Paddy Cultivation in Kerala: A Trend Analysis of Area, Production and Productivity at District Level

(1980-81 to 2012-13)

M. P. Abraham

Assistant Professor
Department of Economics
Government College, Attingal

July, 2019

Abstract

The agriculture in Kerala has undergone significant structural changes in the form of decline in the share of Gross State Domestic Product and commercialization of agriculture. The gross cropped area and the net sown area in the state have declined over a period of time. The changes in land utilization pattern in the form of massive conversion of paddy lands for the cultivation of cash crops and for non-agricultural purposes have landed Kerala in a state of food insecurity. They have also created many social, environmental and ecological problems in the state. Coconut and rubber, the principal rival crops of paddy, have occupied the lion share of paddy area over a period of time. The area and production of paddy have been continuously declining in Kerala and their growth rate has become the highest negative during 1990s. The decline in the production of paddy would have been much higher, had there been no positive change in the yield. The highest negative growth rate in area under paddy is found in Kollam district and lowest in Palakkad district during the period 1980-81 to 2011-12. The highest negative growth rate in paddy production is found in Kollam district and lowest in Alappuzha district. However, the overall growth rate of productivity of paddy is positive in all districts. In all districts, the area effect and interaction effect on paddy production is negative and yield effect is positive. Even though, Kottayam district has the highest negative area effect and interaction effect, production of paddy has increased there on account of its highest yield effect. The study concludes that the absence of an effective land utilization policy has led to the situation of food insecurity and accelerated disappearance of agriculture and allied activities in Kerala.

Part-I

1. Introduction

The agriculture in Kerala has undergone significant structural changes in the form of decline in the share of GSDP from 26.9 per cent in 1990-91 to 9.1 per cent in 2011-12. However, a large share of rural population is still dependent on agriculture for employment and livelihood. Now, Kerala faces a serious challenge in food security as it has a low base in food production. Area under paddy in Kerala was 8.7 lakh hectares in 1970-71 and it became mere 1.97 lakh hectares in 2012-13. During this period, production of paddy declined from 12.92 lakh tonnes to 5 lakh tonnes. "With the growing pressure of population and development of the secondary and tertiary sectors, agricultural land throughout the state is being converted for the construction of residential buildings, commercial establishments, roads, health and educational institutions etc., which in turn reduces the net area sown in the state" (Thomas, 2004). The declining profitability from paddy crop, shortage of farm labourers and the rapid increase in their wages, conversion of paddy lands for other purposes etc. are the major reasons for the decline in paddy cultivation in Kerala.

2. Statement of the problem

Since mid 70's paddy production in Kerala has been continuously declining and the agricultural economy has been undergoing a structural transformation in favour of cash crops and this change has created the problem of food insecurity for Kerala. The study analyses the trend pattern of area, production and productivity of paddy at state level for the period 1970-71 to 2012-13 and at district level for the period 1980-81 to 2011-12.

3. Significance of the study

The issues relating to land utilization pattern and agriculture have greater impact on environment and which have attracted a great deal of attention of researchers and policy makers. Thus, the study has some inter-disciplinary relevance.

Rice accounts for nearly 95 per cent of the total amount of food grains produced within the state. Government implemented many measures to increase the production of paddy. Intensive Agricultural District Programme (IADP) of 1960-61; the Intensive Paddy Development Programme of 1971-72; The Operational Research Project in Integrated Rice

Pest Control implemented from 1975 to 1995; the Group Farming Programme of 1989-90; the Integrated Programme for Rice Development (IPRD) of 1994-95; Scheme on Promotion of Paddy Cultivation in fallow lands introduced in 2004-05; food security project launched during 2008-09 covering the production of rice, egg, vegetables and milk; special schemes launched during 2008-09 by the local governments and the Kerala Paddy Land –Wet Land Conservation Act, 2008 etc. were designed exclusively for the development of the State's paddy farm sector. In spite of these efforts, the performance of the paddy farm sector in the state has been quite disappointing.

Now, Kerala has 90 per cent deficit in food production. The steep fall in paddy cultivation has amplified food insecurity, rural unemployment and environmental and ecological problems. Any change taking place in the agriculture sector is bound to influence the life of a large number of people, environment as well as the society as a whole. Therefore, the study deserves special importance currently.

The study is significant as it examines the trends in paddy cultivation not only at state level but also at district levels in order to understand the district level variations. The study is very useful for understanding the variations at state and district level in area, production and productivity of paddy over a period of time. Further, a study like this will be very useful for identifying the causes for the decline in paddy cultivation and for suggesting policy recommendations for revamping paddy cultivation.

4. Objectives of the study

1. To analyse the agriculture scenario of Kerala
2. To examine the trends in area, production and productivity of paddy in Kerala
3. To analyse the district level variations in area, production and productivity of paddy in Kerala.
4. To make suitable policy suggestions

5. Methodology

The study is partly descriptive and partly analytical in nature. The study is conducted by using secondary data collected from official sources. Secondary data are obtained from various issues of Kerala Economic Review of Kerala State Planning Board, Thiruvananthapuram; Agricultural Statistics of Department of Economics and Statistics, Government of Kerala etc. Simple statistical tools are used to find out the values like average share of crops, percentage changes, growth rate etc.

The trends in area, production and productivity of paddy in Kerala for the period 1970-71 to 2012-13 are examined and the cumulative growth rates of area, production and productivity are estimated. In order to examine the change in production of paddy during the period of study, the area, the yield and the interaction effects on production are analysed. The area effect, yield effect and interaction effect on paddy production in Kerala for the periods 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-01 to 2012-13 are estimated using the formula

$$\Delta P = \Delta A.Y_0 + \Delta Y.A_0 + \Delta A.\Delta Y$$

Where, ΔP shows the change in production, ΔA is the change in area, A_0 is the area in the base year, ΔY is the change in yield or productivity, Y_0 is the yield in the base year, $\Delta A.Y_0$ is the area effect, $\Delta Y.A_0$ is the yield effect and $\Delta A.\Delta Y$ is the interaction effect.

The percentage area of paddy, rubber, and coconut in net sown area are calculated to identify the changes in the share of paddy, rubber and coconut in net sown area of the state for the period 1970-71 to 2012-13.

Regional analyses at district level are also done to get a broad idea about regional variations in area, production and productivity of paddy. For the district level analysis, the period selected is 1980-81 to 2011-12 for all districts except for the lately formed districts like Pathanamthitta, Wayanad and Kasaragod. For these Districts, the selected periods are 1983-84 to 2011-12; 1981-82 to 2011-12; and 1986-87 to 2011-12 respectively.

The trends in area, production and productivity of paddy at district levels for the period 1980-81 to 2011-12 are analysed and the cumulative growth rates of area, production and productivity at district levels are calculated to find out the inter-district variations. Similarly, in order to analyse the changes in the share of paddy at district levels, the percentage of paddy areas in net sown areas of the concerned districts for the period 1980-81 to 2011-12 are examined.

The area effect, yield effect and interaction effect on paddy production at district levels in Kerala for the periods 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-01 to 2011-12 are estimated to find out the influence of the changes in area and yield on production of paddy.

6. Design of the Study

The study is structured in seven parts. The first part deals with introduction which covers objectives, methodology and related issues. The second part deals with literature review in connection with the paddy cultivation in the state of Kerala. The third part examines the agriculture economy of Kerala which covers the changes in land utilisation pattern, changes in gross cropped and net cropped areas and the transformation from food crops to commercial crops in Kerala. Part four examines the trends in area, production and productivity of paddy at state level in Kerala. It also analyses the impact of changes in area and yield on production of paddy. Part five examines the trends in area, production and productivity of paddy at district level in the state. It also analyses the impact of area and yield on paddy production at district level. Part six deals with the major causes for the decline of paddy cultivation in Kerala. The last part summarises the study and proposes some broad suggestions.

Part-II

7. Review of Literature

The review in this study is restricted mainly to literature on area, production and productivity of paddy in India and Kerala. The studies reviewed are arranged in chronological order so that it enables us to trace the historical evolution of the methodology used, the improvement in data coverage and estimation procedure and the contribution of each piece of research to the stock of knowledge.

Mukherjee and Vaidyanathan (1980) used econometric technique and fitted two models to study the effect of rainfall on yield variation and alternatively the effect of rainfall, inputs, the interaction between their effects and sustained changes in output due to productivity changes for the period 1950-51, 1975-76 in Indian agriculture using time series data.

Dholakia and Dholakia (1993) aimed to estimate the sources of growth of Indian agriculture for three sub-periods during 1950-51 to 1988-89 for all crops.

Kumar and Rosegrant (1994) attempted to assess the Total Factor Productivity growth for rice in different regions in India and examined the sources of productivity growth. Index number approach to growth accounting was used by the study. Time series data from different regions were pooled and dummy variables were included for regions, keeping the

eastern region as the reference region. The study revealed that increase in area and production of crop was highly associated with their relative profitability.

Oommen (1962) worked out land productivity of important crops except rubber in Kerala during 1950-51 to 1960-61. A simple linear regression was fitted to find the growth rate. The study found that though productivity of cereals and pulses generally showed a rising trend, many other crops especially cash crops, did not show a steady rise in productivity.

Jeemol Unni (1981) analysed the reason for the shift in cropping pattern away from rice to coconut for the period 1960-61 to 1978-79 using secondary data. Land productivity was computed by simple statistical values like ratios, percentages etc. The result of the study was that coconut was substituted for rice in wetlands because of relative profitability of coconut.

George and Mukherjee (1986) examined the changes in the growth pattern of rice in Kerala over and across time (from 1960-61 to 1974-75, I period and 1975-76 to 1983-84, period II), across seasons (autumn, winter and summer), and across space (major rice growing districts), irrigation and relative prices in explaining the area, yield and production of rice. Regression was run to estimate compound growth rate of area, yield and production. Additive decomposition model was used to identify the contribution of area, yield in explaining the changes in production over the period.

Kannan and Pushpangadhan (1988, 1999) explained the agricultural stagnation that set in Kerala since the mid 70s. The study covering the period between 1962-63 and 1985-86 showed that there was two distinct phases in terms of agricultural growth. During the sixties and up to the mid 70s (1962-63 to 1974-75) there was an overall increase in the rate of growth of area, production and yield for all the crops while in the following period 1975-76 to 1985-86 there was a near stagnation in the growth rate of aggregate area, production and land productivity.

Thomas (1996) examined trends in area, productivity of paddy in Kerala and economic causes of decline in paddy cultivation and tried to identify current problems of paddy for the period 1960-61 to 1991-92 using both secondary time series data and primary data to study current problems. Growth rate calculations were made to examine performance of area and productivity. Additive decomposition scheme was used to measure the change in output.

Job and George (2002) assessed technical efficiency in rice production of the state of Kerala using primary data collected from Kuttanad for 1996. Maximum Likelihood Estimation was resorted.

Job and Nandamohan (2004) attempted to analyse the changes in the growth pattern of rice in Kerala across time and across seasons; between the period 1975-76 and 1998-99, and for autumn, winter and summer. Secondary time series data on area, production and productivity were compiled. Methodology was based on the computation of compound growth rate, decomposition of growth, and measures of instability. Compound growth rates of area, production and productivity of rice in the three crop seasons for the state was estimated using exponential growth model. Rice production was decomposed into area and yield effect. Area effect and yield effect were computed using a multiplicative model. Result of the study revealed that area under rice and production showed significant negative trend and positive trend in productivity.

We have reviewed important studies relating to area, production and productivity of paddy in Kerala. The earlier studies mainly focused on state level trends in paddy cultivation and only a few studies made attempts to study the district level variations in area, production and productivity of paddy in Kerala. Similarly, analysis in the study covers a fairly long period stretching from 1970-71 to 2012-13 for the state as a whole and 1980-81 to 2011-12 for the districts in Kerala.

Part-III

8. Agriculture Economy of Kerala

Two important changes have taken place in Kerala in the utilization of land resource as a result of economic development and urbanization. They are the structural transformation of the agricultural sector and the consequent conversion of food crops area to cash crops area (commercialization of agriculture); and conversion of agricultural lands for non-agricultural purposes.

The structural transformation of agriculture in Kerala for the period 1970-71 to 2011-12 is given in Table-1. It is clear that during the period 1970-71 to 2011-12, land put to non-agricultural use increased from 275000 hectares in 1970-71 to 513480 hectares in 2011-12. The percentage change during the period is 86.72. Cultivable waste during the period increased from 79000 hectares to 95437 hectares and the percentage change during the period

is 20.81. Fallow other than current fallow increased from 22000 hectares to 57670 hectares and the percentage change is 162.13. Current fallow during the period increased from 24000 hectares to 77056 hectares and the percentage change is 221.07. The Net Sown area declined during the period from 2172000 hectares to 2040132 hectares and the percentage change is -6.07. Area sown more than once declined from 761000 hectares to 621625 hectares and the percentage change is -18.31. The total cropped area during the period declined from 2933000 hectares to 2661757 hectares and the percentage change is -9.25.

Table-1

Classification of area under land utilisation: 1970-71 to 2011-12

Classification (Area in hectares)	**1970-71**	**1980-81**	**1990-91**	**2000-01**	**2011-12**	**% change from 1970-71 to 2011-12**
Total Geographical Area	3885497	3885497	3885497	3885497	3885497	-
Forest	1055000	1081509	1081509	1081509	1081509	2.51
Land put to non-agricultural use	275000	269824	297381	381873	513480	86.72
Barren and uncultivable land	72000	85770	58308	29318	17552	-75.62
Permanent pastures and other grazing land	28000	5432	1912	164	85	-99.69
Land under miscellaneous tree crops	132000	63875	34375	15409	3366	-97.45
Cultivable waste	79000	129032	94608	59257	95437	20.81
Fallow other than current fallow	22000	26886	26466	33988	57670	162.13
Current fallow	24000	43579	44164	77853	77056	221.07
Net area sown	2172000	2179590	2246774	2206126	2040132	-6.07
Area sown more than once	761000	705250	773206	815556	621625	-18.31
Total cropped area	2933000	2884840	3019980	3021682	2661757	-9.25

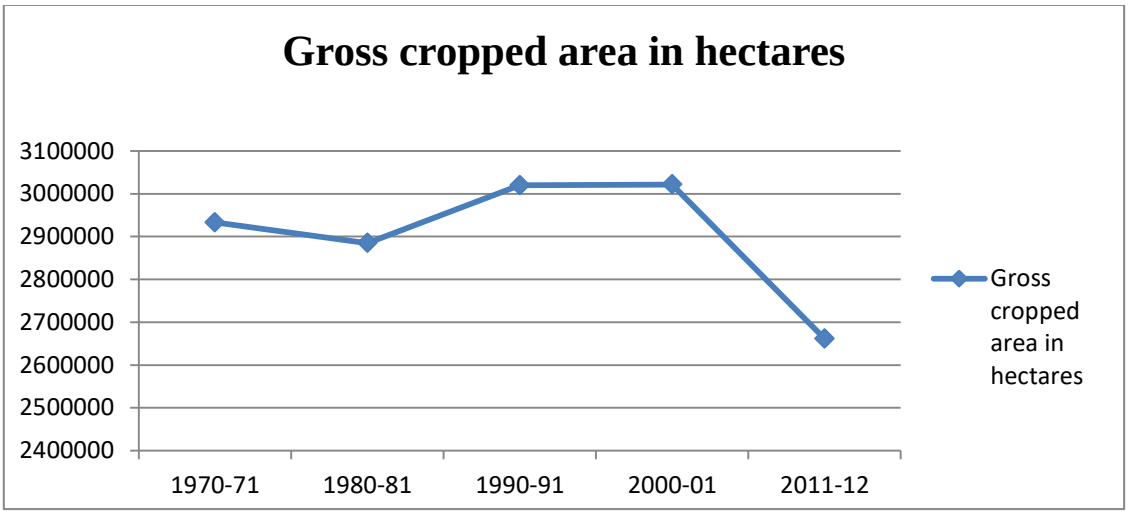
Source: Kerala Economic Reviews

9. Gross Cropped Area

Urbanisation and economic development taking place in the state have their impact on the agriculture economy of Kerala. The changes occurred in the gross cropped area of Kerala is shown in the Figure-1. The total geographical area of Kerala is 38.86 lakh hectares. The gross cropped area in Kerala was above 30 lakh hectares in 1990-91, which further increased and then frequent ups and downs in following years and it finally declined to 26.62 lakh hectare in 2011-12. The trend after 2000-01 is fall in gross cropped area when the impact of economic reforms started to affect Kerala economy.

Fig. 1

Gross cropped area in Kerala



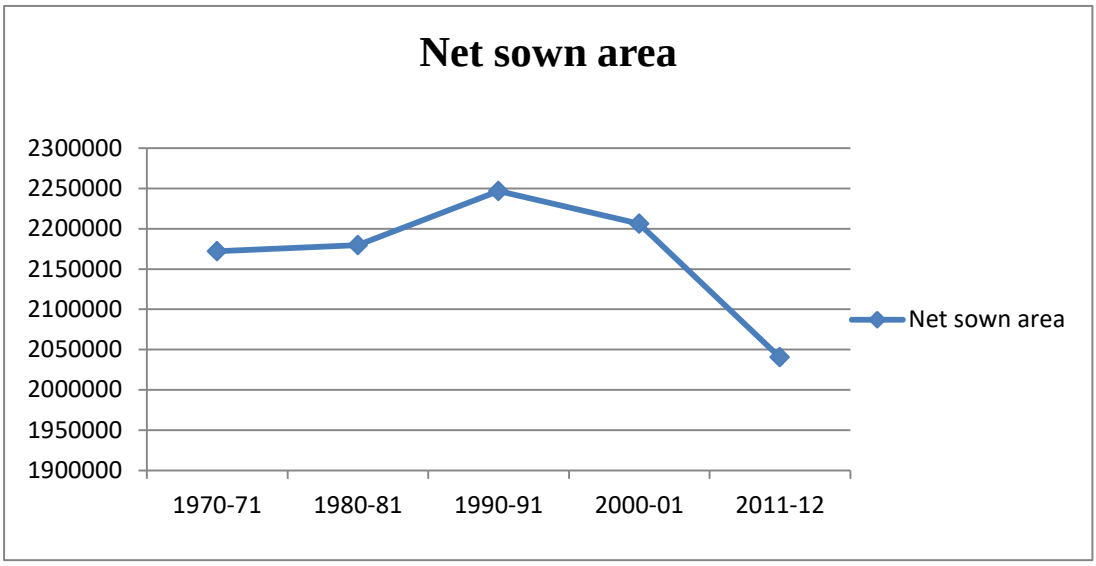
Source: Kerala Economic Reviews, Area in 000'hectare

10. Net Sown Area

Similarly, the net sown area, i.e., the present year cultivation or gross cropped area minus area sown more than once also shows a declining trend especially after 1990-91. Net sown area was 21.72 lakh hectares in 1970-71 which declined to 20.40 lakh hectares in 2011-12. The changes in the net sown area of Kerala are shown in the Figure-2.

Fig. 2

Net Sown area in Kerala



Source : Kerala Economic Reviews, Area in 000'hectare

11. Area under food grain

In food grain, we include only cereals and pulses (i.e. rice and pulses). Tapioca is not included because Government of India does not consider tapioca as a food grain. However, Centre for Development Studies has followed a methodology in which tapioca is included in food grain (CDS, 1975). The per capita food grain production of Kerala in 1970-71 was 62 kg, which continuously declined and reached mere 15 kg in 2010-11.

It is quite relevant to examine the per capita food grain production in India and that of a few major states in India in this context. Prior to Green Revolution, per capita food grain production in India was 160 kg and as a result of Green Revolution, it substantially increased. In 1992-93, it reached 208 kg. It was the period when we just started economic reforms in India.

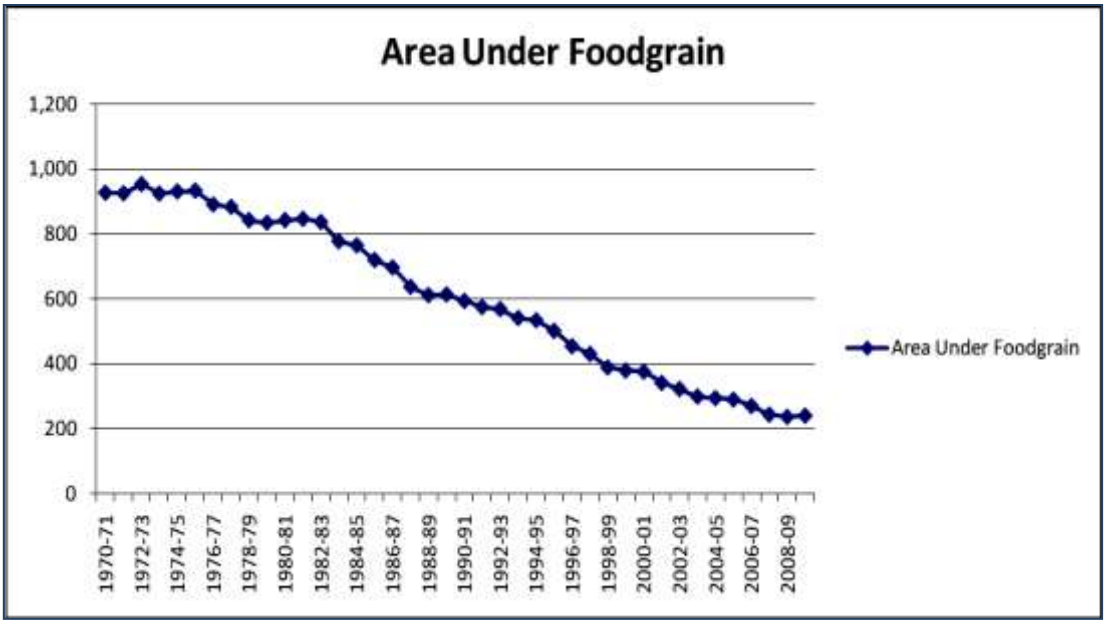
Per capita good grain production in India became180 kg in 2003-04. It substantiates the total neglect of the agriculture sector by the government during reform period. Followed by the introduction of economic reforms, there was large scale acquisition of fertile agricultural land for IT Parks, bio-technology parks, power projects, air ports etc. which had an impact on the per capita food grain production in India. The improvement in 2011-12, ie 202 kg, at the national level was largely due to some centrally sponsored schemes mainly

Rashtriya Krishi Vikas Yojana (RKVY). It is quite relevant to cite one major recommendation by the Famine Commission of 1892 that the per capita per day food grain availability in India should be greater than 500gm to keep the nation just above famine situation.

In Punjab, per capita food grain production increased from 500 kg in 1970 to 1000 kg in 2006; in Andhra Pradesh, it increased from 175 kg in 1970-71 to 225 kg in 2006-07; and in Haryana, it increased from 480 kg in 1970 to about 600 kg in 2007-08. Because of RKVY, food grain production in Jharkand and Bihar increased remarkably. Productivity of rice in Kerala is more than 2500 kg per hectare. In Jharkand, it is less than 2000 kg per hectare and in Bihar; it is between 1500-1600 kg per hectare. With comparatively less productivity of food grains, these states have remarkably expanded production. Our land is very fertile and we have serious food crisis, yet our production has declined significantly. Thus, the position of Kerala is quite pathetic in this respect compared to that of other states. Currently, Kerala has more than 90% deficit in food production. The changes in the area under food grain of Kerala are shown in Figure-3.

Fig. 3

Area under food grain in Kerala



Source: Kerala Economic Reviews, Area in 000'hectare

It is clear from the figure that there has been a continuous decline in area under food grain in Kerala. It was about 9.5 lakh hectares in 1970-71 and then it continuously declined to about 2.13 lakh hectares in 2008-09**.** It mainly happens due to the conversion of food grain area for the cultivation of cash crops and conversion of agriculture land for various non-agricultural purposes. The area under paddy has been declining continuously over the last several years.

Part-IV

12. Area, Production and Productivity of paddy in Kerala

Area under paddy in Kerala was about 8.7 lakh hectares in 1970-71 and it became mere 1.97 lakh hectares in 2012-13. During the period, production of paddy declined from 12.92 lakh tonnes to 5 lakh tonnes. Production reached its peak level in 1972-73 when state produced 13.76 lakh tonnes of paddy. The productivity of paddy increased from 1483 kg/hectare in 1970-71 to 2577 kg/hectare in 2012-13. The improvement in productivity is, however, neutralized by the high decline in area under paddy and the resultant decline in production.

The reduction in area under paddy and the consequent reduction in production of paddy have created the problem of food insecurity for Kerala in addition to certain environmental and ecological problems. The rice growing agricultural wetland ecosystem provides an enormous range of products and services directly as well as indirectly. Conversion of paddy fields leads to a number of socio economic and ecological consequences. Reduction in rice production has an adverse effect on the food security of the state. Kerala has more than 90% deficit in food production. In addition, it contributes to increasing unemployment and poverty, decrease in ground water recharging and prolonged water logging in villages. It also leads to the destruction of rice producing ecosystem in terms of land cover, land quality and capability, weather and climate etc. One acre paddy land has the capacity to store 1200 cubic meter ground water. As a result of the disappearance of 7 lakh hectares of paddy lands between 1970 and 2010, we have lost 82 crore cubic meter ground water.

The actual data on area, production and productivity of paddy during 1970s, 1980s, 1990s and during 2000-01 to 2012-13 are given in the following Tables. The data on area, production and productivity of paddy for the period 1970-71 to 1979-80 are shown in

Table-2. In 1970's, the area under cultivation reached the highest level in 1974-75, i.e.8.81 lakh hectares. The lowest figure was noted in the year 1978-79, i.e. 7.79 lakh hectares. Production in 1970's achieved the highest level in 1972-73, i.e. 13.76 lakh tonnes and the lowest level in 1976-77, i.e.12.54 lakh tonnes. Productivity in 1970's achieved the highest and lowest values in 1979-80 (1638 kg/ha.) and 1973-74 (1437 kg/ha.) respectively.

In 1980's, the area under cultivation reached the highest level in 1981-82, i.e.8.06 lakh hectares. The lowest figure was noted in the year 1988-89, i.e. 5.77 lakh hectares. Production in 1980's achieved the highest level in 1981-82, i.e. 13.39 lakh tonnes and the lowest level in 1988-89, i.e. 10.13 lakh tonnes. Productivity in 1980's achieved the highest and lowest values in 1989-90 (1956 kg/ha.) and 1980-81 (1587 kg/ha.) respectively. The data on area, production and productivity of paddy for the period 1980-81 to 1989-90 are shown in Table-3.

In 1990's, the area under cultivation was continuously declining and the highest area under cultivation was in 1990-91 i.e. 5.59 lakh hectares. The lowest figure was noted in the end of the decade i.e. 1999-2000 i.e. 3.50 lakh hectares. Production in 1990's achieved the highest level in 1990-91, i.e. 10.86 lakh tonnes and the lowest level in 1998-99, i.e. 7.27 lakh tonnes. Productivity in 1990's achieved the highest and lowest values in 1999-2000 (2203 kg/ha.) and 1994-95 (1937 kg/ha.) respectively. The data on area, production and productivity of paddy for the period 1990-91 to 1999-2000 are shown in Table-4.

For the period, 2000-01 to 2012-13, the highest area under cultivation was in 2000-01, i.e. 3.47 lakh hectares. The lowest figure was noted in the year 2012-13, i.e. 1.97 lakh hectares. Production during the period achieved the highest level in 2000-01, i.e. 7.51 lakh tonnes and the lowest level in 2012-13, i.e. 5.08 lakh tonnes. Productivity, during the period, achieved the highest and lowest values in 2011-12 (2733 kg/ha.) and 2003-04 (1984 kg/ha.) respectively. The data on area, production and productivity of paddy for the period 2000-01 to 2012-13 are shown in Table-5.

