Working Paper No. 238

Dissecting Agricultural Stagnation in Kerala: An Analysis Across Crops, Seasons and Regions

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August 1990

NOTE

This paper is the second one in a series of papers which we to bring out as part of our on-going study on Agricultural lopment in a Regional Perspective: A Study of Kerala. The t one was titled "Agricultural Stagnation and Economic Growth erala: An exploratory Analysis" and brought out as Working r No. 227, Centre for Development Studies, Trivandrum, June . An abridged version of this paper was published in omic and Political Weekly, September 24, 1988.

We would like to record ou thanks to Mr. Geoji Thomas for assistance in the computer processing of the data. We are thankful to the participants of an Internal Seminar at the for their valuable comments on an earlier version of the er. However, we alone are responsible for any errors and ssions.

DISSECTING AGRICULTURAL STAGNATION IN KERALA
an analysis across crops seasons and regions

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I

INTRODUCTION

In our earlier paper (Kannan and Pushpangadan 1988) we had put forward, on basis of our empirical analysis of the growth performance of important s in Kerala, the proposition that the agricultural sector is characterized tagnation since the mid-seventies and that it could be explained as due to decline in profitability. The analysis was carried out in terms of two ps of crops; one, foodgrains meaning only paddy and the other, non-food crops under which eleven crops were combined comprising of the two annual s of tapioca and banana and the perennial crops of coconut, rubber, cashew, r, coffee, cardamom, arecanut, tea and seasamum. Our thesis of stagnation ased on the declining output growth for all crops contributed by declining n in area and no trend rate of growth in yield. This was mainly due to a decline in output growth of paddy contributed by a much bigger decline in despite a positive growth rate in yield. For all other crops taken ther, there was no trend in growth rates in either area or yield. In this , the analysis has been extended to individual crops for the state as a as well as across regions to capture the spatial and crop dimensions of phenomenon of stagnation.

Of the 12 crops accounting for 86 percent of the gross cropped area covered in our earlier analysis (see Kannan and Pushpangadan 1988), we have omitted two crops in this analysis. These are tea and seasamum; the former is grown in plantations largely owned and operated by companies (proprietorship or corporate) and thus constitutes itself as a special crop. While tea accounts for 1.5 percent of the gross cropped area, the second one accounts for only 0.5 per cent. Moreover, price data for the latter on a time series basis are not available. The analysis is therefore restricted to the remaining 10 crops accounting for 84 percent of the gross cropped area for the triennium ending 1985-86.

II

Data and Methodology

The data on area, yield and output for the crops are obtained from the Department of Economics and Statistics, DES for short, (formerly known as the Bureau of Economics and Statistics) of the Government of Kerala which is the State Agricultural Statistics Authority. Of the ten crops examined here we may divide them into three categories for purposes of discussing the methodology of estimation of area, yield and output. These are (i) Seasonal and annual crops, (ii) Perennial crops for which estimates are made by the Commodity Boards and (iii) Perennial crops for which estimates are made by the DES.

Under the first category the crops examined here are paddy, tapioca and banana. Here independent estimates are made for area and yield through sample surveys and output is calculated as the product of the two. No biases are therefore involved in the estimates. Under the second category, the DES repo

the estimates made by the Commodity Boards such as the Rubber Board for rubber, Coffee Board for coffee and Spices Board for cardamom. These Boards also publish statistics of these crops independently which are more detailed than those published by the DES. They report the total area under the crop, area under bearing plants, yield per bearing area and total output. Since the yield figures are reported for the bearing area no bias due to changes in age-composition is involved in these estimates as well. Under the third category, there are four crops viz., coconut, cashew, pepper and arecanut, for which estimates of area and output are independently made through sample surveys conducted by the DES. Since the output is arrived at by calculating the yield from the bearing plants the estimate of total output is free from any bias with regard to changes in age-composition[1]. Area under these crops refer not to the geographical area but to the nominal area (taking a given number of plants as equivalent to a hectare of area for that crop). Though the proportion of bearing plants to total plants is known, these are not reported and hence the derivation of yield per hectare is subject to possible bias depending on the nature of change in area. To understand the effect of area change/replantation on yield based on the methodology, the following example may be considered.

Table 1: Area effect on yield of coconut:a hypothetical example

Period	Change in area	Output ('000nuts)	Area (ha)	Yield (2/3)	Change (%)
	(1)	(2)	(3)	(4)	(5)
1	-	100	50	2	nil
2	20 % increase	100	60	1.7	-15
	20% decrease	80	40	2	nil
	20% replanted	80	50	1.6	-20

Assume there are 50 hectares of area under output-bearing coconuts in period 1. Suppose that the average yield is 2000 nuts/hectare which remains the same for the two periods. In the second period, we have examined the yield estimate under three cases: (1) area increase; (2) area decrease; and (3) replantation without any area change. In the first case, suppose 20 percent area from other crops has been brought to coconut cultivation. In this case area has increased to 60 hectares but output remains the same. But the derived yield is only 1700 nuts/ha, a reduction of about 15 percent in yield. Here the yield reduction is purely due to the method of estimation. Consider the second case, a reduction in area under cultivation in the second period. In this case, output will be reduced to 80 and area by the same proportion leaving the yield the same. The estimate gives the actual change in this case. In the third case, 20 percent of the area under coconut is being replanted without any change in the area. In this case output will come down to 80 hectares but area remains the same. As a result the yield comes down to 1600 nuts/ha, a reduction of 20 percent which is purely due to the method of estimation but nothing to do with actual yield of the trees. The example clearly indicates there exists a possibility of declining yield due to the method of estimation while the actual yield remains the same.

However, the above limitation is applicable during the period of analysis mainly to the cashew crop for the following reasons. As we can see in Table 3, there is no trend in area growth for coconut although this by itself does not rule out shifting out of or into coconut. Yield growth here shows declining trend in both the periods. This is unlikely to be an underestimation since studies which have examined trend in yield of bearing trees have reported a decline due mainly, if not solely, to the root wilt disease (e.g. Narayana and

Nair 1989). For pepper there is no trend in area growth as well as in yield growth. Unless large scale replantati . has taken place .nere is no reason to believe that the yield growth is underestimated. Moreover, the area under pepper is only 3.9 percent of the gross cropped area. For arecanut there is no trend in area growth during the first period and a decline in the second period. Since it is a decline in area the estimate of yield need not be affected assuming no significant replantation. Therefore there is no reason to expect any growth in yield.

As in our aggregate analysis, the entire period of 1962-63 to 1985-86 was divided into two sub-periods called Period I (1962-63 to 1974-75) and Period II (1975-76 to 1985-86). The growth rates are obtained by using kinked exponential model suggested by Boyce (1986) for the period-wise analysis which overcomes the possibility of obtaining misleading growth rates if estimated separately for each period by assuming discontinuity[2].

A word of explanatio.. is necessary here regarding the regions specified. Since data are available on area and yield of major crops for individual districts, this should permit us to carry out the region-wise analysis for each crop at the level of the district. However, formation of new districts by carving out certain taluks from the existing districts has come in our way of conducting the district-wise analysis. Therefore our region-wise analysis is an adjusted one taking into account individual districts unaffected by formation of new districts and combinations of districts which are affected by such formation. This will rule out the possibility of obtaining declining trend in area/output purely due to district formation. These adjusted districts are then grouped according to the share of area under each crop

(average for the triennium ending 1985-86) and its concentration in terms of district-combinations. This classification is given in Table 2.

At the sub-regional level, published data are available for paddy by taluks though limited to our Period II. This has made it possible for us to analyse the growth performance during this period characterized by stagnation at a more disaggregated level even though it is confined to only one crop. No major adjustments have been warranted since taluks were by and large unaffected by formation of new districts (except for Wynad which is treated here as one unit) for the period of our analysis.

Our analysis of the performance of crops is given in section III in the following order: (a) growth performance of crops in the state as a whole; (b) growth performance of paddy crop by seasons for the state as a whole, by seasons and all seasons for regions (i.e. districts) and by seasons and all seasons by sub-regions (i.e. taluks); and (c) growth performance of crops other than paddy by regions (i.e. districts). In section IV we examine the proximate reasons for generalized stagnation in Kerala's agriculture in terms of the trend in profitability and instability in earning. Section V deals with the response of the farmers to the situation. Here we examine their strategy of crop mix and the maximization of income per unit of net cropped area. In the last section an attempt has been made to place the experience in terms of the agricultural development models.

e 2 : Districts and district combinations for region-wise analysis

er	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	3.7	5.6	1.6	9.7	4.6	1.2	12.1	14.0	23.0	9.9	2.9	4.2	6.4	3.1		
ece	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	24.4	18.3	6.9	5.2	9.6	4.4	5.0	2.6	5.7	7.4	1.6	1.2	6.7	2.5		
ne	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	12.1	7.7	5.1	4.3	9.3	5.3	10.3	9.4	7.8	9.4	6.7	3.2	8.3	3.6		
ut	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	10.8	10.3	4.0	6.9	7.1	2.4	8.5	8.8	3.6	9.0	15.4	0.5	11.2	5.1		
ur	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	4.5	11.0	7.3	1.4	25.7	9.0	10.9	3.4	4.2	6.3	6.0	1.3	7.5	4.3		
ev	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	4.6	5.3	1.6	2.6	1.0	0.9	2.7	5.3	9.2	14.6	3.1	0.7	41.6	20.4		
er	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	4.6	6.9	3.9	3.3	10.2	13.9	5.7	3.5	1.5	3.7	11.7	8.4	19.3	8.3		
ee	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	*	0.4	0.3	*	1.5	0.1	0.4	0.1	3.6	0.0	0.0	85.4	0.0	0.0		
anam	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	0.3	0.2	0.1	0.0	0.0	84.2	0.0	0.0	5.6	0.3	0.6	7.4	1.3	0.0		
anut	Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd		
	5.5	5.2	2.4	3.8	4.0	4.2	10.0	10.9	3.8	15.0	9.5	2.1	19.3	15.0		

te 1: Tvm=Trivandrum, Qln=Quilon, Pta=Pathanamthitta, Alp=Alleppey, Ktm=Kottayam, Idi=Idikki, Ekm=Ernakulam
Tcr=Trichur, Pgt=Palghat, Mlp=Malapuram, Koz=Kozhikode, Wyn=Wynad, Can=Cannanore, Ksd=Kasargode
* means Negligibly small.

2: Malapuram was formed in 1970/71 by combining taluks from Palghat and Kozhikode. Idikki was formed in 1972-73 by combining taluks from Ernakulam and Kottayam. Wynad was formed in 1981-82 by combining taluks from Kozhikode and Cannanore. Kasargode was formed from Cannanore in 1985-86. Pathanamthitta was formed in 1983-84 by combining the taluks from Quilon and Alleppey.

III

Performance of Crops

While our aggregate analysis revealed a decline in output growth in paddy, the combining of other crops concealed the differential performance of individual crops. Table 3 presents the growth rates in area, yield and output for the ten major crops in Kerala. It shows that during Period I two out of the three seasonal crops i.e. paddy and tapioca, were marked by positive growth rates in output while banana showed no significant trend. However, during Period II all the three crops registered declining growth rates in output. While the positive growth rate in yield of paddy reduced the magnitude of decline in output growth, there was no such compensating factor for either tapioca or banana. For tapioca the decline was entirely due to area decline, the largest of the three, while for banana the decline was entirely due to decline in yield growth.

For other perennial crops, there have been positive growth rates in the output during period I for rubber, cashew, coffee and cardamom contributed largely by growth rates in area except for rubber. Banana, pepper and arecanut did not show any trend at all. Coconut is the only crop which registered a decline in output growth. However, this situation seem to have been changed for the worse during Period II. Pepper has once again showed no trend at all along with cardamom. All the other crops except rubber and coffee have shown negative rates of growth in output. This has been due to a decline in growth in area in such crops as tapioca and arecanut and in yield growth in other crops such as banana, coconut and cashew. Except for cashew which has experienced a regional shift in area the decline in yield could be real.

Table 3 :Periodwise growth rates of major crops in Kerala
1962-63 to 1985/86

Crop		Growth rate in		
		Area	Yield	Output
Paddy	I	0.8	1.0	1.8
	II	-2.1	1.2	-0.9
Tapioca	I	3.6	NS	3.6
	II	-4.9	NS	-4.9
Banana	I	NS	NS	NS
	II	NS	-2.3	-2.3
Coconut	I	NS	-1.8	-1.8
	II	NS	-0.9	-0.9
Rubber	I	NS	7.4	7.4
	II	4.5	NS	4.5
Cashew	I	2.9	NS	2.9
	II	2.4	-6.3	-3.9
Pepper	I	NS	NS	NS
	II	NS	NS	NS
Coffee	I	6.1	NS	6.1
	II	4.9	NS	4.9
Cardamom	I	3.7	NS	3.7
	II	NS	NS	NS
Arecanut	I	NS	NS	NS
	II	-4.1	NS	-4.1

Note : Period I = 1962-63 to 1974-75
Period II = 1975-76 to 1985-86

Source: 1. GOK, Statistics for Planning, various issues.
2. Kannan and Pushpangadan (1988), Table 2.

Therefore in terms of growth performance only two crops, rubber and coffee, have consistently done well in both the periods. All other crops have registered either stagnation or decline in output growth during the period. Therefore, the phenomenon of stagnation in output growth during Period II has affected all the major crops in Kerala except rubber and coffee. The most important finding is that there was a general stagnation in productivity in all the crops except paddy. In the case of paddy, the increase in yield is attributed to marginal area going out of cultivation. While rubber is the fourth most important crop in terms of area spread over most of the districts, coffee ranks only seventh in terms of gross cropped area accounting for a little over two percent and largely concentrated in Wynad district.

Inter-regional and Inter-seasonal Analysis

(a) Paddy

We start with paddy, the principal food crop in the state. Depending on availability of water, three crops can be grown in a year. However, the absence of irrigation during summer has meant that the summer crop is mainly confined to the low-lying areas in the state where the problem is one of water control. We have examined the growth performance of this crop in terms of (i) season-wise performance for the state as a whole for the two periods viz. 1962-63 to 1974-75 and 1975-76 to 1985-86, as well as for the whole period; (ii) annual performance (combining all seasons) for the adjusted districts; and (iii) season-wise performance for the adjusted districts. In addition, since data are available for sub-districts (taluks) for Period II, we have examined the growth performance during this period.

Season-wise performance for the state: Table 4 shows that there is a net lo

in area under paddy during Period II in all seasons. This finding supports the results of another study which noted that area under paddy had declined for all seasons during 1975-83 (George and Mukherjee 1986). The rate of decline has been highest during the summer season (-4.5) followed by autumn (-2.6) and winter (-2.1). What this points to is that the decline in area is not confined to certain seasons only but distributed over the seasons with the summer season registering a higher pace than the other two seasons. The increase in yield growth in the second period for both autumn and winter crops could be attributed to the declining area growth whereby marginal lands might have gone out of cultivation. This would imply the impact of fertility of the soil rather than any breakthrough in productivity due to technical change. However, the lack of increase in yield growth during summer could be due to decline in the area of same fertility. Here water availability might be a crucial factor in determining the technical feasibility of paddy cultivation.

Region-wise performance for all seasons: Except Kuttanad the district combination of Kottayam-Idikki-Ernakulam and Trichur, there was no trend in growth rate in area during the first period. However, this period witnessed either positive growth rates or no significant trend in yield in all regions. However, this picture changed in the second period when there was a decline in area everywhere for all seasons taken together. The highest decline was in the non-traditional area (Cannanore-Kasargod region) and the lowest in Trichur district. However, there was a higher growth rate in yield compared to the previous period, the highest being in the Kuttanad region (Alleppey, Kottayam, Idikki, Ernakulam) followed by Trichur. In the non-traditional area of Cannanore and Kasargod, there was no trend in yield growth. It would appear

that this higher rate of growth in yield is a result of marginal lands being put out of cultivation during the second period. However this explanation is not valid for the Palghat and Cannanore-Kasargod region because a decline in area is accompanied by the decline in yield.

Table 4:Periodwise growth rate in area,yield and output of paddy by seasons in Kerala, 1962/63 to 1985/86.

	Period I	Period II
Autumn		
Area	NS	-2.6
Yield	1.2	1.6
Output	1.2	-1.0
Winter		
Area	1.7	-2.1
Yield	NS	1.0
Output	1.7	-1.1
Summer		
Area	3.4	-4.5
Yield	1.8	NS
Output	5.2	-4.5

Note:

Period I & II: Growth rates in yield are based on the Kinked exponential model and for area Kinked exponential mode adjusted for autocorrelation using Cochrane- Orcutt method.

Source : Same as in Table 3

Table 5 : Periodwise growth rate of paddy by districts and seasons 1962/63 to 1985/86

		PERIODWISE GROWTH RATE					
		AREA		YIELD		OUTPUT	
		I	II	I	II	I	II
TRIVANDRUM	Autumn	NS	-3.4	NS	1.6	NS	-1.8
	Winter	NS	-3.9	NS	NS	NS	-3.9
	Summer	1.5	-16.9	NS	NS	1.5	-16.9
	All Seasons	NS	-4.0	NS	NS	NS	-4.0
QUILON	Autumn	NS	NS	1.7	2.7	1.7	2.7
	Winter	NS	-4.0	NS	NS	NS	-4.0
	Summer	NS	-16.6	3.6	NS	3.6	-16.6
	All Seasons	NS	-3.6	NS	1.0	NS	-2.6
ALLEPPEY	Autumn	NS	NS	2.3	NS	2.3	NS
	Winter	5.3	-4.0	NS	2.7	5.3	-1.3
	Summer	NS	-4.3	3.3	NS	3.3	-4.3
	All Seasons	NS	-3.7	1.6	1.9	1.6	-1.8
KTM+IDI+EKM	Autumn	NS	NS	1.8	2.3	1.8	2.3
	Winter	NS	-2.3	NS	1.7	NS	-0.6
	Summer	4.5	-3.8	1.9	NS	6.4	-3.8
	All Seasons	2.4	-2.0	1.4	1.6	3.8	-0.4
TRICHUR	Autumn	NS	NS	NS	NS	NS	NS
	Winter	NS	-2.5	NS	1.7	NS	-0.8
	Summer	7.0	NS	NS	NS	7.0	NS
	All Seasons	1.0	-1.6	NS	1.5	1.0	-0.1
PGT+KOZ+ MLP+WYN	Autumn	NS	-3.4	1.7	1.4	1.7	-2.0
	Winter	NS	-1.1	NS	NS	NS	-1.1
	Summer	12.3	NS	2.2	NS	14.5	NS
	All Seasons	NS	-1.8	1.1	0.9	1.1	-0.9
CAN+KSGD	Autumn	NS	-6.4	NS	NS	NS	-6.4
	Winter	NS	-6.2	1.4	NS	1.4	-6.2
	Summer	17.8	-7.7	5.1	NS	22.9	-7.7
	All Seasons	NS	-6.1	1.0	NS	1.0	-6.1

Note : If the kinked exponential model shows autocorrelation then Cochrane-Orcutt method is used for estimation. This is applicable for all the growth rate calculations in this paper.

Source: Same as in Table 3

The net result of the growth performance is that there was a positive growth rate in output in the first period but a negative one for the second period. This negative growth rate is much higher in non-traditional areas while traditional paddy-growing regions registering marginal declines.

Regional growth performance by seasons: At the next level we are interested in examining how the decline in paddy is distributed across seasons in the districts. The results presented in Table 5 give further insights into the performance of paddy. In two regions namely, Trivandrum and Cannanore-Kasargod the area has declined during the second period for all the three seasons. In the northern districts of Palghat-Kozhikode-Malapuram-Wynad the decline is for autumn and winter crops whereas in the southern and central districts of Quilon, Alleppey, Kottayam-Idikki-Ernakulam the decline is for winter and summer crops. This is not surprising since the summer crop is largely accounted for by the latter whereas the autumn crop is largely accounted for by the former. In Trichur district the decline is for winter crop only. In general the evidence suggests that the decline in area under paddy has been all pervasive in terms of seasons and regions. Our observation on the yield growth at the state level being the result of marginal lands going out of cultivation seems to hold spatially in most of the cases.

There are limitations in precisely pinpointing the regions of decline in area under paddy in terms of the above analysis although it goes far beyond the state level analysis. The limitations are that (a) the formation of new districts has come in the way of isolating each district, and (b) the districts themselves are relatively bigger units and heterogeneous in terms of geographical and agroclimatic conditions. To overcome these limitations we have examined the data available for taluks. However, the availability of data is restricted

to our second period (1975-76 to 1985-86) which does come in the way of period-wise comparisons but it would certainly help us understand the performance of the paddy crop across taluks. Taluks are reasonably homogeneous in terms of geographic characteristics (e.g. low land, midland or highland) and much more homogeneous in terms of agroclimatic characteristics such as soil type, rainfall and availability of irrigation. Further, excepting for one district - Wynad - the taluks have not been affected by formation of new districts during the period of analysis. For Wynad district, where the tribal population is concentrated along with the influx of farmers from the southern Kerala, the district has been treated as one unit which also makes sense in terms of agroclimatic and geographic characteristics.

The taluks have first of all been classified in terms of their average yield per hectare for the 10 year period, the proportion of area under paddy out of the total for the state, and the proportion of output contributed by the taluks. Further, the performance of these taluks in terms of growth rates in area and yield according to seasons and all seasons have been worked out. These are given in Tables A.1 to A.5 in the appendix. By combining these two sets of information we have been able to obtain significant and interesting results on the spatial performance of paddy in Kerala during the period 1975-76 to 1985-86.

First of all it has been revealed that three-fourths of the output of paddy comes from around 40 percent of the taluks i.e. 22 out of 56 taluks. If we examine further, we find that half the output of paddy is contributed by just 9 or 17 percent of taluks. Still further, 28 percent of paddy is produced by just 4 taluks in one district namely, Palghat. What this suggests is that paddy as a relatively profitable crop is confined to certain pockets only. This we examine further.

By combining the relevant information we have come out with a classification of taluks in terms of (i) High Yield with High Area, (ii) High Yield with Low Area, (iii) Medium Yield with High Area, (iv) Medium Yield with Low Area, (v) Low Yield with High Area and (vi) Low Yield with Low Area. This is given in Table 6. High Yield taluks here are defined as those with 120 percent or above of the state average yield per hectare, Medium Yield as those between 90 and 119 percent of the state average and Low Yield as those with less than 90 percent of the state average. High Area taluks are those with 2 or more percent of the total area in the state and Low Area taluks as those with less than 2 percent of the total area.

When we examine the results of taluk level analysis we are able to obtain a clearer picture of the decline or stagnation in paddy cultivation. The extent of decline in terms of the proportion of taluks is much less than the proportion of districts although stagnation in area is all pervasive in that not a single taluk registered positive growth rate. 23 out of 56 taluks for which data were available showed a decline in area for all seasons which remains more or less the same even when we examine separately for the major seasons of autumn and winter. Yield performance presented a brighter picture with hardly any taluk showing a decline for all seasons. Nearly one out of every six taluks showed a positive growth rate in yield while the remaining showed no significant trend. It is these taluks with positive growth rates which have contributed to an overall growth rate in yield of 1.2 percent for the state as a whole for Period II.

Table 6 : Talukwise growth rate in area, yield and output of paddy and its share in area and output, 1975/76-1985/86.

