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Dynamics and determinants of farm household income in Bihar: evidence from panel data of selected villages

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ABSTRACT

The study is undertaken to analyze the farm household income, income sources, economic inequality, and determinants of income of farm households in Bihar which is based on five-year panel data (2010–11 and 2014–15). Findings of the study show that the income level of farm households in the selected villages of Bihar is low, but exhibited an impressive annual growth rate of 6% from 2010–11 to 2014–15. The income level showed a positive relation with the size of landholding. Further, the sources of household income are quite diverse, and cultivation contributes only one-fourth to the total income of farm households. The level of remittances showed signs of decline, while the share of transfer payments and non -farm activities increased from 2010–11 to 2014–15. Inter- and intra-class inequality in farm household income is also prominent but diminishing with time. Farm assets, diversification, and education level have turned out to be important drivers of farm household income. These findings have significant implications and call for holistic rural development strategies for enhancing farmers' income.

Key words: Bihar, Determinants, Dynamics, Income, Panel data

Bihar is the most densely populated state in the country with about 9% population residing in 2.9% of the geographical area of India and the third most populated (~104 million) state. Until recently, it was also among the slowest-growing states of the country. The growth rate of Bihar's gross domestic product (GDP) has considerably accelerated during the past six years, with the state economy growing at more than 10 % per annum. However, Bihar continues to be among the economically most backward states in India, with one of the lowest per capita income and highest incidence of poverty. Further, under-nutrition and malnutrition are rampant in the state, and a high mortality rate among children persists (Datta A 2016).

Agriculture continues to be a significant sector, contributing about 19 % to the state net domestic product and providing employment to about 67 % of the rural workforce. Agricultural households comprise about 51 % of the total rural households in the state (NSSO 2013). The marginal farms (<1 ha) dominate the agricultural sector in Bihar. The growth in per capita income during the past 7 years has been contributed by the secondary and tertiary sectors. The economic and social well-being of a farm household depends on total household income. Further, the nature and pattern of household farm income may change frequently. There have been extensive studies on different aspects of farm business, but the dynamics of the household income has seldom been explored with a panel micro-level data set. The issue assumes further importance in the wake of the Indian government's commitment to double farmers' income by 2022. A few attempts have been made by scholars to estimate farmers' income. Some were confined to estimates of farm income only (Chand *et al.* 2015) and others were not cognizant of year to year fluctuations in farmers' income (Satyasai 2016). These studies overlooked the farm households' income in totality.

With this view, this study was conducted using five year panel data to analyze the dynamics of farm household income, composition of income sources, economic inequality and determinants of income of farm households in Bihar.

MATERIALS AND METHODS

The study was based on the high-frequency primary data collected from rural households by resident investigators for five years (2010–11 to 2014–15) under the Village Dynamics in South Asia (VDSA), a collaborative project entitled "Tracking Changes in Rural Poverty in Household

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The household-level panel data of five years (2010–11 to 2014–15) were used for the study. Out of total 160 households, the study is based on only 120 households, which were involved in agricultural operations. The farm households were categorized into three groups, namely, marginal (<1 ha), small (1–2 ha) and medium (>2 ha) for analysis. Besides, Gini ratio was computed to measure the income inequality and diversification index to explore about diversity of income sources. Linear regression model was employed to identify the determinants of income. