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Agricultural Development Disparities in Odisha: A Statistical Study

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Abstract

Agriculture plays a dominant role in the economy of the State with contribution of 25.75% to Net State Domestic Product (Census report, Govt. of India, 2000-01). Its contribution has declined to 16.46 per cent in GSDP in 2011-12 (Economic survey 2011-12, Odisha). The contribution of agriculture and allied sectors coming under primary sector to NSDP is more than 40 per cent during past seven years except in 2000-01 (39.50 %). In this study an attempt has been made to measure the levels of agricultural development for the State of Odisha by 2010. The findings of the study revealed that 7 out of 30 districts of Odisha have come under the category of backward districts, which showing that large regional disparities exist in levels of agricultural development in the State. Agricultural development is the highest in Kendrapara district and the lowest in Jharsuguda district.

Keywords: Principal Component, Agricultural Development, Development Disparities

Introduction

Agricultural development is a continuous process of improvement of crop production. The level of agricultural development is affected by several factors such as size of cultivable area, infrastructural facilities, state of farm technology and a balanced human resource etc. Thus, the extent of development in agriculture cannot be captured on the basis of any single indicator.

Development disparities in India continued to remain a serious problem despite the centralised planning effort by the Government (Joshi, 1997; Krishan, 2001; Singh, 2006).

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There is clear evidence that since 1980-81 regional divergence in agricultural productivity and income have grown and the gap between underdeveloped and developed, and, poor and rich States has continued to increase. This has happened despite special efforts made to reduce inter-state disparities by promoting level of agricultural development in underdeveloped States (Chand and Chauhan 1999). Thus, the reasons cited above have led to the skewed development of agriculture across the States in India. It would not be out of context to point out here that what is true of Odisha in comparison to India in terms of agricultural development is also true of its backward districts in respect of the State itself.

A number of authors like Swain and Mohanty (2010), Mohanty and Ram (2001) and Gulati (1991) have developed different ranking techniques including multivariate ones to rank the districts / states of the country. Iyengar and Sudarshan (1982) attempted to classify regions using multivariate data relating to major development basing on composite index method and using theoretical Beta distribution.

Dasgupta (1971), Rao(1973), Rao (1977) and Narain & et al. (1991) attempted to identify backward states and districts by using the factor analysis approach.

In the present study principal component analysis approach has been adopted to classify the districts of Odisha according to different levels of agricultural development on the basis of some selected indicators mentioned below in the methodology section.

Objectives of study

The specific objectives of the present study are:

1. To classify the districts of Odisha according to different levels of agricultural development by using principal component analysis approach
2. To study the disparities among districts of Odisha as regards certain indicators relating to agricultural development.

Sources of Data

The present study is based on secondary data collected from the publications of Govt. of Odisha namely Odisha Agriculture Statistics, District statistical Handbook, Economic Survey, District Statistical Abstract and District at a Glance of 2009-10.

Methodology

A. Selection of Indicators for the Present Study

In the present study seven important indicators as proposed by R.K Meher(1999) have been selected to measure agricultural development. These are:

1. Percentage of cultivable land to total land area
2. Percentage of net area sown to total cultivable area
3. Percentage of gross irrigated area to net area sown
4. Number of electric/diesel pump per 1,000 hectares of area sown
5. Number of tractors/ power Tiller per 1,000 hectares of area sown
6. Cropping intensity
7. Average yields of foodgrains per hectare

B. Method

For this study, Principal Component Analysis (PCA) has been used to measure district-wise agricultural development differential at various principal component levels as well as the aggregate level of development for the year 2009-10(Swain & Mohanty: 2010)

