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Agricultural Diversification and its Impact on Farm Income: A Case Study of Bihar

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Abstract

This paper has assessed the diversification scenario of agriculture at the national level and its reflection at farm level situation alongside. It has been observed that concentration ratio (CR_4) for four major agricultural sub-sectors has declined from 73.6 per cent to 69.6 per cent for the study period, 1999-00 to 2013-14. It clearly indicates a shift in Indian agriculture from cereals-based production pattern to other high-value based production pattern. However, Simpson Index for Diversification (SID) indicates that the average national SID for all agricultural enterprises is 0.83 which spans from 0.60 for Punjab to 0.89 for Karnataka. Relating it to farm level situation, the primary survey in Banka and Bhagalpur districts of Bihar has been carried out in 2016-17 to find out the impact of agricultural diversification on farm income with two-stage least square technique (2SLS). Empirical analysis has suggested that diversification of farm by adopting ancillary, horticulture and other HVE like mushroom, etc. will increase farm income.

Key words: Agricultural diversification, Simpson index of diversification, two-stage least square, high value enterprise, farm income

JEL Classification: Q12, Q18, Q19

Introduction

In India, agriculture is a major sector that plays a crucial role in the development of agrarian economies. However, agriculture sector in India has witnessed drastic changes after introduction of modern technology during green revolution in mid-1960s. Green revolution provided boost to the economy by achieving significant uptrend in cereals-based cropping pattern than less profitable existing crop-mix. As a result, now 50 per cent of gross cropped area comes under high productive major cereal crops, leading to cropping pattern very much skewed towards cereal-based farming which results in low degree of diversification. Although this situation is changing as the area under so-called commercial crops (non-food crops) has doubled since the 1960s and now equals half of the area under food crops (Vyas, 1996), the pace is however meagre. Experiences from different developing countries corroborate the key role of diversification in agricultural development and sustainability (Petit and Barghouti, 1992; Pingali and Rosegrant, 1995; Birthal *et al*., 2005; 2015; Singh *et al*., 2006), but many researchers are sceptical about this view (Pretty, 1994; Hardaker, 1997) and believe that high diversification is stratagem of subsistence oriented farming systems (Morris and Winter, 1999). Therefore, in this context it is important to understand the effect of diversification on production and productivity as they may or may not be always positively correlated (Cochrane *et al*., 1994).

In India, the studies on agricultural diversification are mainly region-based due to diverse agricultural situations of the country. Most of these studies have

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concentrated on crop diversification by constructing Simpson Index of Diversification (SID) which were area based approach neglects importance of some high-value enterprise like spices and condiments, viz. black pepper, cardamom, etc. where area of cultivation is meagre but value of output generated is considerable. The area-based approach also does not include livestock and ancillary enterprises where area under enterprise is not important and it leads to partial consideration of diversification situation neglecting the livestock sub-sector. The established analysis on economics of agricultural diversification and farm income also falls short in its coverage and perceptiveness. So, if the task is to predict the speed of restructuring of an economy and its industries that is being affected by backward linkages like agriculture, clear understanding of agricultural diversification is obligatory. In this context, this study analysed agricultural diversification in a holistic view with wider coverage of various activities in agriculture and allied sector by following value of output approach from each enterprise and subsector of agriculture and allied sector. The study has also analysed the effect of diversification on farm income for selected districts of Bihar.

At present, the development of strategies for augmenting the income of farmers, especially small and marginal farmers, is the major challenge. So, Bihar, a state with more than ninety five percent of marginal and small farmers is selected purposively for a case study.

Data and Methodology

The data used for analysing diversification across different states of India were taken from the Ministry of Statistics and Programme Implementation (MoSPI), Government of India, for the time period 1999-00 to 2013-14. The data series provide statistics on value of output for all major crops and allied agricultural activities with base years 1999-00, 2004-05 and 2011-12. All values were further converted to 2011-12 base year by adjusting with agricultural GDP data series of 2011-2 base year. The data on value of output of agricultural and allied enterprises enabled us to estimate the level of diversification with Simpson Index of Diversification (SID).

$$SID = 1 - \sum_{i=1}^{n} Pi^2 \qquad \ldots(1)$$

where,

$$P_i = \frac{\text{Value of output for } i^{th} \text{ crop}}{\text{Total value of output from all agriculture and allied sectors}}$$

To assess the farm level situation, primary survey was conducted in Bihar during 2016-17. The primary data were collected form 120 farms in two districts (60 farms from each district) of Bihar. For study Banka and Katoria blocks of Banka district and Sabour and Kharik blocks of Bhagalpur district were selected. Multistage stratified random sampling was adopted for selecting high and low agricultural diversified districts. From each district two blocks, from each block, a village cluster, within a village cluster, farms were selected. The rationale behind classifying all districts into two strata was to capture all socio-economic and agronomic situations and conditions in two different parent population in terms of diversification.

