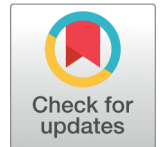# CROP DIVERSIFICATION IS ONE OF THE REFERENTIAL PATTERNS FOR ENHANCED CROP PRODUCTION: A SECONDARY STUDY ON PURBA & PASCHIM MEDINIPUR DISTRICT IN WEST BENGAL

Dr. Kajalbaran Jana[1] ✉ 🆔

[1] Associate Professor Department of Commerce, Tamralipta Mahavidyalaya, Tamluk, 721636, W.B., Purba Medinipur, India. Tel.: 8538014131

Check for updates

ABSTRACT

Crop diversification is a planned innovative approach to maximize land usage with optimum crop production to aim at minimizes losses of seasonal and other impacts on crop. India being one of the biggest countries of agricultural economy and West Bengal, although tiny in size, is one of the biggest producers of few agricultural produces like rice, potato, oil seed etc. Within West Bengal, undivided Midnapore retained a significant role in agricultural produce. After division of the district in to Purba & Paschim Medinipur during 2000, most of the cultivable land is within Paschim Medinipur. Although Puraba Medinipur has some pocket areas that has good reputation of cultivation. The Crop diversification is the need for the hour for small cultivable area. In this particular scenario, this study has tried to focus on the state of crop diversification in the Purba Medinipur district with a comparative study on Paschim Medinipur district because of its history of its erstwhile geographical tie up. At the same time, it has also attempted to find out the effect of crop diversification on crop production. In this particular aspect this study has focused on the condition of this particular aspect on undivided Midnapore district also. It has found that crop diversification on the basis of principal food crop in Purba Medinipur district has significantly positive relationship with production but has insignificant negative relationship in between crop diversity of rice with its production. In Paschim Medinipur and and undivided Medinipur there has been positive relationship between crop diversity and crop production in both principal food crops and rice. This has attracted to conclusive remark that division of district has impaired the scope of crop diversification of Purba Medinipur district but it has sufficient space to improve it as the relationship has indicated positive direction to that end although negative direction in rice crop would be matter further research

Keywords: Crop Diversificaion, Optimum Crop Production, Crop Area, Minimum Loss, Purba Medinipur, Paschim Medinipur, Undivided Midnapore

1. INTRODUCTION

Crop diversity is planned to have more diversified crop of choice with a given land area so that usage of land can be optimize with minimum risk of crop loss as well as income loss. The reported cropped area in India was 198.36 million hectares out of total reported land underutilization to the tune of 307.82 m.h. during 2014-15 (Agriculture statistics, GOI, 2018). It has estimated more than 64.44% land that has been under crop cultivation. The net area sown was 140.13 m.h and area sown more than one was 58.23 m.h. The gross irrigated area was 96.46 m.h. More than one irrigated land was 28.07 m.h. during that time. The crop diversification is meant for more economic production of crops under the patronage of Govt. policy. Marketing facilities and technological inputs for diversification are being taken care by the Govt. initiative.

In West Bengal the total area under cultivation was estimated about 56 lakh hectares. The Net cropped area was 52.5 lakh hectares and the Gross cropped area is 99.73 lakh hectares with cropping intensity of 190 % (2018-19). *Matirkatha.com* (n.d.)

In Purba Medinipur 2.9 lakh hectares area was under cultivable land in which net cropped area was 2.8 lakh hectares and gross cropped area was 5.33 hectares with cropping intensity of 187%. In Paschim Medinipur these have been 4.17, 3.86 and 8.32 lakh hectares respectively with cropping intensity of 216 % (2018-19) *Matirkatha.com* (n.d.)

Rice, wheat, jowar, bajra types other cereals, Gram &Tur like pulses and potato being the principal food crop in both Purba & Paschim Medinipur district. Rice itself the staple food for most of the inhabitants of both the district. Again, rice has been cultivated on the basis Aus, Aman and Boro basis. So, crop diversification is a matter to be identified critically so that its impact plays crucial role in production of those particular crop included in the crop area of both these two districts under discussion

2. LITERATURE REVIEW

Das (2012), pointed out that in order to agricultural sustainability crop diversity is must. The adverse environmental impact as well as technological backwardness is major two constraints for crop diversification. In order to find valid inference to their study, they used tools like Gibb's –Martin Index of crop diversification.

$$\text{Gibb's-Martin Index} = \frac{\sum(x^2)}{(\sum x)^2}$$

Where, x= percentage of total cropped area occupied by each individual crop in hectares.

The value of indices has been classified into four groups ranging from High, Medium, Low and Very LowDiversified crops.

Singh* et al. (2016), pointed out that risks related to yield and price risk have negative influences on farmer's decision on area (acreage) of production. They further pointed out that Minimum support price (MSO)s are also playing very crucial role during decision taken by farmer for crop diversification.

They have analyzed growth rate by using exponential model $Y=ab^{t,}$ t- time period, Y = Area/ production/ productivity, a= constant, b= regression coefficient, they have chosen Modified Entropy Index (MEI) as diversification measure.

$$MEI = -\sum_{i=1}^{n} p_i \log_n(p_i)$$

Shiyani et al. (1998), interestingly found that relatively more crop diversification was there during earlier years than the later years. They have taken 1971- 1996 as study period. They have used Herfindal Index, Ogive Index, Entropy Index, Modified Entropy Index and Composite Entropy Index as crop diversification parameter. They concluded their inference on the basis of MEI, CEI,

Herfindahl Index (H.1.)

Herfindahl Index is the sum of squares of share area of each crop in the total cropped area:

$$H.I. = \sum_{i=1}^{N} P_i^2$$

Where N is total number of crops and P_i represents acreage proportion of the i-th crop in total cropped area. As diversification increases, the Herfindahl Index decreases. The value lies between o and 1. Zero means maximum diversification. One means no diversification for this index.

Ogive Index (0.1.)

Tress (1938) used this index to measure diversity in the industry. It measures dispersions from benchmark of equal proportion of each crop. For example, if there are N crops, the norm used for measuring deviations is 1/N. The formula of computing Ogive Index is as follows:

$$O.I. = \frac{\sum_{i=1}^{N} \{P_i - (1/N)^2\}}{1/N}$$

Like H.I index it is also measure concentration. More of O.I indicates less of diversification.

Entropy Index (E.L)

Entropy Index is regarded as an inverse measure of concentration having logarithmic character. This index has been widely used by many research workers to measure diversification (e.g., Hackbart and Anderson, 1975; Singh etal., 1985; Gupta and Tewari. 1985).

Entropy Index is specified as:

$$E.I. = - \sum_{I=1}^{N} P_i.logP_i$$

$$Or\ E.I. = \sum_{I=1}^{N} P_i.\ log\ (1/P_i)$$

The value of index increases the diversification also increases. The upper bound value of this index equal to logN. where N= No. of crop, which is normally greater than one. However upper limit of this index is chosen on the basis of base of logarithm i.e no. of crop.

Modified Entropy Index (MEI): As discussed earlier

Composite Entropy Index (C.E.I): It is measured as follows:

I= M E I $\times$ {1-(1/N }

The C.E.I. has two components, viz., distribution and number of crops, or diversity. The value of Composite Entropy Index increases with the decrease in concentration and rises with the number of crops/activities. Both the components of index are bounded by zero and one and thus the value of C.E.I. ranges between zero and one

Wedananta1 (2020), has described how inequality in income distribution and community welcome impacted by financial inclusion, investment propensity and capital expenditure of people. This study is pertinent for distribution nature of methodology for distribution as well as for inequality measurement.

"Crop diversification and new varieties" (2011), stated that before taking crop diversification strategy for farmers, cautious market studies should be needed so that new variants would enable greater income generation than present varieties. It was also suggested while taking decision of crop diversifications strategy that would be fully suitable to the available land, labour and capital resources already with the farmers.

Makate et al. (2016), found that crop diversification having positive relationship on land size, farming expertise, assets, location advantage, agricultural extension service, output price information. They also suggested that increased diversity would improve crop productivity, income, food security and nutrition to the households.

M (2020), stated that crop diversification enable improved productivity in small firm size, income, resilience with climate change,employment, soil quality etc. At

the same time it warned about market demand, uncertainty in price and supply inputs,fear of increased complexity etc which could be jeopardized the whole process.

