

Pattern of Crop Diversification in Ganga Delta Region, West Bengal

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ABSTRACT:

In India most of the population is dependent on agricultural activity to survive. Thus the percentage share of GDP is not appreciable, because it is subsistence in nature. But like other South Asian countries India also giving importance in crop diversification. Crop diversification helps not only the farmers to secure their economic condition but also increase the GDP share of the nation. 'Ganga Delta' region of West Bengal is very famous for its high productive land. But it gives more emphasis on rice cultivation rather than other cash crop. But in last few decades the region is facing a change. The decreasing area under rice cultivation and production of rice is signifying the crop diversification. Thus the region has perfectly suitable condition for rice cultivation it is slowly moving towards vegetables, fruit and other cash crop cultivation. This paper deals with the changing pattern of crop diversification in this particular area. The study has been done by analyzing secondary data and using some statistical and GIS techniques. The paper also recommended some suggestion for further progress.

KEYWORDS: Cash crop, Crop diversification, Ganga Delta, GDP.

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I. INTRODUCTION

Like other South Asian countries, India is famous for its intensive agricultural practice. According to 2011 census 61.5 percent population of India is engaged in agriculture. The contribution of agricultural sector in GDP is 17.32 percent. The scenario is clear enough; above 60 percent of total population is practicing agriculture but it contributing below 20 percent of total GDP of a country, because India is practicing subsistence type agriculture. Indian agriculture is dominated by rice. India is world's largest producer of rice accounting 20 percent. So the craze towards rice cultivation reduced the chance of crop diversification. But in present day this dilemma of subsistence agriculture and rice cultivation is eliminating slowly. Due to flourish of food processing industry and increasing demand of other cash crops in market cultivators and farmers are making the change. Government also makes some policies to increase interest for crop diversification. And the result is positive. The scenario is changing not so rapidly but noticeable.

Ganga Delta region is worldwide famous for its fertile soil which is key component for its high agricultural production. Indian part of the delta is located on the state of West Bengal. Southern part of West Bengal is a part of active delta region. Murshidabad, Nadia, North 24 Pargans, South 24 Parganas and Kolkata are the five districts which are situated on Ganga delta plain served by Bhagirathi-Hoogly River. These districts are well-known for its agricultural production (except Kolkata). West Bengal occupied first position in rice production in India. So the mono cropping pattern is dominating this region. But it is necessary to eliminate the dominance of rice and implement some cash crop to this region especially for marginal cultivators. It gives them extra economic supports beside of subsistence farming for survive.

The term 'diversification' of crop is just opposite 'specialization' of crops. It's mean diversity of crop in a particular region. Its helps to reduced dependency in a particular crop, and help to earn more money from agriculture. Diversification change the agricultural pattern mono to multi crop and most of the farmers apply crop rotation method. By this the soil health is protected naturally.

This paper is considering the diversification of crop in Ganga delta region which is mostly dominated by rice cultivation and increasing trend of other cash crops especially vegetable and fruit cultivation in this area.

II. STUDY AREA

The Ganges delta consists of the Nadia, South 24 Parganas, North 24 Parganas, Kolkata and Murshidabad districts (Fig.1). The river Ganges passes through this vast area and divides into three distinct parts – the old delta, the mature delta and the active delta. The old delta consists of the districts of Murshidabad and

Nadia. The formation of delta is complete and the rivers here are heavily silted and many have even dried up in due course of time. The districts of Kolkata and North 24 Parganas form mature delta region. The rivers are slow and meandering and frequently shift their courses. Swamps and oxbow lakes characterises in this region. The district of South 24 Parganas is known to be the active delta of the Ganges, where the formation of delta is still an ongoing process. Alluvial soil mainly covers the most of this region. The soil has large amounts of minerals and nutrients, which is good for agriculture. The Ganges Delta lies mostly in the tropical wet climate zone, and receives between 1,500 to 2,500 mm of rainfall each year. Hot, dry summers and cool, dry winters make the climate suitable for agriculture.

