RPF III **FINAL REPORT**

1.	Institute code No.	**100769002**
2.	ICAR code No.	**100769002**
3.	Name and address of the Research Institute/ Center	**Division of Social Sciences** **Central Plantation Crops Research Institute** **Kasaragod, Kerala 671 124**
4.	Project title	**Impact analysis of production, protection and processing technologies of coconut**
5.	Name and designation of Principal Investigator	**Dr.C.V.Sairam** **Senior Scientist (Agricultural Economics)** **Central Plantation Crops Research Institute** **Kasaragod, Kerala 671 124**
6.	Name(s) and designation of Associate(s) and establishment(s) on which born (a) Whole time	
	(b) Part time (indicate proportion of time to be devoted and other area(s)	**Shri. K.Vijayakumar** **Scientist (SG) [Agril.Statitics]** **CPCRI, Kasaragod**
7.	Location of research project with complete address Division/Section/Sub Station	Division of Social Sciences Central Plantation Crops Research Institute Kasaragod, Vittal and Kayangulam
8.	Date of start	2000-01
9.	Date of termination	2005-06
10.	(a) Objectives (not more than 150 words)	India is one among the major producers of coconut in the world. The country annually produces 12141 million nuts from an area of 19.14 lakh ha and the realized average productivity of 6345 nuts/ha is the highest in the world. Coconut cultivation in India is pre-dominated with small and marginal farmers and

the average holding size in 80% of the total cultivated area is less than one ha. In some states like Kerala, the holding size is much less (<0.2 ha). In this situation, the vicious cycle of less marketable surplus - low return – low capital base for investment in agriculture – low technology adoption – lesser production and productivity continue to operate in the Indian coconut production sector. CPCRI and SAU's have evolved various production, protection and processing technologies in coconut. An impact assessment of these technologies would indicate the relevance of the research findings of CPCRI and SAU's. In this background the present study was undertaken to assess the impact of coconut production technologies in Kerala and Tamil Nadu states.

(b) Practical utility (not more than 100 words)

An impact analysis would help to identify the major factor (s), which influence the coconut production. The major factors of production like the varieties, application of organic manures, chemical fertilizers, plant protection, irrigation, family and hired labour pose high degree of influence the realized output in coconut cultivation. Factor analysis through regression would indicate the most crucial factor, which would influence the coconut production, so that policy perspectives may be formulated based on the influence of the most important factor (s). The practical utility of this study is to identify the crucial factors influencing coconut production in Kerala and Tamil Nadu. Based on that suitable

		development schemes need to be formulated and effectively implemented for sustainable development of coconut.
11	Technical programme (Indicate briefly plan of procedure, techniques, instruments and special materials, organism, special environments etc.)	The objectives will be met through collection, tabulation and analysis of primary and secondary data on the above aspects. The study will be pertained to selected districts of Kerala and Tamil Nadu states.
12.	Final report on the project: (A summary of research not exceeding five pages precisely and concisely stating the fundamental and/or practical significance there of)	Enclosed
13.	Progress of work in relation to the time targeted for completion of work and reasons for non-achievement of targets if any	The research project was carried out as per the schedule and there was no constraint in implementing the same.
14.	Publications during the period (Two copies each to be supplied with this proforma) (a) Research papers (b) Popular articles (c) Reports	Enclosed
15	Details (Nos.etc) of field /laboratory note books and their final location	Not applicable
16.	Signature of Principal investigator	CN Sairam 24/01/06
17.	Signature of Head of Division/Station/Section	Muralidharan 24/1/06
18.	Signature of Director	V. Rajagopal निदेशक केन्द्रीय रोपण फसल अनुसंधान संस्थान कूडलु पोस्ट, कासरगोड़, केरल DIRECTOR CENTRAL PLANTATION CROPS RESEARCH INSTITUTE P.O. KUDLU, KASARAGOD - 671 124, KERALA STATE

DETAILS OF THE RESEARCH RESULTS

1. Impact of coconut production technologies in Tamil Nadu

Technological change in the literature of economics is a stock concept indicating the body of knowledge that can be applied in the productive processes. Consequently, changes in technology imply changes in this stock. The modern agricultural technology involves the use of seeds of high yielding variety, chemical fertilizers, irrigation water and plant protection measures. Their impact on crop production is discussed.