From district level cross-sectional primary data, SID was calculated to examine farm level picture of agricultural diversification as micro-unit. Alongside, the effect of level and direction of diversification on farm income was also assessed for the selected farms using econometric model [Equations (2)-(3)]. However, the variable, level of diversification (denoted by MSID or modified SID) does not only affect farm income, but may also be affected by farm income alongside (Figure 1), resulting endogeneity bias due to presence of bi-directional cause and effect relationship between endogenous variables which make the estimates of parameter erroneous (Bravo-Ureta *et al.*, 2006; Gavian and Fafchamps, 1996; Feder *et al.,* 1985). To address this problem and eliminate the probable endogeneity bias that may arise in this type of analysis, two-stage least square (2SLS) technique was employed.

The farm income model was constructed assuming endogeneity relation prevailing between farm income and level of diversification following the methodology in literature, viz. Bravo-Ureta *et al*. (2006), Weiss and Briglauer (2000), IFPRI (2003).

Empirical Econometric Model

Variable Selection: The exogenous variables incorporated in the empirical model were selected following existing literature on agricultural diversification (Kumar and Gupta, 2015; Birthal *et al*.,

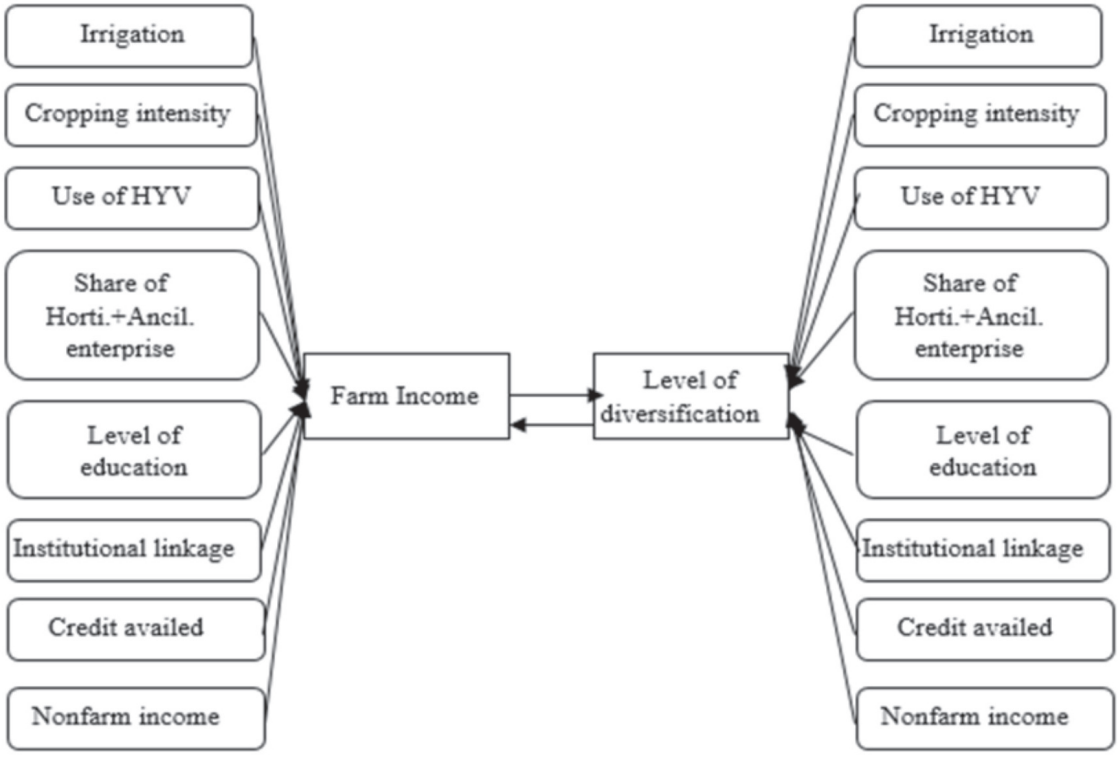

Figure 1. Expected relationship between farm income, level of diversification and other explanatory variables

2007; Singh *et al*., 2006) and on relationship between farm income and agricultural diversification (Birthal *et al*., 2015; Bravo-Ureta *et al*., 2006). Table 1 portrays the description of variables included in the empirical model.

The Econometric Model

Farm Income = *f* (Diversification, Farm size, Irrigation, Wealth, Education, No. of livestock, etc.)

$$\ln Y = \alpha 2 \sum_{i=1}^{n} \beta_{Yi} X_i + u_i \quad \ldots(2)$$

Diversification = *f* (Farm Income, Farm size, Irrigation, Wealth, Education, No. of livestock, etc.)

$$MSID_t = \alpha 1 + \sum_{j=1}^{n} \beta_{Dj} + X_j + u_j \quad \ldots(3)$$

where, Y is the farm income, *MSID* is the modified Simpson Index as a measure of diversification of agricultural activities included and X_i *and* X_j represent all the exogenous variables included in the system of equations.

