CROP DIVERSIFICATION IN MURSHIDABAD DISTRICT, WEST BENGAL: A SPATIO-TEMPORAL ANALYSIS

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Abstract

Crop Diversification is the multiple cropping system i.e. addition of more crops to the existing cropping system along with use of crop species, that could be refined to manufactured products etc. Region like Murshidabad, which is mostly based on agriculture and occupied by different crops has both a tendency to specialize and diversify. The technique crop diversification index identifies the areas having a tendency of crop diversification in the study area, it also aids to know the cropping pattern, crop concentration, crop variation etc. The present paper is an attempt to show the spatial pattern of crop diversification along with the temporal changes. Variations of crop diversification in response to fast changing physical and socio-cultural conditions are studied for 1996-1997 and 2006-2007employing Singh's (1976) index of crop diversification. For block level analysis the technique has been classified into various groups. Rice, jute wheat and mustard along with other pulses are the major crops diversified.

Key Words: Crop diversification, crop diversification index, cropping pattern, spatial pattern, temporal changes.

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Introduction

Crop Diversification is a concept opposite to crop specialization, providing the relative areal strength between crops grown in a region (Husain 1996). It is an agricultural technique where farmers harvest a variety of crops instead of just one. Crop diversification patterns have great relevance in the agricultural landuse studies, and are an important component of the crop geography of a region (Ratnaparkhi 2012). It reduces risk factor resulting from crop failure within a region. Though rich farmers prefer specialization, the poor and substitute farmers are interested in diversification of crops. Diversified crops tend to be more pest-resistant. Diversification enhances nitrogen in the soil to replenish the soil fertility. Thus, it increases the sustainability of arable land. It generates more employment as the agricultural workers remain busy in sowing, weeding, harvesting and marketing of crops throughout the year. Increase in intensity of cultivation and in yields per unit area are the only available options to meet future food needs to feed an ever increasing population (Gunasena 2000). Farmers and their families benefit from greater variety in their diets, and therefore better nutrition. Changes in cropping pattern in terms of acreage allocation among different crops have been the integral part of agricultural development of a region, which further depends on the money invested, production for, available time etc. Crop diversification of a geographical area is based on physical, social and economic factors along with technological, geographical and institutional structure of that region (Todkari 2012). Diversification of crop has been seen in Murshidabad during the post-Green Revolution period. The early years of post-Green Revolution period, favoured of wheat, but later gradually turned to other rabi-crops like potato and mustard. A wide spatio-temporal variation of crop diversity exists among different blocks of Murshidabad district (Pal 2008).

Study Area

Murshidabad district has 26 blocks, is the northern most district of the Presidency Division of West Bengal lying between 23°43'30" and 24°50'20" north latitudes and 87°49'17" and 88°46' east longitude. The rich fertile clayey-loam, loam, loamy-sandy etc. soils provide a vivid scope to explore the cultivation potentialities attracting folk to stick to agriculture the healthiest form of primary activity. Based on agricultural topology, its generalization, diversification, crop rotation, cropping pattern, crop combination is totally revolving around the only land available. With an area of 2143 square miles, the district has two agro-climatic zones viz. old alluvial zone and new

alluvial zone. 399010 hectares land is available for cultivation out of 532500 thousand hectare of geographical area. The net-cropped area is 398700 hectare while gross cropped area is fur more i.e. of 976200 hectare, thus raising the cropping intensity to 249% in the district (2007-08). Areas with high cropping intensity have a probability of more diversification.

Objectives

- To have a comparative study of crop diversification regions for the cropping year of 1996-1997 and 2006-2007.
- To assess the spatio-temporal variation of crop diversification in Murshidabad district.

