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A statistical SWOT up on garbled agricultural disparity at grassroot levels: A statistical analysis at block levels of Sambalpur district

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Abstract
Agriculture is the strength of Indian economy which provides employment for approximately 65% of the workforce across the country. Regional inequality due to the unequal level of agricultural developments remains a major problem in India and Odisha in particular. In the present study, an attempt has been made to study the regional inequality in agricultural development among the nine blocks of Sambalpur district. The study utilizes published data obtained from Statistical Abstract of different districts in Western Odisha and 'District Outlines' published annually by the Directorate of Economics and Statistics (DES), Government of Odisha, for the year 2015-2016. Using technique of Principal Component Analysis (PCA), Seven Principal component were extracted which were found to be normally distributed by Kolmogorov Smirnov test. The three Quartiles Q_1, Q_2 and Q_3 of the Normal probability distributions are used to classify the nine blocks into four homogeneous groups namely Meteoric, Progressive, Mediocre and Laggard on the basis of their composite index scores. The analysis finds that three blocks namely Dhankauda, Jamankira and Jujumura have the highest level of agricultural developments and are the Meteoric while two blocks namely Bamra and Naktideul have the lowest level of development and can be categorised as Laggard blocks. Kuchinda and Maneswar blocks are relatively less developed than Dhankauda, Jamankira and Jujumura and can be categorised as Progressive blocks while Rengali and Rairakhol are relatively more developed than the Lagard blockes and less developed than the Progressive blocks in terms of agricultural developments and may be treated as Mediocre blocks.

Keywords: Principal component analysis, Kolmogorov Simonov test, meteoric, progressive, mediocre and laggard

Introduction
The First Agriculture Policy, that came into force in 1996, conferred the status of industry on agriculture, has been revised twice post globalisation during 2008 and 2013 making it more inclusive and comprehensive, of late has undergone a major metamorphosis with its orientation towards market linkage and expected to bring a substantial change in farmer's income through realisation of better prices, Government launched Samrudhi Agriculture Policy 2020 for the State of Odisha.

A flagship scheme Mukhyamantri Krushi Udyog Yojana (MKUY) of State Government has been launched during 2018 to provide single window facilities for promoting commercial agri-enterprises. Subsidies are being provided for setting up of Commercial agriculture/ horticulture/ animal husbandry/ fisheries units.

NAFIS-2016-17 (NABARD All India Rural Financial Inclusion Survey) was undertaken by NABARD in all states on sample basis for the reference year 2015-16. As per that survey result the estimated average monthly income of an agricultural household for Odisha was INR 7731/- and the same for India was INR 8931/-for 2015-16.

The state Odisha comprising of 30 districts ranks 9th by area and 11th by population has an agricultural-based economy. However, the state faces many developmental problems in terms of regional inequality. Due to several economic, agricultural and social barriers, all regions in Odisha do not share development benefits equally.

The Indian economy is an agricultural economy and is known for its diversity in agricultural development, mainly due to the diversity of economic and social factors (Handa, 2014) [27], The broad concept in Agricultural Development represents the quality and development of the local agricultural system in particular including the development of the agricultural system, improved agricultural resources, irrigation system and irrigation system, good quality of high yielding varieties, fertilizer [NPK], insecticides and pesticides, agricultural potential and agricultural trade Mohammad Ali, (1979) [1]. Development in the agricultural sector is a continuous process of increasing agricultural production and is influenced by a number of factors such as the size of the agricultural area and irrigation, crop accumulation, infrastructure, agricultural technology and human resource technology etc. Krishna G. 1992 [3]. Agricultural development research plays a very important role in identifying the major problems of any appropriate region to show farmers or policy makers the steps to address inequalities in a fair way (Jadhav, 1997) [5]. Since the past six decades, regional diversity in agricultural development has been one of the most important and growing problems in developing and developing countries (Sharma, Kumar 1993) [4]. The regional inequality of development in India continued to be a major problem despite the fact those regional and economic planning efforts by the government and the central government. Kumar (2008) [13], attempted to look at total agricultural growth and productivity and said both were key factors in the development of any economic sector in the southern part of Asia. Pandey (2009) [16] had attempted to research the state of the Indian agricultural sector and found that the country had made significant progress in adopting new farming tools and strategies and building an efficient and sustainable infrastructure for the use of available resources. Since the 1980s, regional diversity in agricultural growth and production has continued steadily among the less developed and developed regions of India. This is despite the fact that special efforts have been made to reduce inequality in the state by promoting the level of agricultural development in developing countries Kumar 2008 [14].