Table- 2

Area, Production and Productivity of paddy in Kerala from 1970-71 to 1979-80

Year	Area, 000' ha	Production, 000' MT	Productivity, kg/ha
1970-71	874.93	1292.01	1483
1971-72	875.16	1351.74	1544
1972-73	873.70	1376.37	1575
1973-74	874.68	1257.67	1437
1974-75	881.47	1333.03	1513
1975-76	876.02	1331.19	1520
1976-77	854.37	1254.00	1468
1977-78	840.31	1294.64	1541
1978-79	779.24	1272.74	1592
1979-80	793.27	1299.70	1638

Source : Kerala Economic Review

Table - 3

Area, Production and Productivity of paddy in Kerala from 1980-81 to 1989-90

Year	Area, 000' ha	Production, 000' MT	Productivity, kg/ha
1980-81	801.70	1272.00	1587
1981-82	806.92	1339.87	1660
1982-83	797.89	1308.01	1639
1983-84	740.09	1207.92	1632
1984-85	730.38	1255.94	1720
1985-86	678.28	1173.05	1729
1986-87	663.28	1133.79	1708
1987-88	604.08	1032.58	1709
1988-89	577.00	1013.00	1754
1989-90	583.39	1141.23	1956

Source : Kerala Economic Reviews

Table - 4

Area, Production and Productivity of paddy in Kerala from 1990-91 to 1999-2000

Year	Area, 000' ha	Production, 000' MT	Productivity, kg/ha
1990-91	559.45	1086.58	1942
1991-92	541.33	1060.35	1959
1992-93	537.00	1085.00	2018
1993-94	507.00	1004.00	1977
1994-95	503.00	975.00	1937
1995-96	471.00	953.00	2023
1996-97	431.00	871.00	2023
1997-98	387.00	765.00	1975
1998-99	353.00	727.00	2061
1999-2000	350.00	771.00	2203

Source: Kerala Economic Reviews

Table – 5

Area, Production and Productivity of paddy in Kerala from 2000-01 to 2012-13

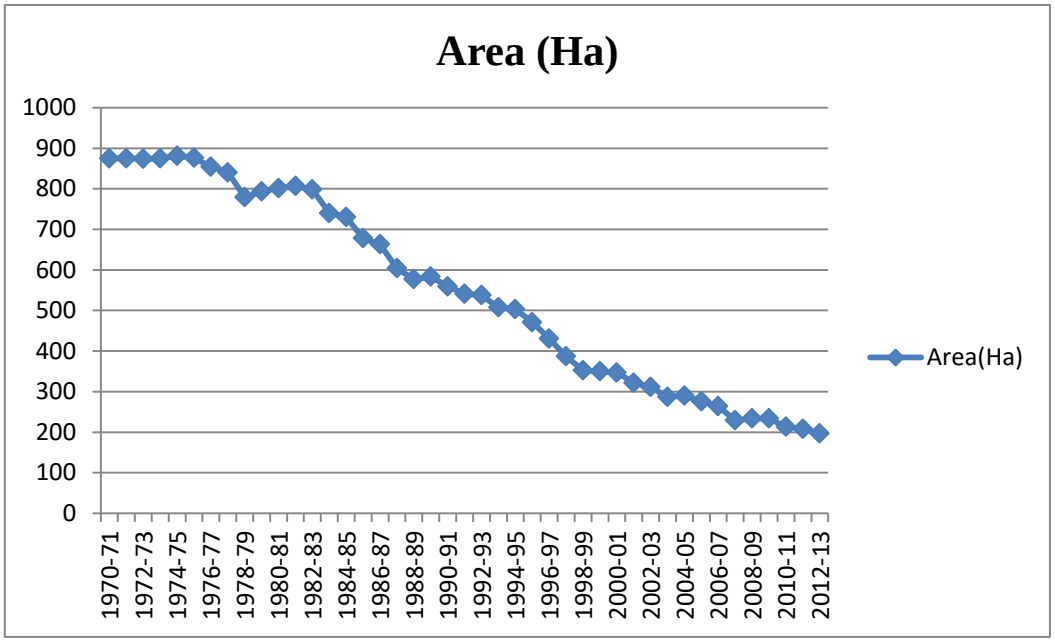
Year	Area, 000' ha	Production, 000' MT	Productivity, kg/ha
2000-01	347.00	751.00	2162
2001-02	322.00	704.00	2182
2002-03	311.00	689.00	2218
2003-04	287.00	570.00	1984
2004-05	290.00	667.00	2301
2005-06	276.00	630.00	2285
2006-07	264.00	642.00	2435
2007-08	229.00	528.00	2308
2008-09	234.00	590.00	2520
2009-10	234.00	598.00	2557
2010-11	213.19	522.73	2452
2011-12	208.16	568.99	2733
2012-13	197.28	508.29	2577

Source: Kerala Economic Reviews

The trends in area, production and productivity of paddy in Kerala during the period 1970-71 to 2012-13 are shown in Figure-4, Figure-5 and Figure-6.

Fig. 4

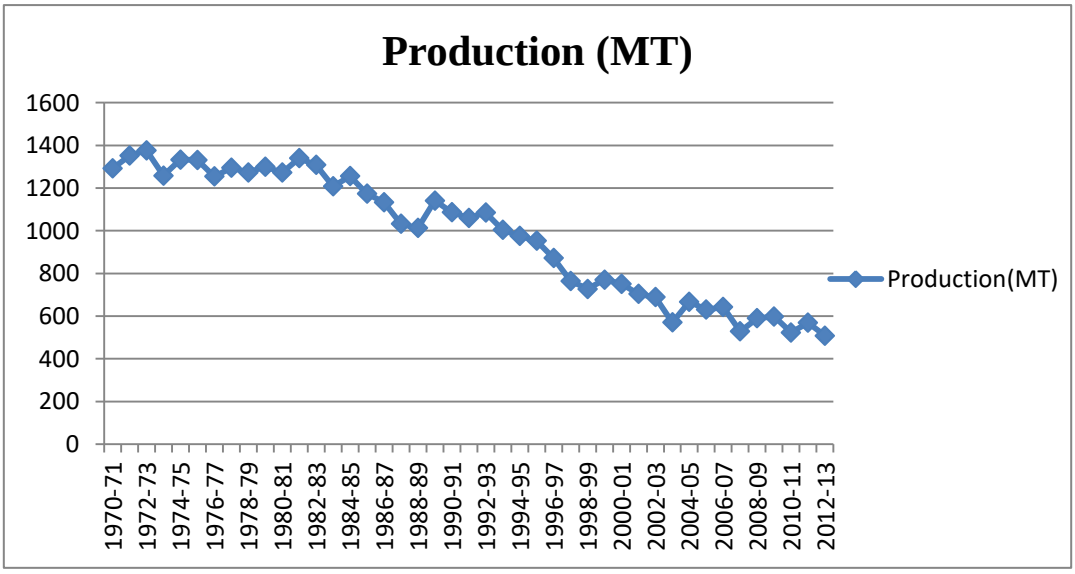
Area under paddy in Kerala



Source: Kerala Economic Reviews

Figure-5

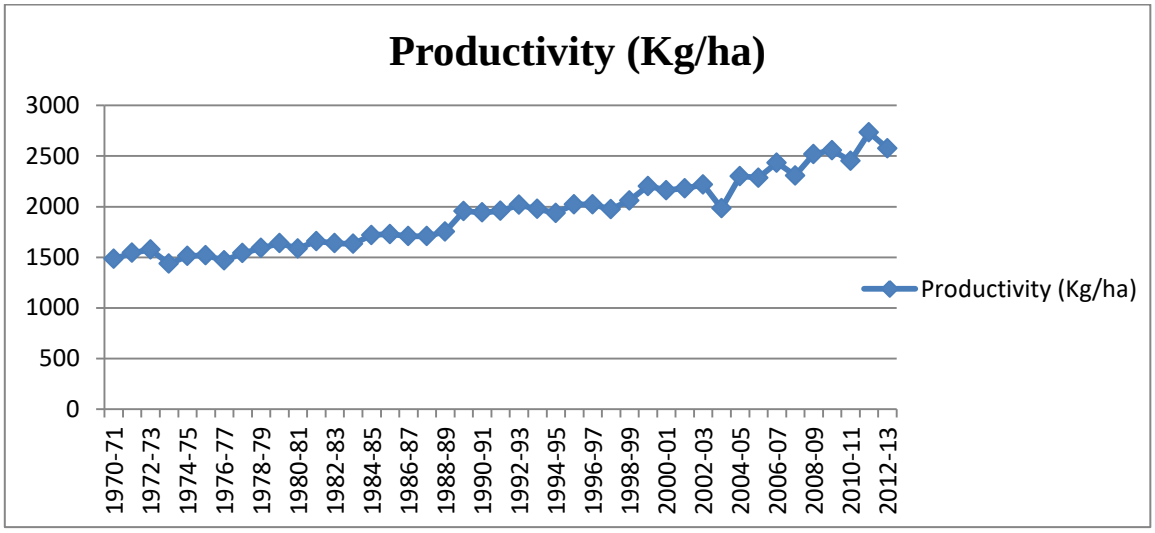
Production of paddy in Kerala



Source: Kerala Economic Reviews

Fig. 6

Productivity of paddy in Kerala



Source: Kerala Economic Reviews

13. Cumulative growth rate of area, production and productivity of paddy

The cumulative growth rates of area, production and productivity of paddy for the period 1970-71 to 2012-13 is shown in Table-6. The cumulative growth rates of area and production of paddy for the period 1970-71 to 2012-13 are negative and they are -3.8 per cent per annum for area and -2.5 per cent per annum for production. However, the cumulative growth rate of productivity is positive for the period and it is 1.4 per cent per annum.

Table – 6

Cumulative growth rate of area, production and productivity of paddy in Kerala (%)

Decade	Area	Production	Productivity
1970-71 to 1979-80	-1.2	-0.4	0.6
1980-81 to 1989-90	-4.2	-2.6	1.6
1990-91 to 1999-2000	-5.6	-4.7	0.9
2000-2001 to 2012-13	-4.5	-2.6	2.0
CGR for the entire period	-3.8	-2.5	1.4

Source: Estimated

The decline in area is the lowest during the period 1970-71 to 1979-80, i.e. -1.2 per cent per annum and highest during 1990-91 to 1999-2000, i.e. -5.6 per cent per annum. The production of paddy has experienced the highest negative growth during 1990-91 to 1999-2000, i.e. -4.7 per cent per annum and the lowest negative growth during 1970-71 to 1979-80, i.e. -0.4 per cent per annum. The growth rate of productivity of paddy is the highest during 2000-01 to 2012-13, i.e. 2.0 per cent per annum and lowest during 1970-71 to 1979-80, i.e. 0.6 per cent per annum. During 1990s, growth rate of productivity is comparatively better than that of 1970s, i.e. 0.9 per cent per annum. Therefore, the highest negative growth rate in production during the period is mainly on account of the highest negative growth rate in area under cultivation.

14. Area, Yield and Interaction effects on Production

The change in the production of paddy is explained by the change in area (area effect), change in yield or productivity (yield effect) and the interaction between the area effect and the yield effect (interaction effect). Symbolically, it is stated as

$$\Delta P = \Delta A.Y_0 + \Delta Y.A_0 + \Delta A.\Delta Y$$

Where, ΔP shows the change in production,

ΔA is the change in area,

A_0 is the area in the base year,

ΔY is the change in yield or productivity,

Y_0 is the yield in the base year,

$\Delta A.Y_0$ is the area effect,

$\Delta Y.A_0$ is the yield effect and

$\Delta A.\Delta Y$ is the interaction effect.

The area effects are negative and very high during the whole period of analysis. Similarly, the interaction effects are also negative for the whole period, but they are comparatively small. The yield effect during the period of analysis is positive, but they are very small. The area effect, yield effect and interaction effect on paddy production in Kerala during 1970-71 to 2012-12 are shown in the Table-7.

Table-7

Area, Yield and Interaction effects on Production of paddy in Kerala

Period	$\Delta A.Y_0$ (area effect)	$\Delta Y.A_0$ (yield effect)	$\Delta A. \Delta Y$ (interaction effect)
1970-71 to 1979-80	-90.69	0.17	-9.48
1980-81 to 1989-90	-81.25	0.14	-18.89
1990-91 to 1999-2000	-88.25	0.11	-11.86
2000-01 to 2012-13	-84.09	0.23	-16.14

Source: Estimated

In 1970s, the decline in the production of paddy is caused 90.69 per cent by the area effect i.e. decline in area and 9.48 per cent by the interaction effect of area and productivity. The influence of productivity i.e. yield effect on production is positive but very small i.e. 0.17 per cent. In 1980s, decline in paddy production is explained 81.25 per cent by the area effect and 18.89 per cent by the interaction effect. The yield effect is positive, i.e. 0.14 per cent and its effect on production is very low. In 1990s, the area effect is -88.25 per cent and interaction effect is -11.86 per cent. During the period also the yield effect is positive and it is 0.11 per cent. The area effect, interaction effect and yield effect for the period 2000-01 to 2012-13 are -84.09 per cent, -16.14 per cent and 0.23 per cent respectively. The decline in production of paddy would have been much higher had there been no positive change in yield.

15. Share of Paddy, Rubber and Coconut in Net Sown Area

There have been changes in the share of paddy, coconut and rubber in the net sown area of Kerala during the period 1970-71 to 2012-13. The share of paddy in net sown area declined from 40.28 per cent in 1970-71 to mere 9.63 per cent in 2012-13. The share of coconut increased from 33.12 per cent in 1970-71 to 38.97 per cent in 2012-13. The share of rubber during the period increased from 8.25 per cent to 26.61 per cent. The changes in the share of paddy, rubber and coconut in the net sown area of Kerala since 1970 are shown in Table-8, Table-9, Table-10 and Table-11. Rubber and coconut are selected in the analysis as they are the principal rival crops of paddy. It is clear from the following Tables that while

the share of area under paddy has been shrinking, the area under rubber and coconut has been increasing.

In 1970s, the average share of paddy, rubber and coconut in net sown area of Kerala were 38.82 per cent, 9.20 per cent, and 32.33 per cent respectively. The percentage share of paddy was 40.28 in 1970-71 and it became 36.14 towards the end of that decade. In the case of rubber, there was constant rise in the share of net sown area in 1970s. The share of rubber increased from 8.25 per cent to 9.87 per cent. However, in 1970s, the share of coconut area declined from 33.125 to 30.24 per cent.

In 1980s, the average share of paddy, rubber and coconut in net sown area of Kerala were 31.81 per cent, 14.07 per cent, and 32.87 per cent respectively. The percentage share of paddy was 36.77 in 1980-81 and it declined to 26.14 towards the end of that decade. In the case of rubber, there was constant rise in the share of net sown area in 1980s. The share of rubber increased from 10.91 per cent to 16.84 per cent. The share of coconut area increased from 29.88 per cent to 39.37 per cent.

In 1990s, the average share of paddy, rubber and coconut in net sown area of Kerala were 20.61 per cent, 19.67 per cent, and 39.56 per cent respectively. The percentage share of paddy was 24.90 in 1990-91 and it declined to 15.63 towards the end of that decade. In the case of rubber, there was constant rise in the share of net sown area in 1990s. The share of rubber increased from 17.09 per cent to 21.12 per cent. The share of coconut area increased from 38.72 per cent in 1990-91 to 41.31 per cent in 1999-2000.

During the period, 2000-01 to 2012-13, the average share of paddy, rubber and coconut in net sown area of Kerala were 12.32 per cent, 23.81 per cent, and 40.16 per cent respectively. The percentage share of paddy was 15.73 in 2000-01 and it declined to mere 9.63 in 2012-13. In the case of rubber, there was constant rise in the share of net sown area during the period also. The share of rubber increased from 21.50 per cent to 26.61 per cent. The share of coconut area marginally decreased from 42.44 per cent in 2000-01 to 38.97 per cent in 2012-13.

Table- 8

Share of paddy, rubber and coconut in net sown area of Kerala. (area in 000' hectares.)

1970-71 to 1979-80

Year	Net sown area	Paddy area	Share of paddy area	Rubber area	Share of rubber area	Coconut area	Share of coconut area
1970-71	2172.00	874.93	40.28	179.1	8.25	719.1	33.12
1971-72	2187.00	875.16	40.01	186.6	8.53	730.3	33.39
1972-73	2197.00	873.70	39.77	195.6	8.90	745.4	33.92
1973-74	2202.00	874.68	39.72	199.6	9.06	744.3	33.80
1974-75	2208.00	881.47	39.92	202.3	9.16	748.2	33.89
1975-76	2189.00	876.02	40.02	206.7	9.44	693.0	31.66
1976-77	2201.00	854.37	38.82	209.7	9.53	695.0	31.57
1977-78	2202.00	840.31	38.16	209.7	9.52	699.1	31.75
1978-79	2204.00	779.24	35.36	214.4	9.73	660.6	29.97
1979-80	2195.00	793.27	36.14	216.6	9.87	663.7	30.24
Average share for 10 years			**38.82**		**9.20**		**32.33**

Source: Kerala Economic Reviews

Table- 9

Share of paddy, rubber and coconut in net sown area of Kerala. (area in 000' ha.)