Methodology

Statistical technique has gained momentum in the recent present and its importance in geography brings vivid scope when applied. The present study is based on secondary data collected from the Murshidabad District Statistical Handbook of years 1996-1997 and 2006-2007 provided by Bureau of Applied Economics & Statistics, Government of West Bengal. Simple statistical method has used to compute crop diversification. The author has purposively used the statistical technique of Jasbir Singh (1976) for delineating crop diversification regions. The study includes those crops which have a share of 5% or more than 5% of the total harvested area.

$$\text{Index of Crop Diversification (Icd)} = \frac{\text{Percentage of total harvested area under 'n' crop}}{\text{Number of 'n' crop}}$$

Where, 'n' crops are those which individually occupy five or more than five percent of crop to total harvested area.

Lastly, the obtained value of Icd of different blocks (1996-97 and 2006-07) has been categorized in five classes, viz. i) Very high, ii) high, iii) medium, iv) low and v) very low crop diversification. Using the GIS software a choropleth map has been drawn based on the above classes.

Results and Discussion

The index of diversification is inversely related to diversification. High index denote specialization, while lower indices indicate diversification. An attempt has been made to show the changes in the crop diversification regions, during the periods of 1996-1997 and 2006-2007

(Table-1). Investigations show that where in some areas significant change has been observed, some showed limited while others sowed negative change. The environmental constraints owing to geomorphic situation soils and climate have put the limit on diversified agricultural productivity. Jasbir Singh's method has identified five crop diversification classes in study area. Farmers grow numerous crops in the field rather than single crops. Rice is the main primary crop, and is seen in every combinations of diversifications in the blocks of Murshidabad.

Very High Crop Diversity (Icd value <20)

Three out of twenty-six blocks have the very high crop diversity covering only a bit of the total cultivated area of the district in the reference year 1996-97. In these blocks five crops are cultivated. Suti-I with crop diversification index (Icd) of 18.771 has a significant reign of rice, jute, wheat, mustard and musur (Table-2). Data acquired from Murshidabad District Statistical Handbook of 1996-1997 reveal that among all three types of paddy, aman occupies 5540 ha of GCA (Gross Cropped Area). Suti-II carrying Icd of 19.177 also cultivates like the preceding. Raninagar-I with Icd 19.592 mostly cultivates rice, jute, wheat, mustard and maskalai.

In 2006-07, four blocks of Murshidabad have experienced very high crop diversity (Table-2). With a crop diversification index of 16.219 Lalgola ranks highest having six major crops cultivated. These are rice, jute, wheat, musur, maskalai and til. Raninagar-II having Icd 18.112 has a culture of rice, jute, wheat and mustard. Sagardighi ranks third in diversification, scoring Icd 18.172, cultivating rice, wheat, mustard, jute and gram. Samserganj carries Icd of 19.952 where five crops viz. rice, jute, wheat, musur and khasari are cultivated (Fig-1).

Table-1: Crop Diversification Index of Blocks of Murshidabad (1996-97 and 2006-07)

Sl. no.	Name of blocks	Index of crop diversification	
		1996-1997	2006-2007
1	Berhampore	32.547	23.394
2	Beldanga-I	24.744	24.853
3	Beldanga-II	31.025	22.820
4	Nowda	31.109	22.141
5	Hariharpara	23.326	22.451
6	Kandi	32.591	45.630
7	Khargram	47.758	32.763
8	Burwan	31.284	24.388
9	Bharatpur-I	47.222	80.969
10	Bharatpur-II	48.519	85.269

11	Farakka	24.077	22.558
12	Samserganj	23.936	19.952
13	Suti-I	18.771	37.416
14	Suti-II	19.177	21.550
15	Raghunathgang-I	32.865	39.576
16	Raghunathgang-II	32.639	20.084
17	Sagardighi	32.173	18.172
18	Lalgola	23.909	16.219
19	Bhagwangola-I	30.917	23.770
20	Bhagawangola-II	24.942	23.395
21	Msd-Jiaganj	24.067	22.295
22	Nabagram	31.945	41.420
23	Domkal	31.211	22.477
24	Jalangi	23.837	23.647
25	Raninagar-I	31.922	21.781
26	Raninagar-II	19.592	18.112

Source**:** Calculated and Compiled by author. Crop Diversification Index after. Based on block wise area under major crops for the cropping years of 1996-97 and 2006-07.