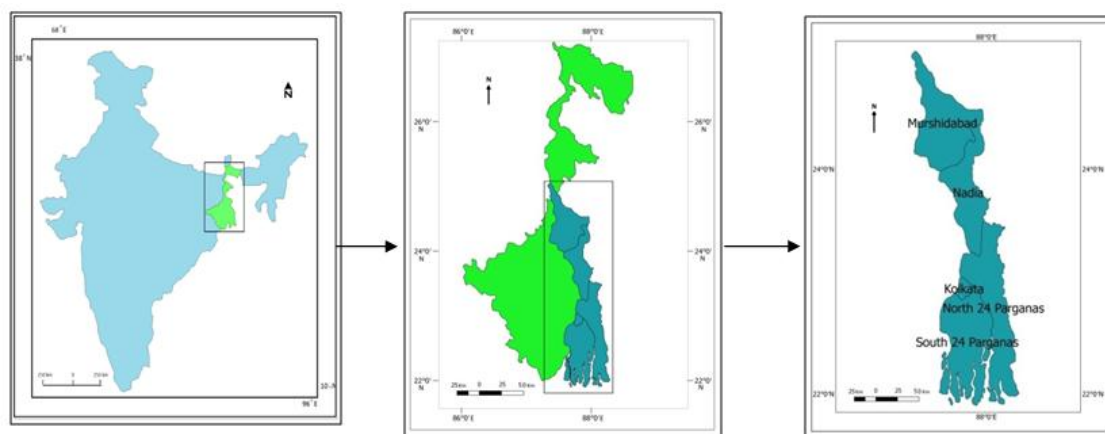


Figure 1: Location Map

III. AIM AND OBJECTIVES

3.1 Aim:

The paper has aimed to observe the changing trend of crop diversification and production of major crops in Ganga Delta region of West Bengal.

3.2 Objectives:

- To study the changing trend of production of rice, wheat, maize, pulses, oil seeds, fibre, miscellaneous crops, fruit, vegetables and flowers in this region for the time period of 2003-04 to 2012-13.
- To analysis the changing trend of rice, vegetables, fruit and flower cultivation during the time period of 2006-07 to 2012-13.
- To analysis the nature of crop diversification in this region by using the Gibbs and Martin's method, Bhatia's method and Herphindhal's method during 2003-04 and 2012-13.

IV. DATABASE AND METHODOLOGY

4.1 Database:

The present study is completely based on secondary data. Data collected from various publications and records of District Statistical Handbook and Agriculture Report of West Bengal published by the Bureau of Applied Economics and Statistics, Govt. of West Bengal. The study has been conducted for the time period 2003-04 to 2012-13.

4.2 Methodology:

Various statistical and GIS technique applied for analysis of the collected data and maps. Time series technique applied to analysis the trend of production of different crops for the time period 2006-07 to 2012-13. The nature of crop diversification in this study has been examined by using three different methods namely, Gibbs and Martin's method, Bhatia's method and Herphindhal's method.

4.2.1 Gibbs and Martin's Method

$$\text{Index of Crop Diversification} = 1 - \frac{\sum X^2}{(\sum X)^2}$$

Here, X is the percentage of total cropped area covered by an individual crop. Magnitude of crop diversification computed by this formula varies from 0.1 to 1.0. According to this formula the index value is directly related to magnitude of crop diversification. It means higher the index value higher the magnitude of crop diversification and vice versa.

4.2.2 Bhatia's Method

$$\text{Index of Crop Diversification} = \frac{\text{Percent of cropped area under } x \text{ crops}}{\text{Number of } x \text{ crops}}$$

Here, X crops are those crops which separately cover 10 % or more than 10% of the total cropped area in each district. The index value calculated by this formula is inversely related to magnitude of crop diversification. It means lower the index value higher the magnitude of crop diversification and vice versa.