Table 1: Indicators of Agricultural Development

SL NO	DISTRICT	X_1	X_2	X_3	X_4	X_5	X_6	X_7
1	BALESORE	66	89	71	313	689	151	1515
2	BHADRAK	70	98	82	728	274	132	1802
3	BOLANGIR	53	95	27	1567	206	147	1101
4	SONEPUR	55	83	96	1486	459	195	1880
5	CUTTACK	48	88	90	635	537	195	1342
6	JAGATSINHPUR	62	88	119	1142	339	199	1399
7	JAJPUR	50	99	58	1218	298	195	1384
8	KENDRAPARA	58	97	78	1558	682	184	1236
9	DHENKANAL	42	84	51	1287	188	168	1154
10	ANUGUL	34	91	36	737	64	165	757
11	GANJAM	49	95	75	573	700	186	1285
12	GAJAPATI	18	92	50	682	42	196	1029
13	KALAHANDI	48	100	54	997	762	169	1209
14	NUAPADA	49	83	34	576	78	169	794
15	KEONJHAR	36	96	38	1204	312	149	1202
16	KORAPUT	35	93	43	675	168	132	1013
17	MALKANAGIR	25	97	45	437	84	160	1107
18	NABARANGPUR	35	99	23	354	63	155	1822
19	RAYGADA	27	84	35	346	95	160	1358
20	MAYURNHANJ	42	88	40	1194	477	130	1273
21	PHULBANI	16	88	28	640	22	168	1103
22	BOUDH	29	92	63	844	109	162	1360
23	PURI	54	72	108	723	418	210	1160
24	KHURDHA	46	96	62	1030	329	179	1408
25	NAYAGARH	34	86	49	1677	179	204	997
26	SAMBALPUR	29	80	65	721	664	168	1071
27	BARGARH	60	86	71	982	681	150	1855
28	DEOGARH	23	82	48	376	92	189	845
29	JHARSUGUDA	42	66	36	653	298	169	669
30	SUNDARGARH	32	90	33	835	631	133	711
	MEAN	42.23	89.23	56.93	873.00	331.33	168.97	1228.03
	STDEV	14.20	7.94	24.61	389.46	241.06	22.84	325.87

Source: Odisha Agricultural Statistics 2009-10, Directorate of Agriculture and Food Production Govt. of Odisha, Bhubaneswar

PCA is a technique to find a few uncorrelated linear combinations of original variables which can be used to summarize the data, losing as little information as possible in other words it is a technique to transform the original set of variables into a smaller set independent linear combinations so that most of the variations in the original data set is explained by those linear combinations. The linear combinations so selected are called Principal Components.

The main purpose of this analysis is to reduce the number of variables into a few ones that can explain most of the variance of the original data set.

C. Data and Analysis

In this study the following indicators have been considered:

X_1 = Percentage of cultivable land to total land area
X_2 = Percentage of net area sown to total cultivable area
X_3 = Percentage of gross irrigated area to net area sown
X_4 = Number of electric/diesel pump per 1,000 hectares of area sown
X_5 = Number of tractors/ power Tiller per 1,000 hectares of area sown
X_6 = Cropping intensity
$X_{7\,=}$ Average yields of foodgrains per hectare

For the data presented in Table 1, the correlation matrix ***R*** is computed in Table 2.

Table 2: Correlation Matrix(*R*)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1						
X_2	0.067	1					
X_3	0.611	-0.137	1				
X_4	0.305	0.140	0.169	1			
X_5	0.544	0.016	0.468	0.191	1		
X_6	0.013	-0.265	0.513	0.173	-0.014	1	
X_7	0.507	0.331	0.452	0.096	0.242	-0.043	1

The eigenvalues (li) and the percentage of variance explained by the principal component derived from the correlation matrix (R) are presented in Table 3.

Table 3: The Eigen Values and the Percentage of Variance

Components	Eigen values (li)	%of Variance	Cumulative %of Variance
1	2.591	37.011	37.011
2	1.524	21.767	58.778
3	.982	14.033	72.811
4	.878	12.548	85.360
5	.535	7.647	93.007
6	.321	4.582	97.589
7	.169	2.411	100.000

The weights of the principal components corresponding to first six eigenvalues computed by using the correlation matrix are presented in the Table 4. The reason for computing first six principal components corresponding to eigenvalues greater than 0.5 is due to the fact that they explain 93.007% of variation in data.