Category	Growth Rate in %			Percentage Share of	
	Area	Yield	Output	Area	Output
1	2	3	4	5	6
High Yield Taluks with High Area					
Chitoor	NS	NS	NS	5.0	7.7
Alathoor	NS	NS	NS	5.3	7.5
Palghat	NS	NS	NS	4.9	6.5
Kuttanad	NS	NS	NS	3.8	5.7
Kottayam	NS	4.3	4.3	1.9	2.3
Weighted Average Sub Total	0	0.3	0.3	20.9	29.7
High Yield Taluks with Low Area					
Changanacherri	-2.7	NS	-2.7	0.7	0.9
Thiruvalla	-3.6	NS	-3.6	0.8	1.0
Chenganoor	NS	NS	NS	0.8	1.0
Peermedu	NS	NS	NS	0.01	0.01
Udumbanchola	NS	4.6	4.6	0.2	0.3
Devikulam	-10.3	S	-10.3	0.3	0.4
Pathanapuram	-1.0	2.2	0.6	1.0	1.2
Weighted Average Sub Total	-2.5	0.8	-1.7	3.81	4.81
Medium Yield Taluks with High Area					
Kasargode	-6.3	NS	-6.3	2.1	2.0
Wynad	NS	2.0	2.0	3.8	4.0
Alwaye	NS	NS	NS	3.1	3.0
Kunnathunad	NS	NS	NS	3.7	3.3
Trichur	-1.6	1.9	0.3	3.7	3.4
Thalapally	NS	NS	NS	4.2	3.7
Perinthalmanna	-3.5	NS	-3.5	2.0	1.8
Ottapalam	-2.0	NS	-2.0	5.1	4.4
Weighted Average Sub Total	-1.3	0.6	-0.7	27.7	25.6

(Contd...)

Table 6 (Continued)

1	2	3	4	5	6
Medium Yield Taluks with Low Area					
Ponnani	NS	NS	NS	1.4	1.2
Manarghat	NS	NS	NS	1.9	1.7
Kothamangalam	-2.6	NS	-2.6	1.1	1.1
Muvatupuzha	-3.5	2.3	-1.2	1.6	1.6
Kunnathur	NS	NS	NS	1.1	1.0
Parur	-4.4	NS	-4.4	1.2	1.0
Vaikom	NS	NS	NS	1.3	1.3
Meenachal	-2.3	1.3	-1.0	1.6	0.7
Kanjirapally	NS	NS	NS	0.01	0.02
Thodupuzha	-5.1	2.0	-3.1	0.7	0.8
Pathanamthitta	NS	NS	NS	0.5	0.6
Kottarakara	NS	NS	NS	0.5	0.7
Karthikapally	-3.3	NS	-3.3	1.5	1.6
Mavelikara	NS	NS	NS	1.6	1.6
Chirayinkil	-1.5	NS	-1.5	1.1	1.0
Nedumangad	-4.5	NS	-4.5	1.1	0.9
Trivandrum	-5.8	NS	-5.8	0.9	0.8
Neyyatinkara	-3.7	NS	-3.7	1.1	1.0
Weighted Average Sub Total	-2.1	.4	-1.7	20.21	18.62
Low Yield Taluks with High Area					
Mukundapuram	-3.7	3.4	-0.3	4.5	3.6
Ernad	-2.6	NS	-2.6	4.0	3.2
Tirur	-2.6	NS	-2.6	2.8	2.1
Weighted Average Sub Total	-3.0	1.3	-1.7	11.3	8.9

(Contd...)

Table 6. (Continued)

1	2	3	4	5	6
Low Yield Taluks with Low Area					
Hosdurg	NS	NS	NS	1.5	1.3
Thaliparamba	-3.2	NS	-3.2	1.7	1.3
Tellicherri	NS	NS	NS	1.3	0.9
Cannanore	NS	NS	NS	1.3	1.0
Kozhikode	-5.9	-2.7	-3.2	1.6	1.0
Quilandy	-6.6	-3.9	-2.7	1.3	0.7
Badakara	-8.5	NS	-8.5	0.7	0.4
Chawghat	-9.6	NS	-9.6	1.2	0.8
Kodungallur	NS	NS	NS	0.3	0.2
Cochin [b]	NS	NS	NS	0.3	0.2
Kanayanoor	-4.3	NS	-4.3	1.2	0.9
Shertalai	-5.4	NS	-5.4	0.9	0.4
Karunagapally	-4.7	NS	-4.7	1.0	0.8
Ambalapuzha	NS	NS	NS	0.9	0.7
Quilon	NS	NS	NS	0.9	0.8
Weighted Average Sub Total	-3.5	0.9	-2.6	16.1	11.4

Note :1 a : Winter crop only b : Autumn crop only

2. The classification of the taluks into various categories is based on the following definition

Category	Condition
High yield	$x \geq 120$
Medium yield	$90 \leq x < 120$
Low yield	$x < 90$
High area	$z \geq 2$
Low area	$z < 2$

where $x = \frac{\text{Mean yield of paddy in the taluk}}{\text{Mean yield of paddy in the state}}$ (%)

$z = \frac{\text{Mean area under paddy in the taluk}}{\text{Mean area under paddy in the state}}$ (%)

3. Weighted average for the subgroup is calculated using the formula

$$O = \Sigma w_i A_i + \Sigma w_j Y_j$$

where $w_i = A_i / \Sigma A_i$, $w_j = Y_j / \Sigma Y_j$. The values of area, A_i, and yield, Y_j, are the averages for the period.

Source : Based on the tables given in apprendix in Kannan and Pushpangadan (1990)

Based on our classification a few observations may be made. (a) High Yield and High Area taluks: There are only just 5 taluks out of the 56 taken here in this group and they together account for one-fifth of the area and around one-third of the output. Significantly there is no decline in area in any of these taluks; growth rates in yield also does not show any trend except for Kottayam where it is an impressive growth rate of more than 4 percent. (b) High Yield and Low Area taluks: Seven taluks in this group account for 4 percent of area and nearly 5 percent of output. Due to the predominance of other crops competition could be stiff and given the fact that yield levels do not match the first group of taluks the decline in area in most of these could be attributed to such competition. (c) Medium Yield and High Area taluks: Here the 8 taluks account for 28 percent of area and nearly 26 percent of output. Half of them have experienced decline in area. Yield growth is confined to Trichur and Wynad only and the latter seems more significant because it does not register any decline in area and hence the yield increase is real and not due to marginal lands going out of cultivation. (d) Medium Yield and Low Area taluks: This is the biggest group accounting for nearly one-third of the taluks. They account for 18 percent of area and more or less the same share of output. More than half of them have experienced decline in area. (e) Low Yield and High Area taluks: Though the number of taluks is small, their low yield should receive special attention in view of their area. All have showed decline in area. (f) Low Yield and Low Area taluks: This last group of taluks seems the least attractive in terms of paddy cultivation. More than half of the taluks have registered decline in area and the two taluks with positive growth rates in yield which could be attributed to the phenomenon of marginal lands going out of cultivation.

The relationship between low yields and decline in area seem to have some

convincing evidence here in the sense that the highest decline is in the last group accounting for 16 percent of area and the least in the first group which account for 21 percent of area under paddy. In sum, the picture of stagnation in paddy cultivation across taluks suggests its pervasiveness with low yields accounting for the higher spread and rate of decline. There are a number of clues emerging from this analysis which could help a more discriminating policy package for enhancing paddy output in the state.

Tapioca

The period-wise growth rates at the regional level for all the crops except paddy are given in Table 7. Tapioca has been mainly a Kerala crop till the sixties accounting for around 88 percent of the area in India; this has however declined to about 76 percent by early eighties partly due to decline in area in Kerala and partly due to increase in area in other states especially Tamil Nadu. Tapioca is considered in Kerala as a poor man's substitute for rice and hence its importance in terms of area and output. It is cultivated extensively particularly in Trivandrum, Kottayam, and Quilon-Pathanamthitta-Alleppey districts accounting for nearly two-thirds of the total area, often as an intercrop in garden lands. In terms of rice equivalence it is more than the output of paddy (13.5 lakh tonnes of rice equivalent output for the triennium ending 1985-86 compared to 11 lakh tonnes of rice). The growth performance of this crop is such that the growth rate in output during Period I for the state as a whole has not only been wiped out but there has been a decline in output during Period II. The decline in output presented here confirms the results obtained in earlier studies in terms of the trend. Since the period of

Table 7 : Periodwise and regionwise growth rates in area, yield and output of major crops other than paddy.

Crop		Tvm	Qln	Pta	Alp	Ktm	Idi	Ekm	Tcr	Pgt	Mlp	Koz	Kyn	Can	Ex
Tapioca															
Area	I	NS	3.24			NS	NS		5.65	7.20				NS	
	II	-3.93	-6.97			-6.60	NS		-6.74	-4.64				NS	
Yield	I	NS	NS			NS	6.02		6.65	NS				7.75	
	II	NS	NS			NS	NS		-3.48	NS				-3.67	
Output	I	NS	3.24			NS	6.02		12.30	7.20				7.78	
	II	-3.93	-6.97			-6.60	NS		-10.22	-4.64				-3.67	
Banana															
Area	I	NS	0.90			4.08			NS	-2.38				-3.75	
	II	NS	-0.80			NS			NS	NS				-2.96	
Yield	I	NS	NS			NS			NS	NS				NS	
	II	-4.96	-2.70			NS			-4.30	NS				-2.96	
Output	I	NS	0.90			4.08			NS	-2.38				-3.75	
	II	-4.96	-3.50			NS			-4.30	NS				-5.92	
Coconut															
Area	I	2.36	NS			NS	3.25		NS	NS					
	II	NS	-2.29			-2.49	NS		NS	NS					
Yield	I	NS	-2.07			NS	-1.86		NS	-2.12					
	II	-2.23	-2.02			NS	NS		NS	NS					
Output	I	2.36	-2.07			NS	1.39		NS	-2.12					
	II	-2.23	-4.31			-2.39	NS		NS	NS					

Table 7 : Period..se and regionwise growth rates i- area, yield and output of major crops other than paddy (contd)

	Tvm	Qln	Pta	Alp	Ktm	Idi	ckm	Tcr	Pgt	Mlp	Koz	Wyn	Can	Ksd
	NS	NS		NS		NS		1.32		4.57			3.38	
	NS	5.51		4.89				1.29		2.99			3.00	
I	11.07	7.78		7.72				4.59		5.34			14.21	
II	NS	-1.23		NS				-1.67		NS			NS	
I	11.07	7.78		7.72				5.91		9.91			18.03	
II	6.45	4.28		4.89				-0.36		2.99			3.00	
	3.72	-1.84		-3.55	-4.40			-2.17	NS	6.37			4.89	
	2.86	NS		2.55	NS			1.47	NS	NS			4.04	
I	NS	NS		NS	NS			NS	NS	NS			NS	
II	-8.78	-10.88		-17.44	-8.20			NS	NS	-9.08			5.49	
I	3.72	-1.84		-3.55	- .40			-2.17	NS	6.37			4.89	
II	-5.92	-10.88		-14.89	-8.20			-1.47	NS	-9.98			-1.45	
	NS	10.84		NS	9.76			14.25		2.49			NS	
	NS	NS		-2.94	4.80			NS		NS			NS	
I	NS	NS		NS	-4.21			NS		6.13			NS	
II	NS	NS		-8.66	NS			NS		NS			NS	
I	NS	10.84		NS	5.55			14.25		6.62			NS	
II	NS	NS		-11.60	4.80			NS		NS			NS	

(Contd...)

Table 7 : Periodwise and regionwise growth rates in area, yield and output of major crops other than paddy

Crop		Tvm	Qln	Pta	Alp	Kam	Idk	Ekm	Tcr	Pgt	Mlp	Koz	Wyn	Can
Coffee														
Area	I					NS						6.48		
	II					6.44						5.56		
Yield	I					NS						NS		
	II					NS						NS		
Output	I					NS						6.48		
	II					6.44						5.56		
Cardamom														
Area	I					NS						NS		
	II					NS						NS		
Yield	I					NS						NS		
	II					NS						NS		
Output	I					NS						NS		
	II					NS						NS		
Arecanut														
Area	I	NS		NS		NS		NS		NS		NS		
	II	-3.86		-6.65		-7.34		NS		-7.60		NS		
Yield	I	NS		NS		NS		NS		NS		NS		
	II	NS		NS		3.28		3.43		NS		NS		
Output	I	NS		NS		NS		NS		NS		NS		
	II	-3.86		-6.65		-4.06		3.43		-7.80		NS		

Source :Same as in table 3.

Note : If the figures are not given for any district, then the area under the crop in the district is n
Wherever the area under a has crop shown a decline at the time of formation of the new districts, the
is calculated only for the combined region (This is displayed by showing the results in boxes)

analysis and method of estimation of growth rates are different, the magnitudes are not the same (George 1989; Pushpangadan 1988). Most of this decline is due to declining growth in area in all the traditional districts mentioned above and some of the non-traditional districts such as Trichur and Palghat-Kozhikode-Malappuram-Wynad. Cannanore-Kasargod and Trichur districts registered a decline in growth of yield also. As a substitute for rice, the response of this crop is closely related to the price of rice and this seems to have been a factor in the declining growth in area. We shall examine this later.

