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A critical analysis on block wise status of agricultural productivity and efficiency: A case study on Birbhum district, West Bengal

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Abstract
The economy of Birbhum district is predominated by agrarian activity. A colossal number of people are directly and indirectly associated with agriculture. But the agricultural production and efficiency are not uniform all over the district rather it varies from block to block. Basically south-western part of the district has low fertile soil and dissected topography but northern, eastern and south-eastern parts of the district have old and young alluvial soils. So the blocks of south-western part of this district have low level of agricultural productivity and efficiency than the other blocks. Here we simply attempt to classify the 19 blocks of Birbhum district into five productivity zones by using Kendall's Ranking Co-efficient method. Besides this, block wise agricultural efficiency\hindrances of agriculture and the possible measures are also discussed.

Keywords: Rank, Irrigation, Productivity Zone, Crop Intensity, agricultural efficiency

1. Introduction
Agriculture is the prime activity which helps the human being to civilize. The predominant activity of Indian society is agriculture but its importance is gradually declining in term of share to GDP though a lump sum of population are directly and indirectly connected with agriculture and arrange their bread and butter from it. Among the all economic activities which are directly associated with land, crop cultivation is the most vulnerable because in India a huge percentage of cropped area has no facility of irrigation rather it depends on monsoon. The production level varies from one area to another depending upon topography, soil, climate, techniques applied in cultivation (Agricultural technology), human skill and labour.In this article block wise crop cultivation of Birbhum district has taken as the concern matter. The block wise agricultural potentiality of Birbhum can be understood significantly by analyzing the determinant factors of agriculture, problems of agriculture, amount of crop production and crop intensity,

2. Area and Location
Birbhum district is situated between 23°32'30" North to 24°35'0" North latitude and 88°01'40" east to 87°05'25" east longitude. It is surrounded by Murshidabad in east to north-east, SanthalPargona of Jharkhand in west to north-west and Burdwan in the south to south east. The area of this district is 4545 km², sub divided into 19 blocks.

3. Factors for Block Wise Disparity in Crop Production in Birbhum District
The temperature varies from 26°C to 41°C in summer and 9°C to 24°C in winter and the amount of average rainfall is 1430mm. According to planning commission Birbhum district is fall under Agro-Climatic Zone III (lower Gangetic plain region). The region is characterized by adequate storage of ground water with high ground water table. The average depth of ground water table varies from 3 meter in post monsoon to 10 meter in pre monsoon. Rice is the main crop but wheat, potato, pulses and oil seed cultivation are also practiced. Canal, tank and tube well are the main sources of irrigation. The irrigation facilitated areas have the potentiality of good production of crop. The south-western part of the district is characterized by upland and dissected hill and the ruggedness is gradually waning towards east and north-east. The absolute relief of south-western part is ranging from 250ft to 376ft and the small proportion of area is cultivated mostly under rain fed condition. The eastern fringe areas of Birbhum have low absolute relief (100ft to 120ft) where the irrigation facility is comparatively better. The south-western blocks viz. Rajnagar, khoyrasol, Dubrajpur, Illambazar, Suri I and Suri II having loose and large grained in consistency and friable lateritic soil, are very low fertile in nature but northern, eastern and south-eastern part of the districts have old and young fertile alluvial soils. The maximum concentration of the waste land can found in Rajnagar block followed by khoyrashole, Suri I, Mohamad Bazar, Dubrajpur,andIllambazar. The other blocks also have some waste land but the percentage is very little. Rajnagar, Khoyrashole and Mohamod Bazar cumulatively have more than half of the total waste land of birbhum. The area of agricultural land is also varying from block to block.A large number of working population is directly connected with agriculture. In case of main working category combine percentages of cultivators and agricultural labours are more than 60% in 14 blocks but it is varying from one block to another along with skill and technology. Availability of fertilizer depots, seed shops and cold storages also influence the agricultural production.

4. Objectives of the study
1) To identify the block wise crop productivity.
2) To analyze the importance of irrigation for intense cropping.
3) To discuss the problems of crop production and the possible measures of it.

