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DECELERATION OF RATES OF AGRICULTURAL GROWTH IN ORISSA: TRENDS AND EXPLANATORY FACTORS

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INTRODUCTION

Agriculture is the main occupation of the people in Orissa. To a large extent agriculture in Orissa means the growing of paddy which occupies an area of 43.72 lakh hectares constituting about 65 per cent of the total area under food crops. The other major food crops are pulses, *ragi*, small millets and wheat. The area under wheat has increased from 14,000 hectares in 1969-70 to 61,500 hectares in 1978-79. This shows the increasing interest of the cultivators in wheat cultivation. The area under all foodgrain crops has increased from 57.7 lakh hectares in 1969-70 to 66.80 lakh hectares in 1978-79 whereas the area under rice during this period has decreased from 44.1 lakh hectares to 43.7 lakh hectares.

The economy of Orissa is heavily dependent on rice production, but the production has not shown any appreciable rising trend. The production has been constant over the last decade. The yield rate of paddy has remained stagnant at about 900 kg. per hectare during the sixties and the seventies while the all-India average has moved up from 1,000 to 1,130 kg. It seems that the new rice technology has not produced much impact in Orissa. Only the summer rice has shown some improvement due to increase in the area under irrigation and high-yielding varieties (HYVs). But its effect on overall rice production is not significant as only about 3 to 4 per cent of the net area sown in the State and 5 per cent of total production are contributed by summer rice. The area under irrigation constitutes at present about 20 per cent of the total cropped area in the State. Taking all the three seasons of rice, *i.e.*, autumn, winter and summer either separately or in combination the performance does not seem to be encouraging when compared with the all-India average.

The possible reasons for stagnation or slow growth rate of foodgrains and non-foodgrains in the State may be either biophysical constraints (*i.e.*, lack of improved seeds and other inputs, inefficient cultural practices, deteriorating soils, weeds, diseases and insects, etc.) or socio-economic constraints (*i.e.*, lack of knowledge, non-availability of inputs, inadequate marketing and credit facilities, lack of profitability, tradition, risk aversion, etc.).

An attempt has been made in this paper to throw light on the growth rate of area and production of rice separately for autumn, winter and summer and for foodgrains and non-foodgrains from the year 1969-70 to 1980-81. The results have been explained through the above explanatory variables, *i.e.*, biophysical and socio-economic. Such analysis may help to identify the most limiting factors in improving the crop yields on farmers' fields. Thus if the

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precise constraints operating in different areas are identified, the gaps between the potential yield in research farms and realised yield in demonstration plots and the gap between the latter and the actual yield in farmers' fields can be reduced.

The objectives of this paper are therefore (*i*) to analyse the growth rate of area and production of rice separately for autumn, winter and summer rice, (*ii*) to analyse the growth in area and production of foodgrains and non-foodgrains and (*iii*) to find out the constraints which limit the growth of area and production of rice, the major crop of Orissa.

METHODOLOGY

Data have been collected on production, yield rate, area under autumn rice, winter rice and summer rice from secondary sources along with relevant data on soils, irrigation, HYVs, fertilizer, rainfall and type of sowing.

Statistical Analysis

(*i*) The growth rate of area and yield of autumn rice, winter rice and summer rice has been estimated using the following functional form:

$$Y = ab^X$$

where Y = yield,
a = constant,
b = regression coefficient,
X = time.

The growth rate is obtained by deducting b from 1. Using the same function, the growth rates of foodgrains and non-foodgrains have been estimated.

(*ii*) The growth rate of rice for the period from 1969-70 to 1980-81 has been explained by independent variables such as area, rainfall, yield rate due to irrigation, yield rate due to fertilizer and yield rate due to HYVs.

The functional form used to explain the impact of these variables is the linear function as given below:

$$Y = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5$$

where Y = yield rate per hectare,
x_1 = average rainfall of the crop season,
i.e., from June to October of the year,
x_2 = yield rate due to application of fertilizer,
x_3 = yield rate due to irrigation,
x_4 = yield rate due to HYVs,
x_5 = area under crop.

Anova table of the result due to application of above function has been prepared.

Limitations

The results of the above function is to be interpreted with the limitations that only important variables such as rainfall, area, irrigation, fertilizer and HYVs have been taken into account while the other variables which are less important have not been taken into account though each has some influence over the function.

