irrespective of irrigated or rainfed conditions.

The details of average yield across the districts are furnished in Table 3. It may be noted here that the values in Table 3 are the simple averages from the sample and not estimates. The estimated annual yield (based on the sampling design) for the districts Kozhikode, Ernakulam and Thiruvananthapuram was 46.2, 42.6 and 41.3 respectively. The variability for yield in Kozhikode is less compared with other two districts. Frequency distribution of yield observed in the district suggest that average yield in the lower yielding group is relatively high in Kozhikode whereas the average yield of high yielding palms was low. The district had less number of palms having very low yield (20 nuts or less).

Table 1. Degree of association between yield and selected input variables across districts (parametric correlation, Kendal's Tau and Spearman's rank correlation in order)

Input variable	Kozhikode	Ernakulam	Thiruvananthapuram
Organic cost per palm	.047	.498**	.499**
	-.045	.363**	.178**
	.016	.373**	.526**
Cow dung (quantity per palm)	.035	.491**	.491**
	.003	.251**	.339**
	.003	.358**	.480**
Green leaf (quantity per palm)	-.003	.320**	.007
	.011	.259**	.366**
	.014	.203**	.009
Inorganic cost per palm	.017	.472**	.231**
	.010	.151**	.007
	-.057	.479**	.241**
Bearing palms per hectare	-.195**	-.240**	-.210**
	-.132**	-.154**	-.166**
	-.194**	-.229**	-.242**

Table 2. Degree of association between yield and selected input variables under irrigated and rainfed conditions

Input variable	Kozhikode		Ernakulam		Thiruvananthapuram	
	RF	Irrig.	RF	Irrig.	RF	Irrig.
Organic cost per palm	.027	.164	.333*	.543**	.509**	.405**
Cow dung (quantity per palm)	.024	.081	.314**	.540**	.540**	.234
Green leaf (quantity per palm)	.009	-.101	.397**	.294** ($)	-.029	.071
Inorganic cost per palm	.049	-.203	.622**.	.440**	.210**	.304** ($)

($) Non-parametric correlations not significant

Table 3. Variation for average annual yield as number of nuts per bearing palm in the selected holdings

Descriptive statistics	Kozhikode	Ernakulam	Thiruvananthapuram	Overall
Mean	41.7	41.4	44.3	42.5
Minimum	11.0	4.7	5.9	4.7
Maximum	138.8	162.0	110.7	162.0
Standard deviation	19.5	29.0	24.2	24.5
First quartile	27.7	22.9	24.4	24.7
Second quartile	37.7	32.9	37.5	36.3
Third quartile	51.4	51.5	61.3	54.6
Per cent holdings with less than 20 nuts per palm	8.0	19.7	14.0	14.1
Per cent holdings with more than 42.5 nuts per palm	40.7	31.8	41.5	38.02
Average yield of the above average group	59.8	74.2	68.2	66.9

Analysis on resource use efficiency may be made through different approaches. The production function approach which summarizes the process of conversion of factors into a particular commodity was the one widely used. However, the objective of the present study was to describe the yield differences for variable levels of inputs. To achieve this, incremental yield of input levels was compared with the average yield of the region without any technology input. It is expected that an analysis of this kind will give more insight to the type of function to be selected for future studies.

The details pertaining to the yield realized under field situation where no inputs were applied are furnished in Table 4. It was observed that in Kozhikode, the yield was approximately 60% more than the other two regions under the aforesaid situation. Comparatively higher yield even under neglected conditions observed in the district might be one of the factors inhibiting substantial degree of association between different levels of input use and yield. These yield levels are compared with the average yield under different input levels in subsequent tables.

Generally, farmers resort to inter cultivation as a means of soil and water conservation and weed management in coconut gardens. In certain areas, taking mounts in the interspace is followed to reduce soil salinity problem. The benefits from this practice is seem to be more in Ernakulam district (Table 5) compared to other two regions.

As stated earlier, application of organic manures is a major input in coconut cultivation. In many cases, the organic manures are produced (at least partly) in the holding itself. No uniform scale is available to report the quantity of different organics applied in the holdings. This problem could be overcome by obtaining conversion factors appropriate to each location to express the measurements in terms of kilogram. To avoid the quality difference among different organic manures, the quantities were converted to values. Table 6 provides the incremental yield when organics was the sole input for coconut cultivation.

The effectiveness of chemical fertilizer application in coconut cultivation is debated against conventional organic farming practiced by the coconut farmers of Kerala. Table 7 provides

Table 4. Average annual yield (nuts per palm) under no input use

	Yield	Number of holdings	CV (%)
Kozhikode	37.0	34	45.9
Ernakulam	22.9	8	84.7
Thiruvananthapuram	25.1	6	67.3

Table 5. Percentage incremental yield with inter cultivation alone

	Yield	% incremental yield	No. of holdings	CV (%)
Kozhikode	39.4	6.5	15	61.2
Ernakulam	28.6	24.9	5	60.8
Thiruvananthapuram	21.1	-15.9	9	32.2

Table 6. Percentage incremental yield with organic application alone

	Yield	% incremental yield	No. of holdings	CV (%)
Kozhikode	43.7	18.2	84	38.8
Ernakulam	27.9	21.9	21	35.5
Thiruvananthapuram	42.0	67.1	59	56.1

incremental yield due to chemical fertilizer application alone in the three regions. Though the farmers use different brands of chemical fertilizer, quantification is straightforward. The quantities were converted to cost for preparation of table 7.