4.2.3 Herphindal's Method

$$\text{Index of Crop Diversification} = \sum_{i=1}^n P_i^2$$

$$P_i = A_i / \sum A_i$$

Where, P_i = Proportion of Area under i th Crop, A_i = Actual Area under i th Crop, $\sum A_i$ = Total Cropped Area. The index value worked out by this formula varies from 0 to 1. It is 0 in case of perfect crop diversification whereas 1 represents the perfect crop specialization.

V. LITERATURE REVIEW

- B. K. Ghosh (2011) stated that, intra-crop substitution happened in West Bengal and non-food grain crops gradually replacing the food grain crops during 1970-71 to 2004-05.
- S. Sengupta and S. K. Bhaumik (2014) found that, the small and marginal farmers adopted crop diversification for increasing their income level levels and economic status in West Bengal.
- R. Singh (2015) reveals that, level of crop diversification of all the states of India considerably increased during 2002-03 to 2012-13. But, with the government and institutional support, India can achieve high level of crop diversification entire all the states.
- L. K. Meena, C. Sen and S. Kushwaha (2016) found that, the degree of diversification of Jaisalmer and Kota are not same due to different geographical location of the districts. But, still commercialization and diversification of small farmers of both the districts occur rapidly and area coverage of fruits, vegetables and flowers increased significantly during the last few years.

VI. RESULTS AND DISCUSSION:

6.1 Changes in Production:

The production of different crops for the year 2003-04 has been computed (Fig.2). First we are considering rice, which is the primary and most dominant crop in Ganga delta region and thus we are getting a high production of it in all the four districts. It almost shows about 30% of the entire production. Next we are getting vegetables where the production is also high because after rice is holds a good mainstay of local market's economy. Next come fruits where the production is less as this is not for middle class regular consumption as the cost is very high. Next a prominent percentage of production is being hold by fibre crops as along the river bank we are having very good infrastructure for this fibre production. Now oil seeds also with very low production put some impact on local market. Pulses also here are very low. Now maize being dry crops showing very low production and it is nil in North 24 Parganas. Nowadays wheat is gradually penetrating as our one of the staple food other than rice and so mainly in Murshidabad its production is medium to high but gradually its production decreases along Nadia, North 24 Parganas and than South 24 Parganas. Flower here is also showing a very minute production according to its importance. And other than all these we are getting potato, chillie, ginger etc. and they are occupying a good quality of production as all the miscellaneous products are very much necessary in our daily food habit.

