

# SOURCES OF PRODUCTIVITY AND PERFORMANCE OF PADDY CROP

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## Chapter 4

# SOURCES OF PRODUCTIVITY AND PERFORMANCE OF PADDY CROP

Estimated annual growth rate in per hectare productivity of paddy crop in Kerala during the second period of the present analysis (1975-76 to 1991-92) is found to be higher than that of the first period (1960-61 to 1974-75). But this relatively better yield rate during the second period is misleading if the rate of decline in area under paddy during this period is not considered. It can be reasonably believed that during the second period, paddy fields with comparatively lower productivity have been going out of cultivation which had infact inflated the average per hectare productivity of remaining paddy fields. As K.P. Kannan and K. Pushpangadan observe, the increase in yield of paddy in the state since mid seventies is not due to any technological change but it is "purely due to the marginal land going out of cultivation."<sup>1</sup>

This chapter is an attempt to verify the hypothesis that the different sources of productivity in paddy crop have not significantly helped to improve its productivity in Kerala and the observed positive growth rates in productivity is mainly due to the decline in area under the crop. Area under HYV paddy, extent of fertilizer use, rainfall index, area under irrigation and adoption of plant protection measures are taken as the sources of paddy productivity.

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1. Kannan K.P., Pushpangadan K. (1990), *op. cit.*, p.43.

**Table 4.1**  
**Spread of HYV Paddy in Kerala (1969-70 to 1991-92)**  
 (Area in '000 hectares)

Year	Area Under HYV	Percentage of HYV Coverage	Year	Area Under HYV	Percentage of HYV Coverage
1969-70	136.0	15.56	1981-82	250.7	31.07
1970-71	159.1	18.17	1982-83	196.4	24.61
1971-72	167.9	19.18	1983-84	212.4	28.70
1972-73	210.4	24.08	1984-85	220.5	30.19
1973-74	248.3	28.39	1985-86	163.3	24.08
1974-75	167.7	19.03	1986-87	165.9	25.02
1975-76	230.1	26.27	1987-88	119.7	19.82
1976-77	264.0	30.90	1988-89	137.0	23.74
1977-78	293.3	34.90	1989-90	155.6	26.67
1978-79	279.2	34.93	1990-91	162.8	29.10
1979-80	282.2	35.57	1991-92	166.3	30.72
1980-81	279.7	34.89			

Source : DES, *Farm Guide* (Various issues)

SPB (1994), *Economic Review 1993*.

## 4.1. Spread And Performance of HYV Paddy in Kerala

### 4.1.1. Growth In Area Under HYV Coverage

Introduction of HYV paddy in India as an integral part of the New Agricultural strategy of mid sixties had not made much impact in the rice economy of Kerala till the early years of seventies. The proportion of HYV paddy to the total area under the crop in the state was only 15.56 percent in 1969-70 which gradually increased to 35.57 percent by the year 1979-80 and thereafter began to decline (Table 4.1).

Area under HYV paddy in the state reached its peak level in 1977-78 when 2.93 lakh hectares were brought under its coverage. During the period 1969-70 to 1977-78 area under HYV paddy increased at the annual rate of 8.33 percent. For a period of nine years from 1978-79 annual growth rate had shown declining trends. Annual average growth in HYV paddy area during this period is found to be (-)8.04 percent. However, from the year 1988-89 onwards area under HYV paddy has shown a moderate rate of recovery and by the year 1991-92 its proportion to the total paddy growing areas in the state had become 30.72 percent.

Compared to all India level the proportion of area under HYV paddy and its annual growth rates are found to be lesser in Kerala. In the year 1976-77, the proportion of HYV paddy in Kerala had been 30.90 percent while at the all India level it was 34.60 percent. Thereafter the difference widened more sharply and during the year 1989-90 while 62.10 percent of the total area under paddy at the all India level was covered by HYV seeds, in Kerala the corresponding proportion remained as low as 26.67 percent.<sup>2</sup>

Season wise distribution of area under HYV paddy in Kerala shows that in

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2. All India figures are quoted from,

Tyag : B.P. (1994), *Agricultural Economics and Rural Development*, Jai Prakash Nath and Co., Meerut, p. 566.