5. Methodology

The study is based on secondary data which have acquired from several sources. District Statistical Handbook; Census of India: District Census Handbook- Birbhum 2011, Internet and different types of articles and books related to agriculture of Birbhum have provided the necessary data and information. To analyze the block wise level of agriculture in terms of crop production, the Ranking Co-efficient method propounded by Kendall has applied. In addition to it cerographic techniques are also introduced.

6. Classification of Blocks of Birbhum on the basis of Ranking Co-efficient method:

Eleven types of crops are selected which are mostly cultivated in this district for standard zoning viz. Aus, Aman, Boro, Wheat, Musur, Khesary, Gram, Masterd, Potato, Sugercane and Till. The block wise crop production data are given bellow.

Table 1: The block wise production of major crops in Birbhum district (2010-2011).

Block Name	Aus Production in Thousand MT	Aman Production in Thousand MT	Boro Production in Thousand MT	Wheat Production in Thousand MT	Musur Production in Thousand MT	Khesari Production in Thousand MT	Gram Production in Thousand MT	Masterd Production in Thousand MT	Potato Production in Thousand MT	Sugercane Production in Thousand MT	Till Production in Thousand MT
Murarai - I	0	26.354	8.084	6.872	0.678	1.591	1.575	2.126	15.604	2.031	0.29
Murarai - II	1.411	27.732	13.147	8.53	0.386	0.328	1.588	2.172	20.764	0.129	0.16
Nalhati - I	-	32.188	10.519	11.149	0.313	-	0.805	1.374	61.353	-	0.064
Nalhati - II	-	20.455	14.586	5.721	0.043	-	0.154	2.036	9.547	-	0.406
Rampurhat -I	-	29.501	6.465	6.47	0.267	-	1.216	2.675	6.602	2.492	0.133
Rampurhat - II	-	30.904	14.251	10.798	0.382	-	0.999	3.226	19.535	-	0.076
Mayureswar -I	-	33.409	11.077	3.282	0.153	0.049	0.185	1.626	25.776	0.909	0.083
Mayureswar -II	0.942	16.827	9.311	2.693	0.296	0.25	0.605	1.056	44.749	8.507	0.205
Mohammad Bazar	-	31.327	0.375	2.094	0.091	0.005	0.276	1.379	21.534	7.491	0.039
Rajnagar	-	7.888	0	1.288	0.026	-	0.108	0.496	3.393	1.592	-
Suri - I	-	11.111	0.988	1.301	0.047	-	0.268	0.792	11.811	1.085	0.058
Suri - II	-	17.584	5.263	1.305	0.052	-	0.31	0.636	8.338	0.726	0.104
Sainthia	-	40.375	19.837	5.761	0.098	-	0.228	1.562	61.292	5.012	0.288
Labpur	-	35.853	22.35	2.843	0.156	-	0.501	1.307	59.328	6.729	0.341
Nanoor	4.55	43.315	26.581	3.73	0.165	-	0.643	2.67	39.012	13.264	0.711
Bolpur	0.187	48.063	15.603	3.16	0.173	-	0.599	1.559	45.842	3.132	0.553
Illambazar	0.016	27.63	18.563	2.193	0.117	-	0.27	0.695	22.102	2.954	0.169
Dubrajpur	-	39.546	4.392	5.25	0.068	-	0.209	1.083	19.388	-	0.12
Khoyrasol	-	19.395	-	3.655	-	-	-	0.683	10.736	2.05	0.119

Source: District Statistical Handbook 2010 & 2011 (combined), Birbhum.

6.1. Calculation of Ranking Co-efficient value of the Individual Block of Birbhum District on the basis of crop production:

The scale effect can be eliminated by converting the block wise production of each crop into ranks. This is a useful technique to remove the weightage problem of calculation. The formula is:

$$\text{Ranking Co-efficient} = \frac{\Sigma R}{n}$$

Where, R = rank

n = number of crop

Here the 19 blocks are ranked according to individual crop production. After that the total ranks of each block are calculated by adding the individual ranks of crop. The block wise 'ranking Co-efficient' values are obtained through dividing the total rank by the total number of crop. The higher ranking Co-efficient value indicates low productive area and the lower value denotes high productive area.