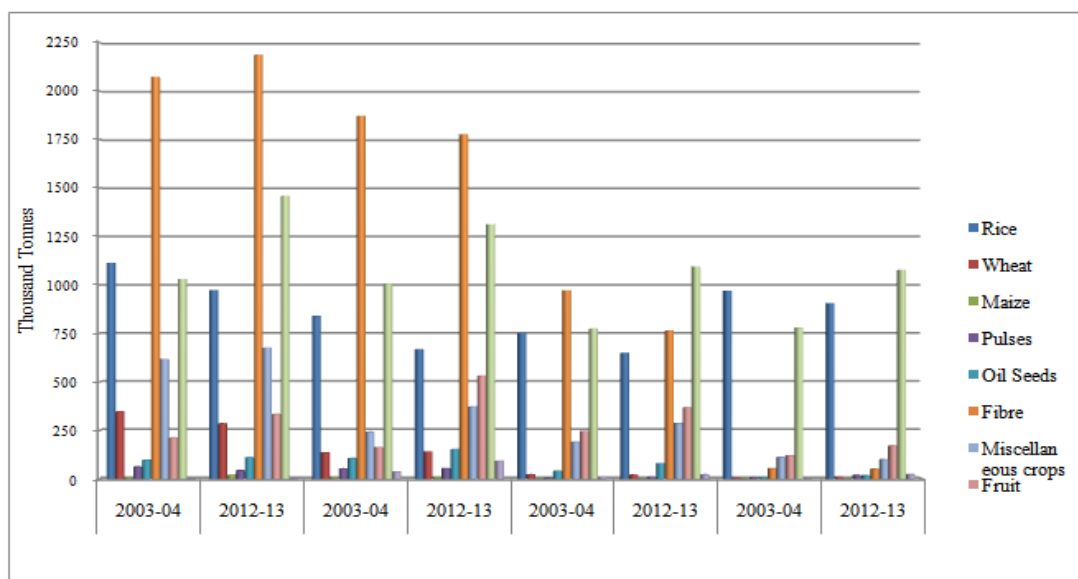


Figure 2: Changes in Production of Crops during 2003-04 to 2012-13

In the year 2012-13 (Fig.2), the production scenario is changing in compare to 2003-04. In case of production of rice, vegetables, fruit and flowers the changing scenario is quiet noticeable. Rice is most primary and most predominant crop in this region and thus we are getting a high production of it in all the four districts. The production of this crop is showing a decreasing trend all the four districts in compare to the year 2003-04. Next we are getting vegetables where the production is also high and increase from the year 2003-04. After rice, it contributes a good mainstay of local market's economy. Next a prominent percentage of production is being holds by fibre crops as along the river bank and the production trend decreasing from the year 2003-04. Next comes fruits where the production is less as this is not for middle class regular consumption as the cost is very high. The production rate of fruits is increasing significantly from the year 2003-04. In case of oil seeds, the production is quiet high than the year of 2003-04. Pulses and Maize also here are very low production in all the four districts. Wheat is one of the most important staple food after the rice. Same as the previous year, in Murshidabad its production is medium to high but gradually its production decreases along Nadia, North 24 Parganas and South 24 Parganas. Flower here is also showing a very minute production according to its importance and production rate increases in compare to 2003-04. And other than all these we are getting a miscellaneous group where we are getting potato, chillie, ginger etc. and they are also occupying a good quantity of production.

6.1.1 Changes in Rice Production:

In the above drawn time-series diagram (Fig.3) we are showing the year wise production of rice from 2006-07 to 2012-13. Here we have shown the production of rice of all the four districts. If we start with Nadia, we will see that it was having the lowest production of the four in the year 2006-07 and continues till 2008, but in 2008-2009 its production suddenly rises to 277.2 ('000 tonnes) more than. Again from 2009-10 we are getting the previous low trend. Then again in the year 2011-12 it rises and then after 2012-13 it is showing a decreasing trend. After Nadia in the production trend we are getting North 24 Parganas. Here initially in 2006-07 till 2008-09 it was having a constant increased trend and after that till 2011-12 it showed a decreasing trend. But after that in 2012-13 onwards it again started rising. Then if we consider South 24 Parganas in 2006-07, the production was very high about 911.1 ('000 tonnes). Here the production was showing a ups and down trend in all the alternate year but it never goes down below 800 ('000 tonnes) and after 2010 it continuously shows an increasing trend. Now at last we are getting Murshidabad with the highest production throughout. In the year 2006-07 it started with a very high production of above 1000 ('000 tonnes). Then it rises to almost 1200 ('000 tonnes). Than till 2009 it was almost the same i.e. high. But after that up to year 2010 it showed a decreasing trend but after that it gave us an uprising trend. Thus though all these four districts lie as a major crop producing zone along the Ganga delta but still there are variations in production between all the four districts.

