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Trend, Determinants and Profitability of Coconut Cultivation in Kerala

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One important feature of Kerala's agriculture is the change in cropping pattern in favour of commercial crops. In this change, plantation crops increased considerably. Among these crops coconut is an important commercial crop in Kerala. There must be certain determinants that motivated the farmers to make such a shift in the cropping pattern. Supply response in terms of area response and yield response models were used to analyse the determinants. The determinants estimated are lagged area, expected price of the crop, lagged yield, expected yield risk and price risk, average annual rainfall, irrigated area, etc. The analysis revealed that irrigated area, rainfall and price risk factors are the significant variables affecting the area allocation of the crop in Kerala. For the crop's yield response, irrigated area, rainfall and expected price risk are the strong variables. The input wise cost of coconut cultivation in Kerala by size of farm did not indicate any specific relation between the total cost of cultivation and the size of farm. Average return per hectare of coconut indicated inverse relation with the size of farm. Estimating costs and returns of coconut cultivation in terms of various investment criteria revealed that this crop is profitable in Kerala. The study also revealed that profitability of coconut is inversely related to the size of farm.
[Key Words: *Kerala; coconut, growth trend, profitability, area response, yield response.**]***
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Introduction

Kerala is endowed with diverse climatic, edaphic and socio-economic conditions and this has given rise to many location-specific cropping systems. Major cropping systems followed in the state includes paddy based cropping systems, coconut based cropping systems, arecanut based systems, plantation crops based cropping systems and other convenient based specific regional cropping systems.

During 1960-61 the order of the first five crops were rice, coconut, tapioca, rubber and pepper, in the descending order of shares to the total cropped area in Kerala. At present, the first five crops are coconut, rubber, rice, pepper and arecanut. Coconut came to the first position by pushing rice to the third.

Agriculture continues to be the core sector in the rural economy of Kerala, providing livelihood security for vast majority of the population. The state which accounts for only 1.18 percent of the geographical area of the country supports nearly 3.10 percent of the population (Karunakaran, N., 2013, pp. 48-58). Kerala is one of the states in India, where land resources are put to more intensive use than anywhere else mainly because of the low per capita availability of land. Out of a geographical area of 38.85 lakhs hectare, land devoted to agriculture is about 58 percent. Even after five decades of development planning, over half of the population in Kerala still subsists on the income generated from the relatively small agricultural holdings (Mani, K.P., 2009, pp.80-84).

In the crop production sub sector, a mixed trend has been observed indicating fluctuations in production of coconut, pepper, ginger, arecanut, banana and coffee with declining trend in cashew and tapioca. The production of rubber has shown consistent increase over the years. Although the growth performance of the sector as a whole is encouraging since 1990 – 91, it is noteworthy that the engine of growth is fuelled by the two principal crops namely coconut and rubber that too on account of the large scale area expansion through the shift in cropping pattern (Santhakumar, V. and Narayanan Nair, K., 1999, p.314).

The land use pattern of Kerala shows that, in the state coconut is a dominant crop. It is mainly a small farmer's crop. More than 75 percentage of the coconut holdings are of less than two hectare in size. Naturally there must be certain determinants in the cultivation of this crop. Any change in its cultivation either in terms of area, production or productivity would seriously affect the weaker sections of the agriculture population. The cost of production and returns are very important for the sustainability of this crop. Hence in this paper an attempt is made to examine the determinants, costs and returns of coconut cultivation in Kerala.

Methodology and Materials

The study used both primary and secondary data. Primary data were collected from the coconut growers of the state. The major sources of secondary data are the various published reports of the Government of Kerala and India. The time element in the calculation of costs, returns and profitability has been considered with the help of the following four investment criteria widely used in the project evaluation.