Vedantu.com (2021) referred agricultural diverdsification as change in cropping pattern or shifting towards non-farming operations like poultry farming, animal husbandry etc. These practices enable farmers to increase production to their farm size and higher income level

3. OBJECTIVES OF THE STUDY

The crop diversification is one of the basic subsistence farming technology which is require to add on facilities using present area of farming with varietal, economic and profitable farm producing ability. By this scenario, this particular study aims at

1. To identify level of Crop Diversification and its implication on Crop Production in Purba Medinipur district,
2. To find out the level of Crop Diversification and its implication on Crop Production in Paschim Medinipur district,
3. To find out the level of Crop Diversification and its implication on Crop Production in Undivided Midinipur district,

4. HYPOTHESIS OF THE STUDY

H0: There is a positive significant relationship of crop diversification on crop production

H1: There is no positive significant relationship of crop diversification on crop production

5. DATA BASE AND METHODS OF THE STUDY

The Data taken for this study has been secondary in nature. It has taken from the District Statistical Handbook, Bureau of Applied Economics & Statistics, Govt. of W.B. The study has been conducted on the availability of the data. The study period is 1990 to 2013. No data still available in this particular area after this period in Govt sources. This study is being conducted in view to search the effect of crop diversity on the production of the crop. Among the crops there are two sub-groups have been chosen; principal food crop and rice itself. In order to find out the change in diversification of crops, if any, there has been an inter temporal analyses of diversification and its effect on production on the basis of division of Midnapore district in the year 2000. There are two sub analyses: one for undivided Midnapore i.e., prior 2000 conditions and after 2000 i.e after division of district into Purba Medinipur and Paschim Medinipur. Study has been started analysis on Purba Medinipur first, then Paschim Medinipur and at last on Undivided Midnapore.

In order to identify the crop diversification level, we have consulted four measures, namely, Herfindal Index (HI), Transform Herfindahl Index (THI), Entropy Index (EI) and Gibb's Martin Index (GMI). As Herfindahl Index (HI) has measure level of concentration, so we use Transform Herfindal Index (THI) as its representative, although HI calculated to show the similarity with Gibb's Martin Index of diversification in this study. Another Entropy Index has been calculated to have better idea of diversification with multiple techniques. In order to use diversification index in statistical analysis an average of THI and EI has been used as yardstick measure for diversification over the period.

In order to identify the testable hypotheses, a simple linear regression model has been fitted

Yt= a+bXt,

Y= Output/ Production of crop/rice, X= Crop diversification Index, a= intercept and b= coefficient of the regression, t= time.

An ANOVA statistic has been used in tabular form to see the level of relationship in term b coefficient and significance level of F value. At the same time t value and p value have been observed to have confirmatory idea of the result. A residual statistic for predictive productions has also been itemized to see the relation with actual production and thus on the overall relationship.

6. ANALYSES AND DISCUSSIONS

6.1 CROP DIVERSITY IN FOOD CROP IN PURBA MEDINIPUR DISTRICT

The crop diversity in Purba Medinipur district has been identified on the basis of principal food crops cultivated simultaneously or seasonal basis in the same or different crop field throughout the year. It is found that HI is shown much higher figure that reflects higher concentration of crop rather diversification. The diversification level is found very low; around 7% to 19% depends on the different measures on diversification used in this particular case. The THI are found almost identical in every year during 2000 to 2013. According to THI, it has been found ranges between 47% as lowest during 2001 and 2012 to the highest 52% during 2005 and 2006. The mean value in this case was 8% and s.d being .022. According to EI, it has been found varied through 13% during 2000 to 8% during 2013 with mean of 9% and s.d being .031.These two indices have been almost similar trend throughout study period. The GHI has also same result as HI/THI revealed.

In Rice variant, the diversification has shown much higher than the total principal selected food crops. According to THI /HI it has been almost varied between 47% to 52% though out the study period with a mean of 49% and s.d 0.18. The EI has shown little gloomy in this particular case. It has been exhibited almost around 34% over the study period with a mean of 34% and s.d being .007. The GMI has exactly the same as HI.

