

Analysis of Crop-Diversification with Spatio Temporal Concept Over Paschim Medinipur District, West Bengal, India

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Abstract

Spatio-temporal change of crop diversification in Paschim Medinipur district of West Bengal has analyzed in this study. Crop diversification is a concept which is opposite to crop specialization. Short term variation of crop diversification has always response to fast changing of physical and socio-cultural conditions. In this study, two years data has been used to compare the diversification index. These are 2007-08 and 2010-11 respectively. The block wise crop diversification index have (ICD) been grouped into very high, high, moderate, low, very low level. The study reveals that crop diversification index in the Paschim Medinipur district has increased (39.05 to 38.750) between two considered study periods which varies widely among different blocks. Keshpur, Chandrokona-II consequently accounts very high degree of crop diversification during 2007-08 whereas Salbani, Garbeta-II experienced very high degree of diversification during 2010-11. Similarly crop diversification index is very low for Jamboni block accompanied with Aman (mono) crop during 2007-08 while Kharagpur-I block replaced that position during 2010-11. Trend of positive diversification index is noticed 11 blocks out of considered 29 blocks with in such a short span of study.

Keywords: *Crop Diversification, Crop Concentration, Crop Diversification Index*

1. Introduction

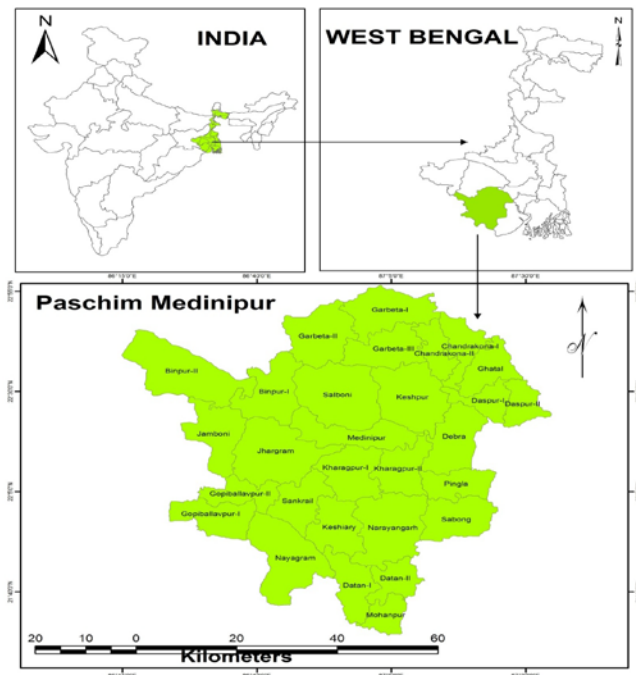
Agricultural development is a multi-dimensional concept which includes a variety of aspects such as agricultural land utilization, crop diversification and concentration, crop productivity, intensity of cropping, commercialization of agriculture, maintenance of

ecological balance and so on. Moreover, agricultural planning has been accepted as suitable devices for planning improvements in agriculturally under developed territories, (Grigg David 1969). For proper execution of agricultural planning programme, agricultural regionalization in micro level is very much important and in this circumstances crop diversification may play significant role. The keener the competition, the higher the degree of diversification, and the lesser competition, greater will be the degree of specialization, or monoculture, (Majid Hussain 1996).

The main advantages of crop diversification lie in the fact that it helps in future planning and development of agriculture. In this context spatial and temporal pattern of crop diversification is of vital importance in understanding the contemporary and changing pattern of struggle amongst crops for area, intensive and judicious, economically remunerative and ecologically supportable crop rotation for maintenance of soil fecundity, ecological stability and effect on productivity. The regions where more than 80% of the total population are involved primarily in agriculture directly and indirectly, such type of study is beneficial for administrators and planners to give more attention on the uneconomical cropping system as well as to encourage propulsive, economic agricultural planning and development. Therefore, an attempt has been undertaken to study the changing scenario of crop diversification during 2007-08 and 2010-2011 in Paschim Medinipur district.