Table 4: Weights of the Principal Components

INDICATOR	PC_1	PC_2	PC_3	PC_4	PC_5
X_1	0.851	0.144	-0.123	-0.16	-0.232
X_2	0.095	0.774	0.348	0.291	0.399
X_3	0.842	-0.362	-0.118	0.211	0.06
X_4	0.414	0.021	0.808	-0.346	-0.195
X_5	0.686	0.071	-0.255	-0.494	0.41
X_6	0.284	-0.772	0.316	0.364	0.231
X_7	0.652	0.415	-0.12	0.476	-0.241

Thus, the principal components d_1, d_2, d_3, d_4 and d_5 are given as follows:

$d_1 = (0.851)Z_1+(0.095)Z_2+\ldots\ldots\ldots\ldots\ldots+(0.652)Z_7$

$d_2 = (0.144)Z_1+(0.774)Z_2+\ldots\ldots\ldots\ldots\ldots+(0.415)Z_7$

$d_3 = (-0.123)Z_1+(0.348)Z_2+\ldots\ldots\ldots\ldots\ldots+(-0.12)Z_7$

$d_4 = (-0.16)Z_1+(0.291)Z_2+\ldots\ldots\ldots\ldots\ldots+(0.476)Z_7$

$d_5 = (-0.232)Z_1+(0.399)Z_2+\ldots\ldots\ldots\ldots\ldots+(-0.241)Z_7$

where $Z_i = \dfrac{X_i - \mu_i}{\sigma_i}$, where μ_i is the mean of X_i's and σ_i is the standard deviation of X_i's

The principal component values for 30 districts of Odisha are presented in Table 5.

Table 5: Principal Component Value for the Districts of Odisha

Sl.No	DISTRICT	d_1	d_2	d_3	d_4	d_5	$\bar{d}$
1	BALESORE	2.6759	1.0592	-2.1779	-0.2583	0.1291	0.2856
2	BHADRAK	2.9978	2.7229	-0.9396	0.7189	-0.7753	0.9449
3	BOLANGIR	-0.4564	1.6927	1.6182	-1.0620	-0.6480	0.2289
4	SONEPUR	4.6703	-1.0318	0.6858	0.5238	-0.7351	0.8226
5	CUTTACK	2.3463	-1.2353	-0.6556	0.5447	0.5725	0.3145
6	JAGATSINHPUR	4.3167	-1.6135	0.3797	0.7380	-0.1778	0.7286
7	JAJPUR	1.5264	0.3423	1.4093	0.6840	0.2849	0.8494
8	KENDRAPARA	3.6874	0.2490	1.3580	-0.7884	0.5836	**1.0179**
9	DHENKANAL	-0.4076	-0.5066	0.8256	-0.4376	-0.6797	-0.2412
10	ANUGUL	-3.0856	-0.1552	0.3683	-0.1046	0.0939	-0.5766
11	GANJAM	2.1487	-0.0460	-0.6903	0.1557	1.1306	0.5397
12	GAJAPATI	-2.7447	-1.1369	0.7215	1.2177	0.5421	-0.2801
13	KALAHANDI	1.6937	1.2590	0.2450	-0.7156	1.1243	0.7213
14	NUAPADA	-2.3584	-0.8460	-0.4096	-0.3517	-0.4404	-0.8812
15	KEONJHAR	-0.9440	1.5287	0.8817	-0.4549	0.0143	0.2052
16	KORAPUT	-2.4303	1.4156	-0.3758	-0.2926	-0.1201	-0.3606
17	MALKANGIRI	-2.8690	0.8103	-0.1756	0.9509	0.4390	-0.1689
18	NABARANGPUR	-1.7783	2.4991	-0.5516	1.8043	-0.2510	0.3445
19	RAYGADA	-2.8101	0.0288	-1.0075	0.7912	-0.3924	-0.6780
20	MAYURNHANJ	-0.2470	1.5612	-0.0146	-1.3268	-0.4398	-0.0934
21	PHULBANI	-3.9668	-0.1908	0.1884	0.6451	-0.0307	-0.6710
22	BOUDH	-1.0384	0.3827	0.2368	0.8656	-0.1617	0.0570
23	PURI	2.7076	-3.7676	-0.9120	0.1842	-0.2456	-0.4067
24	KHURDHA	1.1251	0.5209	0.6403	0.5370	0.1766	0.6000
25	NAYAGARH	-0.4089	-1.7618	2.3666	-0.2750	-0.1837	-0.0526
26	SAMBALPUR	-0.1685	-1.2302	-0.9514	-0.9115	0.5203	-0.5483
27	BARGARH	3.6367	1.2065	-1.0000	-0.3979	-0.5337	0.5823
28	DEOGARH	-3.2713	-2.0307	-0.4672	0.5668	0.2567	-0.9891
29	JHARSUGUDA	-2.4550	-2.6933	-1.1304	-1.5804	-0.7472	**-1.7213**
30	SUNDARGARH	-2.0923	0.9665	-0.4661	-1.9706	0.6946	-0.5736