Table 4.2

## Season wise Distribution of HYV Paddy in Kerala

(Area in '000 hectares)

Year	Seasons		
	Autumn	Winter	Summer
1969-70	39.8 (10.12)	49.7 (13.01)	46.5 (47.06)
1970-71	58.0 (14.66)	48.1 (12.58)	53.0 (54.58)
1971-72	68.6 (17.35)	31.9 (8.36)	67.4 (68.78)
1972-73	94.3 (24.03)	55.0 (14.40)	60.1 (60.34)
1973-74	125.3 (32.62)	57.1 (15.32)	65.9 (55.80)
1974-75	77.5 (19.64)	51.0 (13.25)	39.2 (38.70)
1975-76	98.5 (26.27)	62.2 (15.71)	69.4 (66.03)
1976-77	115.8 (31.83)	73.4 (19.23)	74.8 (68.94)
1977-78	142.1 (38.97)	89.6 (24.19)	61.6 (58.67)
1978-79	144.9 (41.78)	77.9 (22.51)	56.4 (53.06)
1979-80	142.5 (40.94)	84.6 (24.93)	55.1 (52.23)
1980-81	136.2 (39.00)	92.4 (26.09)	51.1 (51.98)
1981-82	138.9 (39.95)	73.6 (20.67)	47.2 (45.52)
1982-83	113.1 (33.00)	51.9 (14.73)	31.4 (37.60)
1983-84	101.8 (31.04)	62.1 (19.17)	48.5 (55.11)
1984-85	112.4 (35.35)	63.7 (19.48)	44.5 (52.35)
1985-86	83.8 (29.93)	40.7 (13.00)	38.8 (45.65)
1986-87	80.1 (27.91)	44.6 (15.02)	41.3 (51.63)
1987-88	54.8 (22.83)	33.8 (11.50)	31.3 (44.71)
1988-89	62.4 (26.78)	38.0 (13.87)	36.7 (52.43)
1989-90	79.0 (32.38)	36.9 (13.77)	39.7 (55.92)
1990-91	80.0 (33.90)	40.0 (15.47)	42.8 (66.05)
1991-92	73.3 (33.50)	49.7 (19.57)	43.3 (63.12)

Note : Percentages to total area under paddy in each season are given in parantheses

Source : DES, *Statistics for Planning* (Various issues)

SPB (1994), *Economic Review 1993*, Table 4.1, p.191.

the beginning of 1970's total area under HYV seeds had been distributed more or less equally among the three seasons- Autumn, Winter, Summer. However, by the end of 1980's nearly 50 percent of the HYV area had come under the Autumn crop and the rest was more or less equally shared between Winter and Summer seasons. As the Summer crop constitutes only a small proportion (nearly 12 percent) of the total area under paddy in the state, it is seen that the coverage of HYV seeds in Summer crop is comparatively higher (Table 4.2).

The relatively better coverage of HYV paddy in Summer season is attributed to a number of factors present during the summer months such as the relatively low level of humidity and high temperature, proper control over water management, low susceptibility to plant diseases etc., which are all essential for the successful adoption of HYV seeds. These factors lessen the risk element involved in the cultivation of paddy during the summer season and paddy farmers are therefore prepared to experiment with new inputs and techniques in that season.<sup>3</sup>

#### 4.1.2. Causes for the lower rate of HYV coverage

The major factor that induces paddy farmers to adopt HYV seeds is its relatively higher rates of yield. During the period 1969-70 to 1979-80, the average annual per hectare yield of HYV rice in Kerala had been 1835 kilograms and for the traditional varieties it was only 1397 kilograms. Thus on an average, yield of HYVs are found to be 31.35 percent higher than that of local varieties (Table 4.3). However, the cost of cultivation of HYV rice is estimated to be nearly 30 percent higher than that of local varieties.<sup>4</sup> Again it is observed that since HYVs are generally dwarf, per hectare yield of straw is relatively low in its cultivation. Thus in terms of profitability comparative advantage of HYVs is only marginal.

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3. Raj K.N., et. al. (1972), *op. cit.*, p. Appendix 1-5.