2. Study Area

Paschim Medinipur district is carved out from the previously Medinipur district of West Bengal on the 1st January 2002. Paschim Medinipur district is located in the western part of west Bengal extending between 20°23'N and 22°56'N latitudes and 86°34'E and 87°54'E longitudes. The total geographical area of the district is 9786 sq km spread over in twenty nine C.D. blocks (Figure-1). The district is characterized by the distinctive topographical pattern which ranges from sub-hilly to flat and concave. The western part of the district is the undulating extension of Chotonagpur plateau which ranges from 100m to more than 300m in elevation above M.S.L. Average slope is 10-20 degree/kilometer which gradually slopes from west to east. About 90% of total area has a ground water yielding potentiality >40 liters/second but rest portion it ranges from 24-40 liters/ second (Irrigation and hydro geological map, NATMO, 2006). Kasai, Subarnarekha, Silai are the three main important river flowing over the district. Climatologically this region is experienced by seasonality of rainfall and temperature effect. The annual rainfall of the district varies from 1400mm to 1500mm while the annual temperature ranges from 9° to 43°C (July to December). Pedologically, the district composed of various types soil groups like younger alluvial in the east and northeast and lateritic and older alluvial in the west. The lateritic soils are interspersed with red sandy and gravelly soils.



3. Objectives

The main objectives of the present study are to bring out spatio-temporal variation of crop diversification and to identify increase or decrease in crop area, spatial pattern of agricultural cropping and to analyze the extent of irrigation facilities and its impact on cropping pattern in the district. Existing problems and various factors responsible for the change in crop diversification in the district are also studied.

4. Methodology

In the present study, an attempt has been made to analyze the changing scenario of agricultural crop diversification in Paschim Medinipur district. The study is empirical in nature and is based on secondary data. The required data for the year 2007-08 and 2010-11 have been obtained from Bureau of Applied Economics and Statistics, Government of West Bengal. District Planning Map has been collected from National Atlas Thematic Mapping Organisation (NATMO) respectively. For spatial analysis of crop diversification, crop varieties like food crops Aus, Aman, Boro, cash crops like mustard, til, potato has been considered for measuring crop diversification. The varying spatial pattern of crops have been studied by employing appropriate statistical and quantitative methods, the results have been presented graphically with the help of Arc GIS 9.3 and Microsoft office Excel.

5. Measurement of Crop Diversification

For the agricultural regionalization process, various methods and techniques have been tested and applied often modified versions of some researches, synthesizing the intensity of cropping pattern. The study of crop concentration and diversification as a measure of the intensity of crop in a region is considered to be a step ahead in determining the regional character of the distribution of crops to highlight the importance or domination of one crop over other. Many researches has used the refined diversity index with a scale ranging from zero to one for measuring diversification. A useful index for the diversification of crops in an area was developed by Gibbs Martin (1962) considering percentages of all crops of the total cropped area. Bhatia (1965) has evolved a simple formula by taking into account of the total cropped area to make an objective measurement of crop diversification. He has taken the ratio between the areas under all those crops which cover up to 10% of the cropped area. Mavi Harpal Singh (1963) has used the mean of the differences in percentages of crops, each of

which more than 5% of the total cropped area. This method gives only the idea of diversification and is very simple to calculate, but Jasbir Singh (1976) has modified the technique of Bhatia. In his modified technique, the crops, which occupy individually less than 5%, are not considered for calculating the index of diversification.

In view of these advantages, an attempt has been made in the present study to identify the crop diversification patterns and their changes during the study period by employing Jasbir Singh's (1976) index of crop diversification, which is suitable for measuring the variations of diversification of crops in the study region.