Literature review

Since the 1960s, many studies have been conducted on regional differences made at the state and national level. Where the researcher has used different tools and methods to reach a conclusion. Rangarajan (1982) [2] in his study analyzed the linkages between agriculture sector and Industrial sector in India. Three types of linkages, namely demand, production, saving and investment were discussed. The results of the report stated that one percent increase in agricultural output increases the industrial production by 0.5% and national income by 0.7%. The findings of the study corroborates the experiences of Indian economy in the 1980s and 1990s. The trend growth rate of 3.2% in agricultural production during the 1980s contributed to the growth in industrial production in the 1990s. Eicher & Staalz (1998) [6] in their book had taken in to account the recent developments in agriculture across the countries in the world. Lessons taken in the field of agriculture and rural development since 1950s in these countries have been discussed. Chand & Chauhan (1999) [7] in their policy paper had shown regional disparities in term of per hectare agriculture productivity and income among various states since 1980-81. The study had witnessed widening gap between developed and underdeveloped, and, poor and rich states. Disparities in terms of per hectare productivity and per rural person NSDP in agriculture among major states (16 states) for different year had been calculated through co-efficient of variation. Results of the study showed that regional disparities in agriculture productivity have increased from 36% during 1980-81 to 1984-85 to 40% during the latter half of 1980s and further increased to 43% during 1990s.

Ferroni, Kohli & Sood (2000) [8] studied performance of agricultural sector in India over the past thirty years. Agriculture in India plays an important role in its overall development and dynamism. However, a lot needs to be done in this sector to sustain high economic growth of the nation. Narain, Shanna & Bhatia (2002) [9] in their paper had estimated the level of development of various districts of Madhya Pradesh. Technique of composite index was used to estimate the level of development separately for agriculture, industrial, infrastructure and socio-economic field. 45 districts were selected and each district was taken as a unit of analysis. The study was carried out for the year 1994-95 on 47 indicators. Coefficient of variation and statistical technique given by Narain *et al*. 2002 [9] were applied to construct composite index. Varma (2004) [10] in his study analyzed inter-regional economic inequalities in Rajasthan with the objective to measure inter-district inequalities prevalent in various sectors of the economy and livelihood. Pardey, Julian & Roley (2006) [11] in their book analyzed the importance of R&D in agriculture in developing countries. The world's agricultural economy was transformed remarkably during the 20th century and in this increasingly interdependent world, both rich and poor countries have depended on agricultural research conducted in the private and public laboratories of these few countries, even if they have not contributed to financing the activity. Shenggen, Gulati & Thorat (2007) [12] in their book reviewed the trends in government subsidies and investments expenditure on Indian agriculture by government and had shown the impact of these expenditures on agricultural growth and poverty reduction in India. The authors had suggested several reform options with regard to re-prioritizing government spending and improving institutions and governance. The major findings of the book were that to make small farmers adopt new technologies initial subsidies in credit, fertilizer, and irrigation are crucial, because of the reason that small farms are often losers in the initial adoption stage of a new technology reason being that the agricultural products prices are typically being pushed down by greater supply of products from large farms which adopted the new technology. EPW Report (2008) [13] discussed the prevailing disparities at state, inter-state and intra-state level and challenges imposed on agriculture sector in terms availability of finance. State-wise analysis revealed that a substantial proportion of farmers wanted to leave farming profession as now it is no longer profitable. Inter-regional disparities had further widened and ground level credit shares of central or eastern region had either declined or stagnated, in spite of increase in state income share of almost all underdeveloped regions between 1993-94/1995-96 averages and 2002- 03/2004-05 averages. Bhalla & Singh (2009) [15] in their research article had thrown light on the changes in Indian agriculture in terms of crop yields and total agriculture output in post economic liberalization period (1990-93 to 2003-06) and compared it with pre-reform period (1980-83 to 1990-93). To support the study the authors had studied detailed data for 281 districts of India and provided district-wise analysis on agricultural growth in India from the beginning of liberalization to the period of slowdown in agriculture and rising farmer distress. The results of the study