Methodology

A field survey was conducted in Coimbatore and Thanjavur districts of Tamil Nadu, with an objective to assess the impact of coconut production technologies on coconut production.. 120 coconut farmers each from these two districts were selected at random using cluster sampling technique. The primary data collected pertains to the year 2003-04.

A technology adoption index was constructed to categorize the sample farmers as a low, medium and high adopters of technology. Planting space, fertilizers, irrigation and plant protection chemical were used as components of technology to construct the index. Each component of technology was given weight according to its share in the total cost of cultivation of each crop.

Value of the technology adoption index so constructed, ranged between 0 to 100 per cent. The farmers were categorized into three groups on the basis of level of adoption of technology. The farmers adopting less than one-third, one-third to two-thirds and more than two-thirds of the Tai were categorized as low, medium and high adopters of technology, respectively. More specifically, the farmers having less than 40 percent Tai were grouped as low adopters. The farmers with value of tai between 40 to 70 per cent wee treated ad medium adopters. Farmers, having more than 70 per cent tai were grouped as high adopters of technology.

The formula to construct the technology adoption index for I th farmer who is growing several crops on the farm is given below.

$$TAI = \sum_{J=1}^{m} \left(w_{aj} \frac{FA_{IJ}}{FR} + w_{bj} \frac{IA_{IJ}}{IR} + w_{cj} \frac{PA_{IJ}}{PR} \right) * \frac{CA_{ij}}{TA_i} * 100$$

I= 1,2,3.........n farmers

j= 1,2,3.........m farmers

TAI = technology adoption index of i th farmer

TA_{IJ} = number of trees per ac by i th farmer

TR= number of trees recommended per acre

FA_{IJ} = quantity of nutrients applied by i th farmer(kg) /ac

FR = quantity of nutrients recommended (kg) /ac

IA_{IJ} =number of litres of water applied per year per acre

IR = number of litres of water recommended per year per acre

PA_{IJ} = amount of plant protection chemicals applied per acre by i th farmer (Rs)

PR = amount of plant protection chemicals recommended per acre.

CA_{ij} = cropped area of j th crop for I th farmer (ac)

TA_i = gross cropped area for the I th farmer

w_{aj} = share of cost of chemical fertilizers by the I th farmer in the cost of cultivation

w_{bj} = share of cost of irrigation by the I th farmer in the cost of cultivation

w_{cj} = share of cost of plant protection by the I th farmer in the cost of cultivation

$w_{aj} + w_{bj} + w_c = 1$

Production function

Various forms of production functions were fitted by using the input and output data. Cobb Douglas production function, which gave the best fit, was selected for this study. Cobb-Douglas production function was used to measure the effect of technological change in shifting the production fraction. The functional form of the production function is given below.

$Y = \alpha S^{b1} F^{b2} P^{b3} I^{b4} L^{b5} e$

Y = yield (nos/ac)

S = no trees planted in an acre

F = quantity of fertilizers(kg/ha)

P= quantity of plant protection chemicals (g/ac)

I = irrigations litres/ac

L=human labour used (mandays/ac)

bi =production elasticity of the i th input

α = constant

u = random term

Cobb-Douglas production function may also be expressed in log liner form and is given below.

$\ln Y = a + b_1 \ln F + \ln b2F + \ln b_3 P + \ln b_4 I + \ln b_5 L + U$

WHERE $a = \ln\alpha$

Test for shift in production function

Chow test was used to test whether the estimated parameters of the production functions of three levels of adoption of technology are different. This test will be used for two production functions at a time. Once, the chow test was found to be significant, and analysis of covariance test was used further to examine the nature of technological change, by which the production function shifts. The shift in production function may be due to change in the intercept or slope parameters or both. If the change in the intercept parameter only was significant, the shift in production function was due to the neutral technological change. A technological change is said to be neutral if it does not change the ratio of marginal products of the inputs. In other words, the neutral technological change means shift in production function as a result of more efficient use of inputs. The nature of technological change was non-neutral, if there was a significant change in the slope parameters of the production functions. A technological change is said to be non-neutral if the technological change results in changes in the ratio of marginal physical technological change, means increase in the efficiency of a particular input due to improvement in technology. The nature of technological change was both neutral and non-neutral when both intercept ands slope parameters changed significantly.