Index of crop diversification (ICD) is inversely proportional to the degree of diversification i.e. higher is the value of the index, lower will be the degree of diversification and vice versa.

$$ICD = \frac{\text{Percentage of total cropped area under } n \text{ crops}}{\text{Number of } n \text{ crops}} \dots(1)$$

6. Result and discussion

Spatio-temporal change of crop diversification indicates agricultural change i.e. changes of cropped area in respect of different crops. Paschim Medinipur district has a fairly moderate degree of crop diversification index for both 2007-08 and 2010-11 temporal span. In spatial context there is a large range of crop diversification value among all blocks. Intensive study of crop diversification has categories viz., very high, high, moderate, low, very low level to identify the minute variation of crop production. Table-1 has shown the block-wise index of crop diversification individually. Including all blocks result, the average ICD value of the entire district during 2007-08 was 39.95 while it was 38.75 during 2010-11. So it should be stated that degree of diversification is slightly increased due to diversified culture of non familiar crops. Percentage of area under Aman culture has decreased by 57.77% to 57.01%, area of Boro cultivation has decreased by 21.03% to 20.82%, area of wheat cultivation decreased by 6.57% to 0.78%, area of Potato cultivation has decreased by 6.63% to 1.71%, whereas area of mustard oil cultivation has increased by 3.86% to 7.84%. Similarly, area of Aus cultivation has increased by 4.51% to 5.34% and area of some minor crops like Til, Khesari production has increased slightly over the entire district.

Table -1: Index of crop diversification -2007-08 and 2010-11

Sl No	Name of Blocks	Index of Crop Diversification (2007-08)	Index of Crop Diversification (2010-11)
1	Jhargram	46.53	47.16
2	Binpur-I	30.20	29.34
3	Binpur-II	48.32	97.91
4	Jamboni	99.64	22.75
5	Nayagram	96.04	48.14
6	Sankrail	23.85	23.92
7	Gopiballavpur-I	46.56	33.20
8	Gopiballavpur-II	30.98	45.05
9	Salboni	24.26	18.79
10	Keshpur	18.99	23.57
11	Garhbeta-I	24.25	23.97
12	Garhbeta-II	23.27	19.42
13	Garhbeta-III	24.10	19.72
14	Medinipur	31.61	19.95
15	Debra	47.01	45.55
16	Pingla	32.08	32.47
17	Keshiary	46.85	48.67
18	Dantan-I	33.31	49.97
19	Dantan-II	49.01	49.25
20	Narayangarh	32.75	47.84
21	Mohanpur	49.80	48.99
22	Sabang	24.78	32.73
23	Kharagpur-I	48.89	98.54
24	Kharagpur-II	33.20	47.69
25	Chandrakona-I	24.44	24.75
26	Chandrakona-II	19.73	23.93
27	Ghatal	19.84	31.41
28	Daspur-I	31.00	19.99
29	Daspur-II	48.24	48.31
Σ/T		39.95	38.75

Class-1 (Very High Crop Diversification, ICD value <20)

The results of crop diversification gradation have shown in Table- 2. It is evident those three blocks like Keshpur, Chandrakona-II, Ghatal indicates their ICD value

at less than 20 during 2007-08. In this region 5 crops are common culture like Aman, Aus, Boro, Potato, Til, Mustard Oil and their practice combination are quite different. The result of crop diversification index for Keshpur block is 18.99, and this block is dominated by Aman, Mustard Oil, Potato, Til, Boro, cultivation. The result of Chandrakona-II is under class-1 category and its ICD value is 19.73, where five crops namely Aman, Potato, Til, Aus, Boro are dominant production.

The classification result of crop diversification in Table-2 also indicates some notable spatial changes of crop diversification during study. The results of five blocks namely Salboni, Garbeta-II, Garbeta-III, Medinipur, Daspur-I indicates class -1 category with high diversification of with usual practice of crops. The ICD result for Saiboni block (18.79) is least where 5 crops namely Aman, Potato, Til, Mustard Oil, Aus prominent culture. Medinipur and Daspur-I have noticed reasonable development in crop diversification from moderate to high degree of diversification and their ICD value decreased by 31.61 to 19.76 and 31.00 to 19.19 respectively.

