



AN ECONOMETRIC STUDY OF PRODUCTIVITY OF RICE: COMPARATIVE EVIDENCE BETWEEN INDIA AND ODISHA

Biswajit Bhoi¹



¹Teacher of Economics at CUO, Koraput, Odisha, India

ABSTRACT

This paper deals with a simple comparative econometric analysis of productivity of Rice between India and Odisha on the wave of green revolution of 1960'S and LPG of 1990-91 in India. It has been found that, although increases in productivity of rice significantly both at All India and Odisha level, it is less in Odisha in compare to India.

KEY WORDS: Agriculture, Rice, Productivity, Employment, Agricultural Labourers, Farmers.

1. INTRODUCTION

After independence from British raj, the government of India under various leaders has initiated a number of programme and policy for the welfare of the economy as a whole. Among all the most two important steps towards welfare of the people are:

- i) Introduction of HYV seeds, which leads to the so called Green Revolution (GR).
- ii) Liberalisation of the economy as whole, so called era of LPG.

With this background of policy liberalisation and GR, this paper tries to analyse the impact of GR and LPG on the agricultural sector, by taking the productivity of rice as simple example from different crops that is cultivated in India and Odisha. This paper tries to know the situation of Odisha Agriculture with respect to Indian Agriculture.

2. ODISHA ECONOMY: IMPORTANCE OF AGRICULTURE

Orissa is the traditional home of the largest number of traditional rice. Rice is an ancient crop in Orissa. Traditionally, Orissa is a rice growing State and rice has remained her main crop. At the beginning of the 20th century, the farmers of Orissa were mainly cultivating rice for their survival. Their production was predominantly subsistence in nature. Some people were cultivating crops like *biri* (black gram), *simba* (legume), wheat, etc, only for their own consumption.

Although the origin of rice is yet unsettled, the Botanical Survey Project on Rice of the ICAR in 1970 claimed that Jeypore Tract of Orissa might be the primary centre for the origin of rice. Though it cannot be said exactly the rise of the era of rice cultivation in Orissa, India, but from the evidences



available, it could be deciphered that rice was being cultivated prior to 2800 B.C., i.e. 4800 years ago. This survey also claimed that the Sauras and Gadava (tribes) were the first rice cultivators.

Orissa, the tenth largest and eleventh most populous State of India, occupies 5% of the geographical area (1.56 lakh sq Km.) and 4% of the population (3.67 crore) of the country (2001 Census of India). Agriculture occupies an important place in the economy of the State like Orissa. While agriculture and animal husbandry contributed 28.54 % of the Net State Domestic product of the state in 2000-01, the agriculture alone provided direct and indirect employment to around 64% of the total work force of the state as per the 1991 census. So, it is obvious that the development of the State depends on the development of agriculture. But as agriculture is a complex and multi-dimensional enterprise, its development depends on various factors like agro-climatic conditions, technology, inputs, and system of land holding and other socio-economic factors. The climate of Orissa is hot and humid. The state's mean annual temperature is 26.89°C. The Indian Council of Agricultural Research (ICAR) has classified the climatic structure Orissa into ten Agro-climatic Zones. Before independence, especially before the advent of modernization the agriculture of Orissa was predominantly subsistent and traditional oriented, in nature.

But the introduction of modernization, Research and Extension programmes has brought about significant changes in the traditional agriculture of Orissa. Along with commercialisation of agriculture, several other developments have taken place in the field of land holding pattern, irrigation system, cropping pattern and fertiliser consumptions.

Hardly a few farmers were going for multi-cropping depending on the irrigation facilities. They cultivated *Sarad Dham* (indigenous paddy) till 1950. With a little attention for hybridisation except *Khari*, a few farmers were going for *Rahi Phasal*. Although the Central Rice Research Institution was established in 1946 at Cuttack, it actually came to function only after Independence. Through the

implementation of different five years plans, the Government, of Orissa was succeeded in developing agricultural production.

While the total cereal production of the state was 23.12 lakh tons just before the First Five Year Plan, it turned into 49.37 lakh tons at the period of 1968, i.e. just before the implementation of 4th-5th years plan (Utkal Prasanga, 1970:21). But after 70's, a tremendous change had occurred in Indian agriculture, due to the advent of technological transformation.