Banana

Under this crop there are a number of varieties grouped as banana and other plantains. This is an annual crop usually taking an average of 10 months to harvest. After a cycle of two or three crops the land is put under some other crop usually paddy before it is brought back again to banana cultivation. There is no particular concentration of area. Although Trivandrum accounts for more than 12 percent of the area the distribution is around 8 to 10 percent for most districts. Unlike the case of tapioca, the declining growth rate in output in Period II is mainly due to declining growth rates in yield in Trivandrum, Trichur, Quilon-Alleppey-Pathanamthitta districts. In Cannanore-Kasargod both area and yield have registered declining growth rates in Period II. However, in Kottayam-Idikki-Ernakulam and Palghat-Kozhikode-Malappuram-Wynad no trend is discernible in either area or yield during the second period.

Perennial Crops

Coconut

Although yield estimates of coconut is subject to bias in situations of

area increase and/or replantation, the output estimates are free from such biases as discussed earlier. The outpu growth declined or the state as a whole in both the periods. During the second period output growth declined for the southern districts except Idikki and Ernakulam. This could be due to a real decline in yield as shown by another study bringing out the trend in productivity of bearing palms (Narayana and Nair 1989). Moreover, the case of coconut is such that there is no increase in area growth in any district in the second period. The possibility of large scale replantation is ruled out here because the opportunity cost of land (e.g. by planting rubber) is higher. This would have resulted in area decline. Therefore the yield estimate here could be subject to less of a bias. That coconut trees in Kerala are affected by an as yet uncontrollable disease called root wilt has now been well documented. This could be the main factor in the declining yield growth. However, the prevalence of this disease is mainly confined to the southern districts of Quilon, Pathanamthitta, Alleppey, Kottayam, Idikki and Ernakulam. This would imply that there is no incentive for increasing the area and that is borne out by the figures on growth rates in area given in Table 7. During Period I, area growth is confined to Trivandrum and Idikki-Ernakulam which in the case of the latter could be due to new planting in the highland area of Idikki district as a result of migration of farmers. In those districts the yield estimation may have a downward bias. More disease-prone districts (Quilon-Pathanamthitta-Alleppey) have shown declining growth in output in both the periods and in area in the second period. The other disease-prone district of Kottayam has shown decline in area and output growth during the second period. Idikki-Ernakulam, the relatively less disease prone districts shows no trend in area and output growth during the second period. No trend is shown in area in the districts not affected by the disease for either period but a decline in output growth

during the first period for Palghat-Malappuram-Kozhikode-Wynad and second period for Trivandrum. In sum it would appear that the root-wilt disease has accelerated the process and intensified the extent of stagnation in the growth performance of coconut.

Rubber

Rubber presents a completely opposite picture of coconut. Unlike in coconut there is no possibility of any bias in estimating yield growth for rubber for reasons mentioned earlier. Rubber has shown consistently positive growth in output for all districts for both periods except for Trichur for the second period. Area growth in the first period was confined to new areas in the northern districts and Trichur while all districts have registered area growth during the second period possibly induced by yield growth during the first period. The impressive growth in yield in the first period is not sustained in the second period and hence the output growth was accounted for largely by increase in area. Rubber is a monocrop unlike other perennial crops such as coconut, pepper and arecanut and one which has perhaps the best institutional support among all the major crops in Kerala. This support includes financial incentives for planting and replanting and marketing of the output along with research and development activities for improving the varieties. However, the attractive private returns on rubber need not necessarily bring in equally attractive social returns. This is because the labour absorption is low compared to seasonal crops, there is hardly any income generating type of processing of output let alone manufacturing taking place within the state thus generating very little of employment and income in post-harvesting as well as raw material for final products within the state.

Cashew

Cashew is, by and large, not a cultivated crop although efforts to expand area under this cash crop meant for export have been initiated since the mid-seventies (Kannan 1983). Since it does not allow for mix-cropping and the income generated per unit of land is considerably less than most other crops, the area under cashew is characterized by soils which are not generally suitable for other crops. This would probably explain why there has been a declining growth in area in all the southern and central districts except Trivandrum and high growth in northern districts in the first period. The northern districts of Cannanore and Kasargod are traditionally the area of concentration of cashew crop since large tracts of these districts have laterite soil unsuited for other competing crops. In the second period, the highest growth rate again is in Cannanore-Kasargod followed by Trivandrum, Kottayam and Trichur. However, the output growth is positive only in the first period and confined to the northern districts and Trivandrum and seemingly sharp decline during the second period in all districts except Trichur. It is possible that there might have been cutting of old trees and planting young ones encouraged by state-sponsored area extension programmes during the second period which is not yet reflected in yield growth.

Pepper

Pepper is basically a mixed crop grown in garden lands consisting coconut and/or other tree crops such as arecanut. While no trend is registered for both periods for the state as a whole the growth in area took place in few districts in the first period but reduced to one area namely, Idikki-Ernakulam, during the second period. The dispersal in output growth during the first period has also been reduced to Idikki-Ernakulam during the second

period. Since the estimation of yield growth is subject to possible downward bias in regions with positive growth rates in area, we may examine such regions for evidence. It appears that this holds good only in Idikki-Ernakulam during the first period which accounts for nearly 20 percent of the area. However, yield growth is much higher than area growth in Palghat-Malappuram-Kozhikode-Wynad region which could possibly be due to the adoption of high yielding varieties. This would imply in terms of our model in Table 1 that yield growth could be higher than the one obtained here. However, the second period does not show any trend in area or output except for Kottayam where the growth rates show a decline while Idikki-Ernakulam shows an increase.

Coffee

Coffee is a crop confined mainly to two districts namely, Wynad and Idikki; the former accounting for nearly 86 percent of the area and the latter more than 8 percent. Along with rubber this is the only other crop which has registered a good performance in terms of growth in output mainly due to growth in area especially in Wynad district for both the periods. The absence of any trend in yield which is free from any estimation bias could be due to the susceptibility of the crop to changes in rainfall conditions which need to be investigated.

Cardamom

As in the case of coffee, this crop is also concentrated in the two districts of Wynad and Idikki, the difference being in their percentage share. In this case, Idikki accounts for 84 percent of the area while Wynad accounts for nearly 8 percent. Though output growth was positive during the first period for the state as a whole as a result of growth in area, there is no such

trend at the regional level. For both periods there is no trend in area, yield or output.

Arecanut

Nearly 85 percent of the area under this crop is accounted for by the central and northern districts. Cannanore-Kasargod has the highest concentration accounting for more than one-third of the area. Area growth was confined to the traditional region of Cannanore-Kasargod during the first period. Growth in output in this region has taken place in both the periods. In all other districts except Idikki-Ernakulam it was a case of declining growth in output during the second period. In sum, both the traditional areas have registered yield growth in the second period but that was not adequate to arrest a declining growth in overall output. The absence of any trend in yield in Cannanore-Kasargod during the first period could be an underestimation because area growth had taken place. However, the growth in yield in this region as well as Idikki-Ernakulam during the second period while showing no trend in area growth is an indication of real growth in yield.

IV

Proximate Reasons for Generalised Stagnation

That there is a clear change in growth performance of principal crops in Kerala between the two periods is beyond doubt. In terms of growth in output of the ten crops examined here in detail, six crops registered positive growth, three showed no trend and only one showed negative growth during the first period. During the second period, however, only two crops registered positive growth, two showed no trend and six showed negative growth rates. This

phenomenon of stagnation/negative growth rate affecting eight out of the ten major crops needs to be explained analytically. We first attempt the proximate reasons for this performance in terms of (i) the trend in profitability and (ii) the stability in earnings per unit of land. These two measures are deemed crucial in understanding the proximate reasons for the performance of crops on the following basis. Profitability measure is based on given input and output prices in the ex-post sense thus ignoring the element of uncertainty about the prices. However, the farmer is faced with uncertainty of income as a result of uncertainty in both output prices and yield in most of the crops. Therefore both profitability and uncertainty have to be taken into account while explaining the growth performance of crops.

Trend in Profitability

The profitability criterion is based on the economic logic that farmers are maximisers of surplus. This assumption could be contested because in situations where family-labour using households dominate, the objective could well be that of maximising income rather than surplus. (Under Kerala conditions the surplus-maximising argument is highly plausible because of the labour-use practices in agriculture. Though there is a significant proportion of small cultivators the proportion using family labour is small due to sociological reasons. This means that a high proportion of labour cost in agriculture is paid-out cost.) However, in order to examine the trend in profitability of different crops over the period of our analysis, we would require time series data on cost of cultivation of these crops. In the absence of such data, we resort to another method. This is in terms of comparing the differential between the growth rates in land productivity and in product wage. The former is taken as a measure of labour productivity under the assumption that the

inputs are used in fixed proportions f production and the latter is obtained by deflating money wages in agriculture by product price.

In our earlier paper, we had argued that under Kerala conditions the fixed proportionality of land and labour use seem to be borne out by empirical evidence at least for paddy crop (see Kannan and Pushpangadan 1988). Since no significant technical change has taken place in agriculture this condition may be extended to other crops mainly for extension of the model. The profitability condition must be valid in growth rate form as well. Under fixed proportionality, land and labour productivity should be related in the following way:

$$(O/L) = k.(O/N)$$

where O, the output, N, land input, and L, the labour input and k, a constant of proportionality.[3] For profit maximization, the marginal value product of labour must be equal to its wage rate. Therefore, the growth rate version of the equilibrium condition, under fixed factor proportion and on the assumption that average product is equal to marginal product, for profit maximization is given by

$$(O/N) = (W/P)$$

where P is the price of the output, W is the wage rate.

Substituting y for O/N and w for W/P, this condition may be stated alternatively as $y - w = 0$. If $y - w = 0$, then real profitability is maintained, if it is > 0 then there is an increase in real profitability and if it is < 0 then there is a decrease in profitability. This could then be compared with the growth rate in area to see whether it responds to the trend

in profitability In Table 8 we report the growth rates in yield and in product wage for the ten crops and its differential for the two periods. While only three crops namely, coconut, coffee and arecanut showed declining trend in profitability in the first period, six reported declining profitability during the second period. In Table 9 we have given the trend in area in relation to the trend in profitability. The area response in general is in conformity with the trend in profitability. The exceptions are coconut and coffee in both the periods and cashew and arecanut in the second period. The case of coconut does bring in a number of issues on the role of certain crops in an agrarian economy. There are certain characteristics of the coconut crop in Kerala unlike many other crops. It is cultivated mostly in small holdings and is more of a subsistence crop. Moreover, the economic value of coconut is not confined to its output of nuts. The tree trunk and cudgels are used as material for housing, the husk is a raw material for the coir industry and its branches and shells are used as cooking fuel. Therefore even in the face of declining productivity as well as real profitability (which captures only the value of nuts as returns), the decision to move away from its cultivation may be governed by factors such as those mentioned above. In the case of cashew the increase in area, as we said earlier, has taken place in districts where such area might not be competing for other crops because of the poor quality of soil. Since there are incentives for area expansion, such lands might well be used for expanding area under cashew. Moreover such increase in area could have resulted in the underestimation of yield which has not been taken care of. On the whole therefore the profitability test does emerge as a proximate reason for the growth performance of most of the crops. The case of coffee and arecanut can be explained in terms of the risk minimizing behaviour of the farmers as shown in the next part of the analysis.

