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TREND OF AREA AND YIELD RATE OF RICE IN ORISSA

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Introduction

Out of 14.5 million acres of net area sown, 10.5 million acres are under rice alone in Orissa. Of this, 9.99 million acres are under winter rice (late rice), 0.5 million acres are under autumn rice (early rice) and the rest 0.1 million acres are under summer rice. Therefore, the relative importance of winter rice as a single harvest may well be understood. This is for all practical purposes an un-irrigated crop and depends on the vagaries of monsoon for its successful production. The economy of this region is therefore highly unstable and is subject to very frequent famines. It may be indicated here that autumn rice is subject to greater degree of risk and uncertainty due to drought compared to winter rice as the land on which the former is grown is situated at a higher elevation subjecting itself to easy drainage. Since summer rice is grown under irrigated conditions only, the risk involved is non-existent.

Data

The estimates of area and yield were based on traditional methods in the State prior to 1959-60 by revenue officers. Since for all practical purposes the village revenue agency does not exist in the State, the work of forecast was entrusted to *kanungoes*, who with their larger jurisdiction cannot claim to have an intimate knowledge of all the villages under them. Under the traditional system the yield rate of winter rice was estimated at about 10 maunds per acre. But the first result of the crop cutting experiment conducted by the Bureau of Statistics and Economics revealed the corresponding figure at 15.55 maunds per acre. While this was received with a pleasant surprise it brought out the degree of error with which the traditional estimates were made. Therefore, it was considered safe to eliminate the traditional estimates and base the present study on the more reliable estimates made by the Bureau. In this case also we have data only from 1959-60. There was therefore no other choice than to accept 1959-60 as the base year for comparison of area and yield rates of rice. It may also be remembered that the base year and the following year are covered under the Second Plan and the last four years included in the study are covered under the Third Plan period.

Trend of Area

Autumn rice though of little importance so far as the area is concerned, it supplies rice to the cultivators and straw to the cattle at a time when both are scarce. It is grown on well drained high lands. This land is particularly suitable for a variety of crops. As the purchasing capacity of the people are increasing the taste also is likely to change. The fall in the area of autumn rice as shown in Table I is most probably the outcome of greater acreage being allotted to other competing crops including vegetables.

TABLE I—TREND OF AREA OF AUTUMN AND WINTER RICE IN ORISSA FROM 1959 TO 1964

Year	Area of autumn rice (in thousand acres)	Relatives	Area of winter rice (in thousand acres)	Relatives
1959-60	1,310	100	9,235	100
1960-61	945	72.13	8,357	90.49
1961-62	1,182	90.2	8,807	95.36
1962-63	773	59.0	10,040	108.71
1963-64	503	38.3	9,989	108.17
1964-65	457	34.9	10,026	108.56

The sampling errors of these estimates of area of autumn rice for the last two years are 5.16 per cent and 4.58 per cent respectively. Even if the error estimates are not available for the other years, it is most likely to be of the same order. Allowing for this extent of error also, there is an obvious fall in the acreage of autumn rice. It will be seen later on that the yield rate of this crop of rice compares very unfavourably with that of winter rice and leaves a very narrow margin of profit. Therefore, it is very likely that this crop is being increasingly substituted by other more remunerative competitive crops. Apart from this, there is also the possibility of converting the autumn rice upland to winter rice low land by pulling out some quantity of earth so that it will be possible to retain water in the field for a longer period of time and thus enabling a longer duration winter rice to grow there.

Unlike the autumn rice, the area under winter rice has registered a rise during the period under study. Even allowing for the sampling error of these estimates which are of the order of 1.76 per cent and 1.31 per cent respectively for the last two years, the data provide evidences of a rise in the area during the last four years. Therefore our assumption that the autumn rice lands are being converted to winter rice lands may not be wholly untrue. Though the percentage fall of the area under autumn rice is much greater between these periods relative to small percentage rise in winter rice, in absolute terms, it comes to about the same figure. Therefore, in the sum total, autumn and winter rice acreages have remained static excepting that more productive winter rice area has gone up at the cost of the autumn rice area.

As indicated earlier, the cultivation of summer rice is confined to only irrigated areas. Therefore, it is but natural to expect a strong correlation between the net irrigated acreage and the acreage under summer rice even if there is another more profitable competing crop of jute. Since jute is very labour and capital intensive, every farmer likes to have only a small acreage under jute. Apart from this, greater stress is being given by the government for increasing the area under summer rice particularly in the package areas of Sambalpur. Out of the total area occupied by this crop as shown in the Table II, roughly about 87 per cent of the area is located in the Sambalpur and the Bolangir district where Hirakud irrigation water is available.