shows that there was deceleration in the growth rate in crop yields as well as total agriculture output in most of the states in India in post-reform period. The authors had used the econometric techniques and statistical measures to analyze significant issues related to agriculture in India. Reddy (2010) [17] in his paper examined how regional diversity in A.P has increased since its inception and suggested policy interventions to reduce this differences. The author used Gini concentration Ratio's (GCRs) to calculate the agricultural production of two paddy and legume crops at regional level and Large Irrigation Area (LIA). The results showed that the Gini Ratio increased LIA indicating that the benefits of land development/ irrigation were growing significantly in a few regions. The author has suggested that the different regions of the state are not geographically different and therefore there is a need for different policy interventions accordingly. Bhalla & Singh (2010) [18] conducted this study with the aim of analyzing the regional approaches to the levels and growth of agricultural production, productivity per agricultural activity in each region, region and region. The report used strategies such as frequency collector, Lorenz curve and economic model to analyze variability. Birtha, Singh & Kumar (2011) [19] in their papers investigated rapid economic growth in major Indian countries during the period of economic independence (1980/81-2004/05) and analyzed factors that contributed to economic growth in these provinces and led these to a similar position of stability. The results showed that there was a complete diversification of inflation rates in all provinces. The paper suggested that investment in tangible infrastructure and human resource development alone is not enough; instead investing in these sectors should go hand in hand with reducing agricultural employment pressures by improving labour market links with non-agricultural sectors to boost economic growth, and by promoting labour-intensive agricultural technology. Chand & Raju (2011) [20] have studied the instability and regional diversity of Indian agriculture in their policy paper. The main reason for the persistent diversity of regional agriculture and farm incomes was the unequal effect of technological change and the formulation of certain government policies. Ramaesh & Kumari (2012) [21] in their paper analyzes regional and regional inequalities in agricultural development in the Uttar Pradesh region using 13 guidelines for agricultural development with the help of a UNDP (United Nations Development Programme)-based approach. The variance associated with the changes in the various regional categories is calculated by the two-year consolidation index for the phases 1990-91 and 2008-09. The results of this paper show that there are high and persistent differences between agricultural countries in government over the years. Andrabi and Khan (2013) [22]. The main purpose of this paper was to look at differences at the level of agricultural development at the district level. The authors used the 'Z-score' process, selected seven variables for agricultural development and ranked the regions according to their level of development. Ordinary schools of the CSS-Composite Standard Scores were consolidated to find inequalities in agricultural development in the Kashmir district Kumar & Jain (2013) [23] in their study highlighted the growth trends and instability of Indian agriculture at the regional level. The paper calculated the crop production rate for different regions - very low, low, average, high, very high. The newspaper suggested that drastic stabilization measures, such as insurance, be taken to reduce the effects of the instability. In addition, the newspaper emphasized the importance of modern technology and the rational management of rainwater. Tripathi & Umakanta (2013) [24] focused on regional diversity development in different regions of Orissa state in their paper. Comparisons were made in two areas of the period 1980-81 and 2000-01. On the basis of the findings the different regions were divided into the most regressive, backward, developing, and advanced categories. This paper used a log-line function to determine the growth rate of different development indicators. The paper suggested that the national government should empower the State Treasury to conduct a multi-level assessment of the needs of the various regions and thus meet the goal of reducing diversity at the level of government. Mukherji, Stuti & Shah (2013) [26] in their paper emphasized the regional divergence in the country's groundwater economy and suggested the need for effective management strategies. The newspaper also reported the decline in India's groundwater economy from 2000-01 on the basis of data from four small amounts of irrigation by the Department of Water Resources between 1986-87 and 2006-07. According to a 2007 commission planning report, there were 1610 critical and critical blocks of which 85% were in nine provinces - Rajasthan was one of them. Power shortages have been identified as a major cause of misuse of groundwater schemes since the 1980s. Gadekar Deepak Janardhan (2015) [28] studied the Interim Human Resource Development Study at Akole Tehsil. He analyzed staff development and compared mathematical strategies with the maps used. The mathematical strategies used are measurement data to convert quality data e.g. overcrowding, growth rate, gender, education, agricultural density, nutrition, calorie intake and small resources. Gadekar Deepak Janardhan (2016) [29] He studied agricultural development in the Ahmednagar region, using Kendall's collaborative approach to analyzing spatial diversity in agricultural development in the Ahmednagar region. The level of agricultural development is determined by ten dynamic foundations. Gadekar Deepak Janardhan and Sonawane Vijay Rajendra (2017) [30] in this study in Ahmednagar district in Maharashtra district selected for his study. The rural economy is almost an agricultural economy, vulnerable to a variety of climatic and economic conditions. Agricultural development is low. However, irrigation has led to the creation of property for used agricultural areas. This type of regional variability has been identified within the tahsil level study conducted. It can be assumed that social development is reflected in all the economic development of the learning environment. Socio-economic status depends on the interests of the community, agricultural development and economic activities in moderate or climatic conditions. Lawande Gangadhar Bhauro and Mhaske PH (2018) [31]. In this study regional variability in technological success has been identified as the third largest in the development process. The credible aspect of such technological divisions in the world cannot be denied at present. As technology is the most important form of development strategy, regional diversity in technological development also plays an important role in increasing compassion for all types of developmental regions. Imran Ali baig & Md. Abdus Salam (2019) [32]. In this study Analyzes regional differences in agricultural development at the level of blocks in Aligarh region of Uttar Pradesh for the period 2017-2018. The research analysis revealed by modifying and compiling the corresponding data with fifteen indicators using Principal Component Analysis [PCA]. The established index was developed using a key component to find regional differences in Block Levels in Aligarh district. Drs. Giri Sanjay Pralhad and Gadekar Deepak, Janardhan