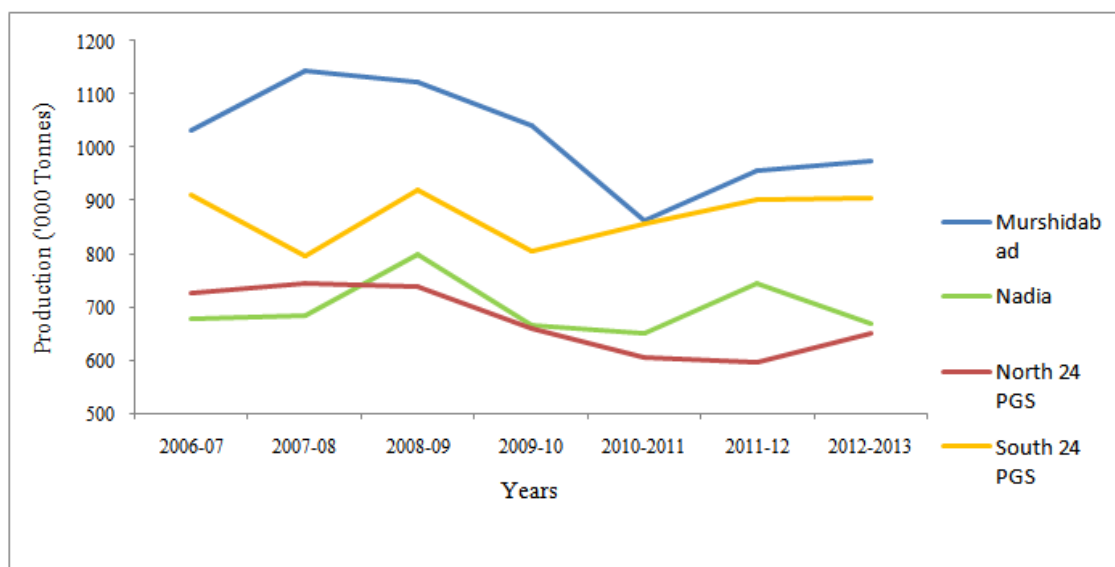


Figure 3: Time Series Analysis of Rice Production

6.1.2 Changes in Vegetables Production:

In the above drawn time-series diagram (Fig.4), we are now showing the vegetable production. Here unlike rice production, we are seeing South 24 Parganas starting with the lowest production of about 800 ('000 tonnes) in the year 2006-07 but from 2007 onwards it is gradually showing an increasing trend. Next to it comes North 24 Parganas, starting with a high production of almost 900 ('000 tonnes) in the year 2006-07. But in 2007-08 it had a sudden fall in production to about 800 ('000 tonnes), but after that it gradually show as increasing trend. Next comes Nadia with a great hike in production and it is starting from about 1100 ('000 tonnes) and after that it showed a continuous increasing trend till 2012-13. Next to it Murshidabad, showed a much more increased production. It is starting from 1200 ('000 tonnes) and after that it showed a continuous increasing trend till 2012-13.