Table 1 Crop diversity Indices in Purba Medinipur during 2000-2013

	Indices for Principal Food Crop					Indices for Rice Variants				
YEAR	HI	THI	EI	GMI	Av: THI, HI	HI	THI	EI	GMI	Av: THI, HI
2000	0.88	0.12	0.13	0.88	0.125	0.52	0.48	0.34	0.52	0.41
2001	0.88	0.12	0.13	0.88	0.125	0.53	0.47	0.33	0.53	0.4
2002	0.96	0.04	0.00	0.96	0.02	0.52	0.48	0.33	0.52	0.405
2003	0.94	0.06	0.07	0.94	0.065	0.52	0.48	0.33	0.52	0.405
2004	0.92	0.08	0.09	0.92	0.085	0.49	0.51	0.34	0.50	0.425
2005	0.92	0.08	0.09	0.92	0.085	0.51	0.49	0.34	0.51	0.415
2006	0.91	0.09	0.10	0.91	0.095	0.48	0.52	0.35	0.48	0.435
2007	0.91	0.09	0.11	0.91	0.1	0.48	0.52	0.35	0.48	0.435
2008	0.92	0.08	0.10	0.92	0.09	0.50	0.50	0.34	0.50	0.42
2009	0.93	0.07	0.09	0.93	0.08	0.49	0.51	0.34	0.49	0.425
2010	0.92	0.08	0.09	0.92	0.085	0.52	0.48	0.33	0.52	0.405
2011	0.91	0.09	0.10	0.91	0.095	0.52	0.48	0.33	0.52	0.405
2012	0.94	0.06	0.08	0.94	0.07	0.50	0.50	0.34	0.50	0.42
2013	0.93	0.07	0.08	0.93	0.075	0.53	0.47	0.33	0.53	0.4
Mean	0.92	0.08	0.09	0.92	0.085	0.51	0.49	0.34	0.51	0.415
S. D	0.022	0.022	0.031	0.022	0.026	0.018	0.018	0.007	0.017	0.012

Source: Secondary data from Handbook of Statistics. Govt. of W.B.
Indices have been calculated by the researcher.

So, it can be said that crop diversification in Purba Medinipur district was significantly low after division of district though positively significant relation with the production and for particular Rice, diversification level was better but insignificantly related with the production.

6.2 THE CROP DIVERSIFICATIONS IN PASCHIM MEDINIPUR AFTER DISTRICT DIVIDED

The picture of crop diversification in paschim Medinipur during this time i.e after division of district has been reflected in the Table 2 . It has been found almost similar in terms of THI and EI over the period under study. They have been ranges between 20% to 25 % over the period. The THI has been found 23% on an average for whole study period with s.d being 0.02. The mean EI has 22% with s.d being same 0.02 for the study period. The Herfindal Index and Gibb's Martin Index have shown same result again in this case also. As compared to Purba Medinipur district, the crop diversification in Paschim Medinipur district has been found better; almost three times higher.

According to the Rice diversification, it has been found that rice diversification is found lower than Purba Medinipur district. The THI is found as high as 49% during 2010 and lowest 40% during 2001, 2002with a mean value 43% and s.d being 0.03, The EI has been ranges as lowest as 30% during 2005 to the highest as many as 35% during 2010 with mean 33% and s.d being 0.01. The HI and GMI have been found

same result as usual.

Thus, we found that so far principal food crop is concerns, the crop diversification in Pachim Medinipur has been much higher than the Purba Medinipur. The diversification of principal food crops in Purba Medinipur was significantly low as result suggested. But diversification for rice is slightly higher in Purba Medinipur than Paschim Medinipur.

Table 2	Crop diversity Indices in Paschim Medinipur during 2000-2013								
	Indices for Principal Food Crop					**Indices for Rice Variants**			
YEAR	HI	THI	EI	G-MI	Av: THI, EI	HI	THI	EI	G-MI	Av: THI, EI
2000	0.77	0.23	0.23	0.77	0.23	0.57	0.43	0.33	0.57	0.76
2001	0.75	0.25	0.24	0.75	0.245	0.60	0.40	0.31	0.60	0.71
2002	0.74	0.26	0.24	0.74	0.25	0.60	0.40	0.31	0.60	0.71
2003	0.75	0.25	0.24	0.75	0.245	0.59	0.41	0.32	0.59	0.73
2004	0.76	0.24	0.23	0.76	0.235	0.58	0.42	0.32	0.58	0.74
2005	0.74	0.26	0.24	0.74	0.25	0.60	0.40	0.30	0.60	0.7
2006	0.75	0.25	0.22	0.75	0.235	0.59	0.41	0.31	0.59	0.72
2007	0.76	0.24	0.22	0.76	0.23	0.53	0.47	0.34	0.53	0.81
2008	0.80	0.20	0.18	0.80	0.19	0.55	0.45	0.33	0.55	0.78
2009	0.79	0.21	0.20	0.79	0.205	0.58	0.42	0.31	0.58	0.73
2010	0.77	0.23	0.21	0.77	0.22	0.51	0.49	0.35	0.51	0.84
2011	0.79	0.21	0.20	0.79	0.205	0.59	0.41	0.31	0.59	0.72
2012	0.80	0.20	0.19	0.80	0.195	0.56	0.44	0.32	0.56	0.76
2013	0.80	0.20	0.19	0.80	0.195	0.56	0.44	0.33	0.56	0.77
Mean	0.77	0.23	0.22	0.77	0.22	0.57	0.43	0.32	0.57	0.75
S. D	0.02	0.02	0.02	0.02	0.021	0.03	0.03	0.01	0.03	0.041