Odisha is primarily an agrarian economy. Agriculture is the state's dominant sector with a contribution of nearly 30 per cent to the Net State Domestic Product (NSDP). About 73 per cent of total main workers are engaged in agriculture including 44.3 per cent cultivators and 28.7 per cent agricultural labourers (1991 census). Nearly 87 per cent of total population lives in rural areas. Though the contribution of agriculture to NSDP has significantly declined from 67 per cent in 1951 to around 30 per cent in 1998, the percentage of workforce engaged in agriculture has remained somewhat unchanged with 73.8 per cent in 1960 and 73 per cent in 1990 (Table 1.1). This implies that there has been an overcrowding in agriculture without any perceptible increase in production. There has been a spectacular increase in disguised unemployment or underemployment in the agriculture sector with zero or near zero marginal productivity of agricultural labour. Cultivated land area remaining more or less fixed, with increase in population the land-man ratio has worsened over time. The per capita availability of cultivated land was 0.39 ha. in 1950 has been drastically reduced to 0.17 ha. in 1999.

Percentage of cultivators to main workers has decreased from 57 per cent in 1960 to 44 per cent in 1990. By contrast the percentage of agricultural labourers to main workers has increased from 17 per cent in 1960 to 29 per cent in 1990. Thus, within a span of three decades the ratio of agricultural labourers to cultivators has increased substantially from about 3:7 in 1960 to 6.5:3.5 in 1990. This is primarily due to increase in landlessness or near landlessness on account of

population growth and sub-division of land holdings among legal heirs. As the pace of industrialisation in the state is slow and has not taken off, agriculture continues to provide sources of livelihood to a significant segment of population. Therefore, agricultural growth holds the key to the overall

development of the state by way of creating employment, generating income, providing raw materials to the industrial sector and last but not the least ensuring self-reliance in food production and food security to the deprived sections.

Table-1.1 Some Indicators Agriculture in Odisha Economy

Sl.no	Indicators	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11
1	2	3	4	5	6	7	8	
i	Share of Agriculture in NSDP (%)	66.8*	@	54.6	@	30.0**	29.7	20.6
2	Percentage of Total Population Living in Rural Area	95.9	93.7	91.6	88.2	87.0	85.00	84.00
3	Percentage of Total Workforce Engaged in Agriculture	@	73.8	77.4	74.7	73.0	@	@
a	Percentage of Cultivators to Main Workers	@	56.8	49.2	46.9	44.3	@	@
b	Percentage of Agricultural Labourers to Main Workers	@	17.0	28.3	27.8	28.7	@	@
4	Per Capita Availability Of Cultivated Land (Ha)	0.39	0.38	0.31	@	0.18**	0.17	@

Source: * Figures for 1951-52, **Figures for 1998-99

Government of Orissa, Economic Survey (Various Issues), and Statistical Abstracts of Orissa,

(Various Issues), Directorate of Economics and Statistics, Orissa, Bhubaneswar.

3. DATA AND METHODOLOGY

This paper's empirical analysis based on data sets of productivity of rice at all India level and Odisha (Agricultural Statistics at a Glance, GOI and GOO). The data of 59 year has been used for the analysis that is from 1950-51 to 2008-09 (Table.1.2). Dummy variable-Simple regression has been used to know the influence of green revolution and liberalisation (LPG) on the productivity of rice. The year from 1950-51 to 1964-65, which is the period of GR have been assumed as Dummy variable

as 0, otherwise 1 for both India and Odisha. Similarly the period from 1950-51 to 1990-91 have been assumed as Dummy variable as 0, otherwise 1 for both India and Odisha. Rice has been only taken as a tool of analysis, because first the rice is one of the crops where most impact of green revolution was felt at all India level after wheat. Second rice is primarily cultivated in Odisha, in which most of the people depends as their source of livelihood and staple food also.

Table-1.2: Productivity of Rice grown in Odisha in comparison with All India (Kg/he¹)

Productivity of Rice grown in Odisha in comparison with All India (Kg/he)							
Rice							
Year	AI	ODISHA	DVGRI	DVGRO	DVLI	DVLO	TIME
1950-51	668	520	0	0	0	0	1
1951-52	714	557	0	0	0	0	2
1952-53	764	582	0	0	0	0	3
1953-54	902	591	0	0	0	0	4
1954-55	820	575	0	0	0	0	5
1955-56	874	543	0	0	0	0	6
1956-57	900	593	0	0	0	0	7
1957-58	790	442	0	0	0	0	8
1958-59	930	562	0	0	0	0	9
1959-60	937	868	0	0	0	0	10
1960-61	1013	986	0	0	0	0	11
1961-62	1028	961	0	0	0	0	12
1962-63	931	832	0	0	0	0	13
1963-64	1033	996	0	0	0	0	14
1964-65	1078	1020	0	0	0	0	15
1965-66	862	766	1	1	0	0	16
1966-67	863	845	1	1	0	0	17
1967-68	1032	822	1	1	0	0	18
1968-69	1076	932	1	1	0	0	19
1969-70	1073	902	1	1	0	0	20
1970-71	1123	917	1	1	0	0	21
1971-72	1141	779	1	1	0	0	22
1972-73	1070	890	1	1	0	0	23
1973-74	1151	930	1	1	0	0	24
1974-75	1045	714	1	1	0	0	25
1975-76	1235	967	1	1	0	0	26
1976-77	1089	735	1	1	0	0	27
1977-78	1308	981	1	1	0	0	28
1978-79	1328	1007	1	1	0	0	29
1979-80	1074	709	1	1	0	0	30
1980-81	1336	1026	1	1	0	0	31
1981-82	1308	926	1	1	0	0	32
1982-83	1231	737	1	1	0	0	33
1983-84	1457	1176	1	1	0	0	34
1984-85	1417	969	1	1	0	0	35
1985-86	1552	1187	1	1	0	0	36
1986-87	1471	1100	1	1	0	0	37
1987-88	1465	856	1	1	0	0	38
1988-89	1689	1237	1	1	0	0	39
1989-90	1745	1431	1	1	0	0	40

