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An Evaluation of the Productivity and Flourishing Situation of the Agricultural Sector: A Block-by-Block Study for Birbhum District, West Bengal, India

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Abstract

Agriculture plays a vital role in the economy of India. Till now major parts of the rural Indian population are directly or indirectly depended on agriculture. From agricultural point of view, India set a unique identity by their physical, infrastructural, institutional and technological factors. India's agricultural productivity is mainly dependent on monsoon. Among the blocks in Birbhum district of West Bengal state, the current study aims to examine the spatial patterns of agricultural productivity, variances in the levels of agricultural development, and the haphazard relationships between agricultural productivity and specific agricultural development variables. The relationship between crop production and the degree of agricultural development is analyzed and illustrated using the Crop production Index and Z-Score statistical tools. The findings indicated a favorable correlation between agricultural development and production. In the western portion of the district, where agricultural growth is likewise at a tough stage, the state of agricultural production is quite bad due its physical attributes.

Keywords: Agricultural Development, Agricultural Productivity, Birbhum District, Z score

1. Introduction

Agriculture is the primary source of economic activity and productivity for most of the individual on Earth. The agricultural sector, which enables India to generate enough food on its own and it is the backbone of the national economy. It is the primary source of income for millions of people in West Bengal and India. It has a direct impact on the GDP (Gross Domestic Product) and social status of the rural people (Mukherjee & Khan, 2016) [6]. The agriculture industry employs 75% of India's labour force and contributes around 50% of the nation's GDP (Kumar & Manimannan, 2014) [5]. It's essential to reducing poverty, meeting food demands, and supplying the agro-industry with raw materials. Agricultural productivity is a measurement that quantifies how much crop production is possible in agriculture. Productivity in agriculture is defined as the ratio of output to input in terms of land, labour, capital, and other resources (Salaria, 2014). It's an appropriate method for assessing the status of agriculture in any particular area. Physical, socioeconomic, political, institutional, and organizational variables all have a significant impact on agricultural output. In the Birbhum district, agriculture is the main source of income. As to the DDA, Birbhum (2017), the net sown area, gross cropped area, and cropping intensity are 320610 hectare, 548724 hectare, and 171.15%, respectively, of the total area of Birbhum district (454500 hactare), of which 76.06% is cultivable, above the state average of 66.94% (HDI report, 2008) [4]. Even with the advancement of technology and the growth of the service sector, over 60% of the people living in the Birbhum district still rely on agriculture for their livelihood (Saha, 2011) [7]. Birbhum District is one of major significant agricultural crop-producing districts in West Bengal; while making up only 5.12% of the state's total geographical area, it produces 7.3% of the state's total food grain production (Chakraborty, 2015) [1]. According to the planning commission, the Birbhum district is included in the lower Gangetic plain region, also known as agro-climatic zone III. The present research attempts to analysis crop productivity and development of agriculture in different blocks of Birbhum district.

Study Area:

The Birbhum district, that covered 4545 square kilometer, is situated between 23º32' and 24º 35' north latitudes and between 87º05' and 88º01' east longitudes. Nineteen Community Development blocks and twenty seven police stations are spread among its three subdivisions Suri, Rampurhat, and Bolpur (Fig 1). Suri is the district head quarter. According to census 2011, total population of the district is 35, 02,404. The district's western boundary is shared by the Santhal paraganas of the state of Jharkhand; the districts of Purba Bardhaman, Paschim Bardhaman, and Murshidabad of West Bengal form the district's other borders. Ajay river is the natural boundary between Bardhaman and Birbhum. Western part of the district is covered by the plateau region of chotonagpur and eastern part of the district is covered by the younger alluvium deposit. Major river of this district are – ajay, makurakhi, dwaraka, bramhni, bakreswar, kopai,hinglo etc. Most of the river of this district is non perennial.Highest elevation is recorded in western part of the district nearly 94m. Major slope of this district is followed from west to east. Lateritic soil is the main soil group in this district. While the weather on the western side is severe and dry, it is slightly milder on the eastern side. The summertime high can reach well over 40 °C, while the winter low can only reach about 6 °C. The western regions receive more rainfall than the eastern regions. In Rajnagar and Nanoor, the yearly average rainfall is 1,405 and 1,212 millimetres, respectively, with the majority of the rainy season occurring from June to October.