I. Pay Back Period (PBP)

The PBP is the number of years an investment project taken to recover costs from its returns. The PBP equals t*, where t* is the lowest value of t for which the following inequality holds:

$$\sum_{t=1}^{t*} Ct < \sum_{t=1}^{t*} Rt$$

Where, Rt = Return in Period t

Ct = Cost in Period t

II. Net Present Value (NPV)

The NPV on investment is the discounted value of all cash inflows, net of all cash outflows of the project during its life time. It can be computed as:

$$\mathbf{NPV} = \sum_{t=1}^{T} \left(\frac{Rt-Ct}{(1+i)t} \right)$$

Where, i = discounted rate

T = number of years

III. Internal Rate of Return (IRR)

The IRR is that discount rate at which the NPV is zero. The equation for its calculation is

$$\sum_{t=1}^{T} \left(\frac{Rt - Ct}{(1 + r)t} \right)$$

IV. Benefit Cost Ratio (BCR)

The BCR of an investment is the ratio of the discounted value of all cash inflows to the discounted value of all outflows during the life of the project. It can be computed as

$$\mathbf{BCR} = \frac{\sum_{t=1}^{T} \frac{Rt}{(1+i)t}}{\sum_{t=1}^{T} \frac{Ct}{(1+i)t}}$$

Supply response models give valuable information regarding farmer's decision behaviour in response to price and non-price factors. The model helps one to know how the farmers react to changes in the price of the crop that they produce (Ramesha, Y.S., Ramanna, R. and Lalith Achoth, 1988, pp.9-13). It also helps one to ascertain how farmers reallocate resources among various crops in response to changes in relative price levels. Various studies pointed out that the popular methodology to discuss the determinants is the supply response models, where the farmer's decisions are discussed from two angles, area response and yield response (Mythili, G., 2006, pp.1-3).

The popular framework which the agricultural economists used to analyse the determinants of changes in cropping pattern is the Nerlovian supply response models (Usha Tuteja, 2006, pp.218-237.). This model has been used in this study and the farmers decisions are discussed in terms of area response and yield response and the following models were developed and estimated for coconut on the basis of Nerlovian lagged adjustment model.

V. Area Response Model for Coconut:

$$At = a_0+a_1At\text{-}i+a_2Pt^e+a_3RFt+a_4Yt\text{-}i+a_5YRt^e+a_6PRt^e+a_7It\text{-}i+vt \quad \text{.... (1)}$$

VI. Yield Response Model for Coconut:

$$Yt = b_0+b_1Yt\text{-}i+b_2Pt^e+b_3RFt+b_4YRt^e+b_5PRt^e+b_6It+ut \quad \text{.... (2)}$$

Where, At = Area under the crop in the current year,

Yt = Yield per hectare of the crop in the current year,

At-i = Area under the crop lagged by i years,
Pt^e = Expected price of the crop (The expected price of the crop in period t was calculated as the average prices prevailing in the preceding three years),
Yt-i = Yield of the crop lagged by i years,
YRt^e = Expected yield risk in the current year (The yield risk in period t was represented by the standard deviation of yield in the past three years from period t),
PRt^e = Expected price risk in the current year (The price risk in period t was represented by the standard deviation of price in the past three years from period t),
It-i = Irrigated area lagged by i years,
It = Irrigated area in the current year,
RFt = Average annual rainfall in mm,

The regression coefficients were estimated by the method of OLS. The regression coefficients were tested for their significance using t test. Durbin-Watson statistic was also computed for testing the incidence of auto-correlation.

Compound Growth Rates of area, production and productivity of coconut for the period 1960-61 to 2011-12 were estimated with the following exponential model.

$$Y = ab^t$$

The growth rate (GR) has been computed using the formula:

$$GR = (\text{Antilog } b-1)100$$

The F test has been applied to test the significance of b.

Results and Discussion

I. Coconut cultivation in Kerala

Kerala was traditionally a coconut growing area along with the coastal states of Karnataka, Tamilnadu and Andhra Pradesh and is the chief economic activity of the people and is a main source of income and employment. The area under coconut has been increasing over the years since 1960-61 in Kerala. From 1960-61 to 2011-12 there has been an increase of 55.86 percent. The percentage changes in the area under coconut cultivation in different periods are presented in Table.1. The table shows that between 1960-61 and 2011-12, the largest area increase was happened in the northern districts and many of the southern districts recorded decrease in the area under coconut.