(2020) [33] in this study they Measure the level of development in the learning area using 19 indicators. The indicators are broadly divided into four categories namely, Census, Resources, Agriculture and Employment. Level of development at the village level in the learning area. Z's scoring system has been used to study the level of development in the national area. This study will show which city is undeveloped and developed. This study will be useful to the local Gram Panchayat and various government agencies to solve local problems.

In the present study an attempt has been made to study the regional variability in agricultural development among the nine blocks of Sambalpur district on the basis of their composite scores by segregating them in different levels of agricultural developments such as Meteoric, Progressive, Mediocre and Laggard so that focus can be put on their relative level of developments.

Data: The study is based on cross sectional data obtained primarily from the 'Statistical Abstract of different districts in Western Odisha and 'District Outlines' published annually by the Directorate of Economics and Statistics (DES), Government of Odisha for the year 2015-2016 [29]. However the composite index has been constructed by using principal component to find out the regional variability at Block Levels in the Sambalpur District. The following indicators are considered for the study: X_1-Consumption of fertilizer per hector [Kg], X_2-Percentage of agricultural labourers to the total main workers, X_3-Density of population, X_4-Number of livestock per thousand population, X_5-Percentage of agricultural laborers to the total main workers, X_6-Percentage of agricultural worker to the total population, X_7-Percentage of area commercial crops to total area, X_8-Percentage of area food grain to total cropped area, X_9-Percentage of cultivator to the total main workers, X_{10}-Cropping intensity, X_{11}-Irrigation intensity, X_{12}-Percentage of net irrigation area by open well to total net irrigated area, X_{13}-Percentage of net irrigation area by tube well to total net irrigated area, X_{14}-Percentage of net irrigation area by lift to total net irrigated area, X_{15}-Percentage of net irrigation area by minor to total net irrigated area, X_{16}-Percentage of net irrigation area by major to total net irrigated area, X_{17}-Percentage of net irrigation area by creek to total net irrigated area, X_{18}-Percentage of literate population to total population, X_{19}-Percentage of total main worker to the total population, X_{20}-Geographical area, X_{21}-Forest area, X_{22}-Miscelineous tree, crops and groves, X_{23}-Permanent pasture and other grazing land, X_{24}-Net area sown to geographical area, X_{25}-Barren and uncultivable waste land, X_{26}-Land put to non-agricultural uses and cultivable waste land.

Objectives of the study

1. To examine the performance of agricultural development amongst the blocks.
2. To quantify region wise disparities in agricultural development.
3. To identify the regional variation in the developmental level of agriculture.
4. To identify the problems and suggest remedies for agricultural development.

Methodology

A Principal Component Analysis (PCA) is concerned with explaining the variance and co-variance structure of a set of variables through a few uncorrelated linear combinations of original variables can explain most of the variance of the original dataset. The linear combinations so obtained are called Principal Component. The Principal component of $i^{th,}$ component $P_i$is given by

$$P_i = a_{i1}Z_1 + a_{i2}Z_2 + a_{i3}Z_3 + \ldots\ldots\ldots\ldots + a_{in}Z_n$$

Where

a_{ik} *are the weight of the input variable* Z_i

in the linear composite of the factor k

and $Z_i = \frac{(X_i - \mu_i)}{\sigma_i}$, are standard normal variable

$(i = 1,2,\ldots\ldots n)$.

The reason for conducting the analysis of the first seven principal component is because they explain 97.229% variation of data and Eigen Value is more than 0.81 [Kaiser's Criterion]. The researcher used Kaiser's law to select the primary component number. Kaiser's case, describe only those parts that are Eigen Value greater than one that are considered important and should be kept in the analysis [Table-1]. Also the scree plot [Figure-1] indicates distinctly seven significant linearly independent components.