In order to examine the shift in production function for different levels of adoption of technology, the chow test was applied only for two levels of adoption of technology ie low and medium and high and low and high. For example, to examine the shift in production functions for low and medium adopters of technology, the estimated production function for low and medium adopters are given below

Low adopters of technology

$\ln Y_o = a_o + b_{o1} \ln F + \ln b_o 2F + \ln b_{o3} P + \ln b_{o4} I + \ln b_{o5} L + U$

Medium adopters

$\ln Y_N = a_N + b_{N1} \ln F + \ln b_N 2F + \ln b_{N3} P + \ln b_{N4} I + \ln b_{N5} L + U$

Pooled for low and medium adopters of technology

$\ln Y_H = a_H + b_{H1} \ln F + \ln b_H 2F + \ln b_{H3} P + \ln b_{H4} I + \ln b_{H5} L + U$

When the chow test was found significant, the analysis of covariance test was further used to examine the nature of technological change using the intercept dummy. The pooled production function with the intercept dummy for low and medium adopters of technology is given below

D = intercept dummy variable, which takes value 1 for medium adopters and 0 for low adopters of technology

The null hypothesis and F statistics for relevant tests are and follows.

Chow test

To find the impact of technology on overall shift in production function using chow test

$$F = \frac{[RSSP-(RSS_O+RSS_N]/K}{(RSS_O+RSS_N)/(n_1+n_2-2K)}$$

DEGREE OF FREEDOM (K, n_1+n_2-2K)

Analysis of covariance test

1) to test whether the technological change is neutral

$$F = \frac{[RSS_P-RSS_D]}{(RSS_D/(n_.K-1)}$$

DF (1, $n_.K-1$)

To test whether the technological change is non-neutral

$$F = \frac{[RSS_D-(RSS_O+RSS_N]/(K-1)}{(RSS_O+RSS_N)/(n-2K)}$$

DF K-1, n-2K

K= number of parameters estimated

$N=n_1+n_2$

If $F_{cal} > F_{tab}$, the null hypothesis is rejected, else it is no rejected. in the light of above results, inferences have been drawn.

Test For Identification Of The Variable Causing The Shift In Production Function

In order to find the exact reason of the shift in production function. following function was fitted including the dummy variable in the pooled data.

$$\ln Y = a + b_1 \ln T + \ln b2F + \ln b_3 P + \ln b_4 I + \ln b_5 L + \S_A D + \S_1 \ln T + \S_2 D \ln F + \S_3 D \ln I \S + U$$

$\S_A$= coefficient of intercept dummy

$\S_1$= coefficient of dummy for trees

$\S_2$= coefficient of dummy for fertilizer

$\S_3$= coefficient of dummy for plant protection

$\S_4$= coefficient of dummy for irrigation

Significance of the coefficient of a specific dummy variable indicates that the relevant factor is a cause of shift in production function. The same procedure as given above was followed to compare the production function estimated for only two levels of adoption of technology.

Results and discussions

Using the technological adoption index first the farmers are categorized into three categorise low, medium and high adopters . It is done for two districts which was reported in the table1.

Table 1 Number of selected farmers under different levels of adoption of technology (Nos)

Category	Thanjavur	Coimbatore
Low adopters	24	17
Medium adopters	69	28
High adopters	26	75

For the different levels of adoption of technology, the production were estimated and compared. An attempt was also made to examine the nature of technological change due to neutral and or non-neutral technological changes.

Cobb-Douglas production function was estimated separately for low, medium and high levels of adoption of technology farmers, irrespective of size of farm. The production function was also estimated for any two levels of adoption of technology farmers for pooled data. In order to test the shift in production function between any two levels of adoption of technology chow's F-statistics was computed in each case. The shift in production function for different levels of technology adoption is discussed separately.