1990-91	1740	1198	1	1	0	0	41
1991-92	1751	1464	1	1	1	1	42
1992-93	1744	1213	1	1	1	1	43
1993-94	1888	1452	1	1	1	1	44
1994-95	1911	1426	1	1	1	1	45
1995-96	1797	1375	1	1	1	1	46
1996-97	1882	993	1	1	1	1	47
1997-98	1900	1390	1	1	1	1	48
1998-99	1921	1212	1	1	1	1	49
1999-00	1986	1127	1	1	1	1	50
2000-01	1901	1041	1	1	1	1	51
2001-02	2079	1589	1	1	1	1	52
2002-03	1744	759	1	1	1	1	53
2003-04	2077	1496	1	1	1	1	54
2004-05	1984	1455	1	1	1	1	55
2005-06	2102	1554	1	1	1	1	56
2006-07	2131	1557	1	1	1	1	57
2007-08	2202	1720	1	1	1	1	58
2008-09	2186	1553	1	1	1	1	59
Average	1380.49153	1012.59322					
SD	454.324446	323.145111					
CV	32.9103394	31.9126283					

Source: Agricultural Statistics of Orissa- At a Glance, 2008-09

4. EPERICAL REGRESSION RESULT AND DISCUSSION

4.1. Regression Models:-

Following the common practice of regression analysis, by taking dummy variable to know the impact of some change in structure of the economy like GR or LPG. For this purpose, the following eight set of dummy variable regression model has been applied. The equations are named as A, B, C, D, E, F, G, and H.

$$A - AI = \beta_1 + \beta_1 (DVGRI) + \beta_1$$

$$B - ODISHA = \beta_2 + \beta_2 (DVGRO) + \beta_2$$

$$C - AI = \beta_3 + \beta_3 (DVLI) + \beta_3$$

$$D - ODISHA = \beta_4 + \beta_4 (DVLO) + \beta_4$$

$$E - AI = \beta_5 + \beta_5 (DVGRI) + \beta_{51} (DVLI) + \beta_5$$

$$F - AI = \beta_6 + \beta_6 (DVGRO) + \beta_{61} (DVLO) + \beta_6$$

$$G - AI = \beta_7 + \beta_7 (TIME) + \beta_7$$

$$H - ODISHA = \beta_8 + \beta_8 (TIME) + \beta_8$$

4.2 FINDINGS

- After running the require regression, I found that due to green revolution, there is an increase in productivity of rice at all India level. But this data is not perfectly fit to this model even at this all India level. Only 40% increase in productivity of rice is due to GR, but in case of Odisha this is 30%. (See appendix, table 1a and 2a)
- Similarly due to liberalisation (LPG), although the productivity of rice has increase with strong level of significant, the model is not perfectly fit to this data. But this is more fit then GR model in both cases of India and Odisha. The increase in productivity is explained by LPG is around 71% in case of India and around 50% in case of Odisha. (See appendix, table 3a and 4a)

- c. Now the combine impact of GR and LPG shows that, there is increase in productivity of rice in both at India and Odisha level. But it very less in case of Odisha in compare to all India level. The R² is 0.82 for India where as it is 0.59 for Odisha. T- Values are significant for all parameters at 95% confidence interval level. (See appendix, table 5a, 5b, 6a and 6b)
- d. Even if we take as time as our explained variable, we can found that the productivity of rice has increased in both cases of India and Odisha. G equation is near to perfect fit to the data, since R-square is around 0.94 for all India level , but it is less for Odisha i.e. 0.69.

not got the benefit of GR and LPG. The era of GR and LPG has not been success in case of Odisha may be due to in efficiency of Odisha economy system. We have to make agricultural sector more productive.