4. Government of Kerala (1976), *High Yielding Varieties Programme in Kerala - (Virippu paddy 1973-74) - An Evaluation Study*, *op. cit.*, p.12.

Table 4.3

## Yield of HYV and Traditional Varieties of Rice in Kerala

(1969-70 to 1979-80)

(Yield in Kgs./ha.)

Year	HYV	TV	Percentage difference
1969-70	1783	1333	33.76
1970-71	1854	1401	32.33
1971-72	2150	1401	53.46
1972-73	1836	1493	22.97
1973-74	1627	1362	19.46
1974-75	1758	1456	20.74
1975-76	1820	1392	30.75
1976-77	1752	1341	30.65
1977-78	1968	1311	50.11
1978-79	1982	1383	43.31
1979-80	2167	1320	64.17
Average annual yield	1835	1397	31.35
C.V	7.16	3.32	---

Source : Suseelan P. (1988), *Problems and Prospects of Rice in Kerala*, Table 4.7, p. 23.

Farm level decisions regarding the adoption of new varieties of seeds depend not only on its yield rates but to a greater extent on the variability in yields also. It is observed that the per hectare productivity of HYV rice is more variable than that of the traditional varieties which makes its adoption more risky. For the period 1969-70 to 1979-80 variability, measured in terms of coefficient of variation (C.V.) of HYV paddy is found to be 7.16 percent while for the traditional varieties it was only 3.32 percent.

Small size of operational land holdings also act as a constraint in the spread of HYV paddy in Kerala. Evaluation studies conducted by the State Planning Board had shown that the rate of HYV adoption in the state is positively related to the size of holdings.<sup>5</sup> In Kerala more than 90 percent of the number of holdings are marginal holdings of less than one hectare while at the all India level only 60 percent of the land holdings are marginal holdings.<sup>6</sup> Since the infrastructural facilities needed for the adoption of HYVs are not generally accessible to marginal farmers and they are usually averse to bear the risk involved in the change of farm technology, majority of them are reluctant to apply HYV seeds in their farms.

Another possible explanation for the low proportion of area under HYV coverage in the state is the relatively higher incidence of pests and plant diseases prone to HYV paddy. Again many of the new generations of HYV plants are dwarf and it makes weeding operations very difficult. Finally, as HYV rice widely regarded to be of low quality and poor taste, its market demand is also found to be poor compared to that of the traditional varieties.

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5. *Ibid.*

6. Government of India (1994), *Basic Statistics - India*, Centre for Monitoring Indian Economy, August, Table .6.



#### 4.1.3. HYV coverage and paddy productivity

It is observed that in Kerala annual growth rate in the per hectare productivity of rice is not necessarily related to the growth rates in area under HYV paddy. During the period 1969-70 to 1977-78 area under HYV paddy in the state had increased at the average annual rate of 8.33 percent. Meanwhile annual rate of increase in rice productivity is found to be 0.46 percent. But inspite of a decline in HYV paddy area, per hectare productivity had shown a comparatively higher positive growth rate during the period 1977-78 to 1985-86. While the annual growth rate in area under HYV paddy during this period is found to be negative at (-)6.62 percent, productivity of rice per hectare had shown an annual positive growth rate of 1.20 percent.

Proportion of paddy area under HYVs shows wide inter district variations within the state. During the year 1991-92, in terms of the proportion of paddy area under HYV coverage, Kottayam district (86.55 percent) stood first followed by its neighbouring districts Alappuzha (66.26 percent) and Pathanamthitta (56.12 percent). But during that year per hectare productivity of rice had been highest in Palakkad district (2344 kilograms) which was closely followed by Kottayam (2312 kilograms) and Pathanamthitta (2310 kilograms) districts. The lowest proportion of HYV coverage is observed in Palakkad district which had shown the highest per hectare productivity in that year (Table 4.4).