Source: Secondary data from Handbook of Statistics. Govt. of W.B.
Indices have been calculated by the researcher.

7. THE CROP DIVERSIFICATIONS IN UNDIVIDED MIDNAPORE DISTRICT BEFORE DIVISION OF DISTRICTS

The situation of crop diversification before division of district of Midnapore has been tabled in Table 3 . It has been evident that the scenario of diversification has been almost similar if those indices have been averaged and sorted out. The THI have been found little lower than the Paschim Medinipur but higher than the Purba Medinipur district. It has been 18% on an average for both THI and EI in Undivided Midnapore where it has been 23% and 22% respectively for Paschim Medinipur and 8% and 9% respectively in Purba Medinipur. Thus, Entropy Index (EI) has been also found lower than Paschim Medinipur but higher than Purba Medinipur. The result for Herfindal and Gibb's Martin index are same in this case also.

The diversification in rice in undivided Midnapore has been found higher than Paschim Medinipur but lower than Purba Medinipur on an average for the study

period. The THI and EI in undivided Midnapore district have been found to be 44% and 33% on an average with s.d being 0.024 and 0.014 respectively. The same for Paschim Medinipur have been 43% and 32% with s.d being 0.03 and 0.01 respectively. For Purba Medinipur those indices have been 49% and 34% on an average for the study period and s.d being 0.007 and 0.017 respectively.

Thus, we find that crop diversification in undivided Midnapore has matched the result of the gross trend of indices as a whole. The indices for principal food crops are found lower in undivided Midnapore than Paschim Medinipur but higher than the Purba Medinipur but for rice diversity it has been changed. It has been lower than Purba Medinipur but higher than Paschim Medinipur.

Table 3 **Crop diversity Indices in Undivided Midnapore District 1990-2000**

	Indices for Principal Food Crop				Av: THI&EI	Indices for Rice Variants				Av: THI&EI
YEAR	HI	THI	EI	G-MI	0.145	HI	THI	EI	G-MI	
1990	0.86	0.14	0.15	0.86	0.175	0.60	0.40	0.30	0.60	0.35
1991	0.83	0.17	0.18	0.83	0.18	0.59	0.41	0.31	0.59	0.36
1992	0.82	0.18	0.18	0.82	0.185	0.60	0.40	0.31	0.60	0.355
1993	0.82	0.18	0.19	0.82	0.19	0.57	0.43	0.32	0.57	0.375
1994	0.81	0.19	0.19	0.81	0.19	0.57	0.43	0.33	0.57	0.38
1995	0.81	0.19	0.19	0.81	0.19	0.56	0.44	0.34	0.56	0.39
1996	0.81	0.19	0.19	0.81	0.19	0.56	0.44	0.33	0.56	0.385
1997	0.81	0.19	0.19	0.81	0.2	0.56	0.44	0.33	0.56	0.385
1998	0.80	0.20	0.20	0.80	0.17	0.53	0.47	0.34	0.53	0.405
1999	0.83	0.17	0.17	0.83	0.185	0.53	0.47	0.34	0.53	0.405
2000	0.82	0.18	0.19	0.82	0.145	0.54	0.46	0.34	0.54	0.4
mean	0.82	0.18	0.18	0.82	0.14	0.56	0.44	0.33	0.56	0.30
s.d	0.015	0.015	0.013	0.015	0.015	0.024	0.024	0.014	0.024	0.019

Source: Secondary data from Handbook of Statistics. Govt. of W.B.
Indices have been calculated by the researcher.