Table 2: Calculation table for Block wise Ranking Co-efficient value in Birbhum.

Block Name	Rank for Aus Production	Rank for Aman Production	Rank for Boro Production	Rank for Wheat Production	Rank for Musur Production	Rank for Khesari Production	Rank for Gram Production	Rank for Masterd Production	Rank for Potato Production	Rank for Sugercane Production	Rank for Till Production	Total of rank	Ranking Co-efficient value	Remarks (Blocks under productivity zone)
Murarai - I	12.5	13	12	4	1	1	2	5	13	10	5	78.5	7.14	Very High
Murarai - II	2	11	8	3	2	2	1	4	10	15	9	67	6.09	Very High
Nalhati - I	12.5	7	10	1	4	12.5	5	11	1	17.5	16	97.5	8.86	High
Nalhati - II	12.5	14	6	7	17	12.5	17	6	16	17.5	3	128.5	11.68	Low

Rampurhat -I	12.5	10	13	5	6	12.5	3	2	18	8	10	100	9.09	High
Rampurhat - II	12.5	9	7	2	3	12.5	4	1	11	17.5	15	94.5	8.59	High
Mayureswar -I	12.5	6	9	11	10	4	16	7	7	13	14	109.5	9.95	Moderate
Mayureswar - II	3	17	11	14	5	3	7	14	5	2	7	88	8.00	High
Mohammad Bazar	12.5	8	17	16	13	5	11	10	9	3	18	122.5	11.14	Moderate
Rajnagar	12.5	19	18.5	19	18	12.5	18	19	19	11	19	185.5	16.86	Very low
Suri - I	12.5	18	16	18	16	12.5	13	15	14	12	17	164	14.91	Very Low
Suri - II	12.5	16	14	17	15	12.5	10	18	17	14	13	159	14.45	Very Low
Sainthia	12.5	3	3	6	12	12.5	14	8	2	5	6	84	7.64	High
Labpur	12.5	5	2	13	9	12.5	9	12	3	4	4	86	7.82	High
Nanoor	1	2	1	9	8	12.5	6	3	6	1	1	50.5	4.59	Very High
Bolpur	4	1	5	12	7	12.5	8	9	4	6	2	70.5	6.41	Very High
Illambazar	5	12	4	15	11	12.5	12	16	8	7	8	110.5	10.05	Moderate
Dubrajpur	12.5	4	15	8	14	12.5	15	13	12	17.5	11	134.5	12.23	Low
Khoyrasol	12.5	15	18.5	10	19	12.5	19	17	15	9	12	159.5	14.50	Very Low

Source: Calculation has computed by researchers.

6.2. Classification of Agricultural Productivity Zone

On the basis of Kendall's ranking Co-efficient method, the blocks of Birbhum district can be subdivided into 5 zones; those are Very High, High, and Moderate, Low, and Very Low productivity zone.

Very High productivity Zone (<7.50)

Those blocks having Ranking Co-efficient value less than 7.50 can be selected as very high productive block. Four blocks named Nanoor, Murarai I, Murarai II and Bolpur are belonging in this zone. Most of the areas of these blocks have alluvial soil, good irrigation facility, large cultivated area, low concentration of waste land, higher use of fertilizer and modern machinery which provide the opportunity of huge amount of crop production.

High productivity Zone (7.50-9.50)

Six blocks having the ranking co-efficient value within 7.50-9.50 are experienced as high productivity zone. The blocks are Nalhati I, Rampurhat I, Rampurhat II, Mayuraswar II, Saintha and labpur. These blocks also have relatively good irrigation facility, low concentration of waste land, alluvial soil, large cultivated area and good opportunity to use modern technology.

Moderate productivity Zone (9.50-11.50)

The moderate level of productivity can observe in Mohammad Bazar, Illambazar and Mayuraswar I. Relatively low irrigation facility and relatively higher percentage of waste lands are causes of moderate level of crop production.