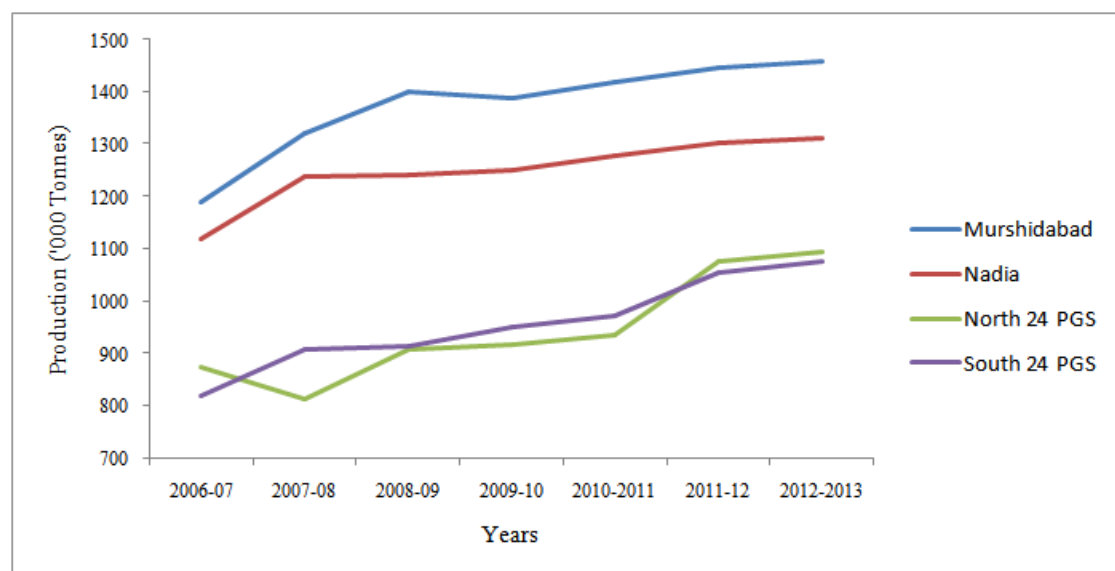


Figure 4: Time Series Analysis of Vegetables Production

6.1.3 Changes in Fruits Production:

Now in this time-series diagram (Fig.5) we are showing the fruit production of the four districts from the year 2006-07 to 2012-13. Now here we are getting the lowest production in South 24 Parganas, it is about 150 ('000 tonnes) and this same production continues till 2012-13. But strikingly here in and position from the side of low production we are getting Murshidabad. Here starting with almost 250 ('000 tonnes), it maintain the same trend till 2011-12 and from 2012-13 it is showing an increasing trend. Next to it we are getting North 24 Parganas. Here starting from 270 ('000 tonnes), it gradually showed an increasing trend till 2012-13. Now at last

we are getting Nadia with 430 ('000 tonnes) and then continuously it shows an increasing trend till 2012-13. Now in the case of South and North 24 Parganas may be due to excessive immigrants, huge population, excessive construction, the cultivation low production growth rate though most nearby of Ganga delta. But for Nadia and Murshidabad with the nearness to the Ganga and along with that comparatively less population is also reflecting an increase in production.