Table-2: **Levels of Crop Diversification in the Blocks of Murshidabad (1996-97 & 2006-07)**

Index Value Range	Diversification class	1996-1997				2006-2007			
		Name of Blocks	Individual index values	Different crops	No. of crops	Name of Blocks	Individual index values	Different crops	No. of crops
<20	Very High	Suti-I	18.771	R,J,W,Ms,Mu	5	Samserganj	19.952	R,J,W,Ms,K	5
		Suti-II	19.177	R,J,W,Ms,Mu	5	Sagardighi	18.172	R,W,Ms,J,G	5
		Raninagar-II	19.592	R,J,W,Ms,Ma	5	Lalgola	16.219	R,J,W,Ms,Ma,T	6
						Raninagar-II	18.112	R,J,W,Ms	4
20-26	High	Beldanga-I	24.744	R,J,W,Ms	4	Berhampore	23.394	R,J,W,Ms	4
		Hariharpara	23.326	R,J,W,Ms	4	Beldanga-I	24.853	R,J,W,Ms	4
						Beldanga-II	22.820	R,J,W,Ms	4
		Farakka	24.077	R,J,Ms,Mu	4	Nowda	22.141	R,J,W,Ms	4
						Hariharpara	22.451	R,J,W,Ms	4
		Samserganj	23.936	R,J,W,Ms	4	Burwan	24.388	R,J,W,Ms	4
						Farakka	22.558	R,W,Ms,K	4
		Lalgola	23.909	R,J,W,Ms	4	Suti-II	21.550	R,W,Ms	3
						Raghunathganj-II	20.084	R,J,W	3
		Bhagawangola-II	24.942	R,J,W,Ms	4	Bhagawangola-I	23.770	R+J+W+Ms	4

						Bhagawangola-II	23.395	R,J,W,Ms	4
		Msd-Jiaganj	24.067	R,J,W,Ms	4	Msd-Jiaganj	22.295	R,J,W,Ms	4
						Domkal	22.477	R,J,W	3
		Jalangi	23.837	R,J,W,Mu	4	Jalangi	23.647	R,J,W	3
						Raninagar-I	21.781	R,J,W	3
26-32	Medium	Beldanga-II	31.025	R,J,W	3				
		Nowda	31.109	R,J,W	3				
		Burwan	31.284	R,P,Ms	3				
		Bhagawangola-I	30.917	R,J,W	3				
		Nabagram	31.945	R,W,Ms	3				
		Domkal	31.211	R,J,W	3				
		Raninagar-I	31.922	R,J,W	3				
32-38	Low	Berhampore	32.547	R,J,W	3	Khargram	32.763	R,W,Ms	3
		Kandi	32.591	R,W,Ms	3				
		Raghunathganj-I	32.865	R,W,Ms	3	Suti-I	37.416	R,W,Ms	3
		Raghunathganj-II	32.639	R,J,W	3				
		Sagardighi	32.173	R,J,W	3				
>38	Very Low	Khargram	47.758	R,W	2	Kandi	45.630	R,W	2
		Bharatpur-I	47.222	R,Ms	2	Raghunathganj-I	39.576	R,W	2
						Nabagram	41.420	R,W,Ms	3
		Bharatpur-II	48.519	R,Ms	2	Bharatpur-I	80.969	R	1
						Bharatpur-II	85.269	R	1

Source: Compiled by author. Crops which individually occupies 5% or more of the total harvested area only included in the combination. Individual Values are derived from Crop diversification index.

High Crop Diversity (Icd value 20-26)

The cropping year of 1996-97 has eight blocks of twenty six blocks in high crop diversity category (Table-2). Among them Hariharpara has the lowest Icd i.e. 23.326 thus ranking highest in this category with a major culture of rice, jute, wheat and mustard. Next is Jalangi, having four major corps culture of rice, jute, wheat and musur with score of 23.837. Lalgola block accounted Icd value of 23.909 where four major crops like rice, jute, wheat and mustard are cultivated. With a score of Icd value 24.067, Msd-Jiaganj cultivates rice, jute, wheat and mustard. Farakka lay slightly behind with Icd values of 24.077; four important crops rice, jute, mustard and musur are cultivated. Samserganj and Bhagawangola-II have near about Icd values of 23.936 and 23.942 respectively of same major crop culture of rice, jute, wheat and mustard. A dominance of like rice, jute, wheat, mustard and sometimes musur is seen.

