Diversification and its Determinants: A Search for Alternative Income and Agricultural Development in Eastern India

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ABSTRACT

The eastern region of India, comprising the states of Bihar, Jharkhand, Assam, Odisha and West Bengal, is one of the most backward regions of the nation. This region occupies about 21.85% of geographical area and supports 34% of the population of the country. Agriculture is the mainstay of economy in the region. About 67% of the cultivators belong to marginal group and over 75% of their earnings are utilized to ensure their food security. Issues related to diversification have been discussed by researchers for a long period and they have been trying to relate diversification to the developmental prospects and various factors responsible for it. Despite this, the eastern region has rich natural resources i.e. fertile land, abundant ground water (145.12 BCM), however, the pace of agricultural development is very slow. In the present study, an attempt has been made to measure diversification using Herfindahl-Hirschman index, known as the most popular method, it was used to measure extent of diversification. The regression model was applied to access the determinants of crop diversification in the region. The study is based on secondary data collected from various published sources from 2001-02 to 2014-15 i.e. for a period of 14 years. The results revealed that in the region, the diversification for the study period was observed very low in almost all the states under study and for the eastern region as a whole. The study pinpointed the fact that despite the rich natural resources, its potential could not be harnessed from the point of view of improving agricultural productivity, poverty alleviation and livelihood improvement. Strengthening of crop diversification depends on market and taking care of production risks through technological support, quality input supply, more insurance coverage and establishment of modern storage-processing centres in the region. Keeping in view the rich natural resources and hidden agricultural development opportunities in the region, government has already taken initiative for Second Green Revolution from the region, however a strong policy push up towards instilling confidence among the farming community is needed in this direction.

Key words: Diversification, Herfindahl Index, Second Green Revolution, Eastern India, poverty alleviation

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Introduction

Crop diversification has been a vital issue of discussion among the researchers and policy makers and they have been trying to relate diversification with developmental prospects (Brithal *et al.,* 2007, Swati *et al.* 2017). The optimal cropping pattern for the country and specifically for eastern India where agriculture is the mainstay of economy is a serious challenge to the economist and planners. Some economist suggested that the shifting of area from traditional paddy and wheat cultivation to alternative crops is the solution of the phenomena (Shergill, 2005). Traditionally, diversification was used more in context of a subsistence type of cultivation wherein cultivators cultivated many crops on their farms. In economics, diversification refers to a situation in which decrease in the dominance of activity, alternatively increase in the share of many activities in a system is depicted (Ajjan *et al.* 1996).

Crop diversification is essential for agriculture based economy. Conventional experiences of the farmers over years have compelled them to diversify farm activities to fulfill the cash need of their families and also to mitigate the risks like changing climatic conditions, declining water tables, flood and drought conditions and also shrinking net sown area (Sinha *et al.,* 2016). The crop diversification is also getting great attention due to market infrastructure, availability of resources, public intervention (Price and credit policies, research and development) and globalization of agriculture (Kumar *et al.* 2012 and Singh *at al*. 2013).

In general, level of diversification is governed by the market forces (Relative price, profitability of crops), advancement of technology (access to inputs and implements), agro-climatic conditions, development of infrastructural facilities like communication, market and storage facility and institutional factors like government's policy, protection and risk factors ((De UK and Chattopadhayay, 2010, Patnayak and Nayak 2004, Mruthhyunjaya, 1989 and Radhakrishnan *et al.* 1988)

The eastern region of India comprising the states of Bihar, Jharkhand, Odisha and West Bengal is one of the most backward regions of the nation. This region occupies about 21.85% of geographical area and supports 34% of the population of the country. Agriculture is the mainstay of economy in this region. About 67% of the cultivators belonged to marginal group and over 75% of their earnings are utilized to ensure food security. Despite the fact

that eastern region have rich natural resources i.e. fertile land, abundant ground water (145.12 BCM), the pace of agricultural development is very slow. There is lot of scope to accelerate farmer's income by improving productivity and including high value crops in cropping pattern of the region. Sustainable use of rich natural resources and hidden agricultural development opportunities in this region may bring Second Green Revolution from this region.