Coconut crop

The effect of adoption of technology on shift in production function of coconut crop has been discussed under three heads namely low versus medium adopters of technology, low versus high adopters of technology and medium versus high adopters of technology for two districts.

Low versus medium adopters

For comparing low and medium adopters of technology, chow's f-statistics was estimated and is given in table 2. It may be seen from this table that f-statistics was significant. This shows that the estimated parameters of the production functions of coconut for low and medium adopters of technology were significant different from each other for the two districts. This implies that there is shift in the production function of coconut crop as a result of change in technology. The shift in production function owing to adoption of different levels of technology may be due to neutral and /or non-neutral technological change.

The nature of technological change in coconut was also examined. For this purpose, the analysis of covariance technique discussed in methodology was used. Pooled production function including all variables and a dummy variable for scale parameter was also fitted. F-statistics were worked out including low, medium and pooled production functions and are also presented in table2. Covariance analysis test indicated that f-value for difference in scale parameter was significant for both districts. Whereas f-ratio for difference in slope parameters was not significant. It reveals that the shift in the production function between low and medium adopters of technology of coconut crop was only due to scale parameter, that is, neutral technological change.

Medium versus high adopters

For comparing medium and high adopters of technology, chow's f-statistics was estimated and is given in table 2. It may be seen from this table that f-statistics was significant. This shows that the estimated parameters of the production functions of coconut for medium and high adopters of technology were significant and different from each other for the two districts. This implies that there is shift in the production function of coconut crop as a result of change in technology. The shift in production function owing to adoption of different levels of technology may be due to neutral and /or non-neutral technological change.

The nature of technological change in coconut was also examined. For this purpose, the analysis of covariance technique discussed in methodology was used. Pooled production function including all variables and a dummy variable for scale parameter was also fitted. F-statistics were worked out including low, medium and pooled production functions and are also presented in table2. Covariance analysis test indicated that f-value for difference in scale parameter was significant for both districts. Whereas f-ratio for difference in slope parameters was significant only for Thanjavur districts. It reveals that the shift in the production function between medium and high adopters of technology of coconut crop in Thanjavur district was due to slope parameter, that is, both neutral and non neutral technological change.

Low versus high adopters

For comparing low and high adopters of technology, chow's f-statistics was estimated and is given in table 2. It may be seen from this table that f-statistics was significant. This shows that the estimated parameters of the production functions of coconut for low and high adopters of technology were significant and different from each other for the two districts. This implies that there is shift in the production function of coconut crop as a result of change in technology. The shift in production function owing to adoption of different levels of technology may be due to neutral and /or non-neutral technological change.

The nature of technological change in coconut was also examined. For this purpose, the analysis of covariance technique discussed in methodology was used. Pooled production function including all variables and a dummy variable for scale parameter was also fitted. F-statistics were worked out including low, high and pooled production functions and are also presented in table2. Covariance analysis test indicated that f-value for difference in scale parameter was significant only for Thanjavur district. Whereas f-ratio for difference in slope parameters was significant for both districts. It reveals that the shift in the production function between low and high adopters of technology of coconut crop in Thanjavur district was due to slope and scale parameter, that is, both neutral and non neutral technological change whereas for Coimbatore district it was due to non neutral technologies.

Test of shift in production function and nature of technological changes for Coimbatore and Thanjavur districts

Chow test	THANJAVUR		COIMBATORE	
	calculated f	Tabulate	calculated f	Tabulat
low medium	202.0229*	2.482	2.54	2.49
medium-high	118.978*	2.478	15.48	2.31
low-high	38.87233*	2.6	8.26	2.32
Neutral technological change				
Category	calculated f	Tabulated f	calculated f	Tabulated f
low medium	129*	3.925	10.09	4.085
medium-high	195.0937*	3.948	34.43	3.93
low-high	147.303*	4.062	0.166	3.95
Non neutral technological change				
Category	calculated f	Tabulated f	calculated f	Tabulated f
low medium	0.87	2.327	1.8	2.65
medium-high	2.446*	2.323	0.064	2.46
low-high	4.108*	2.456	10.39	2.48

Low – medium adopters

In case of low medium category the chow test was significant and there was a shift in the production function. The shift is due to neutral technological changes for both the districts.