Fifteen out of twenty-six blocks have high crop diversity covering a lot of the total cultivated area of the district in the reference year 2006-07 (Table-2). Berhampore grouped in high crop diverse category of Icd 23.394, has four major crops culture of rice, jute, wheat and mustard.

Beldanga-I and Beldanga-II both have four major crops culture of rice, jute, wheat and mustard with Icd values of 24.853 and 22.820 respectively. With Icd of 20.084, Raghunathganj-II has three major cultures of rice, jute and wheat. Though Suti-II and Raninagar-I has a low Icd index of 21.550 and 21.781 respectively, they practice three crop culture with former of rice, wheat and mustard and latter with rice, jute and wheat. Having a dominance of four crop viz. rice, jute, wheat and mustard, Nowda and Hariharpara scores Icd values of 22.141 and 22.451 respectively, while both the former and later has a major four crops culture of rice, jute, wheat and mustard. Burwan has dominance of rice, jute, wheat and mustard of 24.388 Icd value. Farakka also has four major crops cultivation of rice, wheat, mustard and khasari, though the Icd value less than Burwan i.e. 22.558. Both Bhagawangola-I and Bhagawangola-II has rice, jute, wheat and mustard as the four major crops cultivated with Icd values of 23.770 and 23.395 respectively. With Icd value of 22.295 Msd-Jiaganj has three major crops culture of rice, jute, wheat and mustard. Rice, jute and wheat dominates Domkal and Jalangi though the Icd values are 22.477 and 23.674. Thus ten out of fifteen blocks grouped in high crop diversification, have four major crops cultures of mostly rice, jute, wheat and mustard. The rest blocks cultivate three crops, though they have low Icd values. This means these three major crops are intensified and share lot acreages (Fig-1).

Medium Crop Diversification (Icd value 26-32)

Out of twenty six blocks seven blocks of Murshidabad of cropping year 1996-97 are categorized in medium crop diversification. Bhagawangola-I with Icd value of 30.917 has bagged three major crops for cultivation: these are rice, jute and wheat. With Icd value of 31.025, Beldanga-I has a diversification of rice, jute and wheat. Nowda of Icd value 31.109 and Domkal of Icd value 31.211 follow the race with rice, jute and wheat diversification. Burwan has a exceptional diversification of rice, potato an mustard of Icd value 31.284. Raninagar-I has a Icd value of 31.922 with three major crops of rice, jute and wheat culture. With Icd value of 31.945 Nabagram has rice, wheat and mustard has three major crops culture. No such blocks have been found fall in the category of medium crop diversification in the year 2006-07 (Fig-1).

Low Crop Diversification (Icd value 32-38)

In the relevant year of 1996-97, five out of twenty six blocks are categorized in low crop diversification (Table-2). Berhampore had diversified itself with rice, wheat and jute with Icd score of 32.547. Kandi with Icd value of 32.591 and Raghunathganj-I with Icd value of 32.865 had a three major crop culture of rice, wheat and mustard. Sagardighi and Raghunathganj-II had cultivated three major crops namely rice, jute and wheat with Icd values of 32.173 and 32.639 respectively.

Two out of twenty-six blocks have low crop diversity covering a lot of the total cultivated area of the district in the reference year 2006-07. Khargram of Icd value 32.763 has rice, wheat and mustard as three major crop cultivated. Suti-I with Icd value of 37.416 has the same diversification like that of Khargram (Fig-1).

Very Low Crop Diversification (Icd value >38)

The study year of 1996-97 has enlisted three blocks out of twenty six blocks of Murshidabad under very low crop diversification category. Rice and wheat are mostly practiced in Khargram with an Icd value of 47.758. Bharatpur-I and Bharatpur-II both have two major crops culture of rice and mustard. While Bharatpur-I had an Icd value of 47.22, Bharatpur-II had an Icd value of 48.519 (Table-2).