1980-81 to 1989-90

Year	Net sown area	Paddy area	Share of paddy area	Rubber area	Share of rubber area	Coconut area	Share of coconut area
1980-81	2180.00	801.70	36.77	237.80	10.91	651.40	29.88
1981-82	2189.85	806.92	36.85	248.00	11.32	653.00	29.82
1982-83	2179.75	797.89	36.60	259.70	11.91	674.38	30.94
1983-84	2180.36	740.09	33.94	271.20	12.44	674.38	30.93
1984-85	2184.42	730.379	33.43	310.20	14.20	687.48	31.47
1985-86	2190.98	678.28	30.96	326.70	14.91	704.68	32.16
1986-87	2206.74	663.28	30.06	343.20	15.55	706.10	31.99
1987-88	2211.27	604.08	27.32	355.40	16.07	778.37	35.20
1988-89	2212.87	577.00	26.07	366.50	16.56	816.88	36.91
1989-90	2232.12	583.388	26.14	376.00	16.84	878.89	39.37
Average share for 10 years			**31.81**		**14.07**		**32.87**

Source: Kerala Economic Reviews

Table- 10

Share of paddy, rubber and coconut in net sown area of Kerala. (area in 000' ha.)

1990-91 to 1999-2000

Year	Net sown area	Paddy area	Share of paddy area	Rubber area	Share of rubber area	Coconut area	Share of coconut area
1990-91	2246.77	559.45	24.90	384.00	17.09	870.02	38.72
1991-92	2247.97	541.33	24.08	425.77	18.94	863.06	38.39
1992-93	2249.59	537.00	23.87	428.86	19.06	877.01	38.98
1993-94	2238.10	507.00	22.65	437.14	19.53	882.29	39.42
1994-95	2239.49	503.00	22.46	443.30	19.79	910.96	40.68

1995-96	2264.84	471.00	20.80	449.00	19.82	914.37	40.37
1996-97	2268.61	431.00	19.00	455.57	20.08	902.10	39.76
1997-98	2270.60	387.00	17.04	465.28	20.49	884.00	38.93
1998-99	2258.67	353.00	15.63	469.92	20.80	882.28	39.06
1999-2000	2239.36	350.00	15.63	472.90	21.12	925.03	41.31
Average share for 10 years			**20.61**		**19.67**		**39.56**

Source: Kerala Economic Reviews

Table- 11

Share of paddy, rubber and coconut in net sown area of Kerala. (area in 000' ha.)

2000-01 to 2012-13

Year	Net sown area	Paddy area	Share of paddy area	Rubber area	Share of rubber area	Coconut area	Share of coconut area
2000-01	2206.13	347.00	15.73	474.36	21.50	936.29	42.44
2001-02	2190.69	322.00	14.70	475.04	21.68	905.72	41.34
2002-03	2188.54	311.00	14.21	476.05	21.75	899.20	41.09
2003-04	2193.51	287.00	13.08	478.40	21.81	898.50	40.96
2004-05	2154.90	290.00	13.46	480.66	22.30	899.27	41.73
2005-06	2132.48	276.00	12.94	494.40	23.18	897.83	42.10
2006-07	2101.43	264.00	12.56	502.24	23.90	872.94	41.54
2007-08	2089.02	229.00	10.96	512.05	24.51	819.00	39.20
2008-09	2088.95	234.00	11.20	517.48	24.77	788.00	37.83
2009-10	2078.71	234.00	11.26	525.41	25.27	779.00	37.47
2010-11	2071.51	213.19	10.29	534.23	25.79	770.00	37.17
2011-12	2040.13	208.16	10.20	539.56	26.45	820.87	40.24
2012-13	2048.12	197.28	9.63	545.00	26.61	798.16	38.97
Average share for 13 years			**12.32**		**23.81**		**40.16**

Source: Kerala Economic Reviews

Part-V

16. District Level Analyses – Area, Production and Productivity of Paddy

In order to have in-depth information about the changes in the cultivation of paddy, it is essential to examine the changes in area, production and productivity at district level. The district level data available from 1980s are used in the study for that purpose. For the district level analysis, the period selected is 1980-81 to 2011-12 for all districts except for the lately formed districts like Pathanamthitta, Wayanad and Kasaragod. For these Districts, the selected periods are 1983-84 to 2011-12; 1981-82 to 2011-12; and 1986-87 to 2011-12 respectively.

a. District wise area under paddy

In all districts, the area under paddy has been shrinking. The actual data on area under paddy at district level since 1980 are given in Table-12. The district-wise cumulative growth rate of area under paddy for the period 1980-81 to 2011-12 is given in Table-13. The overall growth rate in area has been negative for all districts during the period 1980-81 to 2011-12. The highest negative growth rate is seen in Kollam district i.e. -8.8 per cent growth per annum and which is followed by Thiruvananthapuram, i.e. -8.5 per cent growth per annum. Palakkad has the lowest negative growth rate and here the growth rate is -2.9 per cent per annum. It is followed by Alappuzha with -3.4 per cent and Kottayam and Wayanad with -3.7 per cent each.

Cumulative growth rate of area under paddy has been negative for all districts during 1980-81, to 1989-90 and 1990-91 to 1999-2000. During 1980-81 to 1989-90, Kannur has the highest negative growth rate in area, i.e. -14.5 per cent per annum. During 1990-91 to 1999-2000, Thiruvananthapuram has the highest negative growth rate in area i.e. -9.9 per cent per annum. During 2000-01 to 2011-12, Kollam district has the highest negative growth rate, i.e. -15.7 per cent per annum. The growth rate in area is positive in two districts, Alappuzh and Kottayam for the period 2000-01 to 2011-12. In Alappuzha, it is 0.7 per cent per annum and in Kottayam, it is 1.2 per cent per annum.

Alappuzha, Kottayam, Idukki, Thrissur, Palakkad and Wayanad districts have lower negative cumulative growth rate in area compared to the state average and the remaining

other districts have higher negative cumulative growth rate than the state average during the period 1980-81 to 2011-12.

During 1980-81 to 1989-90, districts like Trivandrum, Pathanamthitta, Alappuzha, Kottayam, Ernakulam, Thrissur, Palakkad, Malappuram and Wayanad districts are having declining growth rate in area less than the state average. The worst districts during the period having declining growth rate in area greater than the state average are Kollam, Idukki, Kozhikode, Kannur and Kasaragod.

During 1990-911 to 1999-2000, districts like Trivandrum, Alappuzha, Idukki, Ernakulam, Palakkad, Wayanad and Kannur districts are having declining growth rate in area less than the state average. The worst districts during the period having declining growth rate in area greater than the state average are Trivandrum, Kollam, Pathanamthitta, Kottayam, Thrissur, Malappuram, Kozhikode, and Kasaragod. In districts like Idukki and Kannur the declining growth rates in area have decreased remarkably and have become lower than the state average during the period 1990-91 to 1999-2000. However, districts like Trivandrum, Pathanamthitta, Kottayam, and Thrissur have worsened their position in the sense that their declining growth rate in area is greater than the state average compared to their performance in 1980-81 to 1989-90.

During 2000-01 to 2011-12, districts like Trivandrum, Kollam, Pathanamthitta, Idukki, Ernakulam, Malappuram, Kozhikode and Kasaragod districts are the worst performing districts having declining growth rate in area greater than the state average. However, Alappuzha, Kottayam have achieved positive growth rate in area and Thrissur, Palakkad, Wayanad and Kannur are having declining growth rate in area lower than the state average during 2000-01 to 2011-12. The declining growth rate has decreased in Thrissur district and it has become lower than the state average and districts like Idukki, and Ernakulam have worsened their position in the sense that their declining growth rates in area are greater than the state average. Kollam, Kozhikode and Kasaragod districts have always declining growth rate higher than the state average during three periods of analysis and they are to be specially focussed for arresting the declining area under cultivation of paddy.

Table-12 District wise Area of paddy in hectares

Year	TVM	Kollam	Pathanamthittah	Alappuzha	Kottayam	Idukki	Ernakulam	Thrissur	Palakkad	Malappuram	Kozhikode	Wayanad	Kannur	Kasargod
1980-81	32583	50055		82466	31948	9261	102500	110314	183634	80022	45451		73465	
1981-82	30775	50406		88606	34428	8957	100884	115511	180877	78974	26953	30089	60411	
1982-83	29391	49601		83862	34596	9249	96010	107711	173158	78502	26488	30482	59440	
1983-84	27079	39846	17883	69201	34801	8072	86732	103391	168034	74749	23155	30571	56572	
1984-85	27020	37563	17439	73610	31990	8475	89183	102540	166312	73185	21345	29651	52066	
1985-86	26352	34794	14498	56045	31884	8251	84804	95215	160855	65462	18750	30767	50604	
1986-87	25444	32824	13130	67838	33603	7085	80817	89527	154864	62308	18123	29999	26961	21280
1987-88	23300	30227	14102	60763	29854	5368	79818	84176	144665	56471	15580	21299	22505	15954
1988-89	21487	27876	13537	64404	28661	5206	71266	78862	142293	52709	13579	20393	20804	16480
1989-90	20921	31074	13949	64534	30063	4914	69801	74451	146739	54704	14004	21032	20982	16220
1990-91	21677	30513	14234	60675	26257	5078	63078	74038	145687	51934	12062	20343	19582	14292
1991-92	19604	27619	13153	55872	23855	4851	65001	69065	147066	50361	11535	19582	20333	13430
1992-93	18361	28460	12892	53344	25448	4397	66158	67151	146095	50908	10755	21135	18334	14170
1993-94	18103	27375	12191	53581	26196	3648	65887	67708	143169	49244	10162	20946	18149	13973
1994-95	17338	25282	11045	54864	25006	4696	60018	62144	140066	42063	8457	23772	17302	12237
1995-96	16986	23252	10810	44132	24878	4660	56533	58703	135630	37919	8749	20388	16801	11659
1996-97	13961	22223	10985	41447	20200	5099	53988	51544	128359	31098	8316	17078	15421	11107
1997-98	11368	20023	8267	43220	13754	4068	46152	40977	120809	28936	7988	17926	15648	7986
1998-99	9598	17571	7497	35125	14393	3846	49730	39215	107467	23818	6843	15642	13878	8008
1999-00	7969	17426	6716	35326	15822	3640	42894	42887	109704	23495	6495	17304	11710	8386
2000-01	6995	14939	6279	37740	16677	3473	37433	39384	118701	23148	6737	15000	11791	9158
2001-02	6810	11459	5218	33111	15250	4388	32905	37012	115904	22654	6402	12855	10987	7413
2002-03	6423	11457	5431	29635	12264	3785	32072	37274	115910	19678	5085	12988	11323	7196
2003-04	5371	10187	5262	32083	11502	3228	29495	34158	105131	17671	5185	12343	9461	6263
2004-05	5196	8949	4339	32158	13161	3166	28145	36351	11029	16749	4623	11331	9102	5675
2005-06	4705	7218	3291	28768	12557	2932	24934	31073	113919	14885	4703	11503	9223	6030
2006-07	3849	5497	2616	31060	13814	2878	21895	27311	109208	15109	4295	11832	8842	5323
2007-08	2867	3538	2001	33335	10969	2190	12343	24422	99173	9496	3800	12408	7232	5164
2008-09	2995	3859	2681	34143	10951	2115	12966	27928	96190	11013	4038	12746	7649	4991

2009-10	2940	3453	2996	33440	15474	2328	10787	25439	100522	8838	3277	12995	7130	4394
2010-11	2919	3342	2986	37060	14775	1819	9016	20259	87511	8949	3003	11054	6339	4155
2011-12	2395	2097	2802	36251	21410	1264	7731	21172	83998	7528	2920	8995	5740	3857

Source: Kerala Economic Reviews

Table-13

District-wise Cumulative Growth Rate of Area under Paddy (%)

District	1980-81 to 89-90	1990-91 to 99-2000	2000-01 to 2011-12	Overall growth rate
Trivandrum	-4.7	-9.9	-9.9	-8.5
Kollam	-6.8	-6.3	-15.7	-8.8
Pathanamthittah	-4.5	-7.7	-8.0	-7.4
Alappuzha	-3.8	-6.0	0.7	-3.4
Kottayam	-1.6	-7.0	1.2	-3.7
Idukki	-7.4	-2.4	-8.6	-4.9
Ernakulam	-4.2	-4.6	-14.1	-7.3
Thrissur	-4.7	-7.1	-5.9	-5.5
Palakkad	-2.9	-3.6	-0.4	-2.9
Malappuram	-5.1	-9.6	-10.1	-7.5
Kozhikode	-10.8	-6.6	-7.1	-7.3
Wayanad	-5.4	-2.8	-2.3	-3.7
Kannur	-14.5	-5.1	-6.1	-7.2
Kasargode	-7.5	-7.0	-6.7	-6.2
State Average	-5.9	-6.1	-6.6	-6.0

Source: Estimated

b. District wise production of paddy

In all districts, the production of paddy has been shrinking. The actual data on production of paddy at district level since 1980 are given in Table-14. The district-wise cumulative growth rate of production for the period 1980-81 to 2011-12 is given in Table-15. The overall growth rates in production are negative for all districts during the period 1980-81 to 2011-12. The highest negative growth rate is seen in Kollam district i.e. -7.6 per cent growth per annum and which is followed by Thiruvananthapuram, i.e. -6.8 per cent growth per annum. Alappuzha has the lowest negative growth rate and here the growth rate is -1.4 per cent per annum. It is followed by Palakkad with -1.5 per cent per annum.