Low Productivity Zone (11.50-13.50)

Dubrajpur and Nalhati II are the two blocks which can be found under low productivity zone. In Dubrajpur, the reasons for low amount of production are higher extension of waste land, low irrigation facility, low level of technological application, low quality of soil, dominancy in lateralization process etc. But in case of Nalhati II, the production level of crops is low but it does not mean that the block has low potentiality of crop production. The Crop Intensity of this block is highest in this district in 2010-11. This block is the smallest block in Birbhum and the net sown area is smaller than the other blocks, due to this the amount of agricultural production is low. This block is situated in north-eastern part of the district and experienced with good irrigation facility, alluvial soil and lower percentage of waste land.

Very Low Productivity Zone (>13.50)

Four blocks of Birbhum district can be identified as very low productive blocks, viz. Rajnagar, Suri I, Suri II and Khoyrasol. These blocks have low fertile soil, insufficient irrigation facility and higher percentage of waste land which are the main hindrances of agriculture. Rajnagar and Khoyrasol have huge waste land. And the predominance of lateritic soil makes these blocks low productive and low efficient in agriculture.

7. Crop Intensity (CI)

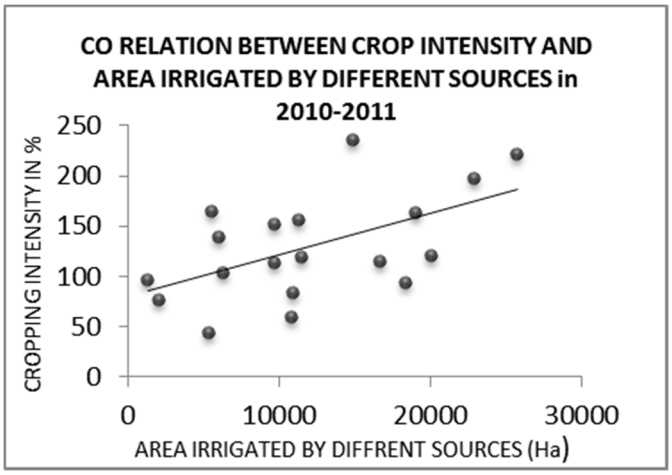
Crop Intensity can be defined as the ratio between Net Cultivated Area (NCA) and Gross Crop Area (GCA). The formula is (GCA/NCA) x100. Higher Crop Intensity value means greater the efficiency of crop production. We can found that the blocks of Birbhum have different CI value. It also reveals the fact of different level of agricultural potentiality.

Table. 3: Block wise Irrigated area (hectare) and Cropping Intensity (%) in 2010-11in Birbhum.

Block Name	Area in hectare irrigated by different sources in2010-11	Cropping intensity (%)2010-11	Block Name	Area in hectare irrigated by different sources in2010	Cropping intensity (%)2010-11	Block Name	Area in hectare irrigated by different sources in2010	Cropping intensity (%)2010-11
Murarai - I	5495	164.46	Mayureswar -II	22860	197.45	Labpur	20069	121.02
Murarai - II	6308	104.1	Mohammad Bazar	10909	84.18	Nanoor	6000	139.77
Nalhati - I	9690	151.18	Rajnagar	1279	96.6	Bolpur	18339	93.73
Nalhati - II	14864	235.34	Suri - I	1970	75.93	Illambazar	9640	113.65
Rampurhat -I	11420	119.21	Suri - II	11295	156.68	Dubrajpur	10766	59.19
Rampurhat - II	19001	163.59	Sainthia	25765	221.32	Khoyrasol	5316	43.21
Mayureswar -I	16692	115.36	r = 0.551892985					

Source: District Statistical Handbook 2010 & 2011 (combined), Birbhum. And Office of the Deputy Director of Agriculture (Admin), Birbhum