TABLE II—AREA AND YIELD RATES OF SUMMER RICE IN ORISSA FOR 1964 AND 1965

Year	Area in thousand acres	Per cent of sampling error	Yield rates in maunds/ acres	Per cent of sampling error
1964	98.7	6.13	10.04	3.11
1965	102.4	5.87	14.92	2.46

Though the increase in the acreage under this crop between the two years does not appear to be perceptibly wide, there are evidences in sight of an appreciable increase in the near future with the intensification of government's extension programme. The reason of optimism is that its cultivation has certain advantages. It provides employment to the farmer and his fixed resources at a time when they otherwise would have remained idle. This accounts for their increased popularity. It is expected, therefore, that the entire irrigated area will in due course be brought under its cultivation.

The yield rate difference between the two years, however, is worth noting. This is assigned to the increased attention of the government in the package programme areas where its cultivation is mostly concentrated. Further, its acreages in the area being small relative to *kharif* rice (winter and autumn), the project staff can have most effective guidance and supervision.

Trend of Yield Rates of Autumn and Winter Rice (Unhusked)

Changes in yield rates of rice over a period of time may well be studied as relatives with reference to a fixed base. This makes it possible for a ready comparison of the values for different years and enables one to follow the movements of the series much more easily. Therefore, the yield rates of autumn and winter rice over the period find illustration in Table III in absolute and relative terms.

TABLE III—VARIATION IN YIELD RATES OF AUTUMN AND WINTER RICE IN THE STATE BETWEEN 1959 TO 1964

Year	Maunds per acre of autumn rice	Relatives	Maunds per acre of winter rice	Relatives
1959	9.91	100.00	15.55	100.00
1960	10.14	102.32	17.64	113.44
1961	9.38	94.65	16.47	105.92
1962	6.95	70.13	14.55	94.21
1963	8.89	89.71	17.25	110.93
1964	8.86	89.40	17.73	114.14

The table shows that the yield rates of autumn rice in terms of relatives and in absolute terms are on the decline. The standard error of these estimates for the last two years are 3.50 and 3.53 per cent respectively. The errors involved in respect of the estimates for other years is likely to be of the same order. With this percentage of error one will pause to think whether there is a real fall in the yield rates of this crop. But it is probably beyond doubt that it has not registered a rise. The rate of growth on the basis of compound interest law is estimated to be —0.0349. In other words, this measure is indicative of a negative growth at an average rate of 3.5 per cent per annum between 1959 and 1964.

The districtwise variation in yield rates and relatives together with their growth rates are given in Appendix 2 for autumn rice and in Appendix 3 for winter rice. As the growth rate is negative in respect of autumn rice, we will confine our studies only to winter rice. Compared to the base year, the yield rates of other years appear to be satisfactory. The standard error of the estimates for the last two years are 0.17 and 0.73 per cent respectively. With the assumption that the standard errors of the estimates of other years are of the same order, there is some reason to believe that there is a positive growth rate. This expectation is further strengthened by its positive growth rate of 0.0137. In other words, the yield per acre of winter rice increases at an average rate of 1.4 per cent per annum during the period under study. Appendix 3 will reveal that the rate of growth in the yield rates of this crop in most of the districts is not only positive but also is as high as 4.3 per cent per annum during the period. One wonders whether the positive growth in the yield rates of this crop is due to favourable weather conditions of which rainfall is most important.

Before making any adjustment in the yield rates for the variation in rainfall, it is felt necessary to study the net effect of rainfall on the yield rates. Since the total rainfall from June to October affects the plant growth, we propose to include this in the study. The other variable included in the study is 'time.' The net regression coefficients of these two variables are estimated for the State as a whole and the individual districts. They have been given in Appendix 1 with their standard errors and the level of significance. The net regression coefficients obtained for the State is 0.05 for the time variable and 0.01 for rainfall while the net regression coefficient of the time variable is not significant, the coefficient of rainfall is just significant at 5 per cent level of probability with only three degrees of freedom, the calculated 't' value being 3.19. Thus, there is every reason to believe that the total rainfall during the period of growth of the plant has a positive effect on the yield rates. This is otherwise also evident from the yield rate figures. It may also be observed from Appendix 1 that the effect of rainfall as indicated by the significance of the net regression coefficients has been positive in three districts. The calculated 't' value in most of the cases has been fairly high. Their non-significance can be explained by the fact that there has been only three degrees of freedom left for testing the significance of the net regression coefficients. Apart from the total rainfall received during the growth of the crop, its distribution over the different months is equally or even more important to push up the rate of yield. On the whole, therefore, some type of adjustment in the yield rates for the variation in rainfall appears necessary. Before proceeding further for the adjustment, it may be advisable to have a look at the net regression coefficients of the time variable in the various districts. Excepting for one dis-