Table 8: Periodwise growth rates in yield, product wage and its differential of major crops

Crop		Period I 1962-1975	Period II 1975-1986	$(\dot{y} - \dot{\omega})$	
				Period I	Period II
Paddy	$\dot{y}$	1.0	1.2		
	$\dot{\omega}$	-0.1	7.7	1.1	-6.5
Tapioca	$\dot{y}$	4.0	NS		
	$\dot{\omega}$	0.5	2.2	3.5	-2.2
Banana	$\dot{y}$	NS	-2.3		
	$\dot{\omega}$	NS	2.3	No Change	-4.6
Coconut	$\dot{y}$	-2.4	NS		
	$\dot{\omega}$	-0.8	0.5	-1.6	-0.5
Rubber	$\dot{y}$	9.0	NS		
	$\dot{\omega}$	3.3	-0.5	5.7	0.5
Cashew	$\dot{y}$	-1.6	-7.4		
	$\dot{\omega}$	-5.1	NS	3.5	-7.4
Pepper	$\dot{y}$	NS	NS		
	$\dot{\omega}$	NS	NS	No Change	No Change
Coffee	$\dot{y}$	NS	NS		
	$\dot{\omega}$	3.5	4.7	-3.5	-4.7
Cardamom	$\dot{y}$	NS	5.1		
	$\dot{\omega}$	-7.1	NS	7.1	5.1
Arecanut	$\dot{y}$	NS	1.2		
	$\dot{\omega}$	8.5	-2.8	-8.5	4.0

Source : 1.GOK, Statistics for Planning, various issues.
2.Nair and Narayana (1984) and Cardamom Board, Cardamom Statistics, various issues.
3.Rubber Board, Rubber Statistics, various issues.
4.Coffee Board, Coffee Statistics, various issues.

Table 9 :Relationship between growth rate in profitability (measured in terms ($\hat{y} - \hat{w}$) and growth rate in area

Crop	Trend in profitability		Trend in area	
	I	II	I	II
Paddy	> 0	< 0	increasing	decreasing
Tapioca	> 0	< 0	increasing	decreasing
Banana	= 0	< 0	no trend	no trend
Coconut	< 0	< 0	no trend	no trend
Rubber	> 0	> 0	no trend	increasing
Cashew	> 0	< 0	increasing	increasing
Pepper	= 0	= 0	no trend	no trend
Coffee	< 0	< 0	increasing	increasing
Cardamom	> 0	> 0	increasing	no trend
Arecanut	< 0	> 0	no trend	decreasing

Note:
If the growth rate is not significant, then it is treated as zero for the calculation of the trend in profitability.

Source: Based on Table 8.

Earnings Instability

We however need to probe further into the proximate reasons by examining another dimension i.e., stability in earnings per unit of land. Here we take the gross value per unit of land as a proxy for gross surplus in the absence of any reliable timeseries estimate for the latter for all the crops included in the analysis. The unit of land is expressed in terms of a hectare of gross cropped area because area under perennial crops cannot be converted into net terms. The fluctuations in earnings is determined here by computing the instability in gross value generated per hectare of gross area.The measure of instability varies according to trend specification (Murray, 1978; Macbean and Nguyen, 1980; Love, 1986 among others). Since the growth rate is based on exponential function, the log trend is used for the calculation of the instability measure(Murray, 1978):

$$\Sigma(x_t - ae^{bt})^2/n\bar{x}$$

where $\bar{x}$, the mean, x_t, the actual and ae^{bt}, the trend of the gross value of output per unit of land of the crop with n observations.

The Log-trend instability (LTI) is calculated for all the crops for the two periods and the results are given in Table 10.

Table 10: Mean instability index of earnings per hectare for all crops: (1962/63-1985/86)

Crop	Period I	Period II	Period II / Period I (%)
Paddy	226.5	69.3	30.7
Coconut	71.6	470.7	657.4
Tapioca	271.6	282.2	103.9
Rubber	138.2	117.0	84.7
Cashew	150.3	207.6	138.1
Pepper	44.1	681.4	1545.1
Banana	2.1	180.1	8576.1
Coffee	1.2	18.6	1550.0
Arecanut	494.8	847.0	171.2
Cardamom	278.8	1925.0	690.2
Mean	167.9	479.9	285.9

Source: same as in table 3.

The instability analysis shows that for all the crops taken together the mean instability in earnings has increased by nearly three times during the second period compared to the first. However, the extent of change in instability has varied a great deal among the crops and between periods. The relative instability position of the various crops during the two periods do not show any systematic pattern since the rank correlation between the mean instability index for the two periods is not statistically significant [4]. The first three crops with the highest instability increase are banana, coffee and pepper. For banana this extent of fluctuations in earnings might be the reason for showing no trend in area growth despite a marginal tendency for increasing profitability. For coffee the instability is the least among the crops for the two periods. This perhaps explains the increasing trend in area despite in profitability. For pepper the profitability seem to have remained the same but increasing instability in earnings again seems to have prevented any growth in area. The next three crops in terms of increase in instability are cardamom, coconut and arecanut. Cardamom shows no change in area growth despite

increasing profitability but it has experienced increasing instability. For coconut decreasing profitability and increasing instability seem to have led to either stagnation in area growth. In case of arecanut increasing profitability in the second period has not resulted in increase in area. This could be due to its high level of instability in earning. In the case of rubber profitability has increased and instability has decreased thus gaining advantage on both the fronts. This has led to increase in area growth. For paddy while instability has declined the profitability has also declined the extent of which was the highest. This extent of decline in profitability has taken away the incentive for paddy cultivation in many areas (as evidenced by a decline or stagnation in area in a large number of taluks given in Table 6) resulting in overall deceleration in area.

Sources of Instability

The detrended value of the earnings, price and yield can be used to identify the source of instability in earnings of various crops (Murray, 1978). The method is as follows:

From the definition,

$\ln PY = \ln P + \ln Y$ where P = price of the crop and Y = yield per acre.

Detrending the above series using loglinear function and calculating the correlation from detrended values of price, yield and earnings, we have the following results given in Table 11.

Table 11: Correlation coefficients of instability in price, yield and earnings

	Period I			Period II			Period I & II		
	P/Y	P/E	Y/E	P/Y	P/E	Y/E	P/Y	P/E	Y/E
Paddy	-	0.99	-	-	0.99	-	-	0.99	-
Coconut	-	0.99	-	-	0.93	-	-	0.96	-
Tapioca	-	0.81	0.83	-	0.96	-	-	0.84	0.78
Rubber	-	-	0.71	-0.75	-	-	-	-	0.65
Cashew	-	-	0.83	-	0.86	-	-	0.75	0.59
Pepper	-	0.96	-	-	0.89	-	-	0.91	-
Banana	-	-	0.99	-	-	0.99	-	-	0.99
Coffee	-	0.84	0.66	0.95	-	-	0.98	-	-
Arecanut	0.82	0.99	0.89	-	-	-	-	-	-
Cardamom	-	0.63	-	-	0.87	-	-	0.76	0.51

Source: Same as in Table 10.

The decomposition of instability in earnings into price instability and yield instability does not give any uniform pattern. Out of the ten crops, three crops namely, tapioca, cashew and cardamom have been affected by instability in both price and yield. But for the two most important crops of paddy and coconut as well as for pepper the main source of instability is the price. For rubber, which seems to be a dynamic crop in Kerala, as well as banana the main source of instability is the yield. For the remaining two crops, coffee and arecanut, source could not be identified because the correlation coefficients are not significant. This is the picture for the whole period 1962-63 to 1985-86.

For the first period both price and yield instability have contributed to earning instability for three crops namely, tapioca, coffee and arecanut. However, no crop has been affected by both price and yield instability in the second period. Price instability alone contributed to earning instability for four crops namely, paddy, coconut, pepper and cardamom in the first period.

This pattern has persisted for these crops during the second period also. In addition, two more crops - tapioca and cashew - have joined the list in the second period. Yield instability alone contributed to earning instability during the first period for rubber, cashew and banana. But only banana figures in the second period. The correlation between detrended value of price and yield can be used to identify the dominant source of instability if the elasticities of demand and supply are approximately equal (Porter 1971). If the correlation is positive (negative), then demand (supply) is the source of instability. If the correlation is insignificant then both sources contributed to instability (Behrman 1984). On the basis of the model, it can be argued that demand had played a dominant role in the earning instability of arecanut in the first period and of coffee in the second period. However, supply factors were responsible for the earnings fluctuations in rubber during the second period. For all other crops both supply and demand factors had influenced the fluctuations in earnings. The findings suggest that any policy for stabilising income of the farmers should concentrate on both supply and demand factors.

V

Farmers' Response to Increasing Risk

The overall increase in instability in earnings during the second period is a clear indication that the farmers are exposed to increased risk in earnings. Under such conditions, economic rationality would dictate the allocation of land among various crops in such a way as to reduce the risk and earn a higher return. In terms of the cropping pattern prevailing in Kerala this would imply that wherever feasible the farmers could resort to mixed

cropping. As it is, Kerala's agriculture is characterized by a high degree of mixed cropping because of the predominance of a number of perennial crops. Whether the mixed cropping strategy has been further made use of in the second period in order to offset the increased risk may be measured by the extent of area concentration among various crops during this period. Although there are a large number of concentration measures available in the literature (Curry and George 1983), we have selected the Hirschman-Herfindahl Index (HHI). This gives maximum weight to large area under a crop as well as the number of crops (Clark 1985:15). Further it can be tested whether this strategy has resulted in increased earnings by computing the average value generated per unit of net sown area in constant prices for the two periods. These results are given in Table 12. Row 1 in this table shows the increase in mean instability during the second period as compared to the first; the extent of instability increasing by 286 percent. The strategy of risk minimisation by reducing the concentration of crops seem to have taken place given in terms of an 8 percent reduction in the HH Index. As a result the gross value of crops has increased by 20 percent during the second period as compared to the first.

However, this increased gross value per unit of net sown area in constant prices does not mean increased profitability because we have seen a faster rate of growth in product wage compared to land productivity for the crops as a whole. What this suggests is that the farmers are resorting to whatever rational strategies within their domain of control. However, they alone are not able to break the impasse in productivity which is the crucial factor determining any further growth in the agricultural sector.

Table 12: Test for risk minimising behaviour in acreage allocation

	Period I (Mean)	Period II (Mean)	% change
1. Earnings instability	167.9	479.9	(+)286
2. HH Index of area concentration	25.4	23.3	(-) 8
3. Average gross value per ha of net sown area at 1970-71 prices	1978.0	2382.0	(+) 20

Source: 1) Table 10, in the text. 2) Same as in Table 3.

Note for item 2: Hirschman-Herfindahl Index (HHI) of concentration is defined as

$$HHI = \sum_{i=1}^{10} (A_i/A)^2$$

where A_i = the area under ith crop, A = total area under all the crops.

The index can also be expressed as

$$HHI = \frac{C^2 + 1}{10}$$

$$C^2 = (1/10) \sum_{i=1}^{10} (A_i^2/\bar{A}^2) - 1$$

where $\bar{A}$ = mean area under each crop; C, by definition, is the coefficient of variation of area under the crops (Clarke 1985:15)

Note for item 3: The average value generated per unit of net area sown is calculated by the following formula

$$Y = (1/T) \sum_{t=1}^{T} \sum_{i=1}^{10} (P_{it} O_{it}/A_t)$$

where Y = average value generated per hectare of net area sown; O_{it} = output of crop i in year t; P_{it} = price of crop i in year t; A_t = net area sown in year t minus area under tea and seasamum; T = number of years in the given period. The time series data generated at current prices are deflated by the whole sale price index numbers of agricultural commodities with base 1970-71 = 100 to obtain constant values.

Agricultural Development Models and Kerala Experience

The analysis indicates that the yield stagnation in agriculture is all pervasive including paddy although yield of paddy has increased during the period which is not due to any technical change. The observed increase in yield for paddy is purely due to marginal land going out of cultivation. That is to say, there is technological stagnation throughout Kerala's agriculture since mid seventies. Moreover, the farmers have resorted to increased mixed cropping to minimise earnings fluctuation from a given acreage. Therefore, the most important component of any strategy for the agricultural development of Kerala is to make technical change as the main source of growth. In the formulation of such a strategy, the historical experiences of the industrially advanced countries may be of great help. The best single source of such an exercise is the most comprehensive survey of literature by Hayami and Ruttan (1971) and Ruttan (1981). On the basis of the survey, they have classified the approaches to agricultural development into five general models: (1) the frontier model; (2) the urban-industrial impact model; (3) the conservation model; (4) the diffusion model; and (5) the high-pay-off input model. Let us briefly examine the relevance of these models in the present context.