To make the agriculture sector more productive and the surplus unproductive labour being fruitfully engaged in industries oriented vocations which shall enable optimization of Orissa’s valuable human resources, we should look for following steps to realise the fruits of GR and LPG.

- ✳ Improving the influence region of planned irrigation activities.
- ✳ To encourage modern agricultural practices through innovative techniques so as to enable multiple cropping.
- ✳ Rain water harvesting technologies to be propagated.
- ✳ Insurance schemes for farmers against natural disasters.
- ✳ Strengthening the institutions and agencies of the state government engaged in agriculture sector promotion.
- ✳ Development of appropriately located agricultural infrastructure and terminal markets.
- ✳ Timely access to adequate line of credit facilities and raw material inputs.
- ✳ Unlocking of huge tracts of fallow land in the coastal districts so as make extra land available for fisheries and aquaculture sectors.

5. CONCLUSION AND POLICY IMPLICATION

In all cases the productivity of rice in Odisha is less before green revolution or LPG and also even after GR and LPG. In any front of analysis we found that the productivity of rice in Odisha is not at all in compare to all India level productivity. Due to GR or LPG India has achieved somehow some little high level of productivity of rice where as Odisha has not yet. Odisha has not benefitted from either GR or LPG significantly like India and other states like Punjab. This means that Odisha has the potential to Increase the level of productivity to all India level or even to high level. This may be due to some bottlenecks in the Odisha Economy. So we have to find out the reason for which Odisha has

6. APPENDIX A: Regression Results by using SPSS

TABLE-1a: Model Summary1:- AI AND DVGRI

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.633 ^a	.401	.390	354.788	.401	38.109	1	57	.000

a. Predictors: (Constant), DVGRI

TABLE-1b: Coefficients¹-1

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error				Lower Bound	Upper Bound
				Beta				
1	(Constant)	892.133	91.606		9.739	.000	708.696	1075.571
	DVGRI	654.844	106.077	.633	6.173	.000	442.428	867.260

a. Dependent Variable: AI



Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.554 ^a	.307	.295	271.350	.307	25.255	1	57	.000

a. Predictors: (Constant), DVGRO

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	708.533	70.062		10.113	.000	568.236	848.831
	DVGRO	407.717	81.131	.554	5.025	.000	245.256	570.178

a. Dependent Variable: ODISHA

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.845 ^a	.714	.709	245.274	.714	142.002	1	57	.000

a. Predictors: (Constant), DVLI

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1128.366	38.305		29.457	.000	1051.661	1205.071
	DVLI	826.412	69.350	.845	11.916	.000	687.540	965.284

a. Dependent Variable: AI

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.707 ^a	.499	.490	230.691	.499	56.805	1	57	.000

a. Predictors: (Constant), DVLO

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	862.610	36.028		23.943	.000	790.465	934.754
	DVLO	491.612	65.227	.707	7.537	.000	360.998	622.227

a. Dependent Variable: ODISHA

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.908 ^a	.824	.818	194.066	.824	130.939	2	56	.000

a. Predictors: (Constant), DVLI, DVGRI

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	892.133	50.108		17.804	.000	791.756	992.511
	DVGRI	372.521	62.923	.360	5.920	.000	246.471	498.570
	DVLI	690.124	59.505	.705	11.598	.000	570.921	809.327

a. Dependent Variable: AI

TABLE-6b: Coefficients^{a-6}

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	708.533	54.247		13.061	.000	599.863	817.203
	DVGRO	242.967	68.121	.330	3.567	.001	106.504	379.430
	DVLO	402.722	64.421	.579	6.251	.000	273.672	531.772

a. Dependent Variable: ODISHA

TABLE-6a: Model Summary-6: ODISHA

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.769 ^a	.592	.577	210.098	.592	40.604	2	56	.000

a. Predictors: (Constant), DVLO, DVGRO

TABLE-7a: Model Summary-7 AI

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.971 ^a	.942	.941	110.278

a. Predictors: (Constant), TIME

TABLE-7b: Coefficients^{a-7}

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	610.254	29.083		20.983	.000
	TIME	25.675	.843	.971	30.454	.000

a. Dependent Variable: AI

TABLE-8a: Model Summary-8: ODISHA

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.835 ^a	.697	.692	179.364

a. Predictors: (Constant), TIME

TABLE-8b: Coefficients^{a-8}

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	541.297	47.302		11.443	.000
	TIME	15.710	1.371	.835	11.457	.000

a. Dependent Variable: ODISHA

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7. Notes:-

HYV=High Yielding Variety

LPG= Liberalisation Privatisation and Globalisation

GR=Green Revolution

@= not available to my best

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