The results of this study revealed that the low index leads to high crop diversification and high index indicates vice-versa. This results mainly due to fluctuation in the amount of rainfall, rugged topography, extension of irrigation facilities from Kasai barrage and socio-economic influences due to setup of cold storage facilities at Garbeta-I, Garbeta-II blocks. The farmers of these blocks duly enjoy the cold storage facility for storage of Potato for commercial purpose.

Class-2(High Crop Diversification, ICD value 20-30)

Out of 29 blocks, 7 blocks are lying in this category according to 2007-2008 production data, where their ICD values ranges from 20-30 category. Among them, Garbeta-II block result is the highest one in this category. Four crops mainly Aman, Potato, Til, Boro are dominant culture.

During 2010-11 Another 7 blocks are also lying in this category according to 2010-11 production data. Remarkably, Jamboni block indicates amazingly developed production with very low crop diversification (mono crop) class to high degree of diversification class; its ICD values decreases by 96.04 to 22.75.

Class-3 (Moderate Crop Diversification, ICD value 30-40)

The results of Binpur-I, Gopiballavpur-II, Medinipur, Pingla, Datan-I, Narayangarh, Kharagpur-II,

Daspur-II indicates class 3 category of crop diversification after data record from 2007-2008. Binpur-I block indicates lowest ICD value (30.20), where three crops like Aman, Til, Mustard Oil are dominant crop practice.

On the other hand, 4 blocks namely Gopiballavpur-I, Pingla, Sabang, Ghatal indicates class 3 category result after analysis of 2010-2011 dataset. Subsequently, the results of Ghatal and Sabang decreases from very high and high and after moderate category. The shift of ICD value for Ghatal has changed by 19.84 to 31.41 and for Sabang has changed by 24.78 to 32.73. For the Ghatal block, Boro, Aman, Aus and for Sabang block, Boro, Aman, Aus are dominant practice.

Class-4 (Low Crop Diversification, ICD value 40-50)

According to 2007-08 dataset, 9 blocks are lying in this category. The result of Jhargram indicates Low ICD value (46.53) and also indicates crop combination association with two dominant crops. On the other hand, 11 blocks are lying in this category after 2010-2011 data record and result of Gopiballavpur-II is lowest in this category. Its ICD value is 45.05, where Aman and Aus are combined practice Aus two crop combinations were noticed.

Class-5 (Very Low Crop Diversification, ICD value >50)

The results after analysis of 2007-2008 dataset, Jamboni and Nayagram blocks are under the very low category. ICD values in these blocks are 99.64 and 96.04 respectively. Only Aman crops the dominant one practice. High amount of rainfall, Irrigational facilities from Subarnarekha River encouraged Aman cultivation for these blocks. Highest diversification (Trend of Positive diversification) has occurred during study period 2007-08 to 2010-11 in Jamboni Block (+76.89). Highest specialization (Trend of negative diversification) has occurred during study period 2007-08 to 2010-11 in Binpur-II (-49.57), Kharagpur-I (-49.65). Positive diversification trend has been occurred during study period 2007- 08 to 2010-11 for 11blocks out of 29 blocks.

Table -2a: Level of crop diversification (2007-2008)

Class	ICD	Name of Blocks	Number of Crops
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1	<20	Keshpur Chandrakona-II Ghatal	Am,M,P,T,B,(5) Am,P,T,Au,B,(5) B,Am,T,M,P,(5)
2	20-30	Sankril Salboni Garbeta-I Garbeta-II Garbeta-III Sabang Chandrakona-I	Am,B,Au,T,(4) Am,P,T,M,(4) P,Am,T,Au,(4) Am,P,T,B,(4) Am,P,T,Au,(4) B,A,Au,M,(4) Am,P,T,B,(4)
3	30-40	Binpur-I Gopiballavpur-II Medinipur Pingla Datan-I Narayangarh Kharagpur-II Daspur-I	Am,T,M,(3) Am,Au,B,(3) Am,P,B,(3) B,Am,Au,(3) Am,B,T,(3) Am,B,T,(3) Am,B,Au,(3) B,Am,P,(3)
4	40-50	Jhargram Binpur-II Gopiballavpur-I Debra Keshiary Datan-II Mohanpur Kharagpur-I Daspur-II	Am,B,(2) Am,B,(2) Am,B,(2) Am,B,(2) Am,B,(2) Am,B,(2) B,Am,(2) Am,B,(2) B,Am,(2)
5	>50	Jamboni Nayagram	Am,(1) Am,(1)