trict (Mayurbhanj), the net regression coefficients have been non-significant. On looking to the yield rate figures in Appendix 4, there is no reason to doubt about the result obtained in the analysis. But on the whole, the conclusion of the study is that there is no significant change in the rate of yield over the period of time. So whatever rate of growth has been observed earlier may be ascribed to the chance factor coming into play.

A more rigorous adjustment in the yield rates can be made by allowing for the variation in rainfall by the statistical technique known as analysis of covariance. For this purpose, the entire period of six years have been split up into two periods. The first two years of the Second Five-Year Plan constitute the pre-plan and the last four years constitute the Third Plan period. The simple analysis of variance does not reveal any real difference in the yield rates between these two periods. With 12 and 52 degrees of freedom for numerator and denominator respectively, the differences in the yield rates between the districts are significant at 1 per cent level of probability. Even by adjustment for regression of yield rates on rainfall, the conclusion derived by the simple analysis of variance did not make any change.

APPENDIX 1

EFFECT OF RAINFALL AND TIME FACTOR ON THE YIELD RATES OF WINTER RICE

Districts	Partial regression of yield rate on time variable			Partial regression of yield rate on rainfall		
	b_1	S. E.	Calculated 't' value	b_2	S. E.	Calculated 't' value
Balasore	0.041	.631	0.06	0.003	.0034	0.79
Bolangir	—0.824	.401	2.06	0.010	.0028	3.64*
Cuttack	—0.032	.537	0.059	0.004	.0030	1.18
Dhenkanal	—0.186	.513	0.363	0.029	.055	0.529
Ganjam	—0.725	.693	1.05	0.009	.007	1.231
Kalahandi	0.677	.268	2.53	0.004	.003	1.33
Keonjhar	—0.113	.240	0.471	0.010	.003	3.86*
Koraput	0.473	.553	0.856	0.004	.004	1.00
Mayurbhanj	1.343	.226	5.93**	0.011	.002	4.18*
Phulbani	0.669	.354	1.89	0.004	.004	1.00
Puri	0.441	.176	2.51	— 0.0017	.003	0.617
Sambalpur	0.300	.332	0.904	0.008	.004	2.00
Sundargarh	—0.452	.369	1.22	0.006	.003	2.00
Orissa	0.5	0.197	0.25	0.01	0.003	3.19*

* Significant at 5 per cent level of probability.
** Significant at 1 per cent level of probability.

APPENDIX 2

INDICES OF YIELD RATES OF AUTUMN RICE (UNHUSKED) IN ORISSA DURING THE PERIOD TOGETHER WITH THE RATE OF GROWTH

(Base year: 1959-60)

S. No.	Districts	1959-60	1960-61	1961-62	1962-63	1963-64	1964-65	Growth rate
1.	Balasore	100	144.16	179.97	139.60	215.02	183.91	+0.1339
2.	Bolangir	100	125.19	88.96	56.23	72.47	79.22	—0.0670
3.	Cuttack	100	104.88	73.83	122.91	157.11	130.40	—0.0670
4.	Dhenkanal	100	107.83	106.58	88.59	56.29	72.34	—0.09157
5.	Ganjam	100	—	96.52	170.08	161.78	114.09	+0.2571
6.	Kalahandi	100	52.23	65.60	69.96	76.22	78.24	+0.0108
7.	Keonjhar	100	107.32	94.51	83.54	104.57	112.35	+0.0171
8.	Koraput	100	123.47	112.44	73.92	95.99	80.64	—0.0513
9.	Mayurbhanj	100	92.40	92.40	77.08	122.30	108.58	+0.0432
10.	Phulbani	100	77.14	118.80	96.79	80.45	83.97	—0.0154
11.	Puri	100	187.02	337.87	263.62	217.23	225.11	+0.1432
12.	Sambalpur	100	81.37	69.77	49.96	73.29	66.73	—0.0626
13.	Sundargarh	100	122.96	103.98	59.18	74.59	54.18	—0.1263
	Orissa	100	102.32	94.65	70.13	89.71	82.44	—0.0349