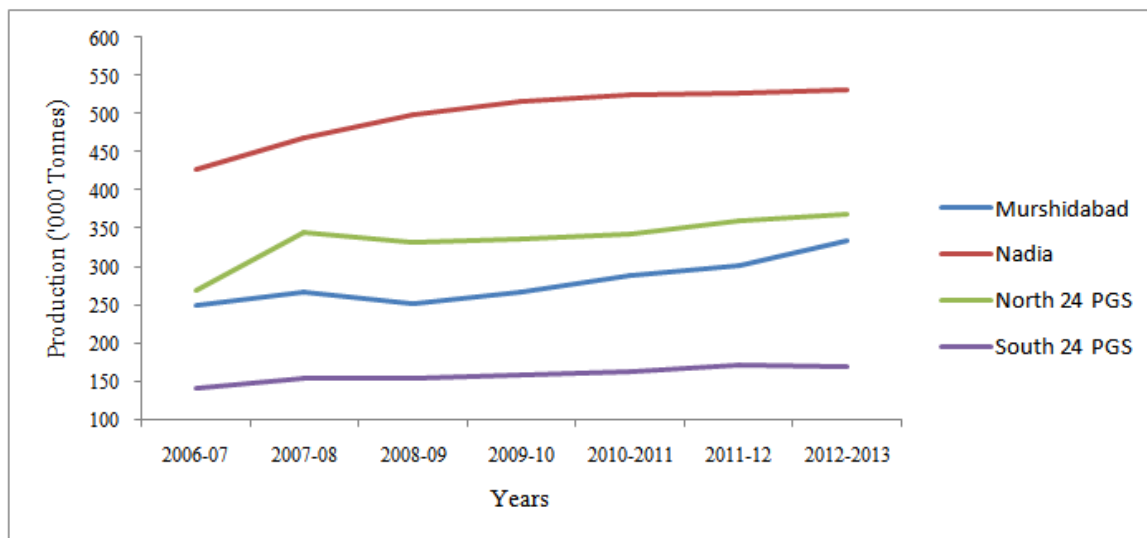


Figure 5: Time Series Analysis of Fruits Production

6.2 Diversification of Crops:

6.2.1 Gibbs and Martin Index:

According to Gibbs and Martin’s crop diversification formula, the index value of the districts Murshidabad, Nadia, North 24 Parganas and South 24 Parganas were respectively 0.76, 0.77, 0.64 and 0.34 for the year of 2003-04. These values indicate the higher level of crop diversification in the districts of Murshidabad and Nadia. Moderate level of crop diversification has been found in North 24 Parganas. The very low level crop diversification is in the South 24 Parganas. But, in the year 2012-13, changing scenario of diversification is quite prominent. The entire four districts are moving towards the direction of high crop diversified regions. The index value of crop diversification of Murshidabad is 0.78. The value increased by 0.2 from 2003-04 and it indicates strongly on highly increased crop diversification. The same scenario is also observed in the case of Nadia district. The index value of this district is 0.81, which is increased by 0.4 and leads the district into the very high diversified zone. The North 24 Parganas district moves into high diversification district from the medium diversification district. The index value of this district is 0.71, which increased by 0.7. The index value of the district South 24 Parganas is 0.44, which increased by 0.10. This district still belongs to the low diversification zone, but a prominent change towards the diversification from specialization has been observed.

Table 1: District Wise Crop Diversification Index by Gibbs and Martin’s Index

Districts	Gibbs and Martin's Index	
	2003-04	2012-13
Murshidabad	0.76	0.78
Nadia	0.77	0.81
North 24 Parganas	0.64	0.71
South 24 Parganas	0.34	0.44

6.2.2 Bhatia’s Method:

In this work, Bhatia’s crop diversification index is also being used for finding the variation of the index value of crops for the years 2003-04 and 2012-13 respectively. In the year 2003-04, the index value of crop diversification of the districts Murshidabad, Nadia, North 24 Parganas and South 24 Parganas were respectively 24.04, 20.19, 27.16 and 45.66. These values indicate the higher level of crop diversification in the district of Nadia. Moderate level of crop diversification has been found in Murshidabad and North 24 Parganas. The low level crop diversification is in the South 24 Parganas. But in the year 2012-13, the scenario is changing from low or medium to high diversification of crops. Murshidabad district changed into high diversified district from medium diversified district and the index value decreased by 4.2. In case of Nadia, the district still belongs to high diversified region and the index value is 19.94. But the value decreased by 0.25 and leads towards the very high diversified district. The index value of North 24 Parganas is 21.94 and fall into medium diversification

district and the index value decreased by 5.22. Therefore, this district moves into high diversification region from medium diversified region. South 24 Parganas district belongs to low diversified region. The index value of this district is 43.78, which decreased by 1.88. Therefore, the district moves towards the diversification from crop specialization.

Table 2: District Wise Crop Diversification Index by Bhatia's Index

Districts	Bhatia's Index	
	2003-04	2012-13
Murshidabad	24.04	19.84
Nadia	20.19	19.94
North 24 Parganas	27.16	21.94
South 24 Parganas	45.66	43.78

6.2.3 Herfindhal Index:

As per the Herfindhal's method, the index values of crop diversification for the following four districts have been computed. In the year 2003-04(Fig.6), the index value of crop diversification of the districts Murshidabad, Nadia, North 24 Parganas and South 24 Parganas were respectively 0.24, 0.23, 0.36 and 0.66. In Murshidabad and Nadia districts high crop diversification was seen. Medium level crop diversification has been found in North 24 Parganas and South 24 Parganas districts. But in the year 2012-13(Fig.7), changing scenario of diversification is quite prominent. The index value of crop diversification of Murshidabad is 0.22. The value decreased by 0.2 from 2003-04 and it indicates strongly on highly increased crop diversification. The same scenario is also observed in the case of Nadia district. The index value of this district is 0.19, which decreased by 0.4 and leads the district into a very high diversified region. The North 24 Parganas district moves into high diversification district from the medium diversification district. The index value of this district is 0.29, which decreased by 0.7. South 24 Parganas move into medium diversified district from low diversified district. The index value of this district is 0.56, which decreased by 0.10. Therefore, the district moves towards the diversification from concentration of crops.