In the frontier model, perhaps the earliest, the source of growth is the area expansion. The model as it is has very limited application since net area sown is fixed in Kerala. But gross cropped area under seasonal crops can be increased by raising a third crop if adequate water supply can be provided through increased irrigation facility. However, our analysis has already demonstrated that this is possible only if profitability is increased. This

would imply that area expansion is possible only if technology is changed to make production profitable. Another way to increase the gross cropped area under perennial crop is by mixed cropping. This method again needs much research input to identify the crop-mix and its optimal combination. Therefore the model, as it is, has not much relevance for the development of Kerala's agriculture.

The urban-industrial impact model was primarily designed to explain the geographical variation in the intensity of the farming systems in the industrialising societies especially that of Germany and USA. In this strategy, higher labour productivity in agriculture in a particular region is due to the existence of more effective product and factor market as a result of rapid urban-industrial development of that region. Therefore, the model is applicable to the less developed regions of the industrially advanced countries but not for the developing countries. However it emphasises an important point that the agricultural and nonagricultural growth are complimentary and reinforcing in the overall growth of the economy.

The conservation model which has its origin in the English agricultural revolution and the soil exhaustion suggested by early German chemists and soil scientists. The model basically suggests that the agricultural development should be based on minimum destruction to the soil fertility and the environment and that all the input requirements should be raised from within agriculture itself. The main limitation of the model is that it had generated only one percent growth of agriculture historically which is far below the requirement for the most of the developing countries (Ruttan 1981 23). The lesson that this model offers to Kerala is not in terms of its growth potential in itself but that of the need to preserve the stock and improve the quality

nd utilizati.. of environmental resources such as soil, water and forests. If ese were to degrade, then the basis on which agricultural growth is made ossible will be knocked out and the result would be either stagnation or ecline. This is what seems to have happened in Kerala. This may be illustrated with the results of the taluk-wise analysis of the growth rformance of paddy. In Table 6 we have seen that nearly one-third of the taluks (i.e. 18 out of 56) have low yield per unit of land for the second eriod. It is precisely these areas which have registered a higher pace in the rate of decline in area under paddy. What this implies is that given the declining relative price of paddy and low yield during the second period, paddy is more uneconomical here than elsewhere.

The question is: is there any pattern in terms of the environmental aspects for these areas? On the basis of available information on agro-climatic conditions and cropping patterns in Kerala there seems to be a clear pattern. Out of the 13 agro-climatic zones in Kerala, these low yield taluks belong to four zones (except one). The common characteristic for all the taluks is the poor quality of soil - laterite, sandy or alluvial - and most of them located in the costal belt. But the poor quality of soil needs to be considered in terms of the topography. All the taluks with laterite soil have more of hills and slopes with varying gradients and all other areas have extensive valleys with raised garden lands. Of the 18 taluks, 13 of them have either no forest cover or very little of it and this could be a factor in the erosion of soil fertility or absence of accretion of fertile soil. Except 4 taluks all others have population density which are much higher than the state average thus adding to the problem of low land productivity.

Thus what the conservation model suggests is the need for eco-restoration

and improving the quality of environmental resources so as to strengthen the bio-foundation of agriculture. However the lessons of this model need to be translated in conjunction with the lessons of the induced innovation model discussed later.

Table 13 : Agroclimatic characteristics of Taluks with low land productivity in Paddy cultivation

Taluks	Agroclimatic zone	Soil type	Altitude	Rainfall	Topography	Forest cover * (% Area)
Mukundapuram	IV	Laterite	Sea Level to 500 m	Two monsoons moderately distributed	Less valleys and more hills and slopes	23
Ernad, Tirur Hosdurg and Kozhikode	VI	Laterite	Sea Level to 500 m	Monsoons less moderately distributed. S-W monsoon concentrated in 3 to 4 months period	Less valleys- Slopes are more steep but hills with table top	15
Thaliparamba Tellichery Cannanore Quilandy Badakara	V	Laterite	Sea level to 500 m	Monsoons less moderately distributed. S-W monsoon concentrated in 3-4 months period	Less valleys- Slopes are steep- hills with moderate gradients	7
Chavghat Kodungallur Cochin, Shertallai Aavalapuzha	II	Sandy	Sea level to 500 m	Two monsoons moderately distributed	Extensive valleys with level but raised garden lands	neg
Karunagapally Quilon Kanayanoor	I	Alluvial	Sea level to 500 m	Two monsoons moderately distributed	Extensive valleys with level but raised garden lands.	neg

Source : GOK (1974)

Note * : This refers to land under the Forest Department which is not synonymous with forest cover. The actual forest cover has been only around one-third of the area under forest department.

neg : Negligible, S-W : South West

The diffusion model is based on the assumption that the productivity differences among the farmers and regions should be narrowed down through more effective dissemination of technical knowledge through extension services with trained manpower. As a result of this approach, disciplines like agricultural economics, farm management and rural sociology have become an essential part of any successful agricultural development strategy. The model, however, failed to generate the expected modernisation of the traditional agriculture due to the unavailability of technology adapted to the needs of the developing countries.

The failure of the diffusion model to deliver the much needed growth in the agriculture was the starting point for Schultz (1964) to suggest the high-pay-off-input model for transforming traditional agriculture. In this model he demolished the view that the farmers in the developing world are inefficient in resource allocation in agriculture using example from Java, Indonesia and Senapur in India (Schultz 1964). In other words, agriculture has settled in these countries to low level equilibrium with low return. The only way to generate growth in such a situation is to supply modern inputs through careful allocation of investible resources to the following area: (i) The establishment of research and experimental stations that generate the required scientific knowledge, (ii) the investment in industrial ventures that develop and market the modern inputs, and (iii) generate conditions for the adaptability of these technologies. This model makes agriculture itself as the leading sector for economic development by carefully channeling the resources in agriculture (Raj 1983; Mellor 1976).

However there is no single formula for agricultural growth and development for countries with varying natural resources and other endowments. This

realization formed the basis for developing what is called an induced innovation model by Hayami & Ruttan (1971) for agricultural development in which "technical change is treated as endogenous in the development process, rather than as exogenous factor that operates independently of other development process". This model was "stimulated by historical evidence that different countries had followed alternative paths of technical change in the process of agricultural development and by a consideration of the wide productivity differentials among countries" (Rutten 1982 27). This could form a basis on which an appropriate technical, organizational and institutional innovation strategy could be designed. Given the intensity of land-use, cropping pattern, abolition of intermediation through land reforms, existence of a network of agricultural research, extension and credit services and above all the relatively higher level of education among the farming community and their receptiveness to new ideas, Kerala's agriculture seems to have reached a threshold warranting such an induced innovation strategy so as to break out of its technological stagnation. Such a strategy should incorporate appropriate lessons from the conservation and high pay off models.

Notes

1. This was suggested to us while discussing the methodology with the officials of the Department of economics and statistics, Government of Kerala.

2. For details, Kannan and Pushpangadan (1988), technical note 2 in the appendix.

3. A version of the model under variable factor proportions is given in Kannan and Pushpangadan, 1988.

4. The rank correlation of the mean instability of the 10 crops between the two periods is 0.54 which is not statistically significant at 1% level

Appendix

Table A.1: Contribution of taluks to yield, area and output of paddy in Kerala for all seasons, 1975-76 to 1985-86.

Rank	Taluk	Yield (Kg/Ha)	Area (Ha)	% Area	Output (Tonne)	% Output
1	2	3	4	5	6	7
1	Chittoor	3757	39405	5.00	148074	7.66
2	Kuttanad	3621	30311	3.84	109320	5.65
3	Alathoor	3492	41505	5.26	144853	7.49
4	Changanacherri	3336	5339	0.68	17771	0.92
5	Palghat	3284	38458	4.88	126189	6.53
6	Thiruvalla	3133	6390	0.81	19961	1.03
7	Udumbanchola	3003	1736	0.22	5060	0.26
8	Kottayam	2973	15143	1.92	44640	2.31
9	Peermadu	2888	56	0.01	169	0.01
10	Chengannur	2881	6905	0.88	19666	1.02
11	Devikulam	2855	2493	0.32	7071	0.37
12	Pathanapuram	2839	7928	1.01	22415	1.16
13	Meenachal	2701	4934	0.63	13268	0.69
14	Pathanamthitta	2700	4228	0.54	11368	0.59
15	Karthigappally	2685	11471	1.45	30527	1.58
16	Thodupuzha	2675	5800	0.74	15311	0.79
17	Kanjirapally	2654	115	0.01	306	0.02
18	Kottarakara	2627	12157	1.54	31813	1.65
19	Muvattupuzha	2597	12291	1.56	31729	1.64
20	Wynad	2559	29904	3.79	76462	3.96
21	Vaikom	2426	10221	1.30	24546	1.27
22	Neyyatinkara	2379	8370	1.06	19780	1.02
23	Kothamangalam	2372	8662	1.10	20482	1.06
24	Alwaye	2370	24331	3.08	57400	2.97
25	Chirayinkil	2358	8380	1.06	19692	1.02
26	Kasargode	2349	16919	2.14	39269	2.03

(Contd...)

Table A.1 (Continued)

1	2	3	4	5	6	7
27	Mavelikkara	2328	12954	1.64	30219	1.56
28	Kunnathoor	2301	8417	1.07	19445	1.01
29	Trichur	2289	29080	3.69	66262	3.43
30	Mannarghat	2267	14841	1.88	33727	1.74
31	Trivandrum	2251	6750	0.86	15072	0.78
32	Perinthalmanna	2230	15874	2.01	35578	1.84
33	Kunnathunad	2215	29065	3.68	64212	3.32
34	Parur	2156	9202	1.17	19923	1.03
35	Neddumangad	2140	8523	1.08	18080	0.94
36	Thalapally	2139	33398	4.23	71206	3.68
37	Ottappalam	2126	40220	5.10	85372	4.42
38	Ponnani	2111	10762	1.36	22770	1.18
39	Hosdurg	2084	11999	1.52	25013	1.29
40	Cochin	2061	2058	0.26	4265	0.22
41	Quilon	2013	7373	0.93	14828	0.77
42	Mukundapuram	2012	35159	4.46	70083	3.63
43	Ernad	1996	31510	3.99	62519	3.23
44	Ambalapuzha	1949	6992	0.89	13589	0.70
45	Karunagappally	1944	8231	1.04	15865	0.82
46	Taliparmba	1942	13084	1.66	25256	1.31
47	Kanayannoor	1875	9240	1.17	17196	0.89
48	Cannanore	1872	10384	1.32	19401	1.00
49	Tirur	1820	22287	2.83	40372	2.09
50	Tellicherry	1757	10240	1.30	17884	0.93
51	Chawghat	1695	9491	1.20	15709	0.81
52	Kozhikode	1614	12392	1.57	19744	1.02
53	Quilandy	1408	10340	1.31	14160	0.73
54	Badakara	1372	5484	0.70	7476	0.39
55	Cranganore	1135	2715	0.34	3100	0.16
56	Shertalai	1067	7315	0.93	7762	0.40
	State	2352	788832	100.00	1933230	100.00

Table A.2: Contribution of taluks to yield, area and output of paddy in Kerala for the autumn crop, 1975-76 to 1985-86.

Rank	Taluk	Yield (Kg/Ha)	Area (Ha)	% Area	Output (Tonne)	% Output
1	2	3	4	5	6	7
1	Chittoor	4112	20865	6.07	85709	10.44
2	Alathoor	3677	19826	5.77	72885	8.88
3	Palghat	3491	20580	5.99	71517	8.71
4	Kuttanad	3253	9409	2.74	31468	3.83
5	Kanjirapally	2955	40	0.01	117	0.01
6	Pathanapuram	2816	3943	1.15	11039	1.34
7	Pathanamthitta	2796	1748	0.51	4870	0.59
8	Kottayam	2777	5112	1.49	14722	1.79
9	Devikulam	2733	984	0.29	2726	0.33
10	Muvattupuzha	2725	4956	1.44	13467	1.64
11	Neyyatinkara	2698	4003	1.17	10676	1.30
12	Thodupuzha	2681	3008	0.88	7886	0.96
13	Meenachal	2614	2182	0.64	5694	0.69
14	Vaikom	2573	3769	1.10	9849	1.20
15	Changanacherri	2503	1558	0.45	3849	0.47
16	Kottarakara	2496	6000	1.75	14960	1.82
17	Trivandrum	2486	3182	0.93	7788	0.95
18	Kothamangalam	2433	4076	1.19	9834	1.20
19	Alwaye	2408	9113	2.65	21980	2.68
20	Chengannur	2387	2737	0.80	6574	0.80
21	Chirayinkil	2333	3912	1.14	9069	1.10
22	Kasargode	2282	10124	2.95	22669	2.76
23	Kunnathunad	2255	10961	3.19	24627	3.00
24	Udumbanchola	2219	357	0.10	869	0.11
25	Perinthalmanna	2151	8542	2.49	18796	2.29
26	Karthigappally	2144	3349	0.97	7484	0.91
27	Neddumangad	2135	4133	1.20	8727	1.06

(Contd...)