8. IMPLICATION OF CROP DIVERSIFICATION ON PRODUCTION OF CROP

The implications of crop diversification on production have been segregated into three parts as per methodology of the study has taken care. These have been measured on Purba Medinipur, Paschim Medinipur and Undivided Midnapore before division of district. In each part there are sections –a) Identifying the relationship between diversification index and principal food crop production b) Identifying the relationship between diversification index and rice production in the district for specified study period.

6.1 In Table 4 it has been represented an ANOVA statistics of diversification index and total principal food crop. The table suggested that there is significant posi-

tive relationship between diversification index and principal food crops in Purba Medinipur district under study. That means if diversification of crop will be increased the production of the food crop will be enhanced significantly. In Table 5 , there has been a comparative statistic of predicted and actual crop production that indicated that actual production has been inconsistent and instable. This has pointed out that increased crop diversification may stabilize the production of principal food crop.

6.2 In Table 6 , the relationship between diversification index and rice has been reflected. The ANOVA statistics has shown that there is insignificant negative relationship between crop diversity with rice production in the district. The predicted value of rice production has also been established this relationship. Whenever actual production of rice has increased predicted value decreased and vice versa reflected in Table 7 . That implied that although crop diversification in Rice in Purba Medinipur has been found higher than Paschim Medinipur, still no positive implication has withstood the position in this respect.

6.3 The ANOVA statistics reflecting relationship between diversity index and principal food crop production in Paschim Medinipur, the foremost cropping intensified district, has been positive but insignificant as we found in Table 8 . Similarly, it has been found that predicted value of production greater in most of the year than the actual production (Table 9). So, it can be said that crop diversification has positive implication in this district but not significantly high.

6.4 The relationship between diversity index and rice production in Paschim Medinipur has been identified in Table 10 . It has been positive insignificant relationship between diversity index and production of rice in the district over the study period. This has been confirmed by Table 11 where the predicted value of production and actual production of rice has been compared. It has been found inconsistent relationship between the two series over the period of observation. But in most cases, it has been similar trend, although actual production has been found larger than predicted value in most of the years. Athough rice diversification and rice production in PaschimMedinipur has been insignificantly positive relationship still it has scope for further improvement.

6.5 In order to evaluate the conditions of such relationship we have tried to find out similar relationships in the undivided Midnapore district before its division on 2000. Table 12 exhibited that there was a positive significant relationship between diversity index and principal food crop production in the undivided Midnapore district before its division in 2000. The predicted value of production Table 13 of principal food crop has been higher in most of the years which has indicated potential scope of further improvement in production with greater diversity in crop production.

6.6 Similarly, we could identify the relationship between rice crop diversity index and rice production through Tables 14 and 15 , where we could find that there is positive significant relationship between diversity index and rice production in undivided Midnapore district before division of district. Moreover, the predicted value of rice production in most of the years have been lower than the predicted values that

implied that more diversification is needed to have more actual production

9. CONCLUSIONS

Crop diversification is aim for sustainable production of crops. In Purba Medinipur district diversification indices for crops and rice itself are very low in value. The relationship between crop diversification index and production of crop in Purba Medinipur is significantly positive which meant for increased crop diversification will be increased more production. Though rice crop diversification has shown little high still has it scope for further improvement in this field as relationship found negative but insignificant. It has indicated that crop diversification is not enough to increase rice production in this district. Other parameters have to be considered. In Paschim Medinipore, the largest crop producing district and highest cropping intensity, has been established relatively higher crop diversification index on an average for principal food crop was concerned. Crop diversification in principal food crop has also shown positive insignificant relationship with total production, implied that increase diversification will surely have positive dimension on production but with limited scope. Another factor will have to be considered. The rice crop diversification has also similar trend with the production level in this district also. It has been felt that crop diversification as well as land area under cropping has much lower in Purba Medinipur district. After division of district, the scope of crop diversification in Purba Medinipur has reduced to a substantial limit. The crop diversification in undivided district before 2000 was as combination of both after division of district. The relationship between crop diversification and production has shown positive dimension though insignificant. In the case of rice also this has been true but significantly. Thus, it can be said that division of district has serious impact in rice crop diversification in Purba Medinipur district which turned out negative from positive significant relationship before division of the district. This may be due to lesser amount of crop field available in rice production in Purba Medinipur as well as other principal food crop as a whole. Thus, diversification in Purba Medinipur does not reveal good extent and thus has insignificant impact on production. Again, to mention that the calculated result for both Herfindahl Index and Gibb's-Martin Index have been found same throughout study period. So, if one wishes to use Herfindahl Index can omit Gibb's Martin Index or vice versa.