2. Database & Methodology

This research preliminary is based on secondary data base. This study made use of data from the Birbhum District (2014) District Statistical Handbook, and the Birbhum District 2011 Census data. SPSS, MS Excel and ArcGIS 10.5 software were used to help with the statistical analysis of the collected data and the implementation of suitable cartographic techniques.

2.1 Crop Productivity Index: The crop production index compares the annual agricultural output to the base period. Crop productivity index has been calculated using Enyedi's (1964) method. The productivity index for each block in the Birbhum district in the year 2013–2014 is determined using the method above, and the productivity zones are distinguished as high, moderate, low, and extremely low productivity.

Productivity Index(PI) = (y/yn) /(t / tn)*10

Where,

y = Production of the total crops in a unit area
yn = Total Production of the crops at the entire zone.
t = Area under crops in unit area.
tn = Total cropped area in the entire zone.

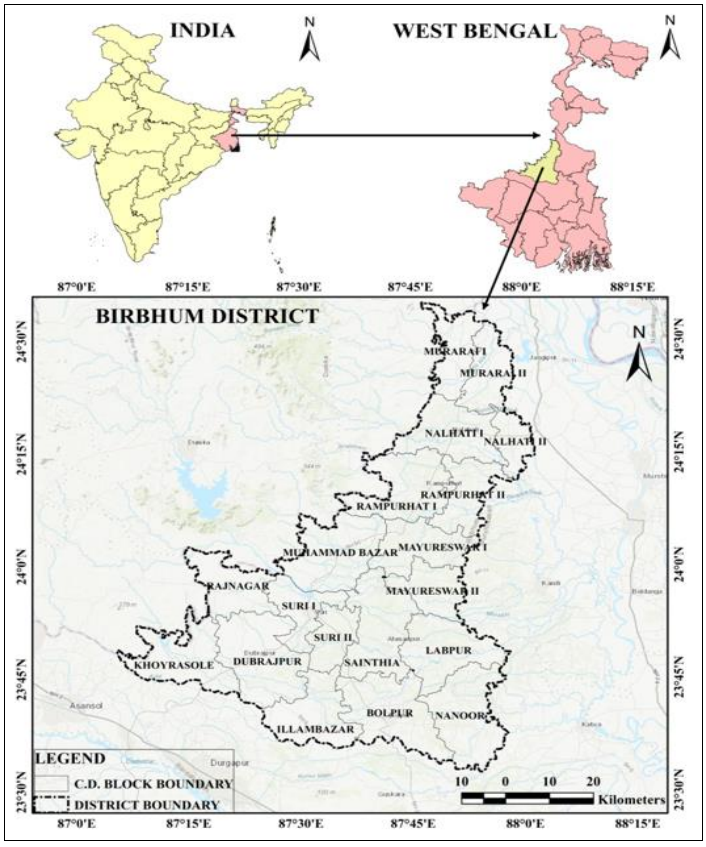

Fig 1: Location map of the study area

2.2 Irrigation Intensity: Its definition is the proportion of the commanded cultivable land that is suggested to get yearly irrigation. One may calculate the irrigation intensity for the whole year by summing the irrigation intensities for each crop season.

Irrigation Intensity= (Gross Irrigated Area / Gross Cropped Area) * 100

2.3 Z score: This is a most important statistical measure that quantifies the relatives' score of different attributes related to development.

Z score = xi – mean / sd

Where, xi = original value of observation

2.4 Composite Z score: Additionally, the composite index is created by averaging the standard score values for each indication, allowing for the consistent measurement of regional variations in the development levels of distinct blocks. Positive numbers for the blocks score indicate a high degree of agricultural development, while negative values suggest a low degree of development. The composite scores are split into three categories: High, medium, and low—to categorize the blocks based on the level of development.

Composite Z score = Standard score for the i^{th} observation/ No. of the observation

This study has employed a number of variables, including productivity, irrigation intensity, the number of seed stores, the percentage of net planted land, the number of fertilizer depots, the number of co-ops, the proportion of agricultural labourers, and the percentage of ground water irrigated area. The rationale behind taking these variables into account is to comprehend the relationships between agricultural growth and production.

3. Result and Discussion

3.1 Spatial distribution of Productivity: There are noticeable regional differences in the quality of agricultural performance in various regions, according to the district-level examination of agricultural production. Table 1 is shows the agricultural productivity of the district.