APPENDIX 3

INDICES OF YIELD RATES OF WINTER RICE (UNHUSKED) IN ORISSA DURING THE PERIOD TOGETHER WITH THE RATE OF GROWTH

(Base year: 1959-60)

S. No.	Districts	1959-60	1960-61	1961-62	1962-63	1963-64	1964-65	Growth rate
1.	Balasore	100	130.17	130.69	96.46	118.36	123.19	
2.	Bolangir	100	107.90	83.28	65.58	90.52	93.57	+0.0247
3.	Cuttack	100	118.65	108.35	95.37	116.89	112.65	—0.0201
4.	Dhenkanal	100	133.13	130.02	94.62	122.43	113.87	+0.0241
5.	Ganjam	100	93.03	69.05	89.05	88.01	81.56	+0.0241
6.	Kalahandi	100	93.61	90.02	109.72	111.00	107.29	+0.0145
7.	Keonjhar	100	119.38	120.08	91.87	118.74	103.26	+0.0076
8.	Koraput	100	125.29	134.01	107.64	121.11	111.81	+0.0181
9.	Mayurbhanj	100	118.01	96.23	108.16	127.12	115.68	+0.0434
10.	Phulbani	100	120.83	122.04	101.46	133.55	119.37	+0.0416
11.	Puri	100	107.32	109.32	111.56	115.07	102.18	+0.0216
12.	Sambalpur	100	116.00	108.26	87.61	111.74	108.33	+0.0134
13.	Sundargarh	100	115.01	92.87	79.12	98.74	91.92	—0.0181
	Orissa	100	113.44	105.92	94.21	110.93	105.14	+0.0137

APPENDIX 4

VARIATION IN YIELD RATE AND RAINFALL OVER THE PERIOD 1959-1964

Districts	1959	1960	1961	1962	1963	1964
Balasore	11.60 (1228.2)	15.10 (1076.1)	15.16 (1019.1)	11.19 (869.6)	13.73 (1404.3)	15.50 (1810.7)
Bolangir	18.36 (1194.5)	19.81 (1181.6)	15.29 (817.6)	12.04 (840.5)	16.62 (1312.5)	18.63 (1456.9)
Cuttack	15.33 (958.2)	18.19 (1150.3)	16.61 (716.6)	14.62 (1022.8)	17.92 (1303.3)	18.73 (1655.2)
Dhenkanal	14.49 (1067.8)	19.29 (1365.1)	18.84 (791.4)	13.71 (1027.8)	17.74 (1257.6)	17.90 (1179.6)
Ganjam	21.10 (992.0)	19.63 (1132.8)	14.57 (966.3)	18.79 (1312.2)	18.57 (1301.0)	18.67 (1149.6)
Kalahandi	15.64 (1492.8)	14.64 (1243.3)	14.08 (1289.3)	17.16 (1320.7)	17.36 (1226.7)	18.20 (1508.8)
Keonjhar	15.74 (1086.9)	18.79 (1176.7)	18.90 (1306.2)	14.46 (871.7)	18.69 (1366.4)	17.52 (1226.2)
Koraput	13.88 (1360.3)	17.39 (1146.8)	18.60 (1353.6)	14.94 (932.8)	16.81 (1263.8)	16.83 (1018.7)
Mayurbhanj	14.60 (1510.6)	17.23 (1545.5)	14.05 (1160.1)	15.79 (1265.9)	18.59 (1387.5)	18.32 (1133.5)
Phulbani	12.34 (1125.3)	14.91 (1387.2)	15.06 (949.9)	12.52 (1027.9)	16.48 (1170.2)	15.98 (1100.9)
Puri	16.52 (1191.0)	17.73 (1088.2)	18.06 (1024.7)	18.43 (1263.4)	19.01 (1297.4)	18.31 (1284.8)
Sambalpur	15.25 (1108.7)	17.69 (1388.5)	16.51 (999.4)	13.36 (976.3)	17.04 (1203.0)	17.92 (1170.6)
Sundargarh	15.85 (1192.8)	18.23 (1451.5)	14.72 (1381.9)	12.54 (991.1)	15.65 (1631.0)	15.80 (1337.8)

Note : Figures within parentheses show rainfall in millimetres and the corresponding figures above show the yield rates of winter rice in maunds per acre.