In this study the researcher uses the composite index which is the arithmetic mean of all the principal components extracted by the method of principal components. Factor Loading represents the correlation between factors and all twenty six indicators [Table-2]. The study used the Kolmogorov-Smirnov to test the normality of all principal components extracted [Table-3]. The criteria for block divisions into four levels of agricultural developments are based on the quartiles of normal distribution. Since the first quartile of Normal distribution given by $Q_1=\mu-0.6745x\sigma$ and $Q_3=\mu+0.6745x\sigma$ where μ and σ are the mean and standard deviation of the composite index (CI) the detailed block classifications are according to the criteria as given in [Table-5].

The data obtained from the above mentioned twenty six indicators on nine blocks of Sambalpur district are analyzed through SPSS-16.0 under the MS-XP environment and seven principal components are extracted that accounts for In this study, Principal Component Analysis has been used to measure block-wise agricultural development differential at various principal component levels as well as aggregate level of development for the year 2015-2016 [29]. However the composite index has been constructed by using principal component to find out the regional variability at Block Levels in the Sambalpur District.

$$CI_j = \frac{1}{7}\sum_{i=1}^{n=7} P_i (j=1,2,3,\ldots\ldots 9;\ i=1,2,\ldots\ldots 7))$$

Where, $CI_j$is the composite index of the j^{th} blocks (j=1, 2….9) and $P_i(i = 1,2,3 \ldots .7)$are principal components. [Table-4].

Table 1: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.681	33.387	33.387	8.681	33.387	33.387
2	4.675	17.981	51.368	4.675	17.981	51.368
3	4.196	16.137	67.504	4.196	16.137	67.504
4	2.924	11.247	78.751	2.924	11.247	78.751
5	1.885	7.248	85.999	1.885	7.248	85.999
6	1.536	5.906	91.905	1.536	5.906	91.905
7	1.384	5.324	97.229	1.384	5.324	97.229