Table 1: Block wise agricultural production of Birbhum District, 2014

S. No	Name of the CD block	Productivity
1	Khoyrasol	75.78
2	Dubrajpur	100.29
3	Illambazar	95.65
4	Bolpur - Sriniketan	125.89
5	Nanoor	101.01
6	Labhpur	118.43
7	Mayureswar II	182.74
8	Mayureswar I	102.68
9	Rampurhat II	87.11
10	Rampurhat I	67.97
11	Nalhati I	116.14
12	Nalhati II	81.45
13	Murarai II	76.74
14	Murarai I	88.2
15	Md. Bazar	102.37
16	Sainthia	115.63
17	Suri II	91.27
18	Suri I	113.3
19	Rajnagar	68.29

Source: Computation by the author

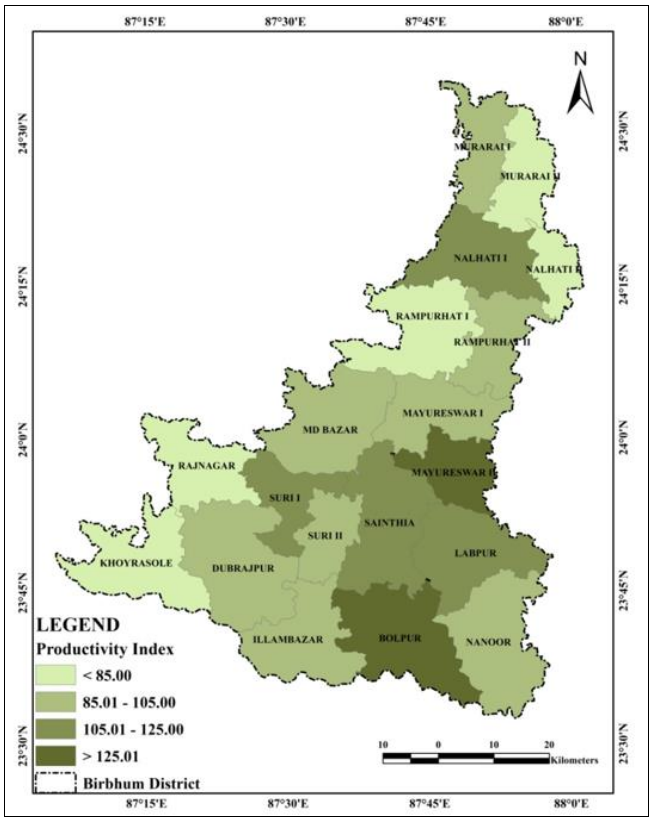

Fig 2: Agricultural Productivity Map of the study area

In Birbhum district, the agricultural productivity index is exceptionally high (>125.01) in just two blocks: Mayureswar II, and Bolpur – Santiniketan. Those blocks have loam soil due to the depositional works of the main rivers. These blocks are a good productive zone because of their pH value, nitrogen content, adequate ground water facilities, their pH value, nitrogen content, adequate ground water facilities, and usage of diverse high-yielding crops, proper manuring, and utilization of contemporary technologies. Suri I, Sainthia, Labpur, and Nalhati I are the only four blocks in the district with a moderate agricultural productivity index (105.01–125.5). Those area covered by clay loam soil. Value of pH and nitrogen are comparatively low in this region. Low production zones include blocks like Murarai I, Rampurhat II, Md.Bazar, Mayureswar I, Dubrajpur, Suri II, Illambazar, and Nanoor (85.01-105.00). The appearance of hills that are a component of Rajmahal hill is represented by little patches of land on the western side of Murarai I and Rampurhat II. There is less agricultural productivity since they are the smallest blocks in Birbhum and have a smaller net planted area than the other blocks. However, certain blocks are less productive than others due to inadequate irrigation, limited technical application, poor soil quality, and a significant amount of waste land. The blocks of Birbhum district identified as having extremely poor productivity include Murarai II, Nalhati II, Rampurhat I, Rajnagar, and Koyrasole (< 85.00). They stand for the eastern margin of the Chhotanagpur plateau complex. Sandy loamy soil is the predominant here and depth of the soil is very shallow. On the other hand, degraded lateritic soil with little organic matter makes the soil unusable. The lack of ground water supplies is one of the main barriers to agriculture, along the surplus of unused land.