Table-14 District wise Production of paddy in MT

Year	TVM	Kollam	Pathanamthittah	Alappuzha	Kottayam	Idukki	Ernakulam	Thrissur	Palakkad	Malappuram	Kozhikode	Wayanad	Kannur	Kasargod
1980-81	45986	82189		144858	58478	15503	144601	147571	373782	107488	54144		97362	
1981-82	44837	83369		173162	64603	16108	148995	155473	385077	105190	27504	55082	79681	
1982-83	45829	85846		149768	83544	20625	149818	149393	365211	98724	28388	48241	80810	
1983-84	36462	58035	30741	133758	70027	13863	119054	155121	339365	93291	21853	61755	74591	
1984-85	45319	58929	35920	140514	66572	17435	149199	147381	350470	100712	23898	53489	66098	
1985-86	47106	60835	27715	111971	58104	16845	142756	151936	306980	93056	22394	54800	78553	
1986-87	43600	54791	24456	17799	67907	14962	131063	143297	290976	95684	19988	57718	38683	32862
1987-88	36577	53496	33490	123122	66062	10657	119810	130887	266049	79021	15996	31261	33606	27571
1988-89	35925	45974	30092	117685	60548	11282	118735	120019	275129	74067	14702	40210	31231	27777
1989-90	39036	59093	31921	145133	71175	11534	120101	124698	328812	86845	16983	42887	34587	28406
1990-91	38363	58385	33226	131663	62719	10953	102689	129287	324907	80830	14834	41974	32308	24440
1991-92	33553	46086	30517	116089	55166	10932	109484	121723	344738	80346	13781	42803	31249	23883
1992-93	34816	54576	33826	123178	60798	9188	113927	119337	335646	82132	13008	50337	28750	25359
1993-94	31920	51713	29852	119186	64654	7651	113052	120833	334611	84640	12685	46609	29085	26018
1994-95	30216	46829	24984	99240	56102	10098	101048	114060	313768	70825	10543	50492	26066	20794
1995-96	31831	45370	27210	121047	55609	10817	101951	110698	280405	65208	10593	46654	26050	19583
1996-97	24877	42237	23690	85192	43728	10578	93382	104966	294065	53443	10429	37563	26599	20612
1997-98	19610	36051	18534	95128	29029	8468	74234	82991	262494	48317	9655	39733	25461	14905
1998-99	17689	33311	19467	91681	35658	8995	84529	74190	237788	42341	7834	34689	22540	16031
1999-00	17550	35083	18639	92087	41431	9056	82326	92209	250911	42117	8720	44761	19800	15996
2000-01	14469	30812	17159	103544	43055	7892	65307	82105	262173	43797	9045	33802	20684	17484
2001-02	14686	24933	12855	72799	34651	10726	59723	84281	269302	44059	8313	32076	19463	15637
2002-03	14119	24204	13521	91561	30884	8574	60886	87272	243926	38981	7167	31326	20794	15644
2003-04	11278	22419	12641	63008	26195	7526	54044	79842	189443	36744	7579	28421	16518	14387
2004-05	12356	20646	10784	78491	32789	7782	54501	87363	260118	36539	6727	29206	17098	12605
2005-06	11034	16063	7518	71748	31261	7500	48033	72951	266634	31377	6314	28385	17383	13786
2006-07	10077	12580	7101	90160	35550	7507	44007	65036	270103	33123	6092	30722	17375	12142
2007-08	7182	7988	4631	62270	28428	5959	24407	59381	244244	21748	5097	32079	14111	10963

2008-09	7274	8292	7399	104250	32154	5494	25907	71909	240143	23265	5613	33861	13637	11043
2009-10	7564	7947	7738	97976	39413	6137	21024	63854	266231	19893	4302	33157	13843	9260
2010-11	6923	7155	6627	91325	40969	4745	17822	53080	218155	21070	3814	27912	13309	9834
2011-12	6139	4768	8989	111980	63579	3135	16572	62316	224413	18577	4274	23526	12170	8555

Source: Kerala Economic Reviews

During 1980-81 to 1989-90, Kannur has the highest negative growth rate in production i.e. -12.5 per cent per annum. During 1990-91 to 1999-2000, Thiruvananthapuram district has the highest negative growth rate in paddy production, i.e. -8.7 per cent per annum and during 2000-01 to 2011-12, Kollam district has the highest negative growth rate in production, i.e. -15.3 per cent per annum. The growth rate in production is positive in two districts, Alappuzha and Kottayam for the period 2000-01 to 2011-12, i.e. 1.9 per cent and 2.9 per cent per annum respectively.

Alappuzha, Kottayam, Idukki, Thrissur, Palakkad and Wayanad districts have the lower negative cumulative growth rate in paddy production compared to the state average and the remaining other districts have higher negative cumulative growth rate than the state average during the period 1980-81 to 2011-12.

During 1980-81 to 1989-90, districts like Trivandrum, Pathanamthitta, Kottayam, Ernakulam, Thrissur, Palakkad, Malappuram and Kasaragod districts are having declining growth rate in paddy production less than the state average. The worst districts during the period having declining growth rate in production greater than the state average are Kollam, Alappuzha, Idukki, Kozhikode, Wayanad, and Kannur.

During 1990-911 to 1999-2000, districts like Alappuzha, Idukki, Ernakulam, Palakkad, Wayanad and Kannur districts are having declining growth rate in paddy production less than the state average. The worst districts during the period having declining growth rate in production greater than the state average are Trivandrum, Kollam, Pathanamthitta, Kottayam, Thrissur, Malappuram, Kozhikode, and Kasaragod. In districts like Alappuzha, Idukki, Wayanad and Kannur, the declining growth rates in production have decreased remarkably and have become lower than the state average during the period 1990-91 to 1999-2000. However, districts like Trivandrum, Pathanamthitta, Kottayam, Malappuram and Kasaragod have worsened their position in the sense that their declining growth rates in production have become greater than the state average compared to their performance in 1980-81 to 1989-90.

During 2000-01 to 2011-12, districts like Trivandrum, Kollam, Pathanamthitta, Idukki, Ernakulam, Malappuram, Kozhikode and Kasaragod districts are the worst performing districts having greater declining growth rate in production than the state average. However, Alappuzha, Kottayam have achieved positive growth rate in production and Thrissur, Palakkad, Wayanad and Kannur are having lower declining growth rate in

production than the state average during 2000-01 to 2011-12. The declining growth rate has decreased in Thrissur district and it has become lower than the state average and districts like

District	1980-81 to 89-90	1990-91 to 99-2000	2000-01 to 2011-12	Overall growth rate

Idukki, and Ernakulam have worsened their position in the sense that their declining growth rates in production have become greater than the state average during the period. Kollam and Kozhikode districts have always declining growth rate higher than the state average during three periods of analysis.

Table-15

District-wise Cumulative Growth rate of Production of paddy (%)

Trivandrum	-2.1	-8.7	-8.2	-6.8
Kollam	-5.7	-5.6	-15.3	-7.6
Pathanamthittah	-0.2	-7.0	-7.5	-6.4
Alappuzha	-5.8	-4.1	1.9	-1.4
Kottayam	-0.1	-6.8	2.9	-2.7
Idukki	-4.9	-1.5	-7.5	-3.8
Ernakulam	-2.5	-3.9	-12.9	-6.3
Thrissur	-2.5	-5.2	-3.8	-3.3
Palakkad	-3.4	-4.0	-0.7	-1.5
Malappuram	-3.3	-8.4	-8.2	-5.6
Kozhikode	-10.3	-6.3	-7.1	-6.3
Wayanad	-4.6	-1.7	-1.3	-2.3
Kannur	-12.5	-4.5	-4.7	-5.9
Kasargode	-4.2	-5.9	-6.0	-4.8
State Average	-4.4	-5.2	-5.6	-4.6

Source: Estimated

c. District wise productivity of paddy

The actual data on productivity of paddy at district level from 1980-81 to 2011-12 are given in Table-16. From the table it is clear that there is improvement in the productivity of paddy in all districts. District-wise cumulative growth rate in productivity of paddy is given in Table-17. The overall growth rate of productivity of paddy is positive for all districts during 1980-81 to 2011-12. The highest growth in productivity is noticed in Thrissur district with 2.3 per cent growth per annum and it is followed by Malappuram with 2.1 per cent growth per annum. The lowest growth in productivity is found in Pathanamthitta, Ernakulam and Kozhikode, where the annual growth in productivity is 1.0 per cent. Trivandrum, Thrissur and Malappuram and Kasaragod districts have the higher cumulative growth rate in productivity compared to the state average; Alappuzha, Wayanad and Kannur districts have the cumulative growth rate in productivity equivalent to the state average; and the remaining other districts have lower cumulative growth rate than the state average.

During 1980-81 to 1989-90, Pathanamthitta district has achieved the highest growth rate in productivity, i.e., 4.5 per cent per annum. During 1990-91 to 1999-2000, Thrissur

district achieved the highest growth rate in productivity, i.e. 2.1 per cent per annum. During 2000-01 to 2011-12, Palakkad and Thrissur have achieved the highest growth rate in productivity, i.e. 2.2 per cent and 2.1 per cent per annum respectively Productivity growth is negative in Palakkad during1980-81 to 1989-90, i.e., -0.5 per cent per annum and during 1990-91 to 1999-2000, i.e., -0.4 per cent per annum. Similarly, growth of productivity is negative in Kozhikode district with -0.1 per cent per annum during 2000-01 to 2011-12.

Kollam, Pathanamthitta, Kottayam, Idukki, Ernakulam, Palakkad and Kozhikode districts have the lower cumulative growth rate in productivity of paddy compared to the state average; Alappuzha, wayanad and Kannur districts have the growth rate same as that of the state average; and Trivandrum, Thrissur, Malappuram and Kasaragod districts have higher cumulative growth rate than the state average during the period 1980-81 to 2011-12.

During 1980-81 to 1989-90, Palakkad has negative growth rate in productivity; and districts like Kollam, Alappuzha, Kottayam, Ernakulam, Kozhikode, and Wayanad districts are having growth rate in productivity less than the state average. Trivandrum, Pathanamthitta, Idukki, Thrissur, Kannur and Kasaragod districts are having growth rate in productivity greater than the state average during the period.

During 1990-911 to 1999-2000, districts like Kollam, Pathanamthitta, Kottayam, Ernakulam, Kozhikode, and Kannur districts are having growth rate in paddy productivity less than the state average and Palakkad has negative growth rate. The districts having growth rate in productivity greater than the state average during the period are Trivandrum, Alappuzha, Thrissur, Malappuram, Wayanad and Kasaragod. In districts like Pathanamthitta, and Kannur, growth rate has become below the state average and in Alappuzha and Wayanad, productivity has become above the state average during the period compared to the previous period.

During 2000-01 to 2011-12, Kozhikode district has negative growth rate in productivity; Kollam, pathanamthitta, Wayanad and Kasaragod have lower productivity compared to the state average; and other districts have higher productivity compared to the state average. Compared to 1990-91 to 1999-2000, districts like Trivandrum, Kottayam, Idukki, Ernakulam, Palakkad, Malappuram and Kannur have improved the growth rate in productivity; while districts like Kollam, Pathanamthitta, Alappuzha, Kozhikode, Wayanad and Kasaragod have poorer performance in productivity growth rate.

Table-16 District wise Productivity of paddy in Kg/ha

Year	TVM	Kollam	Pathanamthittah	Alappuzha	Kottayam	Idukki	Ernakulam	Thrissur	Palakkad	Malappuram	Kozhikode	Wayanad	Kannur	Kasargod
1980-81	1411	1642		1757	1830	1674	1411	1338	2036	1343	1191		1325	
1981-82	1457	1654		1954	1876	1798	1477	1346	2129	1332	1020	1831	1319	
1982-83	1559	1731		1786	2415	2230	1560	1387	2109	1258	1072	1583	1360	
1983-84	1347	1457	1719	1933	2012	1717	1373	1500	2020	1248	944	2020	1319	
1984-85	1677	1569	2060	1909	2081	2057	1673	1437	2107	1376	1120	1804	1270	
1985-86	1788	1748	1912	1998	1822	2042	1683	1596	1908	1422	1194	1781	1552	
1986-87	1714	1669	1863	1736	2021	2112	1622	1601	1879	1536	1103	1924	1483	1544
1987-88	1542	1770	2375	2026	2213	1985	1501	1555	1839	1399	1027	1702	1493	1728
1988-89	1672	1649	2223	1827	2112	2167	1666	1522	1933	1405	1083	1972	1501	1685
1989-90	1866	1902	2288	2249	2368	2351	1721	1675	2241	1586	1213	2039	1648	1751
1990-91	1770	1913	2334	2170	2389	2160	1628	1746	2230	1556	1230	2065	1650	1710
1991-92	1712	1669	2320	2078	2313	2254	1684	1762	2344	1595	1195	2186	1537	1778
1992-93	1896	1918	2624	2309	2389	2090	1722	1777	2297	1613	1209	2382	1568	1790
1993-94	1763	1889	2449	2224	2468	2097	1716	1785	2337	1719	1248	2225	1602	1862
1994-95	1743	1852	2262	1809	2244	2150	1684	1835	2240	1684	1247	2217	1507	1699
1995-96	1874	1951	2517	2743	2235	2321	1803	1886	2067	1720	1211	2288	1551	1680
1996-97	1782	1901	2157	2055	2165	2075	1730	2036	2291	1719	1254	2199	1725	1856
1997-98	1725	1800	2242	2201	2111	2082	1608	2025	2173	1670	1209	2217	1627	1866
1998-99	1843	1896	2597	2610	2477	2339	1700	1892	2213	1778	1145	2218	1624	2002
1999-00	2202	2013	2775	2607	2619	2488	1919	2150	2287	1793	1343	2587	1691	1907
2000-01	2068	2063	2733	2744	2582	2272	1745	2085	2209	1892	1343	2253	1754	1909
2001-02	2157	2176	2464	2199	2272	2444	1815	2277	2323	1945	1299	2495	1771	2109
2002-03	2198	2113	2490	3090	2518	2265	1898	2341	2104	1981	1409	2412	1836	2174
2003-04	2100	2200	2402	1964	2277	2331	1832	2337	1802	2079	1462	2303	1746	2297
2004-05	2378	2307	2485	2441	2491	2458	1936	2406	2343	2182	1455	2578	1878	2221
2005-06	2345	2225	2284	2494	2490	2558	1926	2348	2341	2108	1343	2468	1885	2286
2006-07	2618	2289	2714	2903	2573	2608	2010	2381	2473	2192	1418	2597	1965	2281
2007-08	2505	2258	2314	1868	2592	2721	1977	2431	2463	2290	1341	2585	1951	2123
2008-09	2429	2149	2760	3053	2936	2598	1998	2575	2497	2113	1390	2657	1783	2213

2009-10	2573	2301	2583	2930	2547	2636	1949	2510	2648	2251	1313	2552	1942	2107
2010-11	2372	2141	2219	2464	2773	2609	1977	2620	2493	2354	1270	2525	2100	2367
2011-12	2563	2274	3208	3089	2970	2480	2144	2943	2672	2468	1464	2615	2120	2218

Source: Kerala Economic Reviews

Table-17

District-wise Cumulative Growth Rate of Productivity of Paddy (%)

District	1980-81 to 89-90	1990-91 to 99-2000	2000-01 to 2011-12	Overall growth rate
Trivandrum	2.6	1.3	1.9	1.9
Kollam	1.2	0.7	0.5	1.3
Pathanamthittah	4.5	0.8	0.6	1.0
Alappuzha	1.3	2.0	1.2	1.4
Kottayam	1.6	0.2	1.7	1.1
Idukki	2.7	0.9	1.2	1.1
Ernakulam	1.8	0.8	1.3	1.0
Thrissur	2.3	2.1	2.1	2.3
Palakkad	-0.5	-0.4	2.2	0.7
Malappuram	1.9	1.4	2.0	2.1
Kozhikode	0.5	0.3	-0.1	1.0
Wayanad	1.4	1.1	1.0	1.4
Kannur	2.4	0.6	1.5	1.4
Kasargode	3.6	1.2	0.8	1.5
State Average	1.9	0.9	1.1	1.4

Source: Estimated

17. District-wise Share of Paddy, Coconut and Rubber in Net Sown Area

Net sown area in all districts declined between 1980-81 and 2011-12 except in Idukky and Kasaragod. In Idukky, the net sown area increased from 160920 hectares in 1980-81 to 206908 hectares in 2011-12. In Kasaragod, the net sown area increased from 139556 hectares in 1990-91 to 140788 hectares in 2011-12. The district-wise net sown area in Kerala is shown in Table-18.