In the present paper an attempt has been made to analyze the extent of diversification and to identify the factors influencing diversification the region.

Materials and Methods

To meet the objectives of the present study time series data were collected from various published sources during the period 2001-02 to 2014-15 pertaining to area under different crops groups, population density, rainfall, gross irrigated area, area under HYV crops, fertilizer use (Kg/ha), average land holding size (ha), road length (000' Km) per capita income (000' rupees).

To find out the extent of diversification crop diversification Index (CDI) was worked out using Harfindhal index (HI). The Herfindhal index is sum of square of the proportion of individual crop groups in a portfolio. With an increase in diversification, a sum of the square of the proportion of crop groups is decreases and so also the HI. This is measure of concentration, alternatively, an inverse measure of diversification since the Harfindhal index decreases with an increase in diversification. The HI is bound by zero (Complete diversification) to one (complete Specialization).

$$Herfindhal\ Index\ (HI) = \sum_{i=1}^{n} P_i^2$$

Where P_i is the proportion of the area of crop group

Crop Diversification Index CDI= 1-HI

Where HI = Herfindhal index

The CDI has the direct relationship with diversification. The zero value of CDI indicates specialization and moving towards one showing increase in number of enterprises.

To identify the factors affecting diversification multiple regression analysis was carried out using the time series data from 2001-02 to 2014-15. The crop diversification index (CDI) (Y) was specified as function of the following independent variables

$$\boldsymbol{Y = a + b_1X_1 + b_2X_2 + b_3X_3 \ldots\ldots\ldots + b_nX_n + U}$$

The explanatory variables were as under:

X_1= Population density (per square Km)

X_2= Annual Rainfall (mm)

X_3= percentage of gross irrigated area (GIA) to gross cropped area (GCA)

X_4=Road length (000 Km)

X_5=percentage of HYV area to gross cropped area (GCA)

X_6=per capita income (thousand rupee)

X_7= Fertilizer Consumption (Kg/ha)

X_8= Average land holding size (ha)

In case of time series data and cross sectional data, to check the multicollinearity among different variables, zero order correlation matrix had been calculated for each state as well as for eastern India level. Some of the variable having high correlation was dropped so that all other variable could show their effect on the dependent variable.

Results and Discussion

The cropping pattern of eastern India is presented in Table 1. The share of cereal crops in the first triennium was observed to be 68.42% which decreased to 66.56% in the second TE-2007 and again went up to 72.05% in TE-2015. The rise in area of cereals may be due to shifting of area under pulses and oilseeds to the cereal crops. Decline in area under oilseed and pulses might be due to risks of pest and diseases and damage of pulses crops by animals. The share of food grains remained almost constant throughout the study period. The eastern India has higher proportion of the cultivated area under high value crops like vegetables (about 7.48%) in the last triennium i.e. TE-2015 as compared to all-India average (5.0%). The probable reason is that eastern India has favorable agro-climatic conditions for cultivation of a variety of off-season vegetables, fruits, flowers and other high value crops. Small size and fragmented landholdings and under developed rural infrastructure, poverty and frequent occurrence of natural calamities like flood and drought may be the causes of almost constant share of major crop groups of this region.