RESULTS AND DISCUSSION

Trend of Yield Rate of Rice (Autumn and Winter)

The yield rate of autumn rice varies from that of winter rice over the years from 1970-71 to 1981-82. The yield rates along with their indices are given in Tables I and II separately along with the growth functions.

Table I indicates that there is absence of a clear-cut trend in area, yield rate and production of autumn rice over the period from 1970-71 to 1981-82. The trend in yield rate per hectare is following a path of fluctuations but in general the trend is found to be rising. The yield rate varies from about 5 quintals per hectare to 12 quintals. To find out the growth rate of area and the production over the period, the statistical function of the form of $Y=ab^X$ has been applied and the resulting functions are given below:

TABLE I—AREA, AVERAGE YIELD RATE AND TOTAL PRODUCTION OF AUTUMN RICE IN ORISSA (1970-71 TO 1981-82)

Year	Area ('000 hectares)	Yield rate (quintals/ha.)	Index number	Production of cleaned rice ('000 metric tons)
1970-71	627	8·47	102·34	339
1971-72	847	8·64	104·39	476
1972-73	769	7·72	93·27	386
1973-74	845	8·96	108·26	492
1974-75	697	5·47	66·09	248
1975-76	758	8·93	107·89	440
1976-77	778	6·74	81·43	341
1977-78	839	10·76	130·00	596
1978-79	914	10·45	126·26	630
1979-80	879	4·69	56·67	272
1980-81	865	9·10	109·95	519
1981-82	928	12·12	122·27	620

(*i*) Growth of area $A = 727.9 \times 1.023^t$

where A = area,
a = 727.9,
b = 1.023,
1—b = 0.023.

The growth of area is positive. But the regression coefficient is found to be not significant.

(*ii*) Growth of yield $Y = 345.1 \times 1.023^t$

where Y = yield,
a = 345.1,
b = 1.023,
1—b = 0.023.

The growth of autumn rice is found to be positive but not found to be significant.

TABLE II—AREA, AVERAGE YIELD RATE AND PRODUCTION OF WINTER RICE IN ORISSA (1970-71 TO 1981-82)

Year	Area ('000 hectares)	Index number	Yield rate (quintals/ha.)	Index number	Production of cleared rice ('000 metric tons)
1970-71	3,709	102·34	15·06	108·48	3,574
1971-72	3,637	104·39	12·26	88·31	2,900
1972-73	3,524	93·27	14·62	105·31	3,349
1973-74	3,725	108·26	15·28	110·06	3,699
1974-75	3,579	66·09	11·69	84·20	2,719
1975-76	3,746	107·89	15·75	113·45	2,834
1976-77	3,429	81·43	11·74	84·56	2,616
1977-78	3,377	130·00	15·50	111·56	3,454
1978-79	3,293	126·26	16·38	117·98	3,559
1979-80	3,095	56·67	12·06	86·87	2,462
1980-81	3,154	109·95	16·87	121·51	3,512
1981-82	3,094	122·27	14·90	107·32	3,043

The trend of area and production of winter rice does not show any distinct picture as the index numbers show that the area and production are subject to fluctuations. To find out whether there is any clear-cut growth trend, the same statistical function was fitted to the data on area and yield over the years, and the resulting functions for winter rice are:

(*iii*) Growth trend of area: $A = 3855 \times 0.9828^t$

where A = area under rice,
a = 3855,
b = 0.9828,
1—b = 0.0172.

The b coefficient is 0.9828 which is found to be not significant. It means that there is no significant growth trend of area under rice though the regression coefficient is positive.

(*iv*) Growth trend of production:

$Y = 3319 \times 0.9936^t$

where Y = production,
a = 3319,
b = 0.9936,
1—b = 0.0064.

The function interprets that the growth trend of production of winter rice is positive but not significant over the years.

Trend of Yield Rate of Summer Rice

Table III shows the area, yield rate and production of summer rice in Orissa. An attempt has been made to find out whether there is any trend in increase in production, yield rate and area under rice over the period from

TABLE III—AREA, AVERAGE YIELD RATE AND PRODUCTION OF SUMMER RICE IN ORISSA
(1970-71 TO 1980-81)

Year	Area ('000 hectares)	Yield rate (quintals/ha.)	Production of cleaned rice ('000 metric tons)
1969-70	117	11·59	137
1970-71	135	13·86	187
1971-72	162	15·03	244
1972-73	183	13·57	248
1973-74	164	13·00	213
1974-75	156	12·75	199
1975-76	180	14·31	258
1976-77	173	15·11	261
1977-78	189	14·05	269
1978-79	165	12·90	213
1979-80	143	12·89	184
1980-81	172	15·72	270

1969-70 to 1980-81. Fitting the statistical function of the form $Y = ab^X$ to the relevant data, the resulting functions are:

(*v*) Area $A = 144614.72 \times 1.0186^t$

where A = area,
a = 144614.72,
b = 1.0186,
1—b = 0.0186.

As per the result of the function, the growth trend of area under summer rice is positive but not significant as the regression coefficient is not significant.

(*vi*) Yield $Y = 184155.63 \times 1.0186^t$

where Y = yield,
a = 184155.63,
b = 1.0186,
1—b = 0.0186

The resulting function shows that the growth of production is positive but not significant.

Growth of Area and Production of Total Rice

After discussing separately the growth of area and production of autumn rice, winter rice and summer rice, an attempt is made to find out the growth of area and production of total rice.

TABLE IV—AREA, AVERAGE YIELD RATE AND PRODUCTION OF RICE (TOTAL) IN ORISSA (1970-71 TO 1980-81)

Year	Area ('000 hectares)	Yield rate (quintals/ha.)	Production of cleaned rice ('000 metric tons)
1969-70	4,406	9·02	3,976
1970-71	4,471	9·17	4,100
1971-72	4,646	7·79	3,620
1972-73	4,476	8·90	3,983
1973-74	4,734	9·30	4,400
1974-75	4,432	7·14	3,166
1975-76	4,684	9·67	4,532
1976-77	4,380	7·35	3,218
1977-78	4,405	9·81	4,219
1978-79	4,372	10·07	4,402
1979-80	4,117	7·09	2,918
1980-81	4,191	10·26	4,301

As may be seen from Table IV, the total rice does not show any clear growth trend with regard to area, yield and production. The production of rice is subject to fluctuations from year to year. To ascertain the growth, the same statistical function was fitted to the above data and the resulting functions for area and production are as follows:

(*vii*) Area $A = 912000 \times 1.047^t$

where A = area,
a = 912000,
b = 1.047,
1—b = 0.047.

As per the resulting function, the growth of area is positive but found to be not significant.

(*viii*) Yield $Y = 3948553.2 \times 1.00349^t$

where Y = yield,
a = 3948553.2,
b = 1.00349,
1—b = 0.00349.

As per the resulting function, the growth of production is found to be positive but not significant. The analysis indicates that over the period of one decade from 1969-70 to 1981-82, the growth rates of area and production of all varieties of rice, *i.e.*, autumn, winter and summer and of total rice are not significantly positive. The statistical analysis does not bring about any firm conclusion regarding the positive growth rate of area and production of rice, the major crop of the State. The yield rate has remained stagnant for more than a decade. The problem has been studied by different scholars at different times. Despite the introduction of different technical programmes to obtain a break-through in rice production, the expectation has not yet been realised. The field workers have not been able to transfer the known technology to the farmers in a systematic manner. The time has come to find out the constraints in rice production and to seek possible solutions.

The constraints limiting a break-through in rice production are the pattern of rainfall distribution, extent of irrigation and water management, use of fertilizers and HYVs, etc. In order to ascertain whether and to what extent these variables are responsible for the present growth of production of rice, linear multiple regression function of the following form has been fitted to the data relating to the period from 1969-70 to 1979-80.

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5$$

where Y = yield rate of rice per hectare,
x_1 = average rainfall of the cropped season,
x_2 = yield rate due to application of fertilizer,
x_3 = yield rate due to irrigation,
x_4 = yield rate due to HYVs,
x_5 = area under crop.

The resulting function is

$$Y = -3461.45 + 0.017x_1 + 203.26x_2 + 1.59x_3 + 27.25x_4 + 9.02x_5$$
$$R^2 = 0.99$$

ANOVA TABLE

Source of variation	D. F	S. S.	M. S	F
S. S. due to regression ..	5	2192797·50	438559·50	97·7896
Error	4	17938·89	4484·723	
Total	9	2210736·4		

Regression coefficients ..	b_1	b_2	b_3	b_4	b_5
S.E	0·65	21·12	23·56	18·75	0·15
	N.S.	*	N.S.	N.S.	*
t	0·025	9·622	0·067	1·45	5·95

N.S. = Not significant.

*Significant at 1 per cent level of probability.

As per the results of the above function, fertilizer and area under crop have significant contribution towards the growth of rice production. Irrigation and HYVs have positive impact on growth but not significant. The regression coefficient for rainfall is found to be negative and not significant, implying that not the amount of rainfall but the pattern of distribution of rainfall is more relevant to the growth of rice production. The annual average rainfall of the State is about 1,482 mm., falling within about 75 days. More than 76 per cent of annual rainfall is received during June to September. The distribution of rainfall is also very unreliable and erratic. Erratic rainfall distribution at the beginning and at the end of the monsoon has always resulted in limiting the production due to delayed operations, moisture stress at critical stages, waterlogging at low lands and excessive inundation at the tillering stage. Such situations carry a great risk in farming (75 per cent of the farmers are small and marginal) resulting in low input use. High rainfall without even distribution may be harmful to rice production. The production figures in Orissa indicate that the yield rate and total production are low during the years of less rainfall and particularly low rainfall during the month of October.

Irrigation

Irrigation plays an important role in determining the quantum of rice production. So far only about 20 per cent of the cultivated area is under

irrigation. This means that 80 per cent of rice is grown under non-irrigated conditions. Summer paddy is possible only with irrigation and the success of winter paddy largely depends upon water management whereas the least dependent on irrigation is the autumn paddy. There is significant increase in yield rate due to irrigation and the increase in yield rate ranges from 3 to 8 quintals per hectare. But since irrigation is inadequate it does not have much impact on overall production. During *kharif*, irrigated area comes to only 23 or 24 per cent whereas in *rabi*, it is only 6 to 7 per cent. But what is more important is that irrigation without water management does not have much impact on increasing productivity. At present, water management does not exist during rainy season (that is winter or *rabi* paddy) nor is it easy. While the water from high land is lost by seepage and percolation the same gets accumulated in medium and low lands. Further, unpredictable rainfall induces the farmer to impound as much water as possible leaving only a little surplus to drain out. Such excess water thus impounded at tillering stage results in poor grain production. However, irrigation in winter paddy is meaningful only when there is prolonged drought.

Though summer irrigation is very important in increasing yield due to inadequate control structures and absence of field channels, there is wastage of irrigation water. In fact, poor water management leads to excessive inundation when it is not necessary, waterlogging in low lying areas and scarcity conditions in tail reaches at crucial stages, ultimately leading to low productivity.

Fertilizer

Fertilizer use in the State seems to be the lowest in the country. It is only 10 kg. per hectare. It has become risky to use fertilizer in face of uncertainty of water supply to the field during *kharif*. Excessive rainfall within a short time results in erosion and leaching and has become a deterrent for higher fertilizer use. The farmers are still in the habit of using small quantity of organic matter like farmyard manure or green manure. Application of fertilizer normally has positive effect on yield rates and the increase in yield rate of both autumn and winter paddy due to application of fertilizer ranges from 1 to 3 quintals per hectare. So an increase in the application of fertilizer can ensure an increase in the quantum of production. The low dose of application of fertilizers by the farmers is not only due to uncertainty of rainfall and increase in the cost of fertilizer but also due to non-availability and untimely supply of the same. The condition is still worse in the interior areas where the primary co-operative societies serving as the major channels of fertilizer supply are not properly functioning.

High-Yielding Varieties of Seeds

The coverage under HYVs in the State is very poor. The reasons are mainly three-fold: aberration of the weather, increase in cost and non-avail-

ability of HYV seeds. It is observed that the HYVs have a positive impact on increase in the yield rate both for autumn and winter paddy. The extent of increase in the yield rate due to application of HYVs over the local seeds comes to about 7 quintals per hectare. Though the aberration of the weather cannot easily be controlled, there is still scope to increase the use of HYVs particularly in summer. The policy should be to popularise the use of HYVs in the farming sector. The growth of rice production is not upto expectation due to low coverage under HYVs.

Land and Soil

Rice is grown under a wide range of soils extending from alluvial deltaic areas in the coastal belt, rolling red soils with low fertility in the northern plateau, mixed red and black soils of central table land to reddish brown lateritic and black soils in the eastern ghat region. The soil types vary widely from highly acidic to slightly alkaline and from light sandy soils to stiff clays. The yield rate varies with the type of soil. The sandy soils have low water holding capacity with low yield rate. However, with the application of green manuring and fertilizer, these soils can be profitably managed for high yield of paddy. Clayey and alluvial soils show better performance with higher yield rate compared to that of sandy soils. These soils are more fertile and the yield rate here is slightly higher than that of sandy soils. The type of soils has a predominant role to play in determining the yield rate of paddy. The growth rate of rice is not impressive over a period of one decade due to poor fertility of soil in the State. In fact, rice is grown indiscriminately even on sub-marginal land.