Table-18

District-wise Net Sown Area in Kerala

District	Net sown Area			
	1980-81	**1990-91**	**2000-01**	**2011-12**
Trivandrum	143756	144481	143139	130758
Kollam	206155	143181	142233	124779
Pathanamthitta	-	100125	92805	81071
Alappuzha	144972	105678	94328	85159
Kottayam	182165	181317	173494	157899
Idukki	160920	187566	225689	206908
Ernakulam	178157	182263	169661	143317
Thrissur	156810	153950	145250	128895
Palakkad	213748	217032	204169	198043
Malappuram	201174	210041	200981	177878
Kozhikode	226603	162752	160094	153327
Wayanad	-	115736	116065	115135
Kannur	365130	203096	202502	196175
Kasaragod	-	139556	135716	140788

Source: Agricultural statistics (various years), Department of Economics and Statistics, Govt. of Kerala

Coconut and rubber are the principal rival crops of paddy in almost all districts of Kerala and these two crops occupied the major part of paddy lands in all the districts of Kerala. Area under paddy has remarkably declined in all districts of Kerala during 1980-81 to 2011-12. In the case of coconut, area under cultivation declined only in the case of Trivandrum, Kollam, Pathanamthitta, Alappuzha, Kottayam and Ernakulam. In the case of rubber the increase in area during the period is very significant in all districts except in Kollam where the area under rubber has declined marginally. The district-wise data on the area under paddy, coconut and rubber in Kerala is given in Table-19. The district-wise share of paddy, coconut and rubber in net sown area is given in Table-20.

Table-19

Districtwise area under paddy, coconut and rubber in Kerala (area in hectares)

District	Area under paddy				Area under coconut				Are under rubber			
	1980-81	1990-91	2000-01	2011-12	1980-81	1990-91	2000-01	2011-12	1980-81	1990-91	2000-01	2011-12
Trivandrum	32583	21677	6995	2395	73485	85581	88663	71424	8735	22657	27954	31220
Kollam	50055	30513	14939	2097	84488	77874	79709	55304	38890	30076	36452	36840
Pathanamthitta	-	14234	6279	2802	-	27505	22794	16185	-	43715	47700	50540
Alappuzha	82466	60675	37740	36251	62907	66664	59775	38556	4273	2901	3747	4420
Kottayam	31948	26257	16677	21410	49747	47217	41604	28209	63232	107937	110923	113830
Idukki	9261	5078	3473	1264	15952	14864	23811	17158	17449	34595	38187	40030
Ernakulam	102500	63078	37433	7731	61872	66264	67402	46376	23334	60913	56383	59300
Thrissur	110314	74038	39384	21172	53549	80856	89472	89677	9386	6861	13372	15460
Palakkad	183634	145687	118701	83998	22003	38153	46393	60529	11084	24045	28781	37010
Malappuram	80022	51934	23148	7528	60652	102245	110378	109229	19281	20455	28781	40230
Kozhikode	45451	12062	6737	2920	103672	122062	128739	127699	18171	11342	18016	21425
Wayanad	-	20343	15000	8995	-	4510	10995	10515	-	4712	6411	10450
Kannur	73465	19582	11791	5740	77889	91893	96975	90350	23934	23098	33806	46160
Kasaragod	-	14292	9158	3857	-	44334	59073	59656	-	18308	22248	32650

Source: agricultural statistics (various years), Department of Economics and Statistics, Govt. of Kerala

Table-20
District-wise percentage share of paddy, coconut and rubber in net area sown

District	Share of paddy				Share of coconut				Share of rubber			
	1980-81	1990-91	2000-01	2011-12	1980-81	1990-91	2000-01	2011-12	1980-81	1990-91	2000-01	2011-12
Trivandrum	22.66	15.00	4.89	1.83	51.12	59.23	61.94	54.62	6.08	15.68	19.53	23.88
Kollam	24.28	21.31	10.50	1.68	40.98	54.39	56.04	44.32	18.86	21.01	25.63	29.52
Pathanamthitta	-	14.22	6.77	3.46	-	27.47	24.56	19.96	-	43.66	51.40	62.34
Alappuzha	56.88	57.41	40.01	42.57	43.39	63.08	63.37	45.28	2.95	2.75	3.97	5.19
Kottayam	17.54	14.48	9.61	13.56	27.31	26.04	23.98	17.87	34.71	59.53	63.93	72.09
Idukki	5.76	2.71	1.54	0.61	9.91	7.92	10.55	8.29	10.84	18.44	16.92	19.35
Ernakulam	57.53	34.61	22.06	5.39	34.73	36.35	39.73	32.36	13.10	33.42	33.23	41.38
Thrissur	70.35	48.09	27.11	16.43	34.15	52.52	61.60	69.57	5.99	4.46	9.21	11.99
Palakkad	85.91	67.13	58.14	42.41	10.29	17.58	22.72	30.56	5.19	11.08	14.10	18.69
Malappuram	39.78	24.73	11.52	4.23	30.15	48.68	54.92	61.41	9.58	9.74	14.32	22.62
Kozhikode	20.06	7.41	4.21	1.90	45.75	75.00	80.41	83.28	8.02	6.97	11.25	13.97
Wayanad	-	17.58	12.92	7.81	-	3.90	9.47	9.13	-	4.07	5.52	9.08
Kannur	20.12	9.64	5.82	2.93	21.33	45.25	47.89	46.06	6.55	11.37	16.69	23.53
Kasaragod	-	10.24	6.75	2.74	-	31.77	43.53	42.37	-	13.12	16.39	23.19

Source: Estimated

In all districts, the share of paddy area in their net sown area remarkably declined. In 1980-81, Palakkad had the highest share of paddy in net sown area, i.e. 85.91 per cent and it became 42.41 per cent in 2011-12. In Alappuzha, the share declined from 56.88 per cent to 42.57 per cent during the period. In Ernakulam district, the share of paddy in its net sown area was 57.53 per cent in 1980-81 and it became mere 5.39 per cent in 2011-12. In Thrissur district the share of paddy during the period declined from 70.35 per cent to 16.43 per cent. In 2011-12, Alappuzha district had the highest share of paddy, i.e. 42.57 per cent and then Palakkad with 42.41 per cent. Idukky had the lowest share of paddy in 1980-81 (5.76 per cent), 1990-91 (2.71 per cent), 2000-01 (1.54 per cent) and 2011-12 (0.61 per cent). Coconut and rubber were the major rival crops of paddy in almost all districts of Kerala.

In most of the districts, especially, Trivandrum, Kollam, Alappuzha, Thrissur, Palakkad, Malappuram, Kozhikode and Kannur, the percentage of coconut area in net sown area increased during the period 1980-81 to 2011-12. While in Trivandrum, Kollam and Alappuzha, the increase was moderate, in other districts, the increase was very remarkable. In Thrissur district, the increase was from 34.15 per cent in 1980-81 to 69.57 per cent in 2011-12; in Palakkad, the increase was from 10.29 per cent to 30.56 per cent; in Malappuram, it was from 30.15 per cent to 61.41 per cent; in Kozhikode, it was from 45.75 per cent to 83.28 per cent and in Kannur, it was from 21.33 per cent to 46.06 per cent.

In the above mentioned districts, coconut was the main rival crop of paddy and the increase in coconut area was mainly caused by the conversion of paddy lands for coconut cultivation. In Kottayam, Idukki and Ernakulam districts, the percentage area under coconut declined during 1980-81 to 2011-12. In Kottayam district, the decline was from 27.31 per cent to 17.87 per cent; in Idukki, it was from 9.91 per cent to 8.29 per cent and in Ernakulam, it was from 34.73 per cent to 32.36 per cent. In these districts, rubber was the main rival crop of paddy.

In the case of rubber, the percentage share of area in net sown area increased in all districts during 1980-81 to 2011-12. Kottayam had the highest share of area under rubber in 1980-81, 1990-91, 2000-01 and 2011-12. In Kottayam, the increase was from 34.71 per cent to 72.09 per cent during the period 1980-81 to 2011-12; in Trivandrum, the increase was from 6.08 per cent to 23.88 per cent; in Ernakulam, it was from 13.10 per cent to 41.38 per cent; in Idukki, from 10.84 per cent to 19.35 per cent; in Malappuram, it was from 9.58% to 22.62% and in Kannur, it was from 6.55% to 23.53%. In districts like Pathanamthitta, Kottayam and Ernakulam, rubber has been the major rival crop of paddy.

18. Area, Yield and Interaction effects on Production at District levels

For the district level analysis, the period selected is 1980-81 to 2011-12 for all districts except for the lately formed districts like Pathanamthitta, Wayanad and Kasaragod. For these Districts, the selected periods are 1983-84 to 2011-12; 1981-82 to 2011-12; and 1986-87 to 2011-12 respectively.

In all districts, area effect and interaction effect on paddy production during the period 1980-81 to 2011-12 were negative. The negative area effect was very remarkable in almost all districts. However, the yield effect on paddy production in all districts was positive. The highest negative area effect was seen in Kottayam district, i.e. -376.44 and then Alappuzha with -246.71. The lowest negative area effect was found in Kozhikode district with -101.60 and Kollam district with -101.71.

The interaction of area and yield on production of paddy, i.e. interaction effect was the highest in Kotayam district, i.e. -234.50. It is followed by Alappuzha with -187.03 and Thrissur with -167.75. The lowest negative interaction effect was found in Kozhikode district, i.e. -23.29 and it was followed by Kollam district with -39.15. Both the negative area effect and the negative interaction effect were responsible for the decline in production of paddy in all districts of Kerala.

Even though, Kottayam district had the highest negative area effect and interaction effect, it had the highest positive yield effect on production, i.e. 710.95. As a result of it, the production of paddy in Kottayam district increased from 58478 million tonnes in 1980-81 to 63579 million tonnes in 2011-12. It is followed by Alappuzha with 333.74 and Thrissur with 207.59. The lowest yield effect was found in Kozhikode district with 24.89 and then Kollam district with 40.86. The area, yield and interaction effects on production of paddy at District level is shown in Table-21.

Table-21

Area, Yield and Interaction effects on Production of Paddy at District levels

Period 1980-81 to 2011-12	$\Delta A.Y_0$ (area effect)	$\Delta Y.A_0$ (yield effect)	$\Delta A. \Delta Y$ (interaction effect)
Trivandrum	-106.93	94.22	-87.30
Kollam	-101.71	40.86	-39.15
Pathanamthitta	-119.18	122.42	-103.23
Alappuzha	-246.71	333.74	-187.03
Kottayam	-376.44	710.95	-234.50
Idukki	-108.24	60.35	-52.11
Ernakulam	-104.43	58.67	-54.25
Thrissur	-139.84	207.59	-167.75
Palakkad	-135.75	78.15	-42.41
Malappuram	-109.53	101.28	-91.75
Kozhikode	-101.60	24.89	-23.29
Wayanad	-122.34	74.72	-52.38
Kannur	-105.36	68.57	-63.21
Kasaragod	-110.70	59.02	-48.32

Source: Estimated

Part-VI

19. Major causes for the decline in paddy cultivation

The major causes for the decline in paddy cultivation in Kerala are

a. High demand for land

In Kerala, there is high demand for land for infrastructure, residential and other non-agricultural purposes. This high demand for land and the consequent high land price in Kerala results in conversion of paddy lands for non-agricultural and real estate purposes. The total number of houses in Kerala increased from in 9300000 in 2001 to 14000000 in 2010.

Total population in the state is 3.33 crore. Thus, we have about one house per two persons in Kerala.

The activities in commerce, industry, transport, etc have risen with increase in population and changes in the socio-economic conditions of the people. This increase has led to rise in demand for land for construction of residential houses, shops, establishments, roads, etc. Since there is shortage of land in Kerala, the land required for non-agricultural activities is taken from cultivable areas.

There is widespread expansion of educational institutions, especially professional colleges, IT related institutions and campuses. The demand for land also comes from newer hospitals and tourist resorts, shopping complexes, airport, and exclusive sales centres for jewellery, saris or for all wedding items.

b. Non-profitability of paddy cultivation

In earlier periods, the choice of cropping pattern was guided by agronomic considerations and consumption needs of farmers; but now market forces determine the cropping pattern. By the end of the eighties, cash crops started to generate higher income to the farm sector. Therefore, farmers began to shift from food crops to cash crops.

c. State-intervention

The expansion of Government activities and the policies followed by successive Governments created conditions to which the farm sector had to respond. In the case of rice, the abolition of food zones and the distribution of rice at subsidised prices through fair price shops resulted in the fall in rice price. This decline in price together with the increase in wages of farm labour turned rice cultivation non-remunerative. In the case of rubber, the development support given by Rubber Board through financial and technical assistance and the existence of an assured market for rubber provided the incentive for cultivators to bring new areas under the crop. Acquisition of land by Government for construction of roads and other developmental activities also has affected the land under paddy.

d. Increasing pressure on land

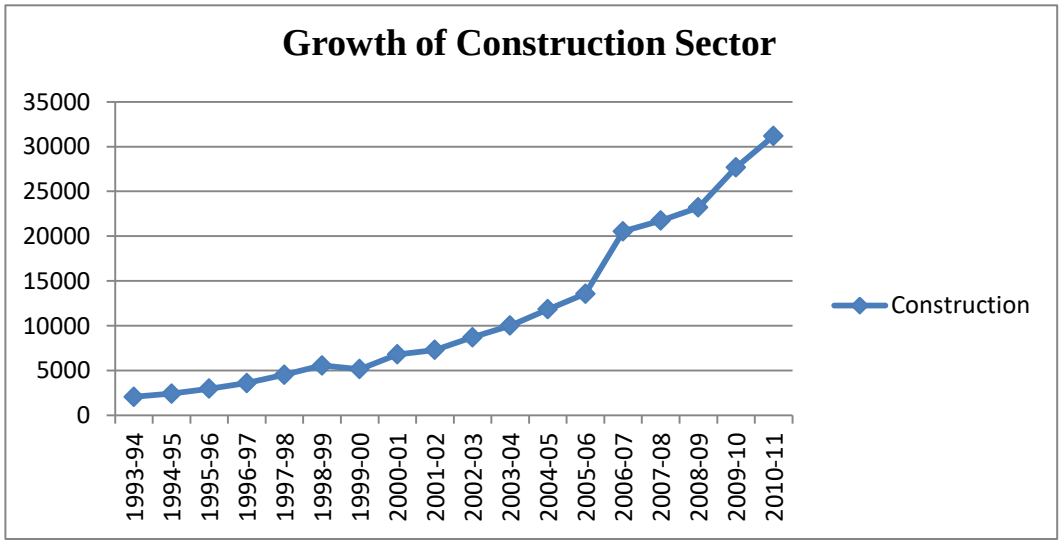
Due to the increase in population, agricultural farms get subdivided and become very small-sized farms. Since small-sized farms are not viable, the owners of these farms turn to

other occupations for their livelihood. For such cultivators farming is only a subsidiary activity. They prefer to cultivate crops that require less personal attention or use the land for non-cultivation purposes.