Table 1: Cropping pattern of Eastern India

(Area %)

Crop Groups	TE-2004	TE-2007	TE-2010	TE-2015
Cereals	68.42	66.56	68.35	72.05
Pulses	8.68	9.20	8.19	5.54
Food grains	77.10	74.19	76.54	77.60
Oilseeds	6.16	6.54	6.04	5.11
Fibers	3.16	2.93	2.98	2.82
Fruits	2.18	2.25	2.08	1.61
Vegetables	7.47	8.41	8.10	7.48
Condiments & spices	1.22	1.30	1.31	1.02
Total food crops	88.66	88.42	88.83	89.54
Total Non-food crops	11.34	11.58	11.17	10.46
GCA	100.00	100.00	100.00	100.00

Nature and extent of diversification

The crop diversification indices (CDI) of different states of Eastern India and region as a whole is calculated and shown in Table 2. A critical examination of the table indicated that diversification indices for the period under investigation remain almost stagnant. The result reflected that the cultivators of the eastern India were traditional cultivators and they were mainly engaged in cultivating food crops for their food security. Less developed infrastructure and marketing facilities were some of the other reasons. The diversification of crops was found less in Bihar and Jharkhand as compared to Assam, Odisha and West Bengal. Despite rich natural resources like groundwater and fertile land in Bihar, irrigation facilities were costly; there were no proper marketing facilities. Probably because of the other reason, cultivators hesitated in diversifying crops and did not want to take risk. diversification was observed less in Jharkhand mainly because it was a dry hilly state.

Table 2: Nature and extent of diversification in Eastern India during 2001-2014-15(CDI)

Year	Bihar	Jharkhand	Assam	Odisha	West Bengal	Eastern India
2001-02	0.35	0.29	0.55	0.63	0.53	0.49
2002-03	0.32	0.30	0.54	0.60	0.54	0.53
2003-04	0.35	0.35	0.55	0.62	0.54	0.49
2004-05	0.36	0.30	0.58	0.63	0.54	0.53
2005-06	0.38	0.29	0.58	0.64	0.54	0.53
2006-07	0.34	0.27	0.62	0.64	0.56	0.54
2007-08	0.34	0.30	0.59	0.64	0.57	0.54
2008-09	0.33	0.29	0.58	0.64	0.55	0.53
2009-10	0.38	0.32	0.58	0.28	0.57	0.57
2010-11	0.38	0.35	0.58	0.29	0.60	0.59
2011-12	0.33	0.34	0.59	0.25	0.58	0.59
2012-13	0.35	0.36	0.59	0.28	0.58	0.59
2013-14	0.39	0.38	0.59	0.25	0.58	0.59
2014-15	0.41	0.42	0.59	0.26	0.58	0.59

Determinants of Diversification

To identify the various factors underlying crop diversification in different states of eastern India and Eastern India as whole multiple regression analysis was carried out separately at state and eastern India levels.

Diversification index was regressed on several causing factors such as population density (per square Km) (X_1), annual rainfall (mm) (X_2), percentage of gross irrigated area (GIA) to gross cropped area (GCA) (X_3), Road length (thousand Km) (X_4), percentage of HYV area to gross cropped area (GCA) (X_5), per capita income (thousand rupee) (X_6), fertilizer consumption (kg/ha) (X_7) and average land holding size (ha) (X_8). To capture the effect of technology adoption the variables percentage of HYV area to gross cropped area, fertilizer use (kg/ha), percentage of gross irrigated area (GIA) to gross cropped area (GCA) were taken and to capture the effect of climate, rainfall (mm) data were included and for infrastructural development road connectivity was taken in the model.

Table 3: Estimated regression function for determinant of crop diversification

State/region	Intercept	Population Density (X_1)	Annual Rainfall (X_2)	%age of GIA to GCA (X_3)	Road length (X_4)	%age of HYV area GCA (X_5)	Per capita income (X_6)	Fertilizer Consumption(X_7)	Average land holding size (X_8)	R^2
Bihar	-0.8673 (0.6235)	-	0.0001*** (0.00004)	0.0047 (0.0031)	0.0003 (0.00035)	0.0061* (0.0028)	-0.0008 (0.0020)	0.0006 (0.0006)	1.3031 (0.9227)	0.709
Jharkhand	0.4146* (0.0970)	-	-0.0001*** (0.00004)	0.0107** (0.0047)	0.003** (0.0013)	-0.0030** (0.0012)	-	0.0004 (0.0002)	-	0.869
Assam	1.127* (0.2931)	-	-0.00003** (0.00001)	0.00069 (0.0054)	0.00014*** (0.00007)	-0.00442 (0.00448)	-	-0.0012 (0.0006)	-0.2591 (0.1741)	0.798
Odisha	1.7898** (0.7850)	-0.0068** (0.0028)	0.0003** (0.0001)	0.0032 (0.0072)	-	0.0161 (0.0148)		0.0011 (0.0022)	-	0.898
West Bengal	0.3039* (0.09826)	0.00007 (0.00009)	-0.000003 (0.00001)	0.0051** (0.0021)	-	-0.0022*** (0.0012)	-	0.00020 (0.00015)	-	0.907
Eastern India	0.9607*** (0.4645)	0.0023** (0.0008)	-	0.0036 (0.0040)	-0.0005 (0.0005)	0.0033*** (0.0016)	-0.0043** (0.0016)	-0.0003 (0.0007)	-	0.937

, ** and * indicate significant at 1 percent, 5 percent and 10 percent probability level, respectively.*

Figures in parentheses denote standard error

Table 3 revealed that population density had positive effect in case of West Bengal and positive and significant effect in Eastern India and negative and significant effect in case of Odisha. The positive impact might be due to increase in demand for varieties of food crops with increasing population. But in case of Odisha the population density is less as compared to other states of eastern India and hence demands for diverse crops may be relatively less hence negative and significant impact was observed in the state.

The impact of rainfall was found to be negative and significant in Jharkhand and Assam and negative in case of West Bengal but in case of Bihar and Odisha it was found positive and significant. The negative and significant values generally indicated deceleration but in case of Bihar and Odisha rainfall seems be accelerating the diversification. In Bihar it was found positive and significant which indicated that cultivation is mainly dependent on rainfall.

The variable percentage of GIA to GCA exerted positive impact in all the state and eastern India as a whole. However, in case of Jharkhand and West Bengal it was found significant which clearly emphasized that increase in irrigation will increase the pace of diversification of the crops and consequently cultivators may fetch good income from diversifying their crops and may get rid of cash scarcity.

The infrastructural development like road length depicted positive relation with diversification in Bihar, Jharkhand and Assam and it was significant in Jharkhand and Assam which clearly indicated that access to market may push up the pace of diversification. But in overall region it was found negative and insignificant.

The factor percentage of HYV area to gross cropped area (GCA) was found to be positive in Bihar, Odisha and in eastern India and negative in Jharkhand, Assam and West Bengal. Adoption of HYV seeds of crops has positive relation with diversification as good quality of seeds increases the production of different crops. Adoption of quality seeds for farms and bringing the area under HYV crops might be due to awareness about the new farming technologies. The Negative relation in Jharkhand, Assam and West Bengal might be due traditional use of seeds or less adoption of technologies. Illiteracy and poverty may be the other cause in adoption of technology in these states.

Fertilizer consumption has dampening effect on diversification in all the states. In state like Assam and Eastern India it had negative impact and other states it has positive relation with diversification. This might be inadequate and erratic use of fertilizers. Appropriate and judicious use of fertilizer may accelerate diversification across the region.

Conclusion

From the ongoing discussion it was observed that the Herfindhal Index was used to measure extent of diversification. Very less diversification was observed in the eastern India during the period of investigation. In the study cropping pattern was found to be almost stagnant in all the triennia under the study period. In the study it was found that percentage of GIA to GCA, road length and fertilizer consumption are important factors of diversification.

On the basis of the above results, it may be concluded that creation of basic infrastructure (assured and cheaper source of irrigation, good road connectivity) is required. Processing and value addition of agricultural commodities will be helpful in increasing the income of the farming community. Hence, a concrete policy intervention is needed to bring to smile on the face of the feeding community of the region and consequently we may lead towards the second green revolution with optimal and judicious use of rich nature resources available in the eastern India.

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