3.2 Spatial pattern of level of agricultural development:

Rural development includes agricultural development, which is a multifaceted process. Enhancing the growth of agricultural output is usually the primary objective of agricultural development. It is necessary for economic expansion. Block to block differences exists in the ways that agricultural potential is utilized and the levels of development obtained.

The area of study has been divided into four agricultural development zones based on the total value of Z-score of all the variables (Fig 3). In this map we are categories it into four part such as <-0.87 is very low agricultural development zone, -0.87 to -0.43 is low agricultural development zone, -0.43 to 0 is moderate agricultural development zone and > 0.01 is high agricultural development zone.

Table 2: Status of agricultural development

S. No	Name of CD Block	Productivity	Irrigation Intensity	Net Sown area (%)	No. fertiliser Depots	No. of Cooperative Society	Agricultural Labour(%)	No of Seed Store	Ground Water Irrigated Area (%)	Composite Z
1	Khoyrasol	-1.1	-1.02	-1.31	-0.57	-1.41	-0.85	-0.82	-0.43	-0.1
2	Dubrajpur	-0.1	-0.47	-0.62	-0.26	0.28	0.03	-0.09	-0.33	-0.2
3	Illambazar	-0.3	-0.56	-0.03	0.5	-0.21	0.56	1.52	-0.74	0.1
4	Bolpur - Sriniketan	0.96	0.69	-0.44	-1.42	0.59	0.29	0.2	0.53	0.2
5	Nanoor	0.04	-1.47	0.01	-0.24	0.34	-0.19	-0.53	0.56	-0.2
6	Labhpur	0.7	0.37	0.15	0.58	-0.07	0.48	0.93	0.61	0.5
7	Mayureswar II	3.2	1.84	-0.12	0.58	-1.19	-0.42	0.93	0.76	0.7
8	Mayureswar I	0.1	1.25	0.68	0.17	0.1	0.41	0.49	-0.67	0.3
9	Rampurhat II	-0.5	-0.06	1.33	0.91	-0.77	1.24	-0.24	0.46	0.3
10	Rampurhat I	-1.24	0.01	-0.05	0.72	0.73	-0.94	2.84	-1.19	0.1
11	Nalhati I	0.6	-0.02	0.9	0.55	0.17	0.55	-0.53	0.64	0.4
12	Nalhati II	-0.6	1.17	1.33	0.55	-0.42	1.18	-0.53	0.25	0.4
13	Murarai II	-0.6	-1	0.87	-1.47	-0.25	0.64	-1.26	0.62	-0.3
14	Murarai I	-0.5	-0.87	0.92	2.64	-0.67	-1.35	-0.53	2.98	0.3
15	Md. Bazar	0.05	-0.11	-1.03	-0.46	0.52	-0.81	-0.82	-1.23	-0.5
16	Sainthia	0.6	1.1	0.24	0.55	1.61	0.85	0.64	0.15	0.7
17	Suri II	-0.4	1.48	0.89	-1.01	-1.16	1.45	-0.53	-0.65	0.01
18	Suri I	0.41	-0.44	-1.03	-0.84	2.81	-2.68	-0.38	-0.93	-0.4
19	Rajnagar	-1.3	-1.66	-2.68	-1.47	-0.99	-0.44	-1.26	-1.39	-1.4

Source: Calculated by Author

When composite Z score value is positive then it is considered as high agricultural development zone. There are basically twelve community development blocks available in this zone. The regions of Murarai I, Nalhati I & II, Rampurhat I & II, Mayureswar I & II, Suri II, Sainthia, Labpur, Illambazar, and Bolpur had significant agricultural growth because to the availability of agricultural labors, chemical fertilizer use, and irrigation facilities. In the category of medium level of agricultural development, there are two blocks such as Murarai II and Nanoor. Three blocks, namely Md. Bazar, Suri I, and Dubrajpur, which comprise the majority of the district's southern region, fall under this low agricultural development category. Rajnagar and Khoyrasol are included in this group of areas with extremely low levels of agricultural development. Those part is situated in the extreme west and south part of the district. There is very little ground water availability and a hard rock structure due to extended part of chotonagpur plateau region, which are the main causes of this extremely poor agricultural growth zone.