Little quantitative information is available on many of these anthropogenic activities so that it is impossible to assess their precise impacts on agriculture and environment**.** However, the gravity of the problem can be understood from the trend in the growth of construction and mining & quarrying over a period of time. The annual growth rate of the construction sector in Kerala for the period 1993-94 to 2010-11 was more than 8%. In Kerala there is no proper regulation of construction activities which results in indiscriminate paddy land conversion, over exploitation of natural capital, irrational sand mining etc.

Fig. 7

Growth of construction sector in Kerala (in crores)

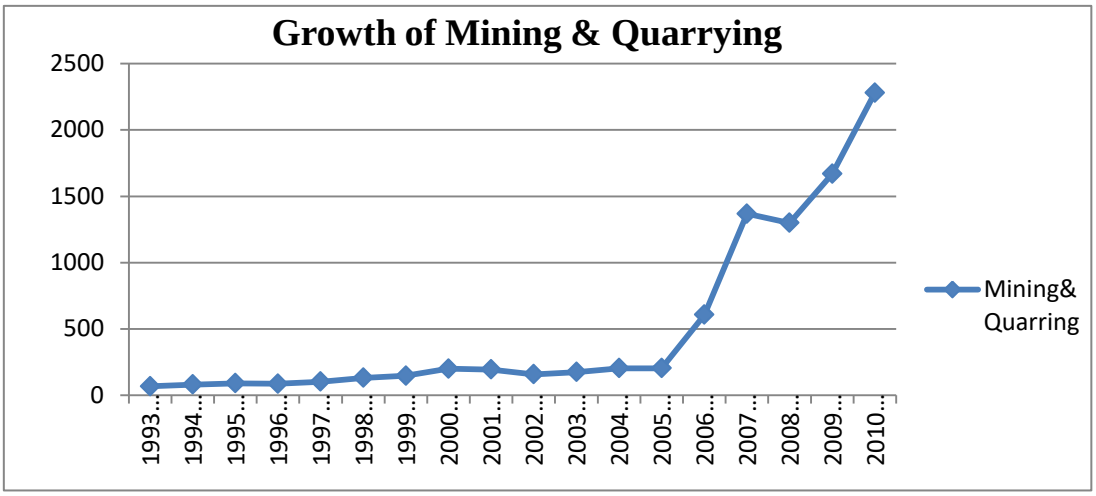


Source : Kerala Economic Review

From the Figure-7, it is clear that construction activities increased steeply after 2005. Similarly, mining & quarrying activities also steeply increased after 2005. It is shown in the Figure-8.

Fig. 8

Growth of mining and quarrying in Kerala (in crores)



Source : Kerala Economic Review

This high expansion of construction and mining & quarrying has led to a drastic change in the land utilization pattern and which has further created a negative impact on the agriculture sector.

Changes in the land use pattern have affected the biodiversity of landscapes. A large proportion of the Kerala home gardens have been converted into small-scale plantations of coconut and rubber or cropping systems consisting of fewer crops due to commercialization and fragmentation of land holdings. Hence, many local varieties of mango, jackfruit and other traditional fruit/vegetable crops, etc. which were once abundant in the Kerala home gardens, are now on the verge of extinction.

Part-VII

20. Summary and Suggestions

The share of agriculture in the Gross State Domestic Product of Kerala has been declining and Kerala is having a low base in food production. Since mid-70s, paddy production in Kerala has been continuously declining and the agricultural economy has been undergoing a structural transformation in favour of cash crops and this change has created the problem of food insecurity for Kerala.

The declining profitability of paddy crop, shortage of farm labourers and the rapid increase in their wages, conversion of paddy lands for other purposes etc. are the major reasons for the decline in paddy cultivation in Kerala. The steep fall in paddy cultivation has amplified food insecurity, rural unemployment and environmental and ecological problems.

The study has made an attempt to examine the trends in paddy cultivation both at state level and at district levels using secondary data in order to understand the variations in area, production and productivity of paddy at state level since 1970-71 and at district level since 1980-81. For the district level analysis, the period selected is 1980-81 to 2011-12 for all districts except for the lately formed districts like Pathanamthitta, Wayanad and Kasaragod. For these Districts, the selected periods are 1983-84 to 2011-12; 1981-82 to 2011-12; and 1986-87 to 2011-12 respectively.

The major objectives of the study are: to analyse the agriculture scenario of Kerala; to examine the trends in area, production and productivity of paddy in Kerala; to analyse the district level variations in area, production and productivity of paddy in Kerala; and to make suitable policy suggestions for the revival of paddy cultivation in Kerala.

The trends in area, production and productivity of paddy crops since 1970 are examined and the cumulative growth rates of area, production and productivity are calculated. In order to examine the change in production during the period of study, the area, the yield and the interaction effects on production are analysed. The percentage of the area of paddy, rubber, and coconut in net own area are calculated to identify the changes in the share of paddy, rubber and coconut in net sown area since 1970. The area effect, yield effect and interaction effect on paddy production in Kerala for the periods 1970-71 to 2012-13 were estimated.

Regional analyses at district level are also done to get a broad idea about variations in area, production and productivity at regional levels. The trends in area, production and productivity of paddy at district levels since 1980s are analysed and the cumulative growth rates of area, production and productivity at district levels are calculated to find out the inter-district variations. Similarly, in order to analyse the changes in the share of paddy at district levels, the percentage of their areas in net sown areas of the concerned districts since 1980 are examined. The area effect, yield effect and interaction effect on paddy production at district levels in Kerala for the periods 1980-81 to 2011-12 were also estimated.

Two important changes have taken place in Kerala in the utilization of land resource as a result of development and urbanization. They are, conversion of food crops area to cash crops area (commercialization of agriculture) as a result of structural transformation of the agricultural sector; and the conversion of agricultural lands for non-agricultural purposes. During the period 1970-71 to 2011-12, land put to non-agricultural use increased remarkably in Kerala. Similarly, cultivable waste, fallow other than current fallow and current fallow also increased during the period. However, the net sown area, area sown more than once and the total cropped area declined during the period in Kerala.

There is a continuous decline in area under food grain in Kerala and it mainly happens due to the conversion of food grain area for the cultivation of cash crops and conversion for various non-agricultural purposes. The area under rice has been declining continuously over the last several years.

Area under paddy in Kerala was about 8.7 lakh hectares in 1970-71 and it became mere 1.97 lakh hectares in 2012-13. During this period, production of paddy declined from 12.92 lakh tonnes to 5 lakh tonnes. The productivity of paddy, however, increased during the period from 1483 kg/hectare to 2577 kg/hectare. The improvement in productivity is neutralized by the steep decline in area and thereby production of paddy. This situation has created the problem of food insecurity for Kerala in addition to certain environmental and ecological problems. Now, Kerala has more than 90% deficit in food production.

In 1970's, the area under cultivation reached the highest level in 1974-75, i.e. 8.81 lakh hectares. The lowest figure was noted in the year 1978-79, i.e. 7.79 lakh hectares. Production in 1970's achieved the highest level in 1972-73, i.e. 13.76 lakh tonnes and the

lowest level in 1976-77, i.e.12.54 lakh tonnes. Productivity in 1970's achieved the highest and lowest values in 1979-80 (1638 kg/ha.) and 1973-74 (1437 kg/ha.) respectively.

In 1980's, the area under cultivation reached the highest level in 1981-82, i.e.8.06 lakh hectares. The lowest figure was noted in the year 1988-89, i.e. 5.77 lakh hectares. Production in 1980's achieved the highest level in 1981-82, i.e. 13.39 lakh tonnes and the lowest level in 1988-89, i.e.10.13 lakh tonnes. Productivity in 1980's achieved the highest and lowest values in 1989-90 (1956 kg/ha.) and 1980-81 (1587 kg/ha.) respectively.

In 1990's, the area under cultivation was continuously declining and the highest area under cultivation was in 1990-91 i.e.5.59 lakh hectares. The lowest figure was noted in the end of the decade i.e. 1999-2000 i.e. 3.5 lakh hectare. Production in 1990's achieved the highest level in 1990-91, i.e. 10.86 lakh tonnes and the lowest level in 1998-99, i.e.7.27 lakh tonnes. Productivity in 1990's achieved the highest and lowest values in 1999-2000 (2203 kg/ha.) and 1994-95 (1937 kg/ha.) respectively.

For the period, 2000-01 to 2012-13, the highest area under cultivation was in 2000-01 i.e. 3.47 lakh hectare. The lowest figure was noted in the year 2012-13, i.e. 1.97 lakh hectare. Production during the period achieved the highest level in 2000-01, i.e. 7.51 lakh tonnes and the lowest level in 2012-13, i.e. 5.08 lakh tonnes. Productivity, during the period, achieved the highest and lowest values in 2011-12 (2733 kg/ha.) and 2003-04 (1984 kg/ha.) respectively.

The cumulative growth rates of area and production and of paddy for the period 1970-71 to 2012-13 have been negative. However, the cumulative growth rate of productivity is positive during the period. The decline in area is the lowest during the period 1970-71 to 1979-80, i.e. -1.2 per cent per annum and highest during 1990-91 to 1999-2000, i.e. -5.6 per cent per annum. The production of paddy has experienced the highest negative growth during 1990-91 to 1999-2000 and the lowest negative growth during 1970-71 to 1979-80. The growth rate of productivity of paddy is the highest during 2000-01 to 2012-13 and lowest during 1970-71 to 1979-80. During 1990s, growth rate of productivity is comparatively better than that of 1970s. Therefore, the highest negative growth rate in production during the period is mainly on account of the highest negative growth rate in area under cultivation.

In 1970s, the decline in the production of paddy is caused 90.69 per cent by the area effect i.e. decline in area and 9.48 per cent by the interaction effect of area and productivity. The influence of productivity i.e. yield effect on production is positive but very small i.e. 0.17

per cent. In 1980s, decline in paddy production is explained 81.25 per cent by the area effect and 18.89 per cent by the interaction effect. The yield effect is positive, i.e. 0.14 per cent and its effect on production is very low. In 1990s, the area effect is -88.25 per cent and interaction effect is -11.86 per cent. During the period also the yield effect is positive and it is 0.11 per cent. The area effect, interaction effect and yield effect for the period 2000-01 to 2012-13 are -84.09 per cent, -16.14 per cent and 0.23 per cent respectively

Rubber and coconut are the principal rival crops of paddy in Kerala. While the share of area under paddy has been shrinking, the area under rubber and coconut has been increasing. The share of paddy in net sown area of Kerala declined steeply from 40.28 per cent in 1970-71 to 9.63 per cent in 2012-13. The share of coconut during the period increased from 33.12 per cent to 38. 97 per cent and that of rubber increased from 8.25 per cent to 26.61 per cent.

In 1970s, the average share of paddy, rubber and coconut in net sown area of Kerala were 38.82 per cent, 9.20 per cent, and 32.33 per cent respectively. The percentage share of paddy was 40.28 in 1970-71 and it became 36.14 towards the end of that decade. In the case of rubber, there was constant rise in the share of net sown area in 1970s. The share of rubber increased from 8.25 per cent to 9.20 per cent. However, in 1970s, the share of coconut area declined from 33.12 to 30.24 per cent.

In 1980s, the average share of paddy, rubber and coconut in net sown area of Kerala were 31.81 per cent, 14.07 per cent, and 32.87 per cent respectively. The percentage share of paddy was 36.77 in 1980-81 and it declined to 26.14 towards the end of that decade. In the case of rubber, there was constant rise in the share of net sown area in 1980s. The share of rubber increased from 10.91 per cent to 16.84 per cent. The share of coconut area increased from 29.88 per cent to 39.87 per cent.

In 1990s, the average share of paddy, rubber and coconut in net sown area of Kerala were 20.61 per cent, 19.67 per cent, and 39.56 per cent respectively. The percentage share of paddy was 24.90 in 1990-91 and it declined to 15.63 towards the end of that decade. In the case of rubber, there was constant rise in the share of net sown area in 1990s. The share of rubber increased from 17.09 per cent to 21.12 per cent. The share of coconut area increased from 38.72 per cent in 1990-91 to 41.31 per cent in 1999-2000.

During the period, 2000-01 to 2012-13, the average share of paddy, rubber and coconut in net sown area of Kerala were 12.32 per cent, 23.81 per cent, and 40.16 per cent

respectively. The percentage share of paddy was 15.73 in 2000-01 and it declined to mere 9.63 in 2012-13. In the case of rubber, there was constant rise in the share of net sown area during the period also. The share of rubber increased from 21.50 per cent to 26.61 per cent. The share of coconut area decreased from 42.44 per cent in 2000-01 to 38.97 per cent in 2012-13.

The district level data available from 1980s are used in the study for examining the changes in area, production and productivity at district level. In all districts, the area under paddy has been shrinking. The overall growth rate in area has been negative for all districts during the period 1980-81 to 2011-12. The highest negative growth rate is seen in Kollam district and which is followed by Thiruvananthapuram. Palakkad has the lowest negative growth rate. It is followed by Alappuzha, Kottayam and Wayanad. The growth rate in area was positive in two districts, Alappuzh and Kotayam for the period 2000-01 to 2011-12.

Alappuzha, Kottayam, Idukki, Thrissur, Palakkad and Wayanad districts have the lower negative cumulative growth rate in area compared to the state average and the remaining other districts have higher negative cumulative growth rate than the state average during the period 1980-81 to 2011-12.

During 1980-81 to 1989-90, districts like Trivandrum, Pathanamthitta, Alappuzha, Kottayam, Ernakulam, Thrissur, Palakkad, Malappuram and Wayanad districts are having declining growth rate in area less than the state average. The worst districts during the period having declining growth rate in area greater than the state average are Kollam, Idukki, Kozhikode, Kannur and Kasaragod.

During 1990-911 to 1999-2000, districts like Trivandrum, Alappuzha, Idukki, Ernakulam, Palakkad, Wayanad and Kannur districts are having declining growth rate in area less than the state average. The worst districts during the period having declining growth rate in area greater than the state average are Trivandrum, Kollam, Pathanamthitta, Kottayam, Thrissur, Malappuram, Kozhikode, and Kasaragod. In districts like Idukki and Kannur the declining growth rates in area have decreased remarkably and have become lower than the state average during the period 1990-91 to 1999-2000. However, districts like Trivandrum, Pathanamthitta, Kottayam, and Thrissur have worsened their position in the sense that their declining growth rate in area is greater than the state average compared to their performance in 1980-81 to 1989-90.

During 2000-01 to 2011-12, districts like Trivandrum, Kollam, Pathanamthitta, Idukki, Ernakulam, Malappuram, Kozhikode and Kasaragod districts are the worst performing districts having declining growth rate in area greater than the state average. However, Alappuzha, Kottayam have achieved positive growth rate in area and Thrissur, Palakkad, Wayanad and Kannur are having declining growth rate in area lower than the state average during 2000-01 to 2011-12. The declining growth rate has decreased in Thrissur district and it has become lower than the state average and districts like Idukki, and Ernakulam have worsened their position in the sense that their declining growth rates in area are greater than the state average. Kollam, Kozhikode and Kasaragod districts have always declining growth rate higher than the state average during three periods of analysis and they are to be specially focussed for arresting the declining area under cultivation of paddy

In all districts, the production of paddy has been shrinking. The overall growth rate in production has been negative for all districts during the period 1980-81 to 2011-12. The highest negative growth rate is seen in Kollam district and which is followed by Thiruvananthapuram. Alappuzha has the lowest negative growth rate and it is followed by Palakkad. The growth rate in production was positive in two districts, Alappuzh and Kottayam for the period 2000-01 to 2011-12.