Medium-high adopters

In case of medium-high category the chow test was significant and there was a shift in the production function for both the districts. In case of Thanjavur district the shift is due to both neutral and non neutral technological changes. In order to identify the specific cause for non-neutral technological change, pooled production function including intercept dummy, all input variables and their slope dummy variable was fitted the estimated parameters are presented in the table. It may be seen from this table that the estimated regression coefficient for interaction between fertilizer and dummy variables was significant. This indicates that the technological change between medium and high adopters of technology was biased in favour of fertilizer(Thanjavur).

Cause of non-neutral technological change between medium and high adopters of technology for Thanjavur district

Regression Statistics	
Multiple R	0.905422
R Square	0.819789
Adjusted R Square	0.800929
Standard Error	0.077718
Observations	96

	Coefficients	*Standard Error*	*t Stat*
Intercept	4.227187	0.752134	5.620255
fertilizers/ac	0.131085	0.04538	2.888606
spacing/ac	0.960708	0.156143	6.152758
Irrigation l /ac	-0.08591	0.06968	-1.23292
human labours	-0.00558	0.018514	-0.30126
pp amt	0.001455	0.002712	0.5366
Intercept dummy	0.252761	0.019255	13.12669
fertilizers/ac dummy	0.011941	0.00444	2.689459
Spacing dummy	0.003629	0.004945	0.733901
Irrigation dummy	0.005433	0.007241	0.750231

Low – high adopters

In case of low high category the chow test was significant and there was a shift in the production function.. In order to identify the specific cause for non-neutral technological change, pooled production function including intercept dummy, all input variables and their slope dummy variable was fitted the estimated parameters are presented in the table. It may be seen from this table that the estimated regression coefficient for interaction between irrigation and dummy variables was significant (Thanjavur). This indicates that the technological change between low and high adopters of technology was biased in favour of irrigation in case of Thanjavur whereas in case of Coimbatore district is due to both irrigation and fertilizer.

Cause of non-neutral technological change between low and high adopters of technology for Thanjavur district

Multiple R	0.980224
R Square	0.960839
Adjusted R Square	0.952242
Standard Error	0.067532
Observations	51

	Coefficients	*Standard Error*	*t Stat*
Intercept	4.060869	0.789638	5.142695
fertilizer/ac/yr	-0.01536	0.072476	-0.2119
spacing/ac	0.818158	0.156397	5.231278
irrigation l/yr/ac	0.306048	0.108259	2.826996
human labours mandays	0.000568	0.018897	0.030049
pp amt Rs	0.001424	0.003384	0.420881
Intercept dummy	0.394944	0.043725	9.032493
Irrigation dummy	0.026029	0.008676	3.000077
Fertilizer dummy	0.003025	0.005237	0.57761
Spacing dummy	0.007284	0.005483	1.328523

Cause of non-neutral technological change between low and high adopters of technology for Coimbatore district

Regression Statistics	
Multiple R	0.971867
R Square	0.944526
Adjusted R Square	0.939047
Standard Error	0.034086
Observations	90

ANOVA

	df	*SS*	*MS*
Regression	8	1.602401	0.2003
Residual	81	0.094113	0.001162
Total	89	1.696514	

	Coefficients	*Standard Error*	*t Stat*
Intercept	4.187643	0.312985	13.37968
Irrigation	0.114799	0.050519	2.272384
fertilizer	0.13016	0.056697	2.295722
spacing/ac	-0.0388	0.058542	-0.66284
Human labour	-0.00224	0.006605	-0.33968
Irrigation dummy	0.065049	0.014523	4.478933
Fertilizer dummy	0.068124	0.019125	3.562086
Dummy spacing	0.002078	0.008617	0.241198
Intercerpt dummy	0.124518	0.024229	5.139141

For sustaining the profitability of coconut cultivation in Thanjavur district Tamil Nadu irrigation is a crucial factor, which needs prime attention by the planners and policy makers. The impact of irrigation on coconut production plays significant role as compared to other factors of production in Thanjavur district, whereas both irrigation and fertilizer application played a significant role in Coimbatore district. .