Extraction Method: Principal Component Analysis.
a. 7 components extracted

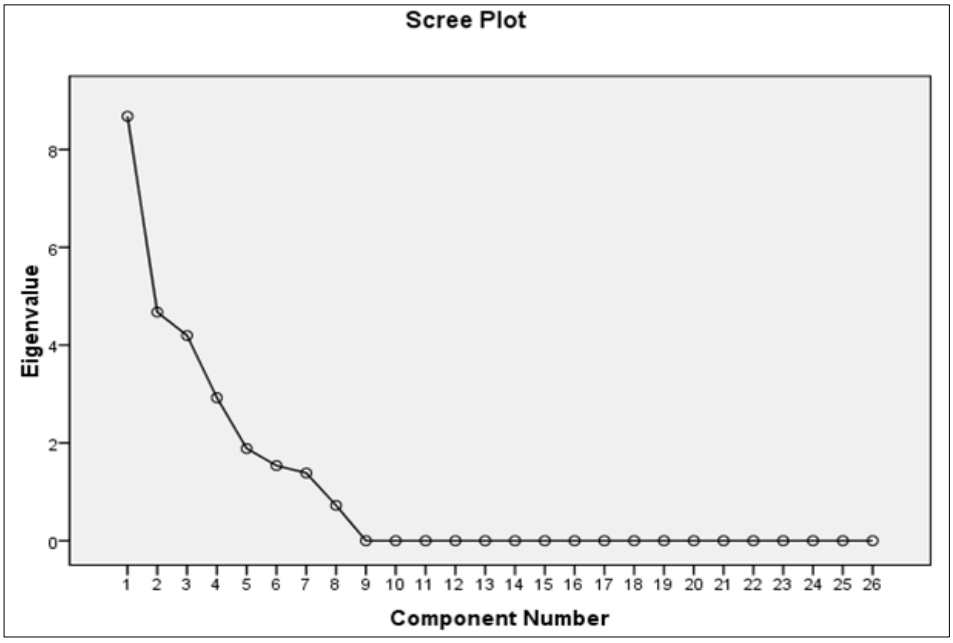

Fig 1: Component number

Table 2: Factor Loadings

Factor Loadings							
Indicators (X)	Component						
	1	2	3	4	5	6	7
Consumption of fertilizer (kg)	.078	.118	.022	.142	.086	.009	-.045
Population density	.085	.097	.067	-.084	-.041	.092	.032
Number of Livestock per hundreds Population	-.080	.005	.033	.202	-.066	-.166	-.189
Percentage of Agriculture labour to total main worker	.024	-.003	.012	-.322	.079	.022	.145
Percentage of Agricultural Worker to total Population	-.079	.143	.035	.031	.044	-.088	-.127
Percentage of Area Food Grain to Total Cropped Area	.057	.038	.169	-.050	.160	-.069	.149
Percentage of Area Commercial Crop to Total Area	.081	.061	.031	.127	-.059	.045	.360
Percentage of Cultivator to the total main worker	-.096	.065	.050	-.021	.019	-.057	.281
Cropping intensity	.054	-.017	-.093	.248	-.038	.151	.130
Irrigation intensity	.084	.090	.099	.088	-.057	-.057	-.037
Percentage of net irrigated area by OPEN well to total irrigation area	-.078	.029	-.069	-.016	.077	.125	.298
Percentage of net irrigated area by TUBE well to total irrigation area	-.091	.063	-.021	-.028	-.019	.344	.000
Percentage of net irrigated area by LIFT to total irrigation area	.024	.181	.098	.010	-.133	.010	.069
Percentage of net irrigated area by MINOR to total irrigation area	.010	.044	.156	-.096	.161	-.088	-.401
Percentage of net irrigated area by MAJOR to total irrigation area	.092	.074	.099	.052	-.070	-.028	.016
Percentage of net irrigated area by CREEK to total irrigation area	-.077	.093	.099	-.089	-.128	.141	.083
Percentage of Literate population to total population	.061	-.128	.127	-.029	-.097	.117	.001
Percentage of total main worker to total population	.074	.006	-.017	-.037	.265	.331	.019
Geographical area	-.063	-.112	.120	.100	.102	.005	.060
Forest area	-.054	-.114	.151	.073	.016	-.061	.137
Misc. tree grove crop	.004	.015	-.044	.111	.487	.063	-.002
Permanent pasture and other grazing land	-.066	.149	-.024	-.087	.017	-.106	.074
Net area sown to geographical area	.051	.042	-.185	-.023	-.178	-.132	.029
Barren and un-culturable waste land	-.059	-.049	.172	.100	-.069	.099	.135
Land put to non-agri uses	.052	-.163	.045	-.099	-.145	.100	-.020
Cultivable waste land	-.036	.060	.012	.050	-.140	.478	-.297

Table 3: One-Sample Kolmogorov-Smirnov Test (Test for Normality)

		P_1	P_2	P_3	P_4	P_5	P_6	P_7
Number of observations		9	9	9	9	9	9	9
Normal Parameters[a]	Mean	-.00011	.00000	.00000	.00011	.00000	.00022	.00011
	Std. Deviation	1.0013	1.00002	1.00090	1.00035	1.00084	.999577	1.00012
Most Extreme Differences	Absolute	.106	.201	.247	.181	.246	.259	.202
	Positive	.106	.137	.247	.181	.246	.259	.154
	Negative	-.100	-.201	-.131	-.179	-.205	-.167	-.202
Kolmogorov-Smirnov Z		.317	.604	.742	.544	.738	.776	.607
Asymp. Sig. (2-tailed)		1.000	.859	.640	.929	.648	.584	.855

a. (Test distribution is Normal)

Table 4: Construction of Composite Index for blocks

Blocks	P_1	P_2	P_3	P_4	P_5	P_6	P_7	$CI_j = \frac{1}{7}\sum_{i=1}^{n=7} Pi$
Bamra	-0.747553	1.094965	-0.79054	-1.45919	-0.52924	-1.21033	0.921005	-0.38870
Dhankuda	1.599384	0.735366	-0.26533	1.561686	-0.82338	-0.32281	0.82996	0.47355
Jaminkira	-0.323267	0.373804	-0.20385	0.648892	2.295339	-0.65048	-0.27937	0.26587
Jujumura	0.213959	-0.02493	-0.61523	-0.16565	0.782286	1.36606	0.498511	0.29357
Kuchinda	-1.436086	1.031328	0.485	0.558783	-0.75187	1.475763	-0.4758	0.12673
Maneswar	1.074540	0.462864	1.918796	-1.02828	0.079933	-0.23199	-0.92436	0.19307
Naktideul	-0.114679	-0.78239	-1.12521	0.314239	-0.72645	-0.69242	-1.96761	-0.72779
Rairakhol	-0.995576	-1.60754	1.174885	0.629818	-0.27594	-0.70049	1.020645	-0.10774
Rengali	0.729281	-1.28346	-0.57851	-1.0603	-0.05068	0.966694	0.37702	-0.12856

Percentage of standard distribution is used to divide Blocks. The methods of blocking blocks in the Sambalpur District are

Table 5: Criteria for Block classification in terms of Agricultural Development

Above[$\overline{CI}$+0.6745xσ]	Meteoric
$\overline{CI}$to[$\overline{CI}$+0.6745xσ]	Progressive
[$\overline{CI}$-0.6745xσto$\overline{CI}$]	Mediocre
Below [$\overline{CI}$-0.6745xσ]	Laggard