Alappuzha, Kottayam, Idukki, Thrissur, Palakkad and Wayanad districts have lower negative cumulative growth rate in paddy production compared to the state average and the remaining other districts have higher negative cumulative growth rate than the state average during the period 1980-81 to 2011-12.

During 1980-81 to 1989-90, districts like Trivandrum, Pathanamthitta, Kottayam, Ernakulam, Thrissur, Palakkad, Malappuram and Kasaragod districts are having declining growth rate in paddy production less than the state average. The worst districts during the period having declining growth rate in production greater than the state average are Kollam, Alappuzha, Idukki, Kozhikode, Wayanad, and Kannur.

During 1990-911 to 1999-2000, districts like Alappuzha, Idukki, Ernakulam, Palakkad, Wayanad and Kannur districts are having declining growth rate in paddy production less than the state average. The worst districts during the period having declining growth rate in area greater than the state average are Trivandrum, Kollam, Pathanamthitta, Kottayam, Thrissur, Malappuram, Kozhikode, and Kasaragod. In districts like Alappuzha, Idukki, Wayanad and Kannur, the declining growth rates in area have decreased remarkably

and have become lower than the state average during the period 1990-91 to 1999-2000. However, districts like Trivandrum, Pathanamthitta, Kottayam, Malappuram and Kasaragod have worsened their position in the sense that their declining growth rates in production are greater than the state average compared to their performance in 1980-81 to 1989-90.

During 2000-01 to 2011-12, districts like Trivandrum, Kollam, Pathanamthitta, Idukki, Ernakulam, Malappuram, Kozhikode and Kasaragod districts are the worst performing districts having greater declining growth rate in production than the state average. However, Alappuzha, Kottayam have achieved positive growth rate in production and Thrissur, Palakkad, Wayanad and Kannur are having lower declining growth rate in production than the state average during 2000-01 to 2011-12. The declining growth rate has decreased in Thrissur district and it has become lower than the state average and districts like Idukki, and Ernakulam have worsened their position in the sense that their declining growth rates in production are greater than the state average during the period. Kollam and Kozhikode districts have always declining growth rate higher than the state average during three periods of analysis.

There is improvement in the productivity of paddy in all districts. The overall growth rate of productivity of paddy is positive for all districts during 1980-81 to 2011-12. The highest growth in productivity is noticed in Thrissur district and it is followed by Malappuram. The lowest growth in productivity is found in Pathanamthitta, Ernakulam and Kozhikode. Productivity growth is negative in Palakkad during1980-81 to 1989-90 and during 1990-91 to 1999-2000. Similarly, growth of productivity is negative in Kozhikode district during 2000-01 to 2011-12.

Kollam, Pathanamthitta, Kottayam, Idukki, Ernakulam, Palakkad and Kozhikode districts have the lower cumulative growth rate in productivity of paddy compared to the state average; Alappuzha, wayanad and Kannur districts have the growth rate same as that of the state average; and Trivandrum, Thrissur, Malappuram and Kasaragod districts have higher cumulative growth rate than the state average during the period 1980-81 to 2011-12.

During 1980-81 to 1989-90, Palakkad has negative growth rate in productivity; and districts like Kollam, Alappuzha, Kottayam, Ernakulam, Kozhikode, and Wayanad districts are having growth rate in productivity less than the state average. Trivandrum, Pathanamthitta, Idukki, Thrissur, Kannur and Kasaragod districts are having growth rate in productivity greater than the state average during the period.

During 1990-911 to 1999-2000, districts like Kollam, Pathanamthitta, Kottayam, Ernakulam, Kozhikode, and Kannur districts are having growth rate in paddy productivity less than the state average and Palakkad has negative growth rate. The districts having growth rate in productivity greater than the state average during the period are Trivandrum, Alappuzha, Thrissur, Malappuram, Wayanad and Kasaragod. In districts like Pathanamthitta, and Kannur, growth rate has become below the state average and in Alappuzha and Wayanad, productivity has become above the state average during the period compared to the previous period.

During 2000-01 to 2011-12, Kozhikode district has negative growth rate in productivity; Kollam, pathanamthitta, Wayanad and Kasaragod have lower productivity compared to the state average; and other districts have higher productivity compared to the state average. Compared to 1990-91 to 1999-2000, districts like Trivandrum, Kottayam, Idukki, Ernakulam, Palakkad, Malappuram and Kannur have improved the growth rate in productivity; while districts like Kollam, Pathanamthitta, Alappuzha, Kozhikode, Wayanad and Kasaragod have poorer performance in productivity growth rate.

Net sown area in all districts declined between 1980-81 and 2011-12 except in Idukky and Kasaragod. However, in all districts, the share of paddy area in their net sown area remarkably declined. In 1980-81, Palakkad had the highest share of paddy in net sown area, i.e. 85.91 per cent and it became 42.41 per cent in 2011-12. In Alappuzha, the share declined from 56.88 per cent to 42.57 per cent during the period. In Ernakulam district, the share of paddy in its net sown area was 57.53 per cent in 1980-81 and it became mere 5.39 per cent in 2011-12. In Thrissur district the share of paddy during the period declined from 70.35 per cent to 16.43 per cent. In 2011-12, Alappuzha district had the highest share of paddy, i.e. 42.57 per cent and then Palakkad with 42.41 per cent. Idukky had the lowest share of paddy in 1980-81 (5.76 per cent), 1990-91 (2.71 per cent), 2000-01 (1.54 per cent) and 2011-12 (0.61 per cent). Coconut and rubber were the major rival crops of paddy in almost all districts of Kerala.

In most of the districts, especially, Trivandrum, Kollam, Alappuzha, Thrissur, Palakkad, Malappuram, Kozhikode and Kannur, the percentage of coconut area in net sown area increased during the period 1980-81 to 2011-12. While in Trivandrum, Kollam and Alappuzha, the increase was moderate, in other districts, the increase was very remarkable. In Thrissur district, the increase was from 34.15 per cent in 1980-81 to 69.57 per cent in 2011-12; in Palakkad, it was from 10.29 per cent to 30.56 per cent; in Malappuram, from 30.15 per

cent to 61.41 per cent; in Kozhikode, from 45.75 per cent to 83.28 per cent and in Kannur, it was from 21.33 per cent to 46.06 per cent. In the above districts, coconut was the main rival crop of paddy and the increase in coconut area was mainly caused by the conversion of paddy lands. In Kottayam, Idukki and Ernakulam districts, the percentage area under coconut declined during 1980-81 to 2011-12. In Kottayam district, the decline was from 27.31 per cent to 17.87 per cent; in Idukki, it was from 9.91 per cent to 8.29 per cent and in Ernakulam, it was from 34.73 per cent to 32.36 per cent. In these districts, rubber was the main rival crop of paddy.

In the case of rubber, the percentage share of area in net sown area increased in all districts during 1980-81 to 2011-12. In Trivandrum, the increase was from 6.08 per cent to 23.88 per cent; in Kottayam, it was from 34.71 per cent to 72.09 per cent; in Ernakulam, from 13.10 per cent to 41.38 per cent; in Idukki, from 10.84 per cent to 19.35 per cent; in Malappuram, from 9.58 per cent to 22.62 per cent and in Kannur, it was from 6.55 per cent to 23.53 per cent

In all districts, area effect and interaction effect on paddy production during the period 1980-81 to 2011-12 is negative. The negative area effect is very remarkable in almost all districts. However, the yield effect on paddy production in all districts is positive. The highest negative area effect is seen in Kottayam district and then in Alappuzha with. The lowest negative area effect is found in Kozhikode district and Kollam district.

The interaction of area and yield on production of paddy, i.e. interaction effect is the highest in Kottayam district. It is followed by Alappuzha and Thrissur. The lowest negative interaction effect is found in Kozhikode district, i.e. -23.29 and it is followed by Kollam district with -39.15. Both the negative area effect and the negative interaction effect are responsible for the decline in production of paddy in all districts of Kerala.

Even though, Kottayam district has the highest negative area effect and interaction effect, it has the highest positive yield effect on production. As a result of it, the production of paddy in Kottayam district has increased from 58478 million tonnes in 1980-81 to 63579 million tonnes in 2011-12. It is followed by Alappuzha and Thrissur. The lowest yield effect is found in Kozhikode district and then Kollam district.

Major causes for the decline in paddy cultivation identified in Kerala are high land price in Kerala which leads to conversion of paddy lands for real estate purpose, high demand for land for infrastructure, residential and other non-agricultural purposes, non-profitability of

paddy cultivation and the resultant shifting of cultivation from food crops to cash crops, increasing pressure on land etc. Since there is shortage of land in Kerala, the land required for non-agricultural activities is taken from cultivable areas.

In Kerala there is no proper regulation of construction activities which results in over exploitation of natural capital, indiscriminate sand mining, high degree of paddy land conversion etc. This high expansion of construction and mining & quarrying has led to a drastic change in the land utilization pattern and which has further created a negative impact on the agriculture sector. Government should strictly regulate all construction activities and make it mandatory for all developers including Government agencies to attach Environmental Impact Assessment (E.I.A.) statements for all applications for obtaining approval for major development projects. The impact of land use change should be studied and reviewed regularly and declare not only in Kuttanad area, but the entire paddy lands in Kerala as heritage farming centres. Government should take measures for the maintenance of the existing paddy lands and take stern action against the conversion of paddy lands.

Changes in land utilization pattern have created serious ecological and environmental problems and complex feedback effects on agricultural production in Kerala. Considering the issues like food insecurity, ecological fragility of land and high density of population, Kerala should re-orient its development priorities. In this context, effective execution of a fool proof land use development policy can be a solution for the present lopsided form of development and food insecurity of the state. The absence of an effective land utilization policy has led to the situation of food insecurity and accelerated disappearance of agriculture and allied activities in Kerala. Considering the dangerous situation of food insecurity and high level of environmental degradation, it is imperative to have a paradigm shift in the management of state's land resource. With the involvement of local bodies and social organisations, government should implement innovative programmes for the revival of the paddy farm sector of Kerala.

****

References

1. Thomas, P.M (2004): "Agricultural Performance in Kerala" in 'Kerala's Economic Development- Performance and problems in the Post-liberalization Period' edited by B.A. Prakash, SAGE publications, New Delhi.
2. Mukherjee and Vaidyanathan (1980): "Growth and Fluctuations in Food grain yields per hectare", *Indian Journal of Agricultural Economics*, Vol. 35, No. 2, April – June, pp. 60 – 70.
3. Dholakia H.R and Dholakia H.B (1993): "Growth of Total Factor Productivity in Indian Agriculture", *Indian Economic Review*, Vol. 28, No.1, pp. 25 – 40.
4. Praduman Kumar & Mark W. Roségrant (1994): "Productivity growth for Rice in India" Economic and Political Weekly, Dec, 31. pp. A183 – A188.
5. Oommen. M. A. (1962): "Agricultural Productivity Trends in Kerala", *Agricultural Situations in India*, Vol. 17, and No. 4, July 1968, pp. 333 – 336.
6. Jeemol Unni (1981): "An Analysis of Change in Cropping pattern in Kerala with Special Reference to the Substitution of Coconut for Rice: 1960-61 to 1978-79". M. Phil Dissertation submitted to Jawaharlal Nehru University, New Delhi.
7. George P.S. and Mukherjee, Chandan (1986), "A Disaggregate Analysis of the Growth Performance of Rice in Kerala", Indian *Journal of Agricultural Economics*, Vol.41, No.1 Jan – March. Pp. 1 – 16.
8. Kannan. K.P and Pushpangadhan. K (1988): "Agricultural Stagnation in Kerala: An Exploratory Analysis", *Economic and Political Weekly*, Vol. 23, No. 39, September 24, pp. A-120 – A-128.
9. Kannan. K.P and Pushpangadhan. K (1999): "Agricultural Development in a Regional Perspective: A Study of Kerala", Centre for Development Studies, Thiruvananthapuram.
10. Thomas, P.M (1996): "Decline of Paddy Cultivation in Kerala: A Study of Economic Causes" Unpublished Ph. D thesis submitted to the Calicut University.
11. Job, Elsamma and George, M.V (2002): "Technical Efficiency in Rice Production – A Frontier Production Function Approach", Agricultural *Economic Research Review*, Vol. 15, No.1, pp. 50 –55.
12. Job, Elsamma and V. Nandamohan (2004): "Rice production in Kerala – Trend and Instability Analysis", *Agricultural Situation in India*, No.3, June, pp. 135 – 139.

13. Centre for Development Studies (1975), 'Poverty, Unemployment and Development: A Case Study of Selected Issues with reference to Kerala', United Nations, New York.
14. Chatterjee, B. (2002): 'Environmental Laws Implementation Problems and Perspectives', Deep and Deep Publication Pvt. Ltd., New Delhi.
15. Datta P S, (2005), "Groundwater Ethics for its Sustainability", *CURRENT SCIENCE*, Vol. 89, NO. 5
16. George, P.S. and Chattopadhyay, S. (2001), "Population and Land Use in Kerala" in 'Growing Populations, Changing Landscapes: Studies from India, China and the United States', National Academy of Sciences, Washington DC, pp 79-106.
17. Iyengar, S. (2003): "Environmental Damage to land Resources Need to Improve Land Use Data Base", *Economic and Political Weekly*, Vol. 38, No. 34, pp. 3596-3604.
18. Jayanarayanan, T. (2001), "Forest degradation in Kerala-causes and consequences: a case study of Peechi-Vazhani area", Discussion paper No. 27. Kerala Research Projecton Local Level Development. Centre for Development Studies, Thiruvananthapuram.
19. Kumar, B.M.(2005), "Land use in Kerala: changing scenarios and shifting paradigms", *Journal of Tropical Agriculture*, vol. 42, No. 1and 2.
20. Mahesh, R. (1999), 'Causes and Consequences of Change in Cropping Pattern: A Location-specific Study', Discussion Paper No. 11, December 1999, Kerala Research Programme on Local Level Development, Centre for Development Studies, Thiruvananthapuram
21. Pouchepadass, J. (1995), "British attitudes towards shifting cultivation in colonial south India: Case study of South Canara district 1800-1920", in 'Nature, Culture andImperialism: Essays on the Environmental History of South Asia', D. Arnold and R. Guha (eds.), Oxford University Press. New Delhi. pp 152-184.
22. Santhakumar, V. (1996), "On-farm biodiversity in Kerala" in 'Using Diversity', L. Sperling and M. Loevinshon (eds), IDRC, New Delhi, pp. 22–34.
23. Shaji E, Bindu J Viju and Thambi D S, (2007), "High fluoride in groundwater of Palghat district", *Kerala Current Science*, Vol. 92, 2, pp 240–245.

24. Economic Review (various issues), Kerala State Planning Board, Thiruvananthapuram.
25. Agricultural statistics (various years), Department of Economics and Statistics, Govt. of Kerala.

****