As d_1, d_2, d_3, d_4 and d_5 are uncorrelated and are shown to be normally distributed by Kolmogorov-Smirnov test (Table 6) we use $\bar{d} = 1/5\sum d_i$, which is also normally distributed to classify the districts of Odisha (Table 7).

Table 6: Test of Normality (One-Sample Kolmogorov-Smirnov Test)

		d_1	d_2	d_3	d_4	d_5	$\bar{d}$
Number of observation		30	30	30	30	30	30
Normal Parameters	Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Std. Deviation	2.5903	1.5241	0.9823	0.8779	0.5347	0.6650
Kolmogorov-Smirnov Z		0.690	0.457	0.633	0.865	0.487	0.501
Asymptotic Significance (2-tailed)		0.728	0.985	0.817	0.443	0.972	0.963

The classification of districts of Odisha on the basis of "*d*" calculated from all the 7 indicators considered in this study is shown in Table 7.

The percentiles of normal distribution are used to classify the districts .The values of $\overline{d}$ have been categorized by the following:

1. Less than ($\overline{d}$-0.6745xδ):	[Less than -0.4485] = Backward
2. ($\overline{d}$-0.6745xδ) to $\overline{d}$:	[-0.4485 to 0] = Underdeveloped
3. $\overline{d}$ to ($\overline{d}$+0.6745xδ):	[0 to 0.4485] = Developing
4. Above ($\overline{d}$+0.6745xδ):	[above 0.4485] = Developed

Further, districts have been divided into four level of development depending upon the values of the principal components, calculated from 7 indicators considered in the study.

Table 7: Classification of Districts

BACKWARD	UNDERDEVELOPED	DEVELOPING	DEVELOPED
ANUGUL	DHENKANAL	BALESORE	KENDRAPARA
NUAPADA	GAJAPATI	BOLANGIR	SONEPUR
RAYGADA	KORAPUT	CUTTACK	JAGATSINHPUR
PHULBANI	MAYURNHANJ	KEONJHAR	JAJPUR
DEOGARH	PURI	BOUDH	BHADRAK
SUNDARGARH	NAYAGARH	NABARANGPUR	GANJAM
JHARSUGUDA	SAMBALPUR		KALAHANDI
	MALKANGIRI		KHURDHA
			BARGARH

Results and Discussions

An analysis of classification of districts according to level of agricultural development of the State has been made in Table 7. This analysis shows an overview of how many districts need to be considered to formulate the revised policy and programmes strategies to improve those indicators which contribute to low level development. It is thus observed that 7 out of 30 districts of Odisha have come under the category of backward districts, 8 districts underdeveloped, 6 districts developing and 9 districts in developed categories, showing thereby that large regional disparities exist in levels of agricultural development in the State. Agricultural development is the highest in **Kendrapara** district and the lowest in **Jharsuguda** district. The result suggests that proper steps be taken by the Government of Odisha to reduce the disparities level in a phased manner by prioritizing the districts for each critical indicator under study.

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