Results and Discussions

Spatio Temporal Trend and Agricultural Diversification Status across the Country

The skewed production pattern of the country towards cereals was the main driving force of agriculture till the past few decades which is visible by high share of value of output of cereals in total value of output of all agricultural enterprises (Table 2).

It can be observed that Concentration Ratio (CR_4) of highest four agricultural sub-sectors constitutes nearly 70 per cent of the total value of output from agricultural crops. It clearly indicates that Indian agriculture has low level of diversification at the overall level. Despite having higher prices than cereals, pulses and oilseeds had a very low share in total value of agricultural output and even recorded a negative growth rate. Though was having a declining trend leading towards diversification for the period 1999-00 to 2013-14, it has very low magnitude. It can be also seen that only six to seven sub-sectors had a share of more than 5 per cent in total value of output from agriculture in

Table 1. Description of variables influencing farm income at farm level

Variables	Description/ Economic rationale in empirical model	Type of variable	Expected effect on farm income
	Endogenous variables		
Farm income (FI)	Income from farm activity	Continuous	
diversification level (MSID)	1/(1-*SID*); [range = 0 –∞]	Continuous	
	Exogenous variables		
	Wealth and income related variables		
Non-farm income	To capture the effect of income diversification of farm household	Continuous	–
Loan per unit cost	To capture the effect of credit and financial ease of access	Continuous	+
	Socio-economic variables		
Institutional linkage score	To capture the effect of agricultural extension activity	Continuous	+
Level of education	To capture the effect of farmers knowledge and openness to modern technology	Dummy (primary=0, secondary=1)	+
	Cropping practice specific variables		
SID for only crop husbandry (excluding horticulture enterprise)	To analyse the effect of direction of diversification on farm income	Continuous	–
Cropping intensity index*	To capture the effect of farm efficiency	Continuous	+
Share of ancillary + horticultural enterprise (Share_HVE#)	To evaluate the effect high-value enterprise	Continuous	+
Share_HVE × MSID	To capture the combined effect of HVE and agricultural diversification	Continuous	–
Irrigation	To capture the effect agronomic condition of farm	Continuous	+
HYV user	To capture the effect of farmers adoption of modern technology	Dummy (If user, then 1, 0 otherwise)	+

Note: # HVE denotes high value enterprise

$$\text{*cropping intensity index} = \frac{\text{cropping intensity of particular farm}}{\text{average cropping intensity of the locality}}$$

the study period. The share of cereals, pulses, oilseeds and livestock was decreasing with time but the share of fruits and vegetables was showing an uprising trend over the same period. However, declining trend of share in total value of output of agriculture for cereals was steady over time and was remarkably higher than other enterprises. For oilseeds, there was a slight reduction in its share in total value of agricultural output over time, as indicated by its negative trend growth rate, i.e. -0.5. It is also observed that for sugarcane, there was a reduction in its share in total value of agricultural output over time. A similar declining trend was observed for fishery sector. This clearly indicates that over the study period, India shifted its production pattern in favour of high-value crops and enterprises from its existing pattern.

The extent of diversification across the states is presented in Figure 2. It can be seen that Karnataka, Maharashtra, Gujrat, Assam, West Bengal, Tripura, Kerala, Odisha, Sikkim, Tamil Nadu, Arunachal

Table 2. Sectorial share and trend in value of agricultural production in India: 1999-00 to 2013-14

(in per cent)

Year	Cereals	Oilseeds	Pulses	Livestock	Fishery	Fruits	Vegetables	Sugarcane	Fibre & cash crops	Spices and condiments	CR_4
1999-00	27.5	7.19	3.44	28.5	5.01	8.55	8.95	3.93	4.66	2.19	73.6
2000-01	26.4	6.77	3.00	30.1	5.38	8.64	9.06	4.04	4.25	2.26	74.3
2001-02	26.6	7.06	3.36	29.5	5.27	8.70	9.14	3.78	4.27	2.25	74.0
2002-03	23.7	5.85	3.09	32.8	5.96	8.86	9.33	3.93	4.21	2.23	74.7
2003-04	25.0	8.06	3.53	29.8	5.46	8.75	9.23	2.90	4.84	2.32	72.9
2004-05	23.5	7.76	3.41	30.8	5.27	8.82	9.44	2.93	5.26	2.67	72.7
2005-06	22.9	8.36	3.27	30.1	5.26	8.79	9.61	3.62	5.39	2.62	71.5
2006-07	23.0	7.49	3.24	29.9	5.28	8.94	9.38	4.69	5.47	2.52	71.3
2007-08	22.9	7.79	3.26	29.3	5.27	8.91	9.46	4.37	5.96	2.63	70.7
2008-09	23.4	7.04	3.19	31.2	5.44	9.35	9.31	2.86	5.54	2.62	73.3
2009-10	21.4	6.77	3.12	31.9	5.51	9.71	10.0	3.27	5.37	2.80	73.1
2010-11	21.3	7.76	3.39	30.7	5.29	8.93	10.2	3.68	5.73	2.87	71.3
2011-12	19.6	6.24	3.05	31.9	4.68	9.59	10.2	3.52	8.28	2.71	69.5
2012-13	19.1	6.03	3.19	32.3	4.86	9.72	10.4	3.40	8.21	2.65	69.4
2013-14	18.8	5.87	3.22	32.2	5.00	9.74	10.4	3.11	8.72	2.75	69.6