Topography or landscape is another important determinant of the yield rate of rice in the State. There is variation in the yield rate due to variation in the topography and landscape. Low land gives better performance than medium land and medium land performs better than high land as far as the yield rate is concerned. The State is divided into four well defined physical regions as per the landscape. These are (*i*) northern plateau, (*ii*) central table land, (*iii*) eastern ghat region and (*iv*) coastal plain. The northern plateau includes the districts of Mayurbhanj, Keonjhar and Sundargarh. About 23 per cent of the total area of the State is under this region. About 45 per cent of the area of this region is covered by forest, and only 36 per cent of the area is under cultivation and a major part of the zone is high land. The productivity is not very high. The central table land covering Dhenkanal, Phulbani and Sambalpur districts is flat with undulating and folded topography. The great plain of this region is very well suited for the cultivation of rice. The eastern ghat region consists of only hilly ranges and the land is highly elevated. It covers about 36 per cent of the total area of the State consisting of the districts of Koraput, Kalahandi and Phulbani. The yield rate is the lowest in the region. The coastal plain covering only 18 per cent of the total area of the State assures favourable rice production.

Method of Sowing

Rice is sown by the method of broadcasting and transplantation. Transplantation always ensures a higher yield rate than the method of broadcasting. The extent of increase in the yield rate often varies from 2 to 6 quintals per hectare. Due to the absence of certainty of rainfall and water supply transplanting is not widely adopted by the farmers in the State.

Growth in Agricultural Production

We may now have a look at total agricultural production of which rice forms a major part. Agricultural production can be analysed under two heads: foodgrains and non-foodgrains. Foodgrains include cereals and pulses whereas non-foodgrains include oilseeds, fibres and other miscellaneous crops. The relevant data on area under and production of foodgrains and non-foodgrains are given in Table V.

TABLE V—AREA AND YIELD OF FOODGRAINS AND NON-FOODGRAINS IN THE STATE (1969-70 TO 1980-81)

Year	Foodgrains				Non-foodgrains			
	Area ('000 hectares)	Index number	Yield ('000 metric tons)	Index number	Area ('000 hectares)	Index number	Yield ('000 metric tons)	Index number
1969-70	5,775	103·1	4,728	104·5	1,126	105·3	816	102·6
1970-71	5,741	103·0	4,863	107·7	1,020	89·4	725	99·9
1971-72	5,950	106·8	4,354	95·7	924	82·8	630	96·8
1972-73	5,915	106·2	4,860	107·2	1,021	98·4	643	106·3
1973-74	6,218	111·4	5,275	116·4	1,066	107·0	720	110·9
1974-75	5,992	107·5	3,971	87·1	1,142	114·0	742	164·8
1975-76	6,484	116·4	5,570	121·8	1,249	123·6	807	116·4
1976-77	6,038	108·4	4,075	88·4	1,171	114·2	717	98·1
1977-78	6,519	117·0	5,761	121·6	1,412	138·5	792	117·3
1978-79	6,680	119·9	5,765	126·2	1,595	163·2	951	169·9
1979-80	6,490	115·7	3,844	84·9	1,838	171·5	869	109·3
1980-81	6,946	123·9	5,822	128·7	1,871	174·6	1,175	147·9

Foodgrains

Table V shows the trend of area and production of foodgrains in the State from 1969-70 to 1980-81. It is observed that the index numbers of area as well as yield have increased over the period with fluctuations in the inter-

vening years. But the trend appears to be rising. The results of the statistical function fitted to the data to find out the growth of area and yield area as follows:

$$A = 5623000 \times 1.023t; \quad Y = 446700 \times 1.023t$$

where A = area,
a = 5623000,
b = 1.023,
1—b = 0.023.

where Y = yield,
a = 4467000,
b = 1.023,
1—b = 0.023.

The regression coefficient of area and yield are positive but not significant. It means that the area under and production of foodgrains have shown an increasing trend but a firm opinion cannot be given in this regard as b is found to be not significant in both the cases.

Non-foodgrains

Like foodgrains, both the area and yield of non-foodgrains have shown an increase during 1969-70 to 1980-81 with fluctuations between the years (Table V). Using the same statistical function, the growth rates of area and yield of non-foodgrains are estimated as follows:

$$A = 912000 \times 1.047t; \quad Y = 676000 \times 1.023t$$

where A = area,
a = 912000,
b = 1.047,
1—b = 0.047.

where Y = yield,
a = 676000,
b = 1.023,
1—b = 0.023.