In the aforesaid tables, exact quantity of inputs was not used for drawing conclusions. To get an insight to variable levels of important inputs on yield, two-way tables were prepared: As mentioned earlier, the quantities of input by farmers were not matching with that of package of practices. Therefore, the level of inputs were classified according the percentiles – less than or equal to the value corresponding to first quartile as 'Low-', more than that of third quartile as 'High-' and in between as 'Medium-' level of input. To have common points in the three regions, quartiles based on data from the three districts together were used. Details are shown in Table 10.

Table 7. Percentage incremental yield with chemical fertilizer alone

	Yield	% incremental yield	No. of holdings	CV (%)
Kozhikode	46.4	25.4	6	32.5
Ernakulam	22.3	-2.7	1	
Thiruvananthapuram	35.0	39.6	6	45.0

Table 8. Percentage incremental yield with organics and inorganics applied

	Yield	% incremental yield	No. of holdings	CV (%)
Kozhikode	39.4	6.6	29	50.4
Ernakulam	65.5	186.0	18	43.5
Thiruvananthapuram	49.8	98.6	51	51.1

Table 9. Percentage incremental yield where organics applied under irrigated condition

	Yield	% incremental yield	No. of holdings	CV (%)
Kozhikode	30.2	-18.4	7	52.4
Ernakulam	56.2	145.5	61	67.2
Thiruvananthapuram	61.4	144.6	17	42.2

Table 10. Values corresponding to quartiles for the inputs (first and third values in the last row only used for classification)

	Cost of inorganics			Cost of organics		
	First	Second	Third	First	Second	Third
Kozhikode	6.39	8.84	13.23	13.38	30.79	53.97
Ernakulam	6.86	15.91	25.68	14.17	23.42	40.48
Thiruvananthapuram	5.34	10.40	15.60	11.39	21.90	34.48
Overall	5.95	11.28	19.44	13.24	24.00	38.82

Table 11. Percentage incremental yield for different levels of organics and inorganics (Figures in the parenthesis are respective sample sizes)

Zones		Inorganics		Organics	
		Low	Medium	High	Overall
Kozhikode	Low	11.1	7.8	22.7	12.7
		(94)	(39)	(034)	(167)
	Medium	46.5	-11.6	12.2	10.8
		(8)	(13)	(7)	(28)
	High		30.3	25.1	29.2
			(3)	(1)	(4)
	Overall	13.8	4.6	21.1	12.7
		(102)	(55)	(42)	(199)
Ernakulam	Low	27.5	50.2	42.4	38.9
		(61)	(58)	(15)	(134)
	Medium	40.2	118.8	190.0	137.6
		(2)	(18)	(10)	(30)
	High	-18.8	119.7	250.7	196.5
		(1)	(12)	(21)	(34)
	Overall	27.1	73.8	169.4	80.8
		(64)	(88)	(46)	(198)
Thiruvananthapuram	Low	23.5	100.4	103.2	60.6
		(76)	(55)	(15)	(146)
	Medium	84.1	123.9	191.2	122.7
		(13)	(22)	(7)	(42)
	High	32.3	78.1	228.7	108.4
		(2)	(7)	(3)	(12)
	Overall	32.3	104.8	143.0	76.5
		(91)	(84)	(25)	(200)

Table 12. Percentage incremental yield for different levels of inorganics in rainfed and irrigated conditions

Zones	Rainfed/Irrigated	inorganics			
		Low	Medium	High	Overall
Kozhikode	Rainfed	11.1	15.7	29.2	12.2
	Irrigated	31.4	-11.4		19.5
Ernakulam	Rainfed	28.4	192.6	182.1	72.9
	Irrigated	43.2	114.0	199.6	83.8
Thiruvananthapuram	Rainfed	50.2	113.5	77.3	64.5
	Irrigated	93.6	146.6	200.8	112.7

Table 13. Effect of neem cake application on yield

Situation	Particulars	Kozhikode	Ernakulam	Thiruvananthapuram
Neem cake applied	Avg. Yield	37.75	55.88	50.13
	No. holdings	14	45	5
	CV (%)	53.19	68.43	48.52
Without any neem cake application	Avg. Yield	42.05	37.16	44.17
	No. holdings	185	153	195
	CV (%)	46.21	65.33	54.86

IMPLICATIONS

1. Input use efficiency varies between different coconut growing zones in the State.

2. Application of manures (organic and inorganic) has a decisive role in productivity in Ernakulam and Thiruvananthapuram districts while the effect is not that evident in Kozhikode district.

3. In all the districts, the palm density showed a significant negative association with yield.

4. In Ernakulam district, the combined effect of manures (organic + inorganic) is very much prominent on the yield, substantiating the relevance of manurial recommendations for root(wilt) disease management by CPCRI.

5. In Thiruvananthapuram district also a similar trend observed but less in magnitude.

6. In Ernakulam district, application of chemical fertilizers alone did not have any effect on yield.

7. Different levels of organic manure application under irrigated situation had incremental and prominent effect on yield in Thiruvananthapuram district, but the effect, though prominent, is not commensurate with levels of organics in Ernakulam district.

8. Even under rainfed situations, organic manure application had favourable effect on yield in Ernakulam and Thiruvananthapuram districts.

9. Irrespective of irrigation status, application of chemical fertilizers results in higher yields.

10. The effect of irrigation on yield was more visible in Thiruvananthapuram district when compared to other two districts.

11. The non-significant association between input use and yield observed in Kozhikode district might be due to factors such as inherent higher productivity of palms.

12. The results of this study indicate that the often assumed effect of input use on yield man not be realized uniformly under varying field situations.

13. Hence, there is a need to initiate on-farm trials on management of resources in coconut holdings under various agroclimatic zones for streamlining/refining recommendations.

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