Note: CR_4 denotes Concentration ratio

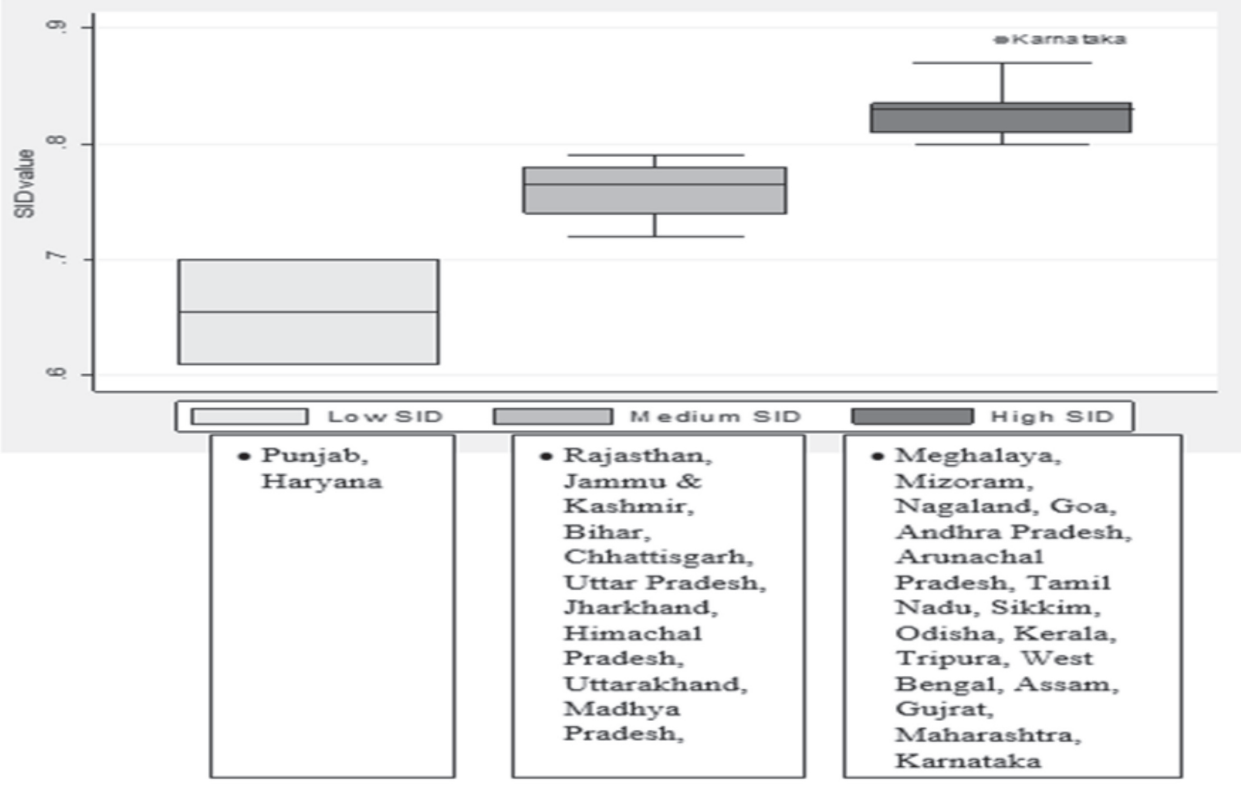

Figure 2. State-wise average diversification level (1999-00 to 2013-14) for the overall agriculture (SID)