2	20-30	Sankril Salboni Garbeta-I Garbeta-II Garbeta-III Sabang Chandrakona-I	Am,B,Au,T,(4) Am,P,T,M,(4) P,Am,T,Au,(4) Am,P,T,B,(4) Am,P,T,Au,(4) B,A,Au,M,(4) Am,P,T,B,(4)	High
3	30-40	Binpur-I Gopiballavpur-II Medinipur Pingla Datan-I Narayangarh Kharagpur-II Daspur-I	Am,T,M,(3) Am,Au,B,(3) Am,P,B,(3) B,Am,Au,(3) Am,B,T,(3) Am,B,T,(3) Am,B,Au,(3) B,Am,P,(3)	Moderate
4	40-50	Jhargram Binpur-II Gopiballavpur-I Debra Keshiary Datan-II Mohanpur Kharagpur-I Daspur-II	Am,B,(2) Am,B,(2) Am,B,(2) Am,B,(2) Am,B,(2) Am,B,(2) B,Am,(2) Am,B,(2) B,Am,(2)	Low
5	>50	Jamboni Nayagram	Am,(1) Am,(1)	Very Low

Crops: Au-Aus, Am-Aman, B-Boro, W-Wheat, M-Mustard
Oil, T-Til, P-Potato

Table -2b: Level of crop diversification (2010-2011)

Class	ICD	Name of Blocks	Number of Crops	Degree of Diversification
1	<20	Keshpur Chandrakona-II , Ghatal	Am,M,P,T,B,(5) Am,P,T,Au,B,(5) B,Am,T,M,P,(5)	Very High

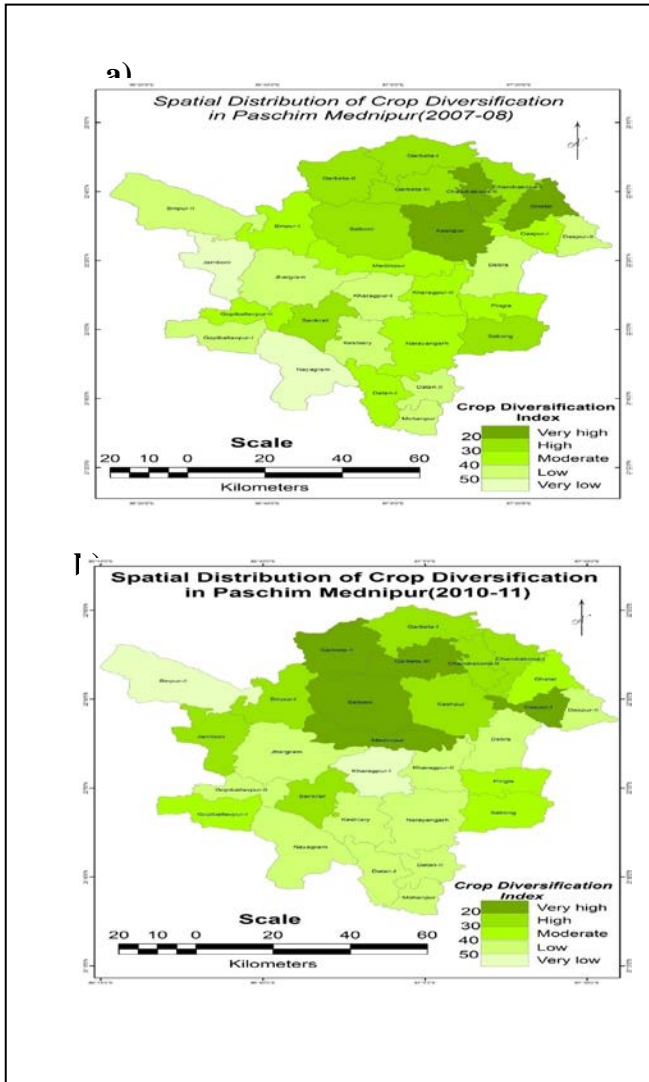


Fig 2: Crop Diversification in Paschim Medinipur

Table-3: Magnitude of Crop Diversification during Study Period 2007-08 to 2010-11