Three out of twenty-six blocks have very low crop diversity covering a lot of the total cultivated area of the district in the reference year 2006-07 (Table-2). Kandi and Raghunathganj-I has two major crops of rice and wheat cultivation. While Kandi has an Icd value of 45.630, Raghunathganj-I has an Icd value of 39.576. With Icd value of 41.420, Nabagram has dominance of rice, wheat and mustard (Fig-1).

Bharatpur-I, Bharatpur-II have shown orthodoxy by sticking to monoculture of local cereal crop i.e. rice. These two blocks have exceptional Icd values of 80.969 and 82.269 respectively which are far from the very low diversity class boundary. This means that not a single crop has attended a 5% share in total cropped area. The Murshidabad District Statistical Handbook of 2006-07 shows that the actual acreages of Bharatpur-I is 23107 ha and that of Bharatpur-II is 1964 ha. These values are really alarming if we study the percentage share of rice is 80.969% for Bharatpur-I and 85.269% for Bharatpur-II itself (computed by author). In 1996-97 Bharatpur-I and Bharatpur-II had 47.22 and 48.299 Icd values. The Murshidabad District Statistical Handbook of 1996-97 shows that Bharatpur-I had 14890 ha of land under rice cultivation, while

Bharatpur-II had 15330ha of land for the same utilization. But calculations reveal that 5.495% and 8.013% of cultivated land i.e. more than 5% of total cropped area is used by mustard.

CROP DIVERSIFICATION REGIONS IN MURSHIDABAD DISTRICT OF WEST BENGAL
(1996-1997 AND 2006-2007)