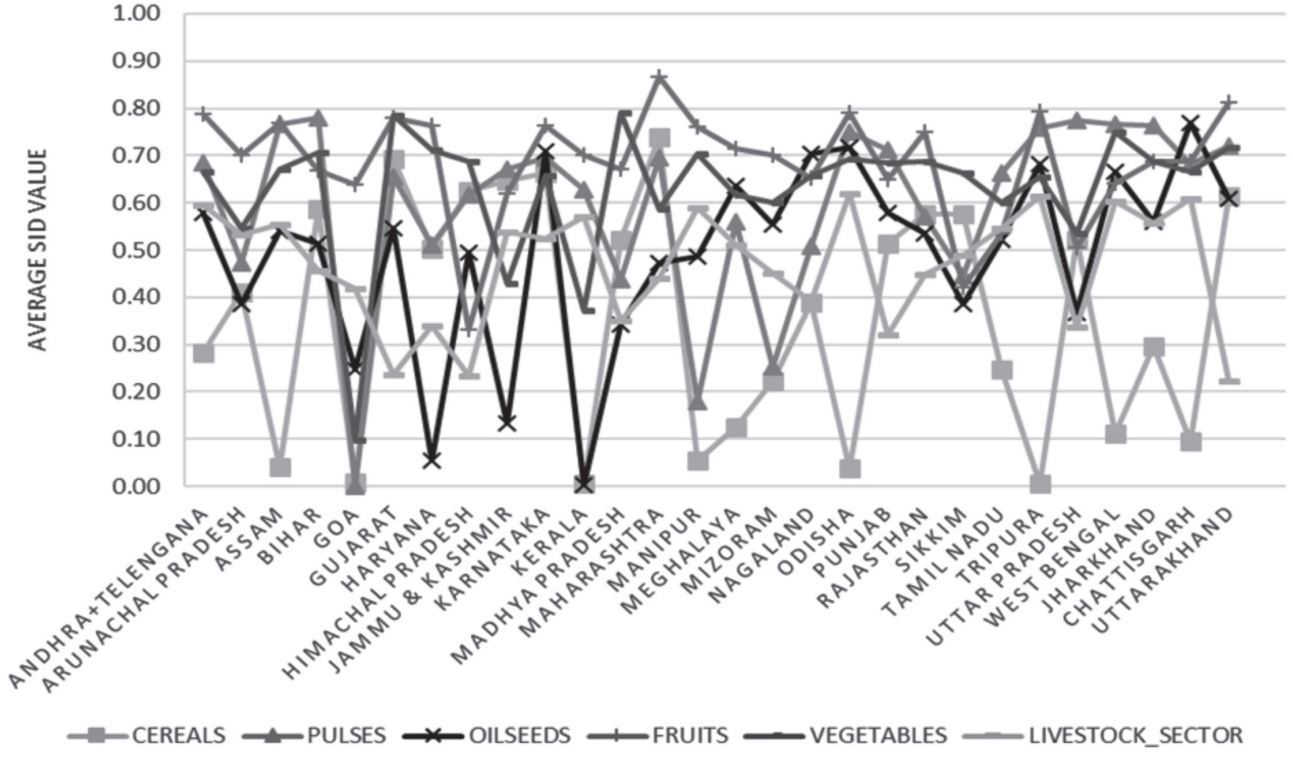

Figure 3. State-wise average diversification scenario (1999-00 to 2013-14) for different agricultural sub-sectors

Pradesh, Andhra Pradesh, Goa, Nagaland, Mizoram, Meghalaya are experiencing high degree of diversification compared to other states. All these states had a high Simpson index value i.e. more than 0.80 for the study period. Karnataka among these states had the highest SID value (0.89) and was identified as an outlier of high diversified states category due to its significantly high SID value. Conversely, Punjab, and Haryana were found to have low Simpson Index value, i.e. nearly 0.70 or below for recent past years indicating low level of overall agricultural diversification which is consistent with previous studies (Kumar and Gupta, 2015; Singh *et al*., 2006). However Rajasthan, Jammu & Kashmir, Bihar, Jharkhand, Chhattisgarh, Uttar Pradesh, Himachal Pradesh, Uttarakhand, and Madhya Pradesh have depicted a moderate level of agricultural diversification with SID value ranging from 0.71 to 0.80. But it is observed that overall diversification in agriculture depicts a different scenario compared to diversification scenario for the sub-sectors of agriculture. It has been noted that production pattern of cereals, pulses, and oilseeds are skewed towards a specific small basket of choice compared to fruits and vegetables, as indicated by position of SID line connecting different states (Figure 3).

Assam, Goa, Kerala, Manipur, Odisha, Tripura, West Bengal, and Chhattisgarh are the states where single cereal-based cropping pattern is prevalent, as indicated by the low value of SID for those states. For pulses and oilseeds, a higher mean Simpson Index of diversification is observed over the study period. Andhra Pradesh, Gujrat, Maharashtra, Odisha, Tripura have experienced a relatively higher diversification in the fruit sector compared to other states. For vegetables, Andhra Pradesh, Bihar, Madhya Pradesh, Manipur, Uttarakhand, West Bengal and Odisha have shown high diversification with Simpson Index of diversification more than 0.8. Gujarat, Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Uttarakhand have shown specialization within the livestock sector with Simpson Index value less than 0.4.