Extent of relationship between the proportion of HYV coverage and per hectare productivity of rice can be examined by estimating Spearman's rank correlation coefficient (P) of the two variables and testing its significance. For this purpose ranks have been assigned to all the 14 districts in the state according to their performance both in terms of per hectare productivity and HYV coverage of paddy. The estimated value of rank correlation coefficient is found to be 0.1 which is not

**Table 4.4**  
**District wise Percentage of Area Under HYVs and Productivity of Rice in Kerala (1991-92)**

District	Percentage of HYVs area	Productivity (in Kg./ha.)	Ranks in	
			Area	Productivity
Thiruvananthapuram	38.11	1771	6	8
Kollam	45.08	1668	4	11
Pathanamthitta	56.12	2310	3	3
Alappuzha	66.26	2077	2	6
Kottayam	86.55	2312	1	2
Idukki	17.11	2253	13	4
Ernakulam	32.68	1684	7	10
Thrissur	24.53	1762	10	9
Palakkad	07.19	2344	14	1
Malappuram	23.21	1595	11	12
Kozhikode	21.06	1194	12	14
Wayanad	32.43	2185	8	5
Kannur	39.35	1536	5	13
Kasaragod	24.57	1778	9	7

Note : Percentages are estimated values.

Source : SPB (1993), *Economic Review 1992*.

significant at both 1 percent and 5 percent level of significance.<sup>7</sup> Thus the present analysis does not suggest any positive relation between productivity and proportion of area under HYV seeds in paddy crop.

## 4.2. Fertilizer Consumption and Paddy Productivity

The New Agricultural Strategy which was adopted in India during the second half of the sixties had also proposed the optimum application of fertilizers along with the use of HYV seeds in order to improve agricultural productivity in the country. As a result of it within a period of 25 years from 1965-66 to 1990-91, per hectare application of chemical fertilizers (N+P+K) in the state increased from the meagre level of 15.40 kilograms to a reasonably high level of 80.92 kilograms. Since cropwise data regarding the per hectare consumption of fertilizers in the state are not available, it is difficult to assess the extent and nature of relationship between fertilizer use and productivity of a crop like paddy. However, the effectiveness of fertilizer application in enhancing paddy productivity can be indirectly examined by comparing the yield rates in different seasons with different levels of fertilizer use. Again per hectare costs on manure can be taken as the indices of fertilizer consumption in each of the seasons in a year.

During the period of 1980-81 to 1989-90 annual average cost of manure for the Summer crop had been 6.16 percent higher than that of Winter paddy and 17.27 percent higher than that of Autumn paddy. Meanwhile per hectare productivity of Summer paddy on an average had been more than 15 percent higher than those of

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7. Test Statistic used for rank correlation coefficient, P is

$$t = \frac{P\sqrt{n-2}}{1-P^2}$$

Estimated value of P = 0.1

Table value of t at 5 percent significance level (d.f. = 12) = 2.18,  
at 1 percent significance level (d.f. = 12) = 3.06.

Since observed value of 't' is less than table values, P is not significant.

**Table 4.5**  
**Season wise Distribution of Manure Cost and Rice Productivity in Kerala (1980-81 to 1989-90)**

Year	Cost of Manure (in Rs./ha.)			Productivity of Rice(in tonnes/ha.)		
	Autumn	Winter	Summer	Autumn	Winter	Summer
1980-81	560	623	514	1.60	1.66	1.73
1981-82	627	735	854	1.62	1.67	1.87
1982-83	632	702	910	1.69	1.60	1.93
1983-84	714	856	947	1.60	1.60	1.93
1984-85	793	966	913	1.73	1.67	2.00
1985-86	893	976	976	1.67	1.73	1.53
1986-87	1007	957	970	1.64	1.67	2.12
1987-88	949	951	1071	1.75	1.60	2.04
1988-89	1000	1106	1224	1.69	1.75	2.19
1989-90	1048	1207	1262	1.99	1.91	2.26
Annual average	822	908	964	1.70	1.69	1.96

Source : DES, *Report on the Cost of Cultivation of Important Crops in Kerala* (Various issues)

Autumn and Winter crops. Thus, among the three seasons per hectare cost on manure had been comparatively higher during the Summer season and its productivity is also found to be relatively higher. However, between Autumn and Winter crops per hectare productivity on an average is found to be slightly higher during the Autumn season eventhough the average annual cost of manure for the Winter crop had been 10.46 percent higher than that of Autumn crop (Table 4.5). It shows that a higher rate of fertilizer use need not lead to higher productivity in paddy crop.