Table A.2 (Continued)

1	2	3	4	5	6	7
28	Mannarghat	2114	6898	2.01	14651	1.78
29	Kunnathoor	2089	4124	1.20	8638	1.05
30	Hosdurg	2065	7709	2.24	15876	1.93
31	Cochin	2061	2058	0.60	4265	0.52
32	Ottappalam	2047	21397	6.23	43702	5.32
33	Parur	2041	3602	1.05	7331	0.89
34	Thiruvalla	2008	1898	0.55	3828	0.47
35	Cannanore	1967	7518	2.19	14714	1.79
36	Thalapally	1958	15945	4.64	31115	3.79
37	Karunagappally	1953	3644	1.06	6976	0.85
38	Ponnani	1945	4125	1.20	8118	0.99
39	Trichur	1925	7325	2.13	13960	1.70
40	Mavelikkara	1908	5005	1.46	9536	1.16
41	Ernad	1873	15996	4.66	29858	3.64
42	Taliparmba	1855	8377	2.44	15519	1.89
43	Kanayannoor	1850	4933	1.44	9032	1.10
44	Tellicherry	1819	6174	1.80	11112	1.35
45	Mukundapuram	1794	11639	3.39	20836	2.54
46	Quilon	1784	3500	1.02	6272	0.76
47	Ambalapuzha	1708	3064	0.89	5409	0.66
48	Tirur	1613	9812	2.86	15687	1.91
49	Wynad	1384	121	0.04	172	0.02
50	Badakara	1344	2504	0.73	3317	0.40
51	Chawghat	1332	3710	1.08	4667	0.57
52	Kozhikode	1319	4847	1.41	6134	0.75
53	Shertalai	1213	4553	1.33	5524	0.67
54	Quilandy	1201	3862	1.12	4430	0.54
55	Cranganore	864	741	0.22	654	0.08
56	Peermadu	0	0	0.00	0	0.00
	State	2163	343551	100.00	821184	100.00

Table A.3: Contribution of taluks to yield, area and output of paddy in Kerala for the winter crop, 1975-76 to 1985-86.

Rank	Taluk	Yield (Kg/Ha)	Area (Ha)	% Area	Output (Tonne)	% Output
1	2	3	4	5	6	7
1	Kuttanad	3749	6019	1.72	23182	2.75
2	Chittoor	3385	17671	5.05	60049	7.13
3	Alathoor	3329	21573	6.17	71691	8.51
4	Devikulam	3069	1334	0.38	4025	0.48
5	Udumbanchola	3062	1371	0.39	4165	0.49
6	Palghat	3060	17473	5.00	53478	6.35
7	Changanacherri	3026	1042	0.30	3191	0.38
8	Peermadu	2888	56	0.02	169	0.02
9	Pathanapuram	2862	3974	1.14	11356	1.35
10	Thiruvalla	2848	1290	0.37	3657	0.43
11	Chengannur	2819	2459	0.70	6927	0.82
12	Kottarakara	2770	6063	1.73	16730	1.99
13	Kottayam	2742	4571	1.31	12340	1.46
14	Meenachal	2729	2549	0.73	6939	0.82
15	Thodupuzha	2673	2792	0.80	7425	0.88
16	Pathanamthitta	2646	2335	0.67	6161	0.73
17	Wynad	2588	23389	6.69	60432	7.17
18	Muvattupuzha	2586	6241	1.78	16050	1.91
19	Kunnathoor	2537	4196	1.20	10667	1.27
20	Kanjirapally	2467	75	0.02	189	0.02
21	Mannarghat	2452	7042	2.01	17380	2.06
22	Chirayinkil	2432	4301	1.23	10453	1.24
23	Kasargode	2398	5154	1.47	12390	1.47
24	Kothamangalam	2375	3975	1.14	9500	1.13
25	Trichur	2319	14023	4.01	32464	3.85
26	Vaikom	2295	5832	1.67	13321	1.58
27	Quilon	2266	3659	1.05	8281	0.98

(Contd...)

Table A.3 (Continued)

1	2	3	4	5	6	7
28	Perinthalmanna	2264	6509	1.86	14694	1.74
29	Thalapally	2248	15353	4.39	34454	4.09
30	Kunnachunad	2244	12362	3.53	27697	3.29
31	Alwaye	2229	9661	2.76	21494	2.55
32	Ottappalam	2223	17892	5.12	39701	4.71
33	Neddumangad	2214	4032	1.15	3938	1.06
34	Neyyatinkara	2142	3990	1.14	8532	1.01
35	Ernad	2133	14769	4.22	31373	3.72
36	Parur	2092	3191	0.91	6763	0.80
37	Taliparmba	2091	4268	1.22	8829	1.05
38	Trivandrum	2090	3243	0.93	6829	0.81
39	Mukundapuram	2089	15674	4.48	32408	3.85
40	Mavelikkara	2068	5222	1.49	10827	1.29
41	Hosdurg	2055	3142	0.90	6461	0.77
42	Karunagappally	1977	4346	1.24	8586	1.02
43	Karthigappally	1977	4344	1.24	8395	1.00
44	Ponnani	1866	4669	1.33	8814	1.05
45	Tirur	1852	10506	3.00	19448	2.31
46	Kanayannoor	1845	3873	1.11	7186	0.85
47	Kozhikode	1805	6679	1.91	12055	1.43
48	Tellicherry	1671	3649	1.04	6124	0.73
49	Cannanore	1619	2803	0.80	4582	0.54
50	Chawghat	1554	4397	1.26	6923	0.82
51	Quilandy	1461	5054	1.44	7258	0.86
52	Ambalapuzha	1364	2212	0.63	3065	0.36
53	Badakara	1348	2788	0.80	3752	0.45
54	Cranganore	1210	1912	0.55	2327	0.28
55	Shertalai	815	2763	0.79	2239	0.27
56	Cochin	0	0	0.00	0	0.00
	State	2267	349762	100.00	842366	100.00

Table A.4: Contribution of taluks to yield, area and output of paddy in Kerala for the summer crop, 1975-76 to 1985-86.

Rank	Taluk	Yield (Kg/Ha)	Area (Ha)	% Area	Output (Tonne)	% Output
1	2	3	4	5	6	7
1	Changanacherri	3946	2739	2.84	10731	3.94
2	Thiruvalla	3891	3201	3.32	12475	4.58
3	Karthigappally	3837	3778	3.92	14648	5.38
4	Kuttanad	3660	15430	16.02	56777	20.84
5	Mavelikkara	3642	2728	2.83	9857	3.62
6	Chengannur	3641	1710	1.78	6165	2.26
7	Kottayam	3225	5460	5.67	17578	6.45
8	Ambalapuzha	3153	1717	1.78	5115	1.88
9	Alwaye	3044	5557	5.77	13926	5.11
10	Ponnani	3002	1967	2.04	5838	2.14
11	Meenachal	2984	223	0.23	698	0.26
12	Perinthalmanna	2893	823	0.85	2088	0.77
13	Chawghat	2887	1384	1.44	4119	1.51
14	Thalapally	2752	2100	2.18	5636	2.07
15	Palghat	2699	405	0.42	1194	0.44
16	Tirur	2542	1969	2.04	5237	1.92
17	Trichur	2566	7733	8.03	19838	7.28
18	Kasargode	2520	1641	1.70	4211	1.55
19	Chittoor	2508	869	0.90	2316	0.85
20	Wynad	2437	6427	6.67	15905	5.84
21	Parur	2413	2409	2.50	5829	2.14
22	Alathoor	2367	106	0.11	277	0.10
23	Hosdurg	2270	1148	1.19	2676	0.98
24	Mukundapuram	2191	7846	8.15	16839	6.18
25	Kanayannoor	2130	434	0.45	979	0.36
26	Udumbanchola	2115	133	0.14	337	0.12
27	Ottappalam	2110	931	0.97	1969	0.72
28	Vaikom	2063	681	0.71	1515	0.56

(Contd...)

Table A.4 (Continued)

1	2	3	4	5	6	7
29	Kunnathunad	2028	5742	5.96	11888	4.36
30	Cranganore	2023	61	0.06	118	0.04
31	Badakara	2017	192	0.20	407	0.15
32	Muvattupuzha	2011	1094	1.14	2212	0.81
33	Pathanamthitta	1996	145	0.15	337	0.12
34	Taliparmba	1905	439	0.46	909	0.33
35	Mannarghat	1889	901	0.94	1696	0.62
36	Kothamangalam	1855	611	0.63	1149	0.42
37	Kozhikode	1791	865	0.90	1554	0.57
38	Quilandy	1737	1424	1.48	2473	0.91
39	Devikulam	1720	194	0.20	353	0.13
40	Ernad	1714	744	0.77	1287	0.47
41	Neyyatinkara	1577	377	0.39	572	0.21
42	Cannanore	1558	63	0.06	104	0.04
43	Tellicherry	1550	416	0.43	647	0.24
44	Karunagappally	1548	240	0.25	303	0.11
45	Trivandrum	1457	325	0.34	454	0.17
46	Kunnathoor	1428	97	0.10	140	0.05
47	Pathanapuram	1316	13	0.01	22	0.01
48	Kottarakara	1315	95	0.10	124	0.05
49	Quilon	1256	214	0.22	275	0.10
50	Neddumangad	1250	358	0.37	415	0.15
51	Chirayinkil	992	166	0.17	171	0.06
52	Peermadu	0	0	0.00	0	0.00
53	Shertalai	0	0	0.00	0	0.00
54	Thodupuzha	0	0	0.00	0	0.00
55	Cochin	0	0	0.00	0	0.00
56	Kanjirapally	0	0	0.00	0	0.00
	State	2100	96325	100.00	272383	100.00

A.5 : Growth rates in area, yield and output of paddy in different taluks in Kerala by Seasons, 1975-76 to 1985-86

Taluk	Area				Yield				Output			
	A	W	S	All	A	W	S	All	A	W	S	All
yattinkara	-4.95	-4.68	-15.78	-3.74*	NS*	NS	NS	NS	-4.95	-4.68	-15.78	-3.76
ivandrum	-4.51	-6.00	-16.39	-5.81	2.86	NS	NS	NS	-1.65	-6.00	-16.39	-5.81
umangad	-3.44*	-3.46*	-42.96	-4.45	2.95	NS	NS	NS	-0.49	-3.46	-42.45	-4.45
rayinkal	NS	-1.13	-41.34	-1.46*	NS	NS	NS	NS	NS	-1.13	-41.34	-1.46
ilon	NS*	-2.22	-17.03	NS*	NS	NS	NS	NS	NS	-2.22	-17.03	NS
ttarakara	NS*	-1.12	-16.24	NS	4.55	NS	NS	NS*	4.55	-1.12	-16.24	NS
nathoor	NS*	NS*	-6.92	NS*	NS	NS	NS	NS	NS	NS	-6.92	NS
thanapuram	-1.28	NS*	..	-1.62	4.67	NS	..	2.21	3.39	NS	..	0.59
thanamthitta	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
runagapally	-5.22*	-2.15	-70.89*	-4.65*	NS	NS*	NS	NS	-5.22	-2.15	-70.89	-4.65
rthigapally	NS	NS*	NS*	-3.28	NS*	3.69*	NS	NS	NS	3.69	NS	-3.28
velikara	NS*	NS	NS	NS	NS	NS	3.12	NS	NS	NS	3.12	NS
enganoor	NS*	NS	-8.91	NS*	NS	NS*	NS	NS	NS	NS	-8.91	NS
iruvalla	NS	-8 28	NS	-3.62	NS	NS	2.74	NS	NS	-8.28	2.74	-3.62
uttanad	NS	NS*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
abalapuzha	NS	NS	NS*	NS	NS	NS	NS	NS	NS	NS	NS	NS
hertalai	NS	-9.79	..	-5.35	NS	NS	..	NS	NS	-9.79	..	-5.35
eermade	..	NS	..	..	..	NS	..	..	..	NS	..	..
evikulam	NS	-27.37	..	-10.3	NS	NS	..	NS	NS	-27.37	..	10.30
duabanchola	..	NS*	..	..	..	4.56	..	..	..	4.56	..	..