Table 3: District Wise Crop Diversification Index by Herfindhal Index

Districts	Herfindhal Index	
	2003-04	2012-13
Murshidabad	0.24	0.22
Nadia	0.23	0.19
North 24 Parganas	0.36	0.29
South 24 Parganas	0.66	0.56

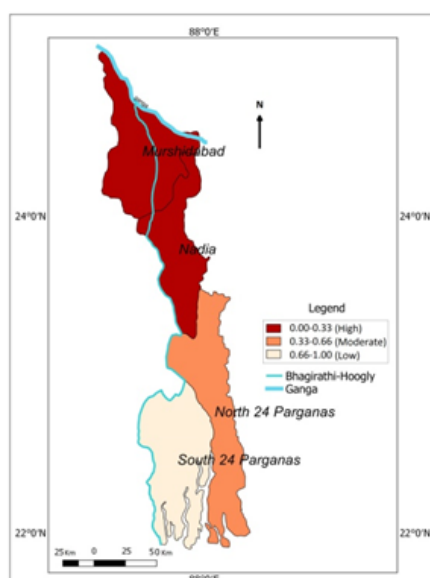


Figure 6: Pattern of Crop Diversification in Ganga Delta Region by Harphindahl Index 2003-04

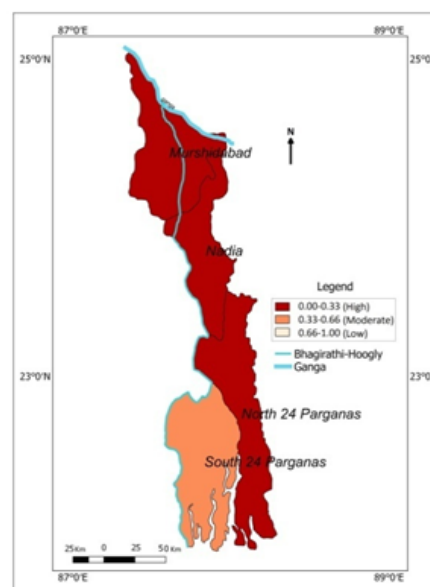


Figure 7: Pattern of Crop Diversification in Ganga Delta Region by Harphindahl Index 2012-13

Figure 6: Pattern of Crop Diversification in Ganga Delta Region by Harphindahl Index 2003-04 Figure 7: Pattern of Crop Diversification in Ganga Delta Region by Harphindahl Index 2012-13

VII. MAJOR FINDINGS:

- i. Area under rice cultivation has decreased.
- ii. Production of rice decreasing continuously.
- iii. Cash crops are seeking more interest of farmers than other food grain.
- iv. Production of cash crops especially fiber, oil seeds, pulses, vegetables and fruit production has increased sharply.
- v. Among the four district of the region Murshidabad and Nadia was highly crop diversified area in 2003-04. North 24 Parganas and South 24 Parganas district was moderate and low diversified accordingly in this year.
- vi. In the year 2012-13 North 24 Parganas district upgraded into high diversified area and South 24 Parganas district become moderate crop diversity region from low diversity.
- vii. In Murshidabad and Nadia district the degree of crop diversity has become stronger in the year 2012-13 than 2003-04.

VIII. CONCLUSION

The present study revealed that the level of crop diversification in Ganga delta region has been moves towards the cash-crops from the traditional ones. Area and production under rice cultivation has shown a decreasing trend entire the four districts of Ganga delta. Cash crops are seeking more interest of farmers than other food grain. Production of cash crops especially fiber, oil seeds, pulses, vegetables and fruit production has increased sharply. Among the four district of the region Murshidabad and Nadia was highly crop diversified area in 2003-04. North 24 Parganas and South 24 Parganas district was moderate and low diversified accordingly in this year. In the year 2012-13 North 24 Parganas district upgraded into high diversified area and South 24 Parganas district become moderate crop diversity region from low diversity. In Murshidabad and Nadia district the degree of crop diversity has become stronger in the year 2012-13 than 2003-04. In spite of state and central govt. took initiative for improved the production of cash-crops, despite that, the diversification entire this region not reaching up to the marks. Therefore, the farmer's interest along with the govt. and institutional support still required for increase the level of diversification from the specialization. Diversification process uplifts the economic status of farmers as well as uplifts the state GDP level. So, that the agriculture of this region can achieves more sustainability in view of agricultural production.

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