Since July 1991, administered prices of Nitrogenous fertilizers were increased by 30 percent in accordance with the New Fertilizer Policy of the Union government. Increase in the prices of Phosphatic and Pottassic fertilizers were in the tune of 250 percent from August, 1992. As a result of the steep hike in prices, average per hectare use of fertilizers in the state had fallen down from 80.92 kilograms in 1990-91 to 67.18 kilograms by the year 1992-93 showing an overall decrease of 16.98 percent.<sup>8</sup> Inspite of this sharp decline, per hectare rice productivity in the state had increased from 1942 kilograms to 2018 kilograms during this period showing an overall increase of 3.91 percent. This erratic behaviour of paddy productivity suggests that increased fertilizer application is not a necessary condition for an improvement in paddy productivity in the state.

### **4.3. Impact of Rainfall and Irrigation on Paddy Productivity**

#### **4.3.1. Annual rainfall and paddy productivity**

Indian agriculture is often described as a 'gamble on monsoon' indicating the strong relationship between the quantum of annual rainfall and agricultural productivity. However, in Kerala at least in the case of paddy variations in annual rainfall had not significantly affected its productivity over the past years. This fact

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8. Government of Kerala (1994), *Economic Review 1993*, p. 31.

**Table 4.6**  
**Annual Rainfall and Index of Paddy Productivity in Kerala**

(Base year = Average of 3 years ending 1972-73)

Year	Rainfall (in mm)	Percentage to normal rainfall	Index of paddy productivity
1972	2746	90.05	102.72
1973	2389	78.38	93.72
1974	2769	90.85	98.67
1975	3528	115.75	99.13
1976	2044	67.06	95.74
1977	3087	101.28	100.50
1978	2323	76.21	103.83
1979	1935	63.48	106.83
1980	2861	93.86	103.50
1981	2977	97.67	108.26
1982	1465	48.06	106.89
1983	2319	76.08	106.43
1984	2620	85.96	112.97
1985	2482	81.43	112.76
1986	1772	58.14	112.11
1987	2040	66.93	112.96
1988	2653	87.04	114.39
1989	2642	86.68	127.57
1990	2780	91.21	126.65
1991	3106	101.90	127.76

Note : Normal Rainfall in Kerala = 3048 mm. Index of Productivity in 1972-73 is approximated as the index for 1972 and so on.

Source : SPB (1993), *Economic Review 1992*.

DES, *Statistics for Planning* (Various issues)

can be verified from table 4.6 which shows the annual amounts of rainfall in Kerala and the index number of paddy productivity for the period 1971 to 1991. Rainfall data correspond to the calendar years while productivity data are of financial years.

It is observed that both the amount of rainfall and productivity of paddy in the state have shown considerable variations over the past years. However, instability in annual rainfall had been comparatively higher as its coefficient of variation is found to be 19.66 percent while for paddy productivity it is estimated as 8.92 percent only.

In order to examine the extent of relationship between annual rainfall and index of paddy productivity in the state, Pearson's coefficient of correlation has been used. Correlation coefficient estimated for the two variables for the period 1971 to 1991 is found to be 0.08 which is statistically insignificant at 5 percent and 1 percent levels of significance.<sup>9</sup> Thus the present analysis shows that the per hectare productivity of paddy in Kerala is not significantly related to the variations in annual rainfall.

