

An economic analysis of crop diversification under inorganic and organic farming in West Bengal

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Abstract

The Indian food basket is diversifying in favour of high value food commodities like fruits, vegetables, dairy products, poultry products and fish products from staple food such as rice, wheat and coarse cereals since the nineties of the 20th century. This raises a challenge to Indian agriculture. On the other hand, dominance of chemical based mono-cropping results soil erosion, water contamination, pesticides poisoning, land degradation through water logging and soil salinity, depletion of bio-diversity, etc. This again raises another challenge to Indian agriculture. Organic farming system may generate such situation to address both the challenges mentioned above. So, attempt has been taken to find out the performance of organic farming, addressing the crop diversification at different level of farm sizes along with different crop growing seasons in West Bengal. To measure the extent and nature of crop diversification, Herfindahl Index (H.I.) and Modified Entropy Index (M.E.I.) have been worked out. The result showed that maximum crop diversification occurred in sub-marginal farms and small farms under inorganic and organic farming system, respectively. On the other hand, rabi season exhibited prominent crop diversification in both inorganic and organic farms due to comparative advantages of residual moisture availability in soil. The estimation highlighted that crop diversification facilitated higher cropping intensity followed by higher net farm income of small and marginal households in West Bengal. The analysis concluded that availability of market and price premium influenced more diversion of area towards vegetables, in organic farms.

Keywords: Bio-diversity, organic, inorganic, diversification, diversification indices, cropping intensity, net farm income

There is a dramatic change in the earning, spending and saving pattern of the people of India in the post reform (economic) period that is post 1991. The Indian food basket is diversifying in favour of high value food commodities like fruits, vegetables, dairy products, poultry products and fish products from staple food such as rice, wheat and coarse cereals. This raises a challenge to Indian agriculture.

The agrarian structure in the state is dominated by small (13.75%) and marginal farmers (82%). Adopting mono-cropping system, these farmers are cultivating their land over the years resulting soil erosion,

water contamination, pesticides poisoning, land degradation through water logging and soil salinity, depletion of bio-diversity, etc. in the agricultural farm. This again raises another challenge to Indian agriculture.

It may not be wondering if we assume that organic farming system may generate such situation to address both the challenges mentioned above. In fact, the experience from conventional farming of the farmers over years has forced him to diversify farm enterprises to meet the cash needs of the family as well as to combat risk associated with mono-

cropping. The crop diversification is also receiving greater emphasis due to price response, availability of resources, public and private interventions for adoption of organic farming. The judicious crop mix has led to increase farm incomes, utilization of under employed resources to mitigate seasonal and under unemployment of labour, and to reduce risks and uncertainties in crops yields due to climatic and biological vagaries. Thus the study was conducted to investigate the degree of crop diversification under inorganic farms vis-à-vis organic farms and to investigate the changes in cropping intensity and net income of the farms due to crop diversification under inorganic farms vis-à-vis organic farms.

DATA BASE

Only primary data have been used in this study. The data for the analysis consisted of land size and area allotted under different crops, crop yields, prices of the farm produce, etc of both inorganic and organic farming system in the sample districts of West Bengal during 2007-08, 2008-09 and 2009-010.

METHODOLOGY

Sampling design and Methods of data collection

For the study, two districts, viz. Jalpaiguri and North 24 parganas were selected purposively since both Government and Non-Government organization (NGO) were working there in the field of promotional activities of organic agriculture. In the second stage, 4 blocks (2 from each district) were selected purposively. In the third stage, 4 villages (1 from each block) were selected. Two villages of NGO activity area were selected randomly. On the other hand, as there was only one village under Government management system for organic farming in each district, so both the villages were selected purposively. In the last stage, 60 sample households (30 inorganic households + 30 organic households) were selected from each village using stratified random sampling (SRS) with probability proportionate to size class (PPS) method. Thus, total 240 respondents (120 inorganic respondents + 120 organic respondents) from the districts have been

selected. The data for the study were collected with the aid of a pretested survey schedule. In addition, information was obtained from discussions with agricultural extension workers and other farmers outside the formal sample to supplement the data.

METHODS OF DATA ANALYSIS

In order to address the degree of crop diversification, following statistical analysis were employed in this study.

Crop diversification measures

To measure the extent and nature of crop diversification, two measures viz. Herfindahl Index (H.I.) and Modified Entropy Index (M.E.I.) have been worked out as follows:

$$P_i = \frac{A_i}{\sum_{i=1}^n A_i}$$

where,

P_i = proportion of ith crop

A_i = area under ith crop (ha)

$\sum_{i=1}^n A_i$ = total cropped area (ha)

$i = 1, 2, 3, \dots, n$ (number of crops)

Herfindahl Index¹ (H.I.)

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

where,

n = total number of crops

P_i = proportion of ith crop

Herfindahl index (H.I.) defined as the sum of squares of all n proportions is a measure of crop concentration. This measure is used to measure crop diversification on acreage proportion. The value of "H.I." varies from zero to one. It takes the value of one when there is complete specialization and approaches zero when the number of enterprises is more showing perfect diversification.

Modified Entropy Index² (M.E.I.)

To ensure the justification of the result of Herfindahl index (H.I.), Modified Entropy Index has been used. It has been computed by the following formula:

$$\text{M.E.I.} = \sum_{i=1}^n P_i \log_n 1/P_i \text{ or}$$

$$\text{M.E.I.} = -\sum_{i=1}^n P_i \log_n P_i$$

where,

n = total number of crops

P_i = proportion of i th crop

This index is also bounded by the number zero and one. But, the index assumes lower limit zero when there is complete concentration, and upper limit of one in case of perfect diversification. This index measures diversification given the number of crops and the index is not sensitive to the changes in the number of crops.

These indices based on area under selected vegetables and cereal crop, i.e., brinjal, lady's finger, tomato, cauliflower, cabbage, cowpea, bean, pointed gourd, bitter gourd, bottle gourd, ridge gourd, radish, carrot, spinach, kalmishak, amon paddy, potato and chilli have been calculated.

To calculate the cropping intensity and net income of the farms due to crop diversification, descriptive statistics has been employed.

RESULTS AND DISCUSSION**To investigate the degree of crop diversification through crop diversification indices****Herfindahl Index (H.I.)**

So far as crop diversification is concerned, it is evident from the Table 1 that the level of diversification is prominent for all size classes of farmers in West Bengal due to favourable agro-climatic condition of the state. The level of crop diversification, as measured through H.I. is higher for all the farm size classes under organic farming system than inorganic farming system. It is also evident from the Table 1

that maximum diversification has been occurred in sub-marginal farms followed by marginal and small farms in inorganic farming system. Interestingly, a reverse picture of crop diversification has been found in organic farming system. In this system, small farms are diversified more followed by marginal and sub-marginal farms.

Table 1: Farm size-wise vis-à-vis growing season-wise Herfindahl Index (H.I) in West Bengal (2005-06 to 2007-08)

Farm size (in ha)	H.I.	Growing season	H.I.	Overall
Inorganic farms				
Up to 0.5	0.173	Summer	0.148	0.126
0.51 – 1.0	0.212	Kharif	0.317	
1.01 – 2.0	0.221	Rabi	0.112	
Organic farms				
Up to 0.5	0.105	Summer	0.104	0.068
0.51 – 1.0	0.071	Kharif	0.073	
1.01 – 2.0	0.062	Rabi	0.065	

Source: field survey

Turning to the growing seasons of crop cultivation, it has been observed that maximum diversification occurred during rabi season in both inorganic and organic farming system. Another observation is that despite more diversification in summer season than kharif season in inorganic farms, more diversification was observed in kharif season than summer season in organic farms.

Modified Entropy Index (M.E.I.)

The computed values of Modified Entropy Index (M.E.I.) for the different size classes of inorganic and organic farming systems in West Bengal are presented in Table 2. The Table shows that maximum diversification occurred in sub-marginal farms followed by marginal and small farms in inorganic farming system. The reverse picture has been observed in organic farms. Thus, the values of index, estimated through M.E.I. method have strengthened the estimates of crop diversification following H.I. method for summer, kharif and rabi season in both inorganic and organic farming system.

Table 2: Farm size-wise vis-à-vis growing season-wise Modified Entropy Index (M.E.I.) in West Bengal (2005-06 to 2007-08)

Farm size (in ha)	M.E.I.	Growing season	M.E.I.	Overall
Inorganic farms				
Up to 0.5	0.951	Summer	0.943	0.858
0.51 – 1.0	0.886	Kharif	0.779	
1.01 – 2.0	0.874	Rabi	0.975	
Organic farms				
Up to 0.5	0.902	Summer	0.948	0.962
0.51 – 1.0	0.964	Kharif	0.955	
1.01 – 2.0	0.989	Rabi	0.976	

Source: field survey

However, based on the above estimations, the overall inference in respect of crop diversification indicated that maximum diversification occurred in sub-marginal farms followed by marginal and small farms under inorganic farming system. This indicates that the larger farm area under inorganic system inclined to specialized farming. Amon paddy was producing in inorganic marginal and small farms as preferential crop. Inorganic sub-marginal farms were dominated by vegetable crops. However, growing of more than one vegetable crop in a piece of land within the year resulted higher diversification of crops in inorganic sub-marginal farms and organic farms. Perhaps, more area allocation for vegetables indicates that farmers are tending to be commercialized through time.

The trend of diversification was more in rabi season followed by summer and kharif season under this farming system. Maximum area was allotted for amon paddy cultivation in kharif season, so there was less diversification in marginal and small inorganic farms. On the other hand, small farms were practiced more diversification in crop cultivation followed by marginal and sub-marginal farms under organic farming system. A large number of vegetables cultivation facilitated higher degree of crop diversification in small farms. It has also been observed that maximum diversification occurred in rabi season followed by kharif and summer season

under this farming system. The advantage of residual moisture in the soil after the monsoon is utilized in rabi season. Moreover, the climatic condition of this season is more favourable for almost all vegetable crops that are dominant in the state. So, maximum diversification of crop cultivation was observed in rabi season in both inorganic and organic farming system. The observation is that, though inorganic farms were more diversified in summer season than kharif season, the organic farms were diversified more in kharif season than summer season. This was happened due to cultivation of vegetables with priority instead of cereal crop, i.e. amon paddy in organic farms.

To investigate the changes in cropping intensity and net income of the farms due to crop diversification therein

More diversification of the farm enterprises leads higher cropping intensity of the farms followed by higher net farm income. Table 3 exhibits the corresponding cropping intensity and net farm income of various farms of different size classes under both inorganic and organic farming systems in West Bengal. It has been observed that the cropping intensity of organic farms was higher as compared to cropping intensity of inorganic farms.

This was because of the higher level of diversification in organic farming system. The result reveals that 15 per cent increase in cropping intensity has been originated in organic farms over inorganic farms. This increased cropping intensity facilitated an overall 19.40% higher income per hectare in organic farms over income from per hectare inorganic farm. Besides the increased cropping intensity, premium price for organic products also played a significant role in increasing organic farm’s income. The existence of premium price of organic farm products was observed during the estimation of net farm income for organic farm.

Concluding observations and Policy implication

On the basis of measurements of crop diversification indices, it has been concluded that crops were more

diversified in organic farming system towards high value crops like vegetables due to price premium. The crop diversification in rabi season facilitates farming business against depletion of underground water. The lower level of crop diversification in the inorganic farming system indicated comparatively higher preference to produce amon paddy. The

modified entropy index was considered as an approach to measure crop diversification based on area in hectare under each crop. The estimate indicates that price premium is found to be one of the most important factors that significantly influence crop diversification and net farm income in organic farms.

Table 3: Farm size-wise cropping intensity vis-à-vis net income in West Bengal (2005-06 to 2007-08)

Farm size (in ha)	Inorganic farms		Farm size	Organic farms	
	Cropping intensity	Net income (₹/ha)		Cropping intensity	Net income (₹/ha)
Up to 0.5	203	92,162.84	Up to 0.5	217	114,117.26
0.51 – 1.0	197	91,388.40	0.51 – 1.0	212	108,462.57
1.01 – 2.0	191	90,684.69	1.01 – 2.0	211	106,873.19
Overall	198	91,722.63	Overall	213	109,534.28
Difference between inorganic and organic farms (Inorganic farms – Organic farms)					
Farm size (in ha)	Cropping intensity		Net income (₹/ha)		
Up to 0.5	(-) 6.9 %		(-) 23.8 %		
0.51 – 1.0	(-) 7.6 %		(-) 18.7 %		
1.01 – 2.0	(-) 10.5 %		(-) 17.8 %		
Overall	(-) 7.6 %		(-) 19.4 %		

Source: field survey

Policy implications

The above discussions substantially pointed out that crop diversification able to provide optimum level of production in farming sector. So, based on the empirical evidences, the following recommendations are suggested to promote crop diversification which will ensure a sustainable level of farm returns for the farmers, avoiding risks and unwanted level of production, in West Bengal.

- (i) There is a positive relationship between irrigation availability and crop diversification. Underground water is depleting. So, policy makers need to devise a way of intensive water harvesting for rainfed areas in particular of the state. This might improve farmers' technology adoption decisions.

- (ii) Attention should be given to design strategies so that farmers might diversify their production to high value crops leaving small land for staple cereal crops.
- (ii) Production technologies for alternative crops in kharif season should be provided to overcome the consequences of flood and drought, which are frequent in the state.
- (iv) Remunerative minimum support price (MSP) for each vegetable and other alternative crop should be declared prior to growing season on regional basis.
- (v) Vegetable products are perishable in nature and farmers are primarily small and marginal in categories. So, easy access to market immediately after harvesting needs to be given attention for sale of the products with profitable price.

FOOTNOTES

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2. Tamil Nadu Agricultural university, Coimbatore – 641003, Tamil Nadu, India

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