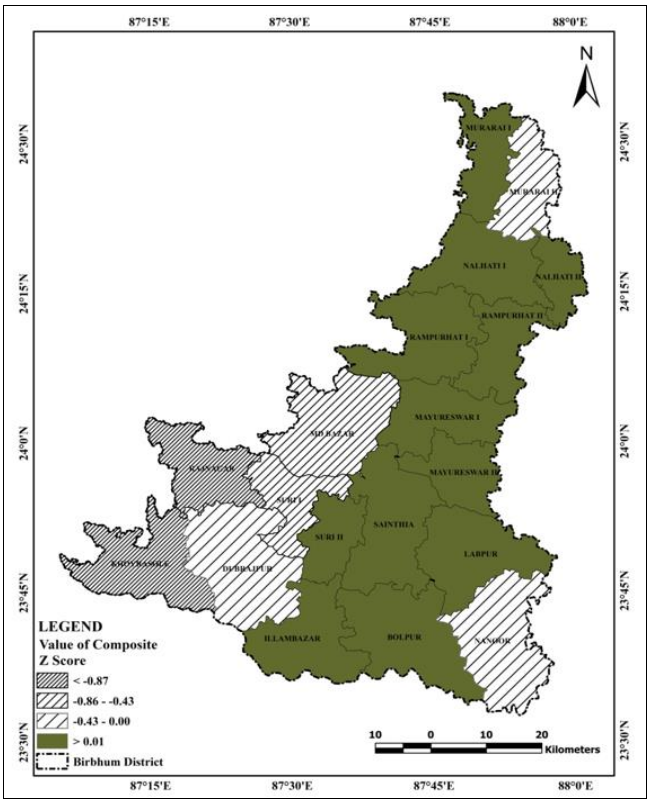

Fig 3: Composite Z score Map of the study area

- **Correlation between agricultural productivity and agricultural development:**

The relationship between the physical, environmental, and socioeconomic domains determines agricultural output, which is manifested in the productivity per hectare and the overall amount of produce (Sing 2012 [8]; Saha & Rudra 2019). It depends on the availability of irrigation, the size of the net sown area, the number of workers in agriculture, the usage of fertilizer, and other factors that indicate the degree of agricultural growth. Thus, a relationship has existed between them (Table 3).

Table 3: Relationship between agricultural productivity and Composite Z Score

S. No	Name of the CD block	Productivity	Composite Z
1	Khoyrasol	-1.09	-0.94
2	Dubrajpur	-0.06	-0.19
3	Illambazar	-0.27	0.1
4	Bolpur - Sriniketan	0.96	0.18
5	Nanoor	0.04	-0.19
6	Labhpur	0.71	0.47
7	Mayureswar II	3.2	0.7
8	Mayureswar I	0.12	0.32
9	Rampurhat II	-0.54	0.29
10	Rampurhat I	-1.24	0.11
11	Nalhati I	0.64	0.43
12	Nalhati II	-0.67	0.36
13	Murarai II	-0.67	-0.32
14	Murarai I	-0.49	0.33
15	Md. Bazar	0.05	-0.48
16	Sainthia	0.55	0.69
17	Suri II	-0.4	0.01
18	Suri I	0.41	-0.39
19	Rajnagar	-1.3	-1.4

Source: Calculated by Author

According to Table 3, blocks like Mayuresewar II, Bolpur, Labhpur, Nalhati I, and Sainthia have high crop productivity and a high degree of agricultural development. These blocks are also known for having high levels of agricultural productivity.However, based on the value of the composite z score, Khoyrasole, Rajnagar, Md. Bazar, Suri I, and Murarai-II have poor levels of agricultural development. Thus, this segment demonstrates the favorable correlation between agricultural progress and production.

4. Conclusion

The degree of agricultural development and the spatial pattern of agricultural production indicated that there is a great deal of variance in the various blocks of the research region. With the exception of Nalhati-I, agricultural production is quite low in the western and northern portions of the region and very high in the eastern portion. However, the eastern portion of the region has a high degree of agricultural development, whereas the north-western portion has a low level.Thus, there is a good rapport between them. As a result, new tactics must be developed to reduce the horizontal differences in the advancement of agricultural status. Since irrigation is the primary input in agriculture, low-productive areas must establish an effective irrigation network through water conservation. In order to improve net sown area, it is critical for some blocks in the western and northern regions to quickly convert waste land to agricultural land. Although the physiographic barrier cannot be removed, its intensity can be decreased with creative research and technological advancements. However, ecological constraints for sustainable agricultural development should be taken into account before using this technique.

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