#### 4.3.2. Irrigation and productivity of paddy

With a view to enhance agricultural production government had given great importance to the development of irrigation in Kerala. Till the end of 1991-92, the state government had spent Rs.1049.02 crores in the irrigation sector and the net area benefited was 3.39 lakh hectares.<sup>10</sup> Up to the year 1972-73 ten major and medium irrigation projects were completed in the state with a total cost of Rs. 23.55 crores. The expected net area irrigated from these projects was 121.37 thousand hectares

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9. In order to test the significance of correlation coefficient,  $r$ , 't' test was used. Estimated value of 't' is found to be 0.341, while the critical value of  $t$  at 5 percent level of significance is 2.1 and at 1 percent level of significance it is 2.88. Since the calculated value of  $t$  is less than critical value correlation is insignificant. Test statistic  $t$  is given as,

$$t = \frac{\sqrt{n-2}}{\sqrt{1-r^2}} \cdot r$$

10. Government of Kerala (1993), *Economic Review 1992*, p. 42.

Table 4.7

Irrigated Area Under Paddy in Kerala (1979-80 to 1990-91)

(Area in '000 hectares)

Year	Irrigated Paddy Area	Percentage to Total Paddy Area
1979-80	286.80	36.15
1980-81	276.86	34.53
1981-82	275.45	34.14
1982-83	279.44	37.76
1983-84	286.93	38.77
1984-85	312.86	40.17
1985-86	282.53	42.60
1986-87	298.44	45.00
1987-88	376.45	60.71
1988-89	342.47	59.35
1989-90	326.96	56.04
1990-91	341.10	60.95
Growth rate	2.25	4.58

Source : DES, *Farm Guide 1988*.SPB, *Economic Review* (Various issues)



but the achievement till the end of 1991-92 was only 76.69 thousand hectares.<sup>11</sup> During the period 1972-73 to 1992-93 no major or medium irrigation projects were commissioned in the state.

In Kerala irrigation is mainly confined to paddy and seven out of the ten major and medium projects completed in the state till 1991-92, viz., Chalakkudy, Peechi, Pothundy, Malampuzha, Walayar, Vazhani and Mangalam are located in the two major rice producing districts of Palakkad and Thrissur.

Eventhough any major or medium projects were not commissioned, the proportion of irrigated area under paddy has substantially increased in Kerala since the beginning of the eighties. In absolute terms during the period 1979-80 to 1990-91 irrigated area under paddy increased at the annual rate of 2.25 percent. In relative terms, the percentage of irrigated area under paddy during this period increased at the annual rate of 4.58 percent (Table 4.7). The difference in growth rates is due to the decline in area under paddy in the state during these years.

The very fact that both the area under irrigation and productivity of paddy had increased in the state over the past years is not an indication of the positive relationship between the two variables. In order to examine the nature of relationship, yield rates in irrigated areas must be compared with yield rates in non-irrigated areas keeping the other sources of productivity intact. Lack of data makes such an attempt impossible. However, the direction of the resultant changes in paddy productivity due to irrigation can be detected by comparing the performances of different districts having various levels of irrigation facilities. Table 4.8 shows the district wise distribution of irrigated area under paddy and its per hectare productivity during the

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11. As per available data net area irrigated in the state declined from 4.65 lakhs hectares to 2.21 lakh hectares (a sharp decline of more than 50 percent) between the years 1974-75 to 1976-77 which makes the authenticity of data dubious.

Refer, Kannan K.P., Pushpangadan K. (1988), *op. cit.*, p. 56.

**Table 4.8**  
**District wise Proportion of Paddy Area and**  
**Productivity of Paddy (1986-87)**

District	Irrigated Paddy area (%)	Productivity (in Kg./ha.)	Ranks in	
			Irrigated Area	Productivity
Thiruvananthapuram	34.53	1714	8	7
Kollam	12.09	1669	14	8
Pathanamthitta	31.65	1863	10	5
Alappuzha	15.37	1736	13	6
Kottayam	31.72	2021	9	2
Idukki	44.78	2112	4	1
Ernakulam	76.89	1622	1	9
Thrissur	62.37	1601	2	10
Palakkad	55.84	1879	3	4
Malappuram	35.79	1536	7	12
Kozhikode	18.51	1103	12	14
Wayanad	42.38	1924	5	3
Kannur	25.49	1483	11	13
Kasaragod	37.70	1544	6	11

Source : DES, *Agricultural Statistics of Kerala 1986-87*.

SPB (1993), *Economic Review 1992*.

year 1986-87. Ranks are given to all the districts based on the proportion of irrigated paddy area and per hectare productivity of paddy.