The regression coefficients in both the cases are found to be not significant. The area under and production of non-foodgrains are increasing but not significant. The index numbers of area and production have also shown an increase during the period with fluctuations between the years but the fluctuations are pronounced in the case of production.

The trend of area and production in sub-groups, *i.e.*, cereals, pulses, oilseeds, fibres and miscellaneous crops has also a rising tendency but with fluctuations between the years.

The above analysis does not show any significant increase in growth of area and production of both foodgrains and non-foodgrains during the period from 1969-70 to 1980-81. Of all the factors which are responsible for the low yield, the main cause seems to be natural calamities and uneven distribution of rainfall. The State is influenced by the monsoon climate characterized by high temperature from March to May and high rainfall from June to September. Major source of rainfall is from the south-west monsoon and 76 per cent of the rainfall is received from June to September. The constraints

imposed by precipitation patterns are two fold. First is its concentration during the relatively short monsoon season leaving a substantial period in the year during which water requirement of the crop exceeds rainfall and the second is that at both ends of the monsoon, there are periods of highly variable precipitation. This makes crop planning and yield assurance quite difficult. Due to less rainfall dry spell occurs in the month of October which affects the paddy crop at the flowering stage resulting in low yield.

Floods, droughts and cyclones occur almost in every alternate year in a severe form, causing substantial loss in production. While floods occur almost every year, varying with intensity, severe drought conditions are experienced once in almost three years. Due to frequent natural calamities, agricultural production in the State does not show any favourable trend. As shown in Table VI, there has been crop loss in 11 years out of 17 years due to natural calamities.

TABLE VI—FOODGRAINS PRODUCTION OVER THE YEARS

(lakh tonnes)

Normal years	Foodgrains production	Abnormal years		Foodgrains production
1964-65	49·24	1965-66	Severe drought	36·85
		1966-67	Drought	42·31
		1967-68	Flood and cyclone	41·35
		1968-69	Mild flood	47·21
		1969-70	Mild flood	47·28
		1970-71	Mild flood	48·63
		1971-72	Severe cyclone and flood	43·54
		1972-73	Drought and flood ..	48·60
1973-74	52·75	1974-75	Severe drought and flood	39·71
1975-76	55·70	1976-77	Severe drought ..	40·75
1977-78	55·61			
1978-79	57·65	1979-80	Severe drought ..	38·72
1980-81	59·77			

The table above indicates that Orissa has no respite from droughts, floods and cyclones for more than a decade. It has been estimated by one research worker that during the period 1951-52 to 1965-66, 40 per cent of the variation in agricultural production was accounted by erratic monsoon whereas during the period 1957-58 to 1977-78, 60 per cent of the variation was accounted by

the same. He has also shown that during the first period, foodgrains production increased at a rate of 2.34 per cent per annum whereas in the second period, it was only 1.40 per cent. Though the improvement in technology was better in the second period than the first, due to hazards of monsoon the effect on the yield was almost negative during the latter period. It is therefore imperative to overcome hazards of monsoon in Orissa by increasing irrigation, improving water management system and diversifying crop production. The irrigation potential in the State has been estimated at 40 lakh hectares. By the end of 1977-78, the State achieved a potential of 20 lakh hectares. Of this, only 14 lakh hectares of land received irrigation which accounted for about 70 per cent of the total irrigation potential created in the State. This shows that there is great scope for improvement in irrigation.

We have already indicated technological constraints. Apart from the climatological factors which impede technological change, sociological constraints are no less important in preventing technological change. In Orissa, the scheduled tribes and castes account for about 40 per cent of the population and they are economically the weakest community. Many of these communities still depend upon shifting cultivation. Those who have taken to settled cultivation are not in a position to accept modern technology due to their poverty and ignorance. The small and marginal holdings account for about 75 per cent of all operational holdings and control less than 30 per cent of total cultivated area. Farmers having five hectares or more representing less than 7 per cent of the holdings control one-third of the cultivated land. The operational units are small and scattered. Consolidation of holdings has hardly made any progress. Share-croppers who cultivate a sizeable area do not have any interest in increasing productivity. All these have stood in the way of technological change. Unless there is a structural change along with diversification of the economy, agriculture in Orissa cannot be a business proposition.