Table 4 ANOVA statistics Depicting Relationship between Diversity Index and Principal Crop Production in Purba Medinipur District

ANOVA								
	df	SS	MS	F	Significan F			
Regressi	1	290139.6	290139.6	5.270733	0.040504			
Residual	12	660567.5	55047.29					
Total	13	950707.1						
	Coefficien	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercep	680.4105	224.5929	3.029528	0.010476	191.0646	1169.756	191.0646	1169.756

Continued on next page

Table 4 continued

X Variable 1	5800.547	2526.582	2.295808	0.040504	295.5974	11305.5	295.5974	11305.5

Table 5 **Predicted Production of Principal Food Crop in Purba Medinipur District,2000-2013**

Observation	Predicted Y	Actual output
1	1405.479	1701.8
2	1405.479	1771.6
3	796.4214	1060.4
4	1057.446	1070
5	1173.457	1138.6
6	1173.457	859.3
7	1231.462	1111.3
8	1260.465	910.8
9	1202.46	958.4
10	1144.454	1173.5
11	1173.457	1376.2
12	1231.462	1138.1
13	1086.449	1183.9
14	1115.451	1003.5

Table 6 **ANOVA statistics Depicting Relationship between Diversity Index and Rice Production in Purba Medinipur District during 2000-2013**

ANOVA

	df	SS	MS	F	Significance F			
Regression	1	28541.37	28541.3	1.28340	0.279396			
Residual	12	266866.1	22238.8					
Total	13	295407.4						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2619.07	1410.554	1.85676	0.08805	-454.264	5692.404	-454.264	5692.404
X Variable 1	-3852.33	3400.496	-1.13287	0.27939	-11261.4	3556.713	-11261.4	3556.713

Table 7 **Predicted Production of Rice in Purba Medinipur District,2000-2013**

Observation	Predicted Y	Actual

Table 7 continued

1	1039.614	1240.2
2	1078.138	1269.6
3	1058.876	973.2
4	1058.876	1008.4
5	981.8294	1065.4
6	1020.353	786.7
7	943.3061	1045.3
8	943.3061	821.8
9	1001.091	879.9
10	981.8294	1038.1
11	1058.876	1228.8
12	1058.876	1010.2
13	1001.091	1060.3
14	1078.138	876.3

Table 8 **ANOVA statistics Depicting Relationship between Diversity Index and Principal Food Crop Production in Paschim Medinipur District during 2000-2013**

ANOVA								
	df	SS	MS	F	Significan F			
Regressi	1	215964.8	215964.8	0.693432	0.421264			
Residual	12	3737323	311443.6					
Total	13	3953288						
	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercep	1713.951	1601.662	1.070108	0.305623	- 1775.77	5203.673	- 1775.77	5203.673
X Variable 1	5939.708	7132.853	0.832725	0.421264	- 9601.44	21480.86	- 9601.44	21480.86

Table 9 **Predicted Production of Principal Food Crop in Paschim Medinipur District,2000-2013**

Observation	Predicted Y	Actual
1	3080.084	2560.8
2	3169.179	2829.3
3	3198.878	3432.4
4	3169.179	3104.2
5	3109.782	3052
6	3198.878	3193.3
7	3109.782	2676.3
8	3080.084	3710
9	2842.496	2435.1
10	2931.591	2034.3
11	3020.687	4230.5

Table 9 continued

12	2931.591	2949.1
13	2872.194	3375
14	2872.194	2560.8

Table 10 ANOVA statistics Depicting Relationship between Diversity Index and Rice Production in Paschim Medinipur District during 2000-2013

ANOVA

	df	SS	MS	F	Significan F			
Regressio	1	36318.04	36318.04	1.429874	0.25488			
Residual	12	304793.7	25399.47					
Total	13	341111.7						
	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	709.9892	813.3967	0.87287	0.399864	-1062.25	2482.228	-1062.25	2482.228
X Variable 1	2595.086	2170.216	1.195773	0.25488	-2133.41	7323.58	-2133.41	7323.58

Table 11 Predicted Production of Rice in Paschim Medinipur District, 2000-2013

Observation	Predicted Y	Actual
1	1696.122	1344.3
2	1631.245	1441.1
3	1631.245	1551.8
4	1657.196	1508.2
5	1670.171	1736.8
6	1618.269	1629.6
7	1644.22	1798.8
8	1760.999	1798.9
9	1722.073	1856.7
10	1657.196	1756.5
11	1799.925	1718.6
12	1644.22	1774
13	1696.122	1880.2
14	1709.097	1742.6

Table 12 ANOVA statistics for Undivided Midnpore depicting relations between Diversity Index and Production

ANOVA

Table 12 continued

	df	SS	MS	F	Significan F				
Regression	1	1326798	1326798	5.853057	0.038654				
Residual	9	2040162	226684.7						
Total	10	3366961							
	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%	
Intercept	-806.03697	1866.571	-0.43183	0.676027	-5028.513	3416.439	-5028.51	3416.439432	
X Variable 1	24763.403	10235.73	2.419309	0.038654	1608.566	47918.24	1608.567	47918.24012	

Table 13 **Predicted Value of Production with Actual Production in Undivided Midnapore**

RESIDUAL OUTPUT		Actual Production
Observation	Predicted Y	
1	2784.656513	2338.1
2	3527.558613	3578.7
3	3651.37563	3246
4	3775.192647	3446.7
5	3899.009664	3758.4
6	3899.009664	3660.7
7	3899.009664	4376.7
8	3899.009664	3942.9
9	4146.643697	3726.5
10	3403.741597	4323
11	3775.192647	4262.7

Table 14 **ANOVA statistics for UndividedMidnpore depicting relations between Diversity Index and Rice Production**

ANOVA									
	df	SS	MS	F	Significan F				
Regression	1	286292.5	286292.5	5.539218	0.043054				
Residual	9	465161.7	51684.63						
Total	10	751454.1							
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%	
Intercept	-1145.61	1417.496	-0.80819	0.43982	-4352.2	2060.993	-4352.2	2060.993	
X Variable 1	8748.153	3716.996	2.353554	0.043054	339.7231	17156.58	339.7231	17156.58	

Table 15 Predicted Value with Actual Rice Production in Undivided Midnapore

Observation	Predicted Y	Actual
1	1916.248	1529.3
2	2003.73	2259.8
3	1959.989	2066.3
4	2134.952	2097.4
5	2178.693	2283.8
6	2266.174	2093.2
7	2222.433	2362
8	2222.433	2302
9	2397.396	2055.9
10	2397.396	2418.9
11	2353.656	2584.5

REFERENCES

Crop diversification and new varieties. (2011). *Climate Technology Centre & NetworkCTCN*.

Das, B. (2012). Pattern of Crop Diversification and Disparities in Agriculture: A Case Study of Dibrugarh District, Assam (India). *IOSR Journal of Humanities and Social Science*, *6*(2), 37–40. Retrieved from https://dx.doi.org/10.9790/0837-0623740 10.9790/0837-0623740

M, W. (2020). 'Crop Diversification', Extension | University of Nevada, Reno, FS-20-28. In *Crop Diversification.* Reno. Retrieved from https://extension.unr.edu/publication.aspx?PubID=3816on29.06.21

Makate, C., Wang, R., Makate, M., & Mango, N. (2016). *Crop diversification and livelihoods of smallholder farmers in Zimbabwe: adaptive management for environmental change*, 1135–1135. Retrieved from https://springerplus.springeropen.com/articles/10.1186/s40064-016-2802-4on29.06.21

Matirkatha.com. (n.d.).

Shiyani, R. L., Pandya, H. R., & *. (1998). Diversification of Agriculture in Gujarat:A Spatio-Temporal Analysis. *Indian Journal of Agricultural Economics*, *53*(4), 627–639.

Singh*, J., Kaur*, A. P., , & Singh**. (2016). *Empirical Analysis of Area Response in Crop Production of Punjab: Determinants of Crop Area Allocation*. Research Gate. Retrieved from https://www.researchgate.net/publication/321966615

Vedantu.com. (2021). Retrieved from https://www.vedantu.com/commerce/agricultural-diversification

Wedananta1, B. Y. (2020). The Effect of Financial Inclusion, Investment, and Capital Expenditure on Inequality in Income Distribution and Community Welfare in Regencies/Cities in Bali Province. *IJISET - International Journal of Innovative Science, Engineering & Technology*, *7*, 38–46.