Sl No	Name of Blocks	Index of Crop Diversification (2007-08)
1	Jhargram	-0.63
2	Binpur-I	+0.86
3	Binpur-II	-49.57
4	Jamboni	+76.89
5	Nayagram	+47.9
6	Sankrail	-0.07
7	Gopiballavpur-I	+13.46
8	Gopiballavpur-II	-14.07
9	Salboni	+5.47
10	Keshpur	-4.58
11	Garhbeta-I	+0.28
12	Garhbeta-II	+3.85
13	Garhbeta-III	+4.38
14	Medinipur	+11.65
15	Debra	+1.46
16	Pingla	-0.39
17	Keshiary	-1.82
18	Dantan-I	-16.66
19	Dantan-II	-0.24
20	Narayangarh	-15.09
21	Mohanpur	+0.81
22	Sabang	-7.95
23	Kharagpur-I	-49.65
24	Kharagpur-II	-14.49
25	Chandrakona-I	-0.31
26	Chandrakona-II	-4.2
27	Ghatal	-11.57
28	Daspur-I	+11.01
29	Daspur-II	-0.07
Total		1.2

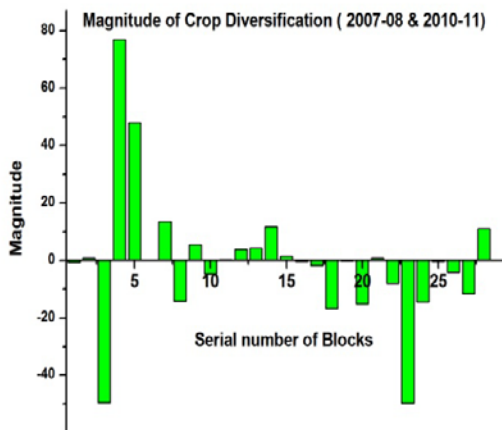


Fig-3: Magnitude of Crop Diversification during Study Period 2007-08 to 2010-11

7. Conclusion

From the analysis of crop diversification the following conclusions may be drawn:

- i. Intensive stress on Aman monoculture effects crop diversification. Lack of adequate knowledge about other profitable crops and their potentialities compelled the farmers to practice rice cultivation.
- ii. Secondly, the most of blocks shows rapid changes in the status of diversification in cropping within a very short time.
- iii. Thirdly, most of the blocks where the diversification level is quite high but actually shares of other crops to Gross Cropped Area (GCA) are insignificant.
- iv. Lastly, within four years the ICD level in respect to district average has positively changed to 1.2 which is almost stagnant in nature.

There is a wide range of crop diversity among various blocks, temporal variation is also noteworthy, but overall result of ICD value is not so high where concentration of population is very high. Moreover, concentration of Aman cultivation is very high for most of the blocks and share of other cropping area is even below subsistence level. Those blocks which show prosperous up gradation in regard to crop diversification did not able to carry on the status of development unfortunately. Refusing their traditional culture rejecting a prospective Rabi culture, Zaid crops like varieties of vegetables along the sandy loam soil of the river bank areas. Such intensive rice culture without proper crop rotation using ground water, costly chemical fertilizers, and pesticides is not economically fruitful, and not ecologically balanced. So,

immediately necessary action plan should be undertaken for these blocks, so that the crop diversification would reach in a reasonable mark regarding scientific but eco-friendly techniques. Scientific crop diversification with proportional, justified shares of different crops would make a satisfactory solution for these blocks. Along with government, local people must come forward to change rice dominant agricultural scenario.

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