Empirical Findings

Sample Dynamics

The economic, cropping and farming infrastructure related conditions of the sample farms in the selected districts are presented in Table 3.

The status of agricultural diversification across the Banka district is found fairly well as indicated in

Table 3. Summary statistics for sample farms in selected districts of Bihar

Variable	Banka		Bhagalpur	
	Mean	Standard deviation	Mean	Standard deviation
Cropping scheme				
Simpson index of diversification	0.79	0.137	0.4	0.177
Average farm size (ha)	0.81	1.479	0.59	1.0869
Cropping intensity (%)	153.9	37.941	146.98	42.094
Average No. of crops cultivated	2.9	1.203	2.866	1.255
Share of ancillary & horticultural enterprise (%)	46.6	0.281	47.8	0.309
Economic scheme				
Average No. of cattle per farm household	0.783	1.823	0.6	1.06
Farm income per family (₹)	58776	19548	46204	27686
Cost A1 per farm per hectare	65759	67521	71698	54755
Infrastructure facility				
Family labour per farm	2.479	1.228	2.5	1
Market distance (km)	4.24	2.661	4.56	2.131
Institutional linkage score	1.566	0.302	1.1	0.62

Table 3 which may be the result of occupation of higher cultivated area per farm (0.81 ha compared to 0.4 ha in Bhagalpur). However, as the districts fall in the same agro-climatic sub-region, the variety of crops cultivated in both the districts does not differ significantly but cropping pattern of farms are considerably different as indicated by their SID score. The per family income is also higher for Banka than Bhagalpur which may be the result of higher cropping land occupancy, higher number of cattle per farm and higher cropping intensity in Banka district. The other parameter of sample selection, i.e. average number of crops cultivated, is nearly similar for both the districts but allocation of area and share of each crop in total revenue of farm differs considerably, as implied by their SID score. Infrastructure facility does not diverge considerably across these two districts though Banka district has a slight edge over Bhagalpur in more developed institutional linkages.

Rationale for Agricultural Diversification

Diversification in agriculture commonly means growing different crops instead of concentrating under a single crop. However, Pingali and Rosengrant (1995) defined diversification as "change in product (or enterprise) choice and input use decisions based on market forces and the principles of profit maximization". Conversely, Joshi *et al*. (2004) have defined "agricultural diversification as movement of production-portfolio from a low-value commodity mix (crop and livestock) to high-value commodity-mix (crops and livestock)" making a shift from traditional definition. However, to encompass all the agricultural and allied sector, diversification should be considered as a strategy of changing crop or enterprise-mix with more equivalent distributive share for each sector. But the rationale to select agricultural diversification as a strategy connects different logic *viz.* risk minimization, sustainability or high production depending on the intention of the farmer. The economic objective of different kinds of diversification has been presented in Table 4.

Impact of Agricultural Diversification on Farm Income

The estimates of parameters used in the empirical model [Equations (2)-(3)] are presented in Table 5. Due to possibility of presence of endogeneity bias in the sample, Durbin-Wu-Hausman test was employed to confirm it. The test revealed the presence of contemporaneous correlation between the proposed endogenous variables and the error term in the farm income equation at 10 per cent level of significance and corroborated the assumption of endogeneity bias indicating preference of 2SLS over ordinary least square model.

Table 4. Economic intent for different types of diversification

Concept of diversification	Definition/ Strategy	Economic objective
Horizontal diversification	Farmer producer adds more crops to existing crop-mix in cropping pattern	Home consumption/ Risk reduction
Vertical diversification	Farmer producer engages different value-added activities within its own farm	Income augmentation
Spatial diversification	Growing different crop-mix in a larger area	To capture benefit of integrated farming approach
Temporal diversification	Diversifying existing crop-mix for a particular farm, over time	Sustainability of cropping system
Structural diversification	Makes crops within field more structurally diverse (Hossain *et al.*, 2001)	Risk reduction (Pest attack)
Genetic diversification	Growing mixed variety of species in monoculture (Zhu *et al*., 2001)	Risk reduction (Disease attack)
Crop rotation	Rotating fixed number of crops in same field over time (Krupinsky *et al.*, 2002; Smith *et al*., 2008)	Enhancement of total production/ Risk reduction
Polyculture	Growing more number of crop species and wild varieties within farm using spatial and temporal diversification strategy (Tilman *et al*., 2002)	Enhancement of total production/ Risk reduction