Where

$\overline{\mathrm{CI}}$ = Mean composite index score= $\frac{1}{k}\sum_{j=1}^{k} \mathrm{CI_j} = 0$ and

σ = Standard deviation of composite index

Score = $\sqrt{\frac{1}{k}\sum_{j}^{k}\left(\mathrm{CI_j} - \overline{\mathrm{CI}}\right)^2}$=0.378047

k=1, 2, 3…….9 based on the mean value of the combined index ($\overline{CI}$) listed in all twenty-six indicator (Table No. 5). The blocks are segregated into different four classes such as Meteoric, Progressive, Mediocre and Laggard based on their respective CI score as depicted as follows (Table-6).

Table 6: Block classification in terms their Composite index Scores

Composite Index Score	Blocks	Class
[Above 0.254961]	Dhankauda (0.47355), Jujumura (0.29357), Jaminkira (0.26587).	Meteoric
[0.0 to 0.254961]	Maneswar (0.19307), Kuchinda (0.12673).	Progressive
[-0.254964 to 0]	Rairakhol (-0.10774), Rengali (-0.12856).	Mediocre
Below -0.254961	Bamra(-0.38870), Naktideul(-0.72779)	Laggard

Table 7: Z-Score Matrix

(Z-Score Matrix)								
Z1	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**
-0.7545116	-0.0314701	-0.2925583	1.2389412	0.9553646	-0.3388778	-0.4263556	1.3245535	-1.2623482
1.9563620	1.1738590	-0.2311057	-1.1476877	-0.6699917	0.3990892	2.3743039	-0.9348687	2.0488998
0.7485470	-0.3312757	0.5704137	-0.4931196	0.8177218	0.1757929	-0.2761147	0.3592406	-0.0394317
-0.1908646	-0.4068814	-0.9784562	0.5878828	-0.4591347	0.3664116	0.0970642	-0.2702501	0.6768791
-0.0835033	-0.1448786	1.2825801	-1.0213368	1.6084357	-0.9107342	-0.4360486	1.2634310	-0.2661400
0.7485470	1.6178970	-0.7974119	1.1248743	-0.0374206	2.0520263	0.2412470	-0.6404975	-1.2366255
-0.5666292	-1.1008543	0.8557013	-0.8546237	-0.1984920	-1.4689749	-1.3217427	-1.1442306	0.2395938
-1.3718392	-1.4355548	1.1147824	-0.5422561	-0.2673134	0.2656560	-0.3106459	0.9838135	-0.2783473
-0.4861082	0.6591588	-1.5239454	1.1073256	-1.7491697	-0.5403891	0.0582924	-0.9411917	0.1175201
Z10	Z11	Z12	Z13	Z14	Z15	Z16	Z17	Z18
-0.7545116	-0.0314701	-0.2925583	1.2389412	0.9553646	-0.3388778	-0.4263556	1.3245535	-1.2623482
1.9563620	1.1738590	-0.2311057	-1.1476877	-0.6699917	0.3990892	2.3743039	-0.9348687	2.0488998
0.7485470	-0.3312757	0.5704137	-0.4931196	0.8177218	0.1757929	-0.2761147	0.3592406	-0.0394317
-0.1908646	-0.4068814	-0.9784562	0.5878828	-0.4591347	0.3664116	0.0970642	-0.2702501	0.6768791
-0.0835033	-0.1448786	1.2825801	-1.0213368	1.6084357	-0.9107342	-0.4360486	1.2634310	-0.2661400
0.7485470	1.6178970	-0.7974119	1.1248743	-0.0374206	2.0520263	0.2412470	-0.6404975	-1.2366255
-0.5666292	-1.1008543	0.8557013	-0.8546237	-0.1984920	-1.4689749	-1.3217427	-1.1442306	0.2395938
-1.3718392	-1.4355548	1.1147824	-0.5422561	-0.2673134	0.2656560	-0.3106459	0.9838135	-0.2783473