(Contd...)

Table A. 5 (Continued)

Taluk	Area				Yield				Output			
	A	W	S	All	A	W	S	All	A	W	S	All
Thodupuzha	-6.41	-3.91*	..	-5.08	3.01	NS	..	2.03	-3.40	-3.91	..	-3.0
Changanacherri	-3.77	14.02*	-5.88	-2.72	NS	NS*	NS	NS	-3.77	14.02	-5.88	-2.7
Kanjirapally	NS	26.33*	..	NS	NS	3.36	..	NS*	NS	29.69	..	NS
Kottayam	NS*	NS*	NS	NS	NS*	4.34	5.46	4.26	NS	4.34	5.46	4.2
Vaikom	NS	NS	..	NS*	NS	NS	..	NS	NS	NS	..	NS
Meenachal	NS	NS	..	-2.32	NS	1.73	..	1.37	NS	1.73	..	-0.9
Kothamangalam	-2.35	-2.37	NS	-2.58	1.65	NS	2.85*	NS*	-0.70	-2.87	NS	-2.5
Muvatupuzha	-4.47*	-2.52	NS	-3.45*	3.10	1.99	NS	2.32	-1.37	-0.53	NS	-1.1
Cochin	NS	..	..	..	NS	..	..	..	NS	..	..	..
Kanayanoor	-7.51	NS	NS	-4.27	NS	NS	NS	NS	-7.51	NS	NS	-4.2
Kunnathunad	NS*	NS	NS*	NS*	NS	NS	3.08	NS	NS	NS	3.08	NS
Alwaye	NS*	-1.30	NS	NS	NS*	NS	NS	NS	NS	-1.30	NS	NS
Parur	-2.42	NS	-10.26	-4.36	NS	NS	NS	NS	-2.42	NS	-10.26	-4.3
Cranganore	NS	4.91	NS	NS*	NS	NS	NS	NS	NS	4.91	NS	NS
Mukundapuram	NS*	-1.46	NS	-3.73*	3.42	3.83	NS	3.36	3.42	2.37	NS	-0.3
Trichur	-4.54*	NS	NS	-1.55	NS	NS	NS	1.91	-4.54	NS	NS	3.0
Thalapally	NS	NS*	NS*	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chowghat	NS*	-10.78	NS	-9.64	NS	NS	NS	NS	NS	-10.78	NS	-9.1
Chittoor	NS	NS	NS*	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alathoor	NS	NS*	NS	NS*	NS	NS	-6.82	NS	NS	NS	-6.82	NS
Palghat	NS	NS	NS	NS	NS	NS*	-7.64	NS*	NS	NS	-7.64	N

(Contd...

ble A.5 (Continued)

Taluk	Area				Yield				Output			
	A	W	S	All	A	W	S	All	A	W	S	All
Ottapalam	-2.57	NS	-10.67	-1.98	NS	NS	NS	NS	-2.57	NS	-10.67	-1.98
Manarghat	-1.96	NS*	NS	NS	NS*	NS	NS	NS	-1.96	NS	NS	NS
Perinthalmanna	-4.51	-2.21*	-10.96	-3.47	-3.23	NS	NS	NS	-7.74	NS	NS	NS
Ponnani	-7.24	NS*	NS*	NS*	NS	NS	NS	NS	-7.24	NS	NS	NS
Tirur	-5.07	NS	NS*	-2.59	NS	NS	NS	NS	-5.07	NS	NS	-2.59
Tirnad	-3.34	-1.79	NS	-2.56	NS*	NS*	NS	NS*	-3.34	-1.79	NS	-2.56
Kozhikode	-8.44	-4.71	NS	-5.85	5.29	NS	NS	2.66	-3.15	-4.71	NS	-3.19
Quilandy	-6.02*	-5.34	NS*	-6.59	NS*	3.28	NS	3.90	-6.02	-2.06	NS	-2.69
Vadakara	-6.91*	-6.88	NS	-8.53	NS	NS	NS	NS	-6.91	-6.88	NS	-8.53
Tellicherry	-6.00	NS	NS	NS*	NS	NS	NS	NS	-6.00	NS	NS	NS
Cannanore	NS*	NS*	NS*	NS*	NS	NS	NS	NS	NS	NS	NS	NS
Thaliparamba	-2.80	NS	-28.51*	-3.27	NS	2.95	NS	NS	-2.80	2.95	-28.51	-3.27
Kasdurg	NS*	NS	NS	NS*	NS*	NS	NS	NS	NS	NS	NS	NS
Kasargode	-6.59	-3.43	-11.92*	-6.30	NS	NS	NS	NS	-6.59	-3.43	-11.92	-6.30
Wynad	..	NS	NS	NS	..	2.07	NS	NS	..	2.07	NS	NS

Note : * Autocorrelated data .. Missing Data

A : autumn crop ; W : winter crop ; S : summer crop; All : all seasons

Table A.6 : Periodwise growth rates in yield and product wage fo. paddy across districts

	Growth rate in product wage		Growth rate in yield	
	I	II	I	II
TRIVANDRUM	-0.27	11.37	NS	NS
QUILON	1.01	11.32	NS	1.04
ALLEPPY	0.52	9.86	1.63	1.87
KOTTAYAM	1.34	8.54	2.21	NS
ERNAKULAM	-0.53	9.57	0.80	1.62
TRICHUR	-0.10	10.99	NS	1.45
PALGHAT	0.61	7.34	1.61	NS
KOZHIKODE	1.04	10.35	NS	NS
CANNANORE	2.35	9.80	0.97	NS
KERALA	-0.14	7.71	1.00	1.20

ble A.7 : Periodwise growth rates in yield and product wage for tapioca across districts

	Growth rate in product wage		Growth rate in yield	
	I	II	I	II
TRIVANDRUM	-0.46	3.57	2.41	NS
QUILON	0.81	3.52	4.97	-3.26
ALLEPPY	0.32	2.06	5.03	NS
KOTTAYAM	1.14	0.74	3.73	NS
ERNAKULAM	-0.73	1.77	5.38	NS
TRICHUR	-0.30	3.19	6.65	-3.48
PALGHAT	0.41	-0.46	5.69	NS
KOZHIKODE	0.53	2.55	4.60	-5.34
CANNANORE	2.15	2.00	7.66	-3.36
KERALA	0.47	2.23	4.00	NS

Table A.8 : Periodwise growth rates in yield and product wage for banana+plantain across districts

	Growth rate in product wage		Growth rate in yield	
	I	II	I	II
TRIVANDRUM	-1.47	3.64	NS	-4.96
QUILON	NS	3.55	NS	-2.37
ALLEPPY	NS	2.07	NS	-3.35
KOTTAYAM	NS	NS	NS	NS
ERNAKULAM	-1.64	NS	NS	NS
TRICHUR	NS	3.26	NS	-4.30
PALGHAT	NS	NS	NS	NS
KOZHIKODE	NS	NS	NS	-2.19
CANNANORE	NS	NS	NS	-2.27
KERALA	NS	2.31	NS	-2.26

Table A.9 : Periodwise growth rates in yield and product wage for coconut across districts

	Growth rate in product wage		Growth rate in yield	
	I	II	I	II
TRIVANDRUM	-1.76	1.87	NS	-2.23
QUILON	-0.49	1.82	-2.07	-3.12
ALLEPPY	-0.98	0.36	-1.83	NS
KOTTAYAM	-0.16	-0.96	-2.03	NS
ERNAKULAM	-2.03	0.07	-1.54	NS
TRICHUR	-1.60	1.49	NS	NS
PALGHAT	-0.88	-2.16	-3.73	NS
KOZHIKODE	-0.46	0.85	-1.62	NS
CANNANORE	0.85	0.27	-2.91	-2.31
KERALA	-0.83	0.53	-2.40	NS

Table A.10 : Period-wise growth rates in yield and product wage for rubber accross districts

	Growth rate in product wages		Growth rate in yield	
	I	II	I	II
TRIVANDRUM	2.44	0.77	11.27	-1.75
QUILON	3.71	0.72	7.29	-1.16
ALLEPPY	3.22	-0.74	15.15	-1.67
KOTTAYAM	4.04	-2.06	13.50	NS
ERNAKULAM	2.17	-1.03	10.66	NS
TRICHUR	2.80	0.39	4.59	-1.67
PALGHAT	3.31	-3.26	7.30	NS
KOZHIKODE	3.74	-0.26	5.98	NS
CANNANORE	5.05	-0.80	17.23	NS
KERALA	3.37	-0.57	9.00	NS

Table 3.13 Period-wise growth rates in yield and product wage for cashew accross districts

	Growth rate in product wages		Growth rate in yield	
	I	II	I	II
TRIVANDRUM	-5.96	NS	NS	-8.78
QUILON	-4.56	NS	NS	-7.73
ALLEPPY	-4.99	NS	NS	-19.13
KOTTAYAM	-3.87	NS	NS	-17.44
ERNAKULAM	-6.09	NS	NS	-7.97
TRICHUR	-5.76	NS	NS	-8.86
PALGHAT	-5 24	NS	NS	-12.36
KOZHIKODE	-4.98	NS	NS	-7.35
CANNANORE	-3.62	NS	NS	-5.80
KERALA	-5.06	NS	-1.57	-7.36

Table A.12 : Period-wise growth rates in yield and product wage for pepper accross districts

	Growth rate in product wages		Growth rate in yield	
	I	II	I	II
TRIVANDRUM	-3.86	NS	-4.18	NS
QUILON	NS	NS	-2.45	NS
ALLEPPY	NS	NS	-4.17	NS
KOTTAYAM	NS	NS	-4.05	-8.27
ERNAKULAM	-4.03	NS	-3.13	-3.81
TRICHUR	-3.70	NS	-6.53	NS
PALGHAT	NS	NS	NS	NS
KOZHIKODE	-2.92	NS	5.54	NS
CANNANORE	NS	NS	NS	4.45
KERALA	NS	NS	NS	NS

Table A.13 : Period-wise growth rates in yield and product wage for cardamom accross districts

	Growth rate in product wages		Growth rate in yield	
	I	II	I	II
PALGHAT	-7.28	NS	NS	NS
KOZHIKODE	-7.02	NS	NS	-14.90
CANNANORE	-5.66	NS	NS	NS
KERALA	-7.05	3.63	NS	5.07

Table A.14 : Period-wise growth rates in yield and product wage for coffee accross districts

	Growth rate in product wages		Growth rate in yield	
	I	II	I	II
QUILON	3.96	5.98	18.74	9.67
KOTTAYAM	4.64	3.06	NS	NS
ERNAKULAM	2.43	4.22	5.02	NS
PALGHAT	3.28	NS	NS	-4.21
KERALA	3.51	4.74	NS	NS

Table A.15 : Period-wise growth rates in yield and product wage for arecanut accross districts

	Growth rate in product wages		Growth rate in yield	
	I	II	I	II
TRIVANDRUM	7.62	NS	NS	-3.34
QUILON	8.99	NS	NS	-4.43
ALLEPPY	8.56	-2.99	NS	-4.78
KOTTAYAM	9.67	-4.42	-1.94	3.91
ERNAKULAM	7.45	-3.26	NS	4.79
TRICHUR	7.79	NS	NS	2.39
PALGHAT	8.31	-5.39	NS	1.80
KOZHIKODE	8.56	-2.30	2.05	NS
CANNANORE	9.92	NS	NS	4.24
KERALA	8.54	-2.75	NS	1.16

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