Production Function analysis

Production function analysis indicated that in the case of Coimbatore district, linear production function was better suited as compared to Cobb-Douglas production function, whereas in the case of Thanjavur, the later was the best fit.

Model Summary of Coimbatore district data

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.609	.371	.352	1765.532

a Predictors: (Constant), Labour Cost per ha , Organic Cost per hectare , Fertilizer Cost per hectare
b Dependent Variable: Production per ha

ANOVA of Coimbatore district data

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	178550636.610	3	59516878.870	19.094	.000
	Residual	302359192.180	97	3117105.0		
	Total	480909828.790	100			

a Predictors: (Constant), Labour Cost per ha , Organic Cost per hectare , Fertilizer Cost per hectare
b Dependent Variable: Production per ha

Coefficients of Coimbatore district data

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	9941.388	9875.700		1.007	.317
	Organic Cost per hectare	3.893	.636	.536	6.120	.000
	Fertilizer Cost per hectare	.188	.108	.152	1.732	.086
	Labour Cost per ha	-4.834	6.842	-.057	-.706	.482

a Dependent Variable: Production per ha

It could be inferred from the above results that amount of organic manures applied per hectare significantly influences the production per hectare, whereas other independent variables such as fertilizer cost per hectare and labour used per hectare were not significant. However since the 'F' value is highly significant, all these three variables in combination significantly affect the coconut production per hectare.

Model Summary of Thanjavur district

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.908	.824	.473	.10604

a Predictors: (Constant), Log Labour , Log PP, Log Phosphorous , Log organics, Log Neem Cake , Log Micronutrients

ANOVA of Thanjavur district

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.158	6	.026	2.346	.259
	Residual	.034	3	.011		
	Total	.192	9			

a Predictors: (Constant), Log Labour , Log PP, Log Phosphorous , Log organics , Log Neem Cake , Log Micronutrients
b Dependent Variable: Log production

Coefficients of Thanjavur district

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	35.436	11.097		3.193	.050
	Log PP	6.715E-02	.217	.137	.310	.777
	Log Neem Cake	-.410	.176	-1.446	-2.331	.102
	Log Phosphorous	-5.565	3.843	-1.226	-1.448	.243
	Log organics	.299	.150	.667	1.997	.140
	Log Micronutrients	.778	2.169	.287	.359	.743
	Log Labour	-5.142	2.099	-1.056	-2.449	.092

a Dependent Variable: Log production

In the case of Thanjavur district, it could be inferred from the above results that though the Cobb-Douglas production function was exhibiting a good fit, none of the variables had significantly influenced the production

Impact analysis of production, protection and processing technologies of coconut

A field survey was conducted in Kasaragod district of Kerala in 370 coconut gardens selected at random using cluster sampling technique. The input output data collected were pertained to 2003-04. The linear production function analysis for coconut cultivation indicated that all the prime factors of production viz., labour, organic manures, expenditure on irrigation and plant protection has significantly influenced the coconut production in Kasaragod district.

The socio-economic characters indicated that 66.7 % of the sample farmers are in age group of 30 to 60. The sex wise classification indicated that 70.9 percent of the farmers are males. More than 93 percent of the sample farmers had primary or secondary education. 75 percent of the sample farmers have medium to rich level of experience in farming. The classification of the operational holdings indicated that 31.3 percent were marginal farmers, 49.6

were small farmers 12.5 percent are medium farmers and 6.6 percent are large farmers.

The same based on area under coconut are 39.5 percent marginal, 48.5 percent small, 9.6 percent medium and 2.4 percent large. The data regarding the source of information indicated that 63.9 percent of the farmers depend on traditional source of information, while 30.6 percent depend on modern source of information such as television channels, web sites etc. Only 9.6 percent of the sample farmers are serving as members in professional bodies and 3.2 percent are serving as leaders in some societies / organizations. 42.4 percent of the farmers indicated that they respond to newer technologies in agriculture. It is interesting to note that 38.7 percent of the farmers are helping in technology dissemination by sharing the technologies with other farmers. They also reported that they do test the new technologies in their own farm. Only 5 percent of the farmers participate in other professional activities.