According to the proportion of irrigated paddy area Ernakulam and Thrissur districts stand in the first and second positions while in terms of yield rates Idukki and Kottayam hold the first and second ranks respectively (Table 4.8). Rank correlation coefficient estimated from the data is found to be 0.21 which is not statistically significant at both 5 percent and 1 percent level of significance.<sup>12</sup> Thus the present analysis does not suggest any positive relationship between the proportion of irrigated paddy area and its per hectare productivity.

#### **4.4. Other Sources of Productivity**

Other sources of paddy productivity imply plant protection measures such as the use of fungicides, insecticides, weedicides and rodenticides. Due to lack of crop wise data with regard to the extent of its application, it is assumed that the proportion of pesticides and insecticides used among the various crops in Kerala had remained the same over the past years.

Total amount of pesticides and insecticides used in the state had declined from 1092.07 tonnes in 1980-81 to 705.55 tonnes by the year 1992-93 and the annual rate of decline during the period is estimated as (-)3.57 percent (Table 4.9). Meanwhile per hectare productivity of paddy in the state had shown a positive compound growth rate of 2.02 percent per annum. Period wise analysis shows that during the first period (1980-81 to 1986-87) while the use of pesticides and insecticides declined at a mild rate of (-)0.82 percent per year, paddy productivity in the state had increased at the annual rate of 1.34 percent. However, during the second period (1987-88 to 1992-93) when the amount of pesticides and insecticides declined at higher rate of (-)8.15 percent, paddy productivity had shown a better growth rate of 3.10 percent,

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12. Observed value of  $t$  is found to be 0.76 which is less than the table values of  $t$  at 5 percent level of significance (2.18) and 1 percent level of significance (3.06).

**Table 4.9**  
**Consumption of Fungicides, Pesticides, Weedicides**  
**and Rodenticides in Kerala**

(Quantity in tonnes)

Year	Fungicides	Insecticides	Weedicides	Rodenticides	Total
1980-81	304.17	615.76	153.62	18.52	1092.07
1986-87	536.45	472.15	24.35	6.50	1039.45
1987-88	488.81	556.54	25.73	7.92	1079.00
1992-93	349.01	302.17	36.72	17.65	705.55

**Compound Growth Rates**

1980-81 to 1986-87	9.92	(-)4.33	(-)26.43	(-)16.01	(-)0.82
1987-88 to 1992-93	(-)6.52	(-)11.50	7.37	17.38	(-)8.15
1980-81 to 1992-93	1.15	(-)5.76	(-)11.24	(-)0.40	(-)3.57

Source : SPB, *Economic Review 1992*, Table 4.21.

SPB, *Economic Review 1993*, Table 4.22.

indicating that the per hectare yield of paddy in the state has not been adversely affected by the decline of various plant protection materials used in its cultivation.

An analysis of the per hectare costs of pesticides and insecticides and paddy productivity during the Autumn and Winter seasons for the period 1980-81 to 1989-90 also suggests that productivity in paddy crop is not influenced by the amount of plant protection costs. The average annual per hectare costs on pesticides and insecticides during the period for Autumn and Winter crops are found to be Rs. 52.60 and Rs. 88.70 respectively.<sup>13</sup> Thus on an average, plant protection costs of Winter crop had been 68.63 percent higher than that of Autumn crop. In spite of it, the average per hectare yield of Autumn paddy during the period (1698 kilograms) is found to be marginally higher than that of Winter crop (1686 kilograms).

To sum up, it is observed that at the state level none of the different sources of productivity that we have examined such as the adoption rate of HYV seeds, level of fertilizer consumption, extent of irrigation facilities and plant protection measures had any significant positive role in improving paddy productivity even though in individual farms at the micro level the situation can be different. It is in confirmation with our earlier observation that the positive linear growth rate observed in the productivity of paddy crop in the state over the past years was not due to any significant positive contribution of the different sources of productivity, but rather it was the result of marginal paddy lands with relatively lesser productivity going out of cultivation in the state.

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13. Costs are estimated from,

Government of Kerala, *Report on the Cost of Cultivation of Important Crops in Kerala* (1980-81 to 1989-90), Department of Economics and Statistics, Thiruvananthapuram.