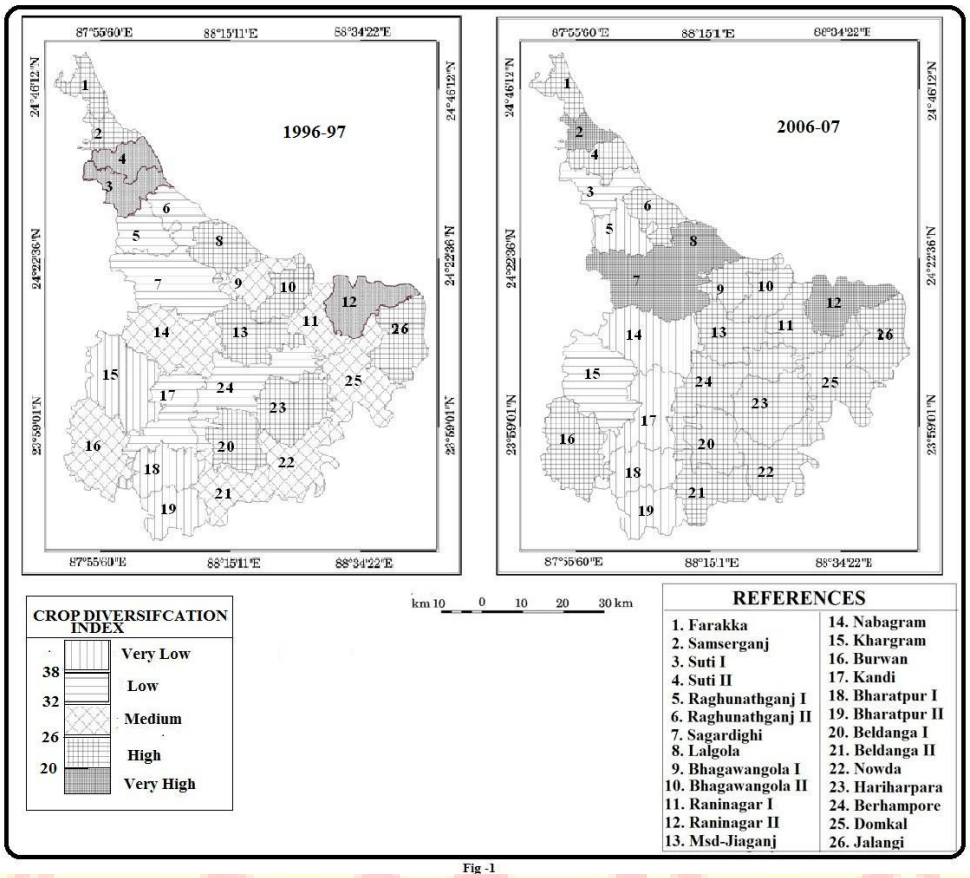

Fig -1

Critical Review of Crop Diversification Pattern in Murshidabad District

Modernizations in agriculture along with proper irrigation facilities have added charm to varitification. Rice, jute, wheat and mustard prevails with a combination of either musur or maskalai or gram or sometimes khasari or even til is seen in very high crop diversification category. Crop diversification ranges from four to even six crops in this category. The study year of 1996-97 shows grouping of eight blocks while 2006-07 shows a rise in blocks under high crop diversification category. This shows a clear indication of a tendency of diversification. A dominance of rice, jute, wheat and mustard with sometimes musur and khasari is seen in both the study years of high crop diversification category. The study year of 2006-07 has enlisted not a single block under the medium crop diversification category. This is mainly because a bulk of the blocks falls in high diversification category and the rest have still stuck to specialization.

Khargram which was in the very low crop diversification category in 1996-97 has located itself to the preceding category. While Suti-I, which in 1996-97 was placed in very high crop diversified category, fell down to low crop diversification category in 2006-2007. This is mainly because the flood of 2000 has left a fear of risk factor in the minds of farmers to opt for specialization. Kandi which had dominance of three major crops of rice, wheat and mustard in 1996-97; has a dominance of rice and wheat in 2006-07. Raghunathganj-I had a dominance of rice, wheat and mustard in 1996-97, now has two major crops of rice and wheat cultivation. Thus both have come from low crop diversity to very low crop diversity. Nabagram has a diversity of three major crops viz. rice, wheat and mustard in both the study years of 1996-97 and 2006-07. Interestingly, the Icd values differ a lot i.e. from 31.945 in 1996-97 to 41.420 in 2006-07. With same crop culture but different Icd values have detoriated the diversification class of medium crop diversification to very low crop diversification. From this it is clear that though the number of crop cultured are same the dominance of rice has outhrowned the proportion of other crops.

Conclusion

The cropping pattern of Murshidabad District is high diversification in many blocks where irrigation and other favourable facilities entertains multiple cropping system. But after having obtained self sufficiency in food grains production, agriculture became increasingly commercialised. A disparity of ten years shows a significant change in crop diversification levels of classes, though not much as in index values. In 1996-97, the crop diversification was restricted to three blocks in very high diversification category and eight in high diversification class, the scenario changed in 2006-07, with not much change in very high diversification class with mere four blocks by ten years; but with fifteen blocks in high diversification category. The highest number of crops diversed is six while the lowest monocrop. Farmers of few blocks hardly ever attempt for diversification in even better conditions. Moreover a tradition of rice and jute cultivation persists along with wheat, mustard in winter which provides support to generalization. They restrict their cultivation to monocrop or bicrop i.e. opt for a generalization tendency in some blocks due to the district's flood prone nature. Due to locational factors rivers spread their distributaries in their lower course, which leaves it to often flood resulting in fresh silt deposits. This as a result is both a blessing and curse. Alluvial deposits suits best for monocrop or two crop combinations can to some extent withstand in the aforesaid calamity thus

farmers opt for specialization. A block wise disparity persists, which clearly indicates to more scope of diversity. Though diversity of four or three crops are common, farmers also grow other crops to such an amount which is just below 5% of the total area harvested. Thus it could not be shown keeping in mind the index computations. Comparative study of Murshidabad District Statistical Handbook of years 1996-1997 and 2006-2007 shows more inclusions of pulses and oilseeds in recent present. In addition, growing vegetables, especially potato cultivation have risen to a greater extent in Murshidabad.

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