Data on planting density of coconut indicated that 32.8 percent of the farmers adopt lower level of planting density, 35.2 percent adopt medium to optimum level, 13.2 percent adopt higher planting density and 18.8 percent adopt very high planting density. The data on adoption of high yielding varieties of coconut, it was observed that only 7.4 percent of the coconut farmers adopt them. Production function analysis indicated that expenditure on organic manures, plant protection, irrigation and labour had significant positive impact on coconut production per hectare.

Model Summary of coconut cultivation in Kasaragod district

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.896	.803	.799	1815.845

a Predictors: (Constant), Total labour utilized , Fertilizer Rupees, Organic Rupees, Plant Protection Rupees, Irrigation Rupees, Miscellaneous

ANOVA in coconut cultivation in Kasaragod district

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3326031653.970	6	554338608.995	168.119	.000
	Residual	814431317.290	247	3297292.783		
	Total	4140462971.260	253			

a Predictors: (Constant), Total labour utilized , Fertilizer Rupees, Organic Rupees, Plant Protection Rupees, Irrigation Rupees, Miscellaneous

b Dependent Variable: Coconut Production Nuts

Coefficients of the production function for coconut cultivation in Kasaragod district

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	138.379	159.035		.870	.385
	Miscellaneous	.476	.211	.097	2.254	.025
	Irrigation Rupees	.614	.193	.130	3.180	.002
	Organic Rupees	.257	.060	.191	4.302	.000
	Fertilizer Rupees	-8.253E-02	.100	-.029	-.822	.412
	Plant Protection Rupees	9.583	.851	.473	11.266	.000
	Total labour utilized	.318	.061	.253	5.188	.000

a Dependent Variable: Coconut Production Nuts

Arecanut production function

The planting density of arecanut indicated that 64.9 percent of the arecanut farmers were adopting low planting density, while 24.6 percent are adopting medium to optimum planting density and 10.5 percent are adopting high planting density. In the case of adoption of high yielding varieties of arecanut, it was observed that only 5.8 percent are cultivating high yielding varieties such as Mangala, while 94.2 percent are cultivating only the local variety. Since the system dynamics in perennial crops, especially for replanting / under-planting process is a long run process, unless concerted efforts are taken, increasing the area under high yielding varieties is a difficult process. Regarding adoption of arecanut based cropping system models, it is satisfying to note that 93.2 percent of the farmers adopt various ABCS models.

Production function analysis indicated that expenditure on chemical and organic fertilizers and miscellaneous expenditure had increased the production.

Model Summary of arecanut cultivation in Kasaragod district

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.895	.802	.797	437.089

a Predictors: (Constant), Fertilizer Rupees, Organic Rupees, Miscellaneous, Plant Protection Rupees, Irrigation Rupees, Total labour used

ANOVA in arecanut cultivation in Kasaragod district

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	211681953.296	6	35280325.549	184.669	.000
	Residual	52346730.988	274	191046.463		
	Total	264028684.285	280			

a Predictors: (Constant), Fertilizer Rupees, Organic Rupees, Miscellaneous, Plant Protection Rupees, Irrigation Rupees, Total labour used

b Dependent Variable: Arecanut Production Kg

Coefficients of the production function for arecanut cultivation in Kasaragod district

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	-4.973	29.726		-.167	.867
	Total labour used	-9.045E-04	.026	-.002	-.035	.972
	Miscellaneous	.600	.066	.415	9.149	.000
	Irrigation Rupees	7.397E-02	.045	.074	1.643	.101
	Plant Protection Rupees	-1.320E-02	.025	-.024	-.526	.599
	Organic Rupees	-1.464E-02	.007	-.114	-2.162	.032
	Fertilizer Rupees	.282	.018	.591	15.408	.000

a Dependent Variable: Arecanut Production Kg

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