-0.4861082	0.6591588	-1.5239454	1.1073256	-1.7491697	-0.5403891	0.0582924	-0.9411917	0.1175201
Z19	Z20	Z21	Z22	Z23	Z24	Z25	Z26	
-1.04022	-0.77595	-0.87691347	1.891688	1.060143	-0.80579	-0.96783	-0.82819	
-0.97867	-0.79366	-0.13665008	-0.59414	1.307502	-0.52042	-0.18272	-0.47511	
0.649225	0.110275	2.25065408	0.669593	-0.66344	-0.37398	-1.33759	-0.79125	
-0.67517	-0.69143	1.043427484	-0.72162	0.2113	-0.27936	-0.06285	0.746807	
0.625878	0.358996	-0.47420295	1.220301	-0.96471	1.201557	-1.01848	2.226608	
-0.29525	0.066004	-0.54388544	-0.35788	-0.84367	0.229798	0.742521	-0.03181	
-0.41411	-0.54976	-0.44795889	-0.69613	0.990904	-0.83433	0.366008	0.370286	
2.105204	2.413164	-0.45791353	-0.72842	-1.40182	2.053912	0.737456	-0.79267	
0.023111	-0.13764	-0.35655718	-0.68338	0.303796	-0.67137	1.723481	-0.42467	

Conclusion

Natural calamities like cyclone, drought, floods and pest attack are common features in Odisha. Almost every year or in alternate year, one part or the other of the State is hit by natural calamities of varying intensity and agricultural production is badly affected. In spite of so many risk factors, timely interventions and introduction of risk mitigation schemes of Government like PMFBY (Pradhan Mantri Fasal Bima Yojana) and other interest subvention and input subsidy schemes could restructure farmers' distress and the State has now become self-sufficient in food grains. Agricultural credit is an important input for the increasing capital intensive and technology driven nature of agriculture, such as for irrigation, farm implements and machines, quality seeds, etc.

Crop-loan is the most important need of the farmer to increase and maintain his productive ability in a technology driven nature of agriculture. Crop loan is a short term advance that is given to the farmers by banks and cooperative societies can be used to purchase improved seeds, fertilizers etc. and adopt new technologies to improve the productivity as well as income. Cheaper availability of crop loan, in a very low interest rate, is meant to give easy working capital to the farmers.

During the recent years several post harvesting structures have been created and different post-harvest activities have been implemented in Odisha. The most of the post harvesting structures are mandis, regulated multi commodities cold storage, cashew processing plants, small scale presentation unit, pack houses, low cost onion structures, e-NAM mandies etc.

A Farmers' welfare programme - Krushak Assistance for Livelihood and Income Augmentation (KALIA) has been introduced in 2018 to accelerate agricultural prosperity and reduce poverty in the State through providing support to cultivators for cultivation for small and marginal farmers both for Kharif and Rabi seasons, livelihood support for landless agricultural households for taking non-farm activities such as goat, sheep, poultry farming, mushroom cultivation, bee keeping and fishery activities. This initiative of the State Government has been recognised and appraised at the various forums in the country.

The new scheme Balaram (Bhoomihina Agriculturist Loan and Resources Augmentation Model) has been launched by Govt. of Odisha during 2020 to provide institutional credit to share croppers among the majority of marginal and small farmers cultivating others' land on lease and those have no other access to avail institutional credit. The target is to facilitate one lakh JLGs covering 5 lakhs sharecroppers. This is a model scheme of the state for poor share croppers with objective to increase the living standard of farmers and income of farmers' household.

In order to establish an intensive pest monitoring mechanism and to strengthen the pest surveillance and management system, e-pest surveillance programme was launched by the State during 2010-11 with the involvement of National Research Centre of Integrated Pest Management (NCIPM), New Delhi, Central Integrated Pest Management Centre (CIPMC), Bhubaneswar & OUAT, Bhubaneswar which helps in monitoring the pests and adoption of timely control measures. (Government of Odisha, 2021) [34].

An analysis of the classification of blocks according to the level of agricultural development is shown in Table No. 6. The result clearly shows that remedial measures are required during the formulation of appropriate policy and program planners to improve those factors that contribute to low agricultural development. We have analyzed from the table above [Table 6], the low level of agricultural development due to the low level of technology and rural infrastructure in the agricultural sector in those blocks. Districts such as all nine blocks with low level of agricultural development require special attention to policy and are designed to improve farmers' awareness of technological advances and the use of fertilizers, fertilizers etc. Government should increase budget and community investment in agricultural investment and revise its mandate. Government should focus on major agricultural problems such as irrigation, high quality seeds and shortages of agricultural inputs such as HYVS seeds, Fertilizers and pesticides by providing a high amount of subsidies to farmers who play a key role in reducing the cost of food grain production. However, farmers compensate for the budget and expenditure on other aspects of the agricultural sector and farmers are encouraged to cultivate more and ensure investment to attract more investment in the entire agricultural sector. The government should take appropriate action to reduce regional diversity in agricultural development in the right way by prioritizing each critical indicator at the level of prevention in the Sambalpur region.

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