Crop Intensity has a direct relation with irrigation. According to 2010-11 data the correlation can be establish which shows moderately positive relation (r = 0.551892985). It is found that in Nalhati II (235.34%) and Santhia (221.32%) have Crop Intensity value more than 200% where Rajnagar, Mohammad Bazar, Suri I, Bolpur, Dubrajpur and Khoyrasol have this value less than 100%. On the basis of 2010-11 data the blocks of Birbhum can be subdivided into four categories. (1) High productive block with Low Cropping Intensity: Bolpur (CI: 93.73%) and Murarai II (CI: 104.11%) have much lower CI value where these are in Very high productivity zone. In respect of other blocks the amount of production is much better in these blocks but insufficient irrigation water supply in 2010-11, the practice of double and triple cropping could not be done significantly and a large number of areas which could be available for agriculture were not used for crop cultivation which leads low Crop Intensity. (2) Low productive block with High Cropping intensity: Nalhati II is under low productive zone but the CI is the highest among 19 blocks. In Nalhati II block, the amount of agricultural production is low due to its relatively small net cultivated area (smallest block in Birbhum) but all most every arable land has used for cropping in different season due to its sufficient supply of irrigation water. (3) Low productive block with low Cropping Intensity: Rajnagar, Mohammad Bazar, Suri I, Dubrajpur and Khoyrasol are fall in this category. (4) High productive block with High Cropping Intensity: Murarai I, Santhia etc. blocks have high Cropping intensity with high crop production.



8. Agriculture related problems in Birbhum district

- To increase the efficiency of agriculture, irrigation facility is very necessary but in this district so many blocks have low irrigation facility. The network of canal irrigation is very low in percentage. There are so many areas which are irrigated by ground water lifting and this may reduce the ground water table. The supply of irrigation water also varies in different years. As for example, in Bolpur block the area irrigated by different sources in 2003, 2008 and 2010-11 are 22830 hectares, 26221 hectares and 18339 hectares respectively.
- Continuous increase of population puts a huge pressure on agricultural land that is why land gets fragmented into small holdings. This Small Fragmented lands are the main offender of modern technological intervention.
- Higher number of small and marginal farmers and the conflict between land lord and bargadars are also affecting the agricultural production.
- The lower numbers of cold storage and unavailability of good quality of seeds also affect the production. The ongoing price of fertilizer creates difficulties to the small and marginal farmers and due to this the production of crop is not up to the mark.
- The biggest problem is that the farmers are pushing to sale their crop below the minimum support price (MSP) which leads the farmers into financial crises.

9. Remedial Measures

- Establishment of good irrigation network though water conservation with cost effective manner is very necessary. In this regard well and pond can be helpful as the sources of irrigation. The area where canal irrigation is not present can be covered by these sources. Rain water harvesting should be a useful technique which can provides the required water to the crops and also reduces the soil erosion.
- The progress of execution of waste land is very poor. Mahammad Bazar, Suri I, Rajnagar, Nanoor and Saintha have huge percentage of cultivable waste land. Local people should be motivated to land conservation.
- Fertilizer should be available as per farmer's need and periodic soil test is very necessary and the degradation of soil can be measured by proper campaigning.

- The less irrigated areas of Birbhum district may be used for less water consuming crops like Millets.
- The irrigation facilitated areas should bring under modern agricultural process. In this regard knowledge on modern farming likes System of Rice Intensification (SRI) and Sustainable Sugarcane Initiative (SSI) very significant.
- The small and marginal farmers are very vulnerable because if agricultural production falls, they drip into economic crises. Those poor farmers should be divided into some small groups and should be motivated for co-operative farming which can reduce the intensity of financial crisis.
- The number and the capacity of cold storage should be increase and number of food processing industry like rice mill; oil mill etc should be increase which can motivate the farmers to adopt modern agriculture instead of subsistence type. And the competition among industries may increase the demand of crop which can help to gain the MSP to the farmers.

10. Conclusion

The physiographic hindrances cannot be overcome but the intensity of hindrances can be reduced through intervention of new ideas and technologies. Due to the physico-cultural difficulties, the amount of production and the efficiency of production both are varying from block to block. State and Central Government projects and schemes are ongoing to develop to agricultural condition of this district. Now some non-government organizations are providing their best effort in this regard. The new generation technology based on scientific research and the agricultural planning of 'Government' and 'voluntary organization' will play a pivotal role to achieve satisfied level of productivity and efficiency in agriculture in this district in near future.

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