Table 5. Estimates of 2SLS empirical model

Number of observations	120		
Wald $chi^2(11)$	46.78		
Prob> chi^2	0		
Root MSE	0.953		
Two stage least square			
Dependent variable: ln(Farm income)	Coefficient	Z	P>|z|
Modif_SID_farm (MSID)	0.775***	3.02	0.003
Modif_onlyagril_SID	-0.495***	-1.66	0.097
ln(nonfarm income)	0.055*	1.94	0.052
Cropping intensity index#	1.249***	3.16	0.002
Institutional linkage score	0.101	0.57	0.572
Share of ancillary & horticultural enterprise	0.824	1.56	0.119
Education dummy (primary=1, 0 otherwise)	-0.106	-0.58	0.56
HYV_user	0.678**	-2.55	0.011
Irrigation_per_acre	5.05E-05***	2.72	0.007
ln(loan per unit cost)	-0.226*	-1.91	0.056
Share of HVE×MSID	-0.138*	-1.92	0.054
Constant	6.87	8.69	0.000

Note: *, ** and *** indicate significance at 10 per cent, 5 per cent and 1 per cent, respectively

The 2SLS results identified the coefficients of 8 variables as significant at least at 10 per cent level out of 11 variables. The results indicate that farm income is negatively influenced by agricultural loan availed per unit of cost, and on interaction term of high-value enterprise with modified Simpson Index of diversification of farm. Though farm income is positively related with overall diversification level in the farm, it is negatively related with the level of diversification only in agricultural crops (excluding horticultural crops). Analysis indicates that one unit increase in diversification index will increase average farm income by 0.78 per cent while one unit increase in modified SID for only agricultural crops (Modif_onlyagril. SID) will decrease farm business income by 0.495 per cent keeping all other things constant. This fact sturdily indicates that farm income is not augmented by diversification only in agricultural crop husbandry, instead diversification towards high-value enterprises (HVE) like horticultural enterprise and/or ancillary enterprise like poultry, piggery, goattery, etc. enhance farm income.

It is evident from the study that one unit increase in nonfarm income will increase 0.05 per cent increase in farm business income, keeping all other things constant. It implies that the farm which was having support from non-farm sector has better performed.

The other factors like cropping intensity index along with irrigation and use of HYV were found to influence farm income positively as indicated by their estimated coefficients. However, it was found that the coefficient of interaction term of high-value enterprise and modified Simpson Index of diversification is negative, indicating the competitive interaction between these two variables. It implicates that higher level of diversification not matched by high share of high-value enterprises in farming, will reduce overall farm income. So, in resource scarce condition farms cannot go for both higher farm diversification and involving in ancillary enterprises in large scale as they may have to compete for resources. However, inference drawn her is mainly valid for small and marginal farms due to the nature of sample collected.

It should be noted that the validity of coefficients of parameters in two stage least square also depends on validity of selected instrument variables (Gujarati, 2006; Sargan, 1958). One rule for instrument variable (IV) selection is that it should not be correlated with estimated error. Keeping this criterion in consideration, the IVs were selected (farm size, number of crops cultivated, number of enterprises and varietal diversity). Farther, to check the validity of selected instrument variables, SARG test (Sargan, 1958) was employed and it was found that calculated SARG statistic $<\chi^2_{22\text{-}1}$ at 1 per cent level of significance indicated validity of selected instrument variables.

After estimation of parameters of regression, distribution of its residual was checked because it will indicate the validity of the inference for the regression analysis.

The distribution of residual of the regression model was found non-normal as shown in Figure 4 by its quantile-quantile plot and kernel density estimation.

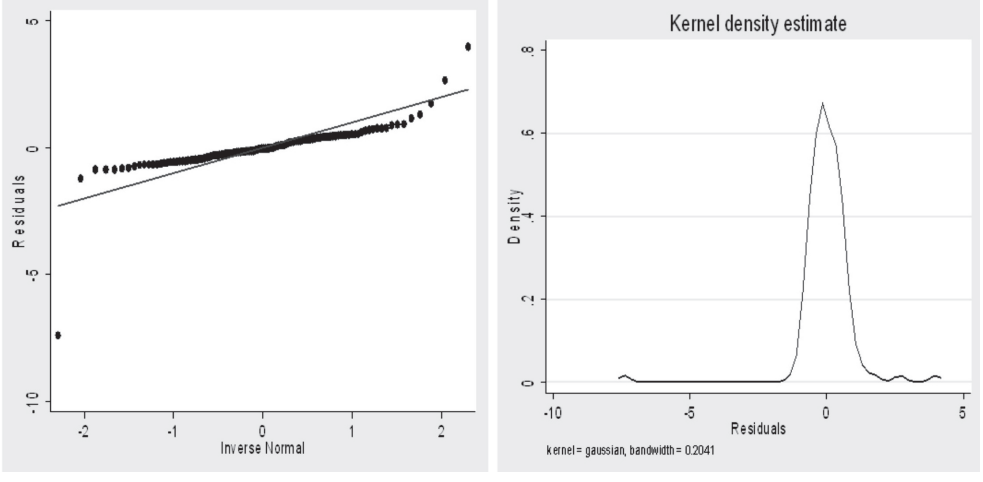

Figure 4. Distribution of 2SLS regression residual

Table 6. Farm income and farm efficiency measure for different categories of farms based on size of holding