Table. 1. Percentage Change in the Cultivation of Coconut in Kerala in Different Periods (1960-61 to 2011-12).

Sr. No	Districts	1970-71 over 1960-61	1980-81 over 1970-71	1990-91 over 1980-81	2000-01 over 1990-91	2011-12 over 2000-01	2011-12 over 1960-61
1	Thiruvananthapuram	38.33	-3.11	16.01	3.60	-18.26	31.68
2	Kollam	41.75	-10.87	-4.76	2.36	-26.51	-9.48
3	Pathanamthitta	-	-	-	-17.13	-21.46	-34.91
4	Kottayam	28.76	-32.48	-76.26	-11.89	-15.33	-40.09

5	Alappuzha	8.75	-23.47	5.62	-10.33	-26.43	-42.01
6	Ernakulam	44.34	-4.51	8.84	1.72	-26.69	11.86
7	Idukki	-	-	-10.55	60.19	-16.32	19.91
8	Trissur	40.23	7.09	49.65	10.66	-8.69	127.0
9	Palakkad	84.24	-32.61	66.22	21.59	30.18	226.6
10	Malappuram	-	-	71.33	7.95	-5.12	75.49
11	Kozhikkode	39.52	-31.84	29.21	5.47	-4.51	23.74
12	Wayanad	-	-	-	143.79	11.79	172.5
13	Kannur	94.06	-22.32	25.92	5.53	-15.21	69.83
14	Kasaragod	-	-	-	33.25	-3.41	28.69
15	State	43.61	-9.42	23.89	14.72	-15.69	55.86

Source: Computed from (i) Statistics for planning (various issues), Department of Economics and Statistics, Govt. of Kerala, Thiruvananthapuram. (ii) Economic Review (various issues), State Planning Board, Govt. of Kerala, Thiruvananthapuram.

Time series analysis of acreage, production and productivity data shows that the growth rate of coconut production was determined more by increase in area. Table.2 revealed that coconut depicted fluctuating trend in productivity growth rate during different decades. It is also worthwhile noting that among the non-food categories, the growth of area expansion index is tremendous in the case of coconut.

Table. 2. Compound Growth Rates of Area, Production and Productivity of Coconut in Kerala (1960-61 to 2011-12).

Sr. No	Item	1960-61 to 1969-70	1970-71 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-00	2000-01 to 2011-12	1960-61 to 2011-12
1	Area	4.013	-1.229	2.742	** 0.910	*** -1.202	1.072
2	Production	2.197	-3.403	4.034	2.113	**** 1.009	1.386
3	Productivity	-1.439	-2.202	1.259	1.193	2.662	0.366

** - Significant at probability level 0.03
*** - Significant at probability level 0.05
**** - Significant at probability level 0.10

II. Determinants of Coconut cultivation in Kerala

The important determinants included are prices, yields, irrigation, rainfall, acreage and the risk factors. In estimating yield response and area response functions for coconut during the three periods these variables are incorporated in the form of lagged area, expected price, average rainfall, lagged yield, expected yield risk, expected price risk and lagged irrigated area. The significance of the R-square value indicated that these variables are capable of explaining area response and yield response of coconut in Kerala in different periods.

1. Area response of Coconut

Considering the area response function (Table.3), by far the most important variable determining area allocation during period one for coconut

seems to be irrigated area and it has a very strong positive influence on the area planted under coconut during the period. The area response results of the second period are entirely different from that of the first period. The estimated results of price and yield risks, rainfall, previous years yield and irrigated area seems to be negative during the period.

Table. 3. Regression Coefficients of the Area response of Coconut in Kerala in Different periods.

Sr. No.	Variables	1960-61 to 1989-90	1990-91 to 2011-12	1960-61 to 2011-12
1	a_0	1.4185	4.5022	3.7708
2	At-i	0.2025 (0.210)	*0.8047 (0.311)	***0.3051 (0.153)
3	Pt^e	-0.0001 (0.131)	0.0264 (0.057)	0.0196 (0.054)
4	RFt	0.0412 (0.119)	-0.112 (0.060)	0.0528 (0.073)
5	Yt-i	0.0061 (0.355)	-0.1753 (0.190)	-0.1394 (0.144)
6	YRt^e	-0.0222 (0.017)	-0.00003 (0.011)	-0.0179 (0.012)
7	PRt^e	0.0129 (0.034)	-0.0069 (0.009)	0.0113 (0.018)
8	It-i	0.3188 (0.320)	-0.0744 (0.067)	0.139 (0.118)
9	R Square	0.6075	0.8817	0.8088
10	Durbin-Watson statistic	2.2276	1.7799	2.2226

Figures in bracket shows standard error

*- Significant at 0.01 level of significance

***- Significant at 0.05 level of significance

The area response function tried for coconut during the period 1960-61 to 2011-12 for the state presented in Table.3 revealed negative influence of yield risk and previous years yield on the area response of coconut. The expected price variable is positive but is statistically insignificant in the case of coconut. The estimated parameters of price risk showed positive significant value (0.0113) indicating the farmer's perceptions of risks for area adjustments. The results of Table.3 show that irrigated area is the most significant determinant affecting the area response of coconut. In addition to that rainfall and price risk factor also have significant value in the case of the area allocation decision of coconut farmers.

2. Yield response of Coconut

With regard to the yield equations presented in Table.4, irrigated area is the most important factor determining the yield response of coconut during the first period. The influence of rainfall and expected yield risk are weak for coconut during that period. The expected price risk variable has positive influence on the yield of crop whereas the expected price has significant negative influence on the yield response of coconut during the first period in Kerala. The results of the second period presented a different picture like that of area response. Rainfall and irrigated area has significant negative influence on

the yield response. Yield risk is insignificant and expected price have to be interpreted as a significant factor (0.0777) in the yield response of coconut.

Considering the entire period from 1960-61 to 2011-12, irrigated area variable turns out to be an important factor determining the yield response of coconut. Rainfall and expected price risk also has strong positive influence on the yield of coconut. While the expected price of coconut has strong negative influence (-0.0863) associated to the yield influencing variables. From the analysis, it is derived that the variables like irrigated area, expected price risk, rainfall, etc, in the model are the most determining area influencing factors of coconut. These variables are estimated to have significant influence on the yield response of coconut also, except expected price, in Kerala over the years from 1960-61 to 2011-12.

Table. 4. Regression Coefficients of the Yield response of Coconut in Kerala in Different periods.

Sr. No.	Variables	1960-61 to 1989-90	1990-91 to 2011-12	1960-61 to 2011-12
1	b_0	3.0233	2.8204	0.3091
2	Yt-i	0.2696 (0.193)	0.9445 (0.176)	0.7408 (0.106)
3	Pt^e	-0.2364 (0.057)	0.0777 (0.082)	***-0.0863 (0.042)
4	RFt	0.009 (0.065)	-0.0744 (0.090)	0.0403 (0.056)
5	YRt^e	0.0008 (0.010)	0.0011 (0.014)	-0.0002 (0.009)
6	PRt^e	**0.0434 (0.019)	-0.0046 (0.012)	0.0261 (0.014)
7	It	*0.3687 (0.136)	-0.1825 (0.097)	***0.1727 (0.088)
8	R Square	0.7753	0.9018	0.8271
9	Durbin-Watson statistic	2.0888	2.7128	2.4349

Figures in bracket shows standard error

*- Significant at 0.01 level of significance

**- Significant at 0.03 level of significance

***- Significant at 0.05 level of significance

III. Cost and returns of coconut cultivation in Kerala

As long as cultivation is in the private sector, commercial farmer will continue the cultivation only if it is a gainful activity. The profit or loss of cultivation of a crop is the difference between the cost of various inputs used and the value of main product and the by product obtained from it (Lathika, M. and Ajithkumar, C.E., 2005, p.686). Therefore, an analysis of the costs and returns is very relevant for coconut cultivation in the state.

1. Cost of production of Coconut cultivation in Kerala

The cost of coconut cultivation in Kerala is estimated under three different concepts of cost. The result is presented in Table. 5.

(1) COST A: The important items of Cost A are seed/seedlings, hired human labour, farm yard manure, chemical fertilizers, irrigation, depreciation, plant protection, interest on working capital and other expenses. Among the different cost components, hired human labour is the major component of cost A and it accounts more than 40 percentages of the total cost.

(2) COST B: It includes Cost A, rental value and interest on fixed capital.

Table.2 indicates that the estimated cost B includes more than 90 percentage of the total cost.

(3) COST C: It is the totality of Cost B and family labour charges and is estimated by adding the imputed value of house hold labour to cost B. Table.5 gives the household labour charges for different size group estimated at the value of hired human labour. Table.5 reveals that the estimated family labour charge per hectare is highest among small farmers.

The estimated cost of coconut cultivation under various cost concepts given in Table.2 indicated that cost A, B and C exhibited positive relation with the size of farm. The proportion of total costs on hired human labour, farm yard manure, irrigation, chemical fertilizers, plant protection, interest on working capital and other expenses indicate positive relation with the size of farm; whereas proportion on total cost on seed/seedlings, depreciation, rental value, interest on fixed capital and family labour charges exhibited negative relationship with the size of farm.

Among the small farmers, hired human labour charges accounted for the highest share of the total cost followed by farm yard manure, rental value, family labour charges, irrigation and interest on fixed capital. In the case of medium farmers also hired human labour charges accounted for the highest share of the total cost followed by farm yard manure, rental value, irrigation, family labour charges and interest on working capital. The large farmer's hired human labour charges accounted for the highest share of the total cost followed by farm yard manure, rental value, irrigation costs, interest on working capital and interest on fixed capital.

Table. 5. Input-wise Maintenance Cost of Coconut cultivation in Kerala

(Rupees per Hectare)

Sr. No.	Particulars	Size of coconut farm		
		Small	Medium	Large
1	Seed/seedlings	1620	1564	1452
2	Hired Human Labour	17002	17857	19162
3	Farm yard manure	5932	6304	6940
4	Chemical Fertilizers	1692	1696	1712
5	Irrigation	2632	2892	3012
6	Depreciation	1380	1212	1064
7	Plant Protection	1665	1885	1905
8	Interest On Working Capital	2480	2664	2892
9	Other Expenses	1344	1672	2104

Cost A		35747	37741	40243
10	Rental Value	1958	1952	1948
11	Interest On Fixed Capital	2632	2504	2576
Cost B		39437	41297	43867
12	Family Labour Charges	3493	3214	2536
Cost C		42730	44311	46203

Source: Primary Data.

2. Returns from Coconut Farm in Kerala

The data presented in Table.6 indicated average returns from coconut farms in Kerala and it shows that the size of farm is negatively related to yield per hectare. It is estimated that the average yield of coconut per hectare is 127 quintals for small farm, 116 quintals for medium farm and 110 quintals for large farm.

Table. 6. Returns from Coconut Farm in Kerala

Sr. No.	Size of coconut farm	Yield per Hectare (in Quintals)
1	Small	127
2	Medium	116
3	Large	110

Source: Primary Data.

3. Profitability of Coconut Cultivation in Kerala

The time element in the calculation of costs and returns was worked out for evaluating the profitability of coconut garden in Kerala. Since the gestation period for coconut is much longer than that for other crops and its economic life is about 60 years, the age wise data on costs and returns were also worked out for computing the various measures of profitability. The net present value (NPV) and benefit cost ratio (BCR) are functions of discount rate and are negatively related to discount rate. The discount rate used in the study is equal to the opportunity cost of capital and since the opportunity cost could vary from 8 to 15 percentages, these measures were calculated separately for two discount rates, viz, 12 and 14 percentages.

The four measures of profitability, viz, payback period (PBP), net present value (NPV), internal rate of return (IRR) and benefit cost ratio (BCR) were calculated and the result is given in Table.7.

Table. 7. Measures of Profitability of Coconut cultivation in Kerala

Particulars	Size of coconut farm		
	Small	Medium	Large
PBP (in Years)	13.60 (I)	14.30 (II)	14.50 (III)
IRR (in percentage)	35.50 (II)	35.70 (I)	35.40 (III)
NPV (in Rupees)			
At 12 percentage	46205 (II)	53459 (I)	41744 (III)
At 14 percentage	41488 (II)	45648 (I)	36292 (III)
BCR(in percentage)			
At 12 percentage	1.43 (II)	1.77 (I)	1.34 (III)
At 14 percentage	1.35 (II)	1.65 (I)	1.30 (III)

Figures in bracket indicate rank.

The payback period obtained is less than the maximum PBP (15 years) desired by the farmers. Hence according to the criteria of PBP, coconut cultivation is profitable in the state. Results of Net Present Values (NPV) at 12 percentages and 14 percentages were positive and quiet high also indicates the profitability of coconut cultivation. The Internal Rate of Return ranged from 35.40 percentages for large farmers to 35.70 percentages for medium farmers. It was much greater than the cost of borrowing capital, which ranged from 10 to 15 percentages, for borrowing from financial institutions in Kerala shows that coconut cultivation is profitable. The benefit cost ratio at 12 percentage of discount rate ranged from 1.34 percentages in large farmers to 1.77 percentages in medium farmers. Even at a higher rate of discount of 14 percentages, the BCR ranged from 1.30 percentages in large farmers to 1.65 percentages in medium farmers. In all the size groups it was greater than unity. Hence, according to the criterion of BCR also coconut cultivation is profitable.

Conclusion

Even in the 21st century, agriculture is the chief economic activity of the people of Kerala. The agricultural economy of the state has been showing signs of stagnation in few and most of its important sectors. One important feature of the agriculture sector is that of change in cropping pattern, particularly in favour of commercial crops.

From the analysis of the growth trends of area of principal crops in Kerala over the different periods, it is clearly established that the cropping pattern in the state made a significant change from food crops to non-food crops. This change in cropping pattern is mainly due to farmers' decisions. There must be certain determinants that motivated the farmers to make such a shift in the cropping pattern. Area response and yield response models were used to analyse the determinants.

The analysis divided the period into two sub-periods and estimated area responses and yield responses of coconut revealed that the irrigated area, rainfall and price risk factors are the significant variables affecting the area allocation of the crop in Kerala. For the crop's yield response, irrigated area, rainfall and expected price risk are the strong variables.

Coconut cultivation is one of the main economic activities of the state and is an important source of income and employment to the people. Therefore, an analysis of the costs and returns of this crop is a real necessity so as to measure the profitability. The analysis of the cost of cultivation of coconut by size of farm did not indicate any specific relation between the total cost of cultivation and the size of farm. Average return per hectare of coconut farm indicated inverse relation with the size of farm. Estimating costs and returns of coconut cultivation in the state revealed that coconut cultivation is profitable in Kerala. It is also seen that the profitability of coconut crop is inversely related to the size of farm. This envisaged the implementation of proper measures and regulations on the part of the government for the effective development of coconut crop in the state.

Notes:

Size of coconut farm was determined on the basis of area cultivated. The holdings selected were grouped into small, medium and large according to the criteria presented below: Small < 0.20 hectare, Medium 0.20 to < 0.80 hectare and large ≥ 0.80 hectare.

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