Farm category	Farm (No.)	Average farm size (ha)	Livestock unit (No./farm)	SID value	Farm income (₹/ha/ annum)	Family income (₹/ha/ annum)	Returns to variable cost (₹)
Marginal	93	0.36	0.76	0.57	144511	36241	2.34
Small	23	1.23	0.42	0.71	83888	74345	2.73
Semi-medium & medium	4	2.48	0.45	0.78	81072	93246	2.22

Table 7. Farm income and farm efficiency measure for different categories of farms based on enterprise mix

Farming enterprises	Farm (No.)	Farm size (ha.)	Livestock unit (No./farm)	SID value	Farm income (₹/ha/ annum)	Family income (₹/ha/ annum)	Returns to variable cost (₹)
Agri+ Horti	38	0.56	0.18	0.59	80879	40952	2.05
Horti+ Livestock	11	0.13	0.86	0.42	234270	69474	3.1
Agri + Horti + Livestock & ancill.	43	0.57	0.73	0.67	116361	52584	2.68
Others	28	0.59	0.37	0.60	106915	48342	2.7
Total	120	0.61	0.48	0.61	115813	52491	-

Note: #indicates number of marginal, small and semi-medium and medium farms

In contrast to the case of OLS regression, where, normality of residual was a strict assumption for drawing inference, the two-stage least square does not strictly depends upon normality assumption of residual (Kelejian, 1971; Brown, 1990).

Economics of Agricultural Diversification on Farm Income

Table 6 reveals that marginal farms had average annual per family income of ₹ 36241, which is less than half compared to income of small and medium farmers. But conversely, marginal farms had considerably higher per hectare farm income. It strictly denotes marginal farms had a better efficiency in utilization of resources. Though average farm size is only 0.358 ha for marginal farms, average number of livestock per farm is 0.76. In addition to that, average SID for marginal farms is also low (0.571) compared to SID for small and medium farms (0.71 and 0.78). It implies that the level of agricultural diversification only does not determine farm income in a strict sense; a higher share of livestock enterprise will increase farm efficiency. It is more evident with the mean value of returns over variable cost for marginal farms (2.34) which did not differing significantly from other categories of farms.

Transversely, considering the scenario enterprise-wise (Table 7), it was found that the farms with horticulture and livestock enterprises had the highest per hectare farm income, and returns to variable cost ratio. It was also seen that farms having livestock component, could reap better returns compared to farms which relied only on agriculture. Agriculture, horticulture and livestock enterprise-mix was the most profitable and rational venture as indicated by farm income and efficiency measure from Table 7. However, it is evident from Table 7 that with high level of diversification inclined towards horticulture and livestock will augment farm income.

Conclusion

The paper has looked into the status and trend of agricultural diversification across different states of India and also at farm level for selected districts of Bihar. Alongside it has analysed the impact of

agricultural diversification on farm income. Over the study period, several changes have been observed in crop-mix and also in enterprise-mix across the states, although the overall level of agricultural diversification still differs noticeably which ranges from 0.61 (Punjab) to 0.89 (Karnataka) bracketing most of the states in medium or high diversified states category. However, the crop diversification strategy which was intended to provide wider choice of production of different crops, was lacking in its impressions over time because crop diversification though reduces risks associated in agriculture (Bradshaw *et al*., 2004; Elbers *et al*., 2007), it is not regarded as a measure of income augmentation in the strict sense.

The cross-sectional analysis for selected districts of Bihar revealed that marginal farmers in general did not have sole source of income as crop husbandry as they have diversified towards ancillary enterprises, viz. small poultry, duckery, piggery or goatery. Due to using an integrated farming approach, these ancillary enterprises were proving to be highly profitable in small scale with sufficiently low degree of risks due to its small magnitude of span of operation. The study has concluded that along with over all agricultural diversification, irrigation, cropping intensity, and high-value and ancillary enterprises will supplement farm income and will help to achieve farm income security.

Policy Implications

The study has shown that diversification of farm business does not always increase farm income, because, it depends on the direction of diversification. Therefore, with an integrated farming approach, diversification of farm by adopting ancillary, horticulture and other high-value enterprises like mushroom, etc. should be promoted to increase farm income. For the resource-poor marginal and small farmers, income will increase with diversification towards high-value enterprises complemented with small-scale ancillary enterprises. Surprisingly, though having high profitability, these ancillary enterprises were not being popular among the higher-resource farmers, because of social stigma associated with these enterprises and are considered to be inferior enterprises bounded only in low caste groups. Specific policy intervention is needed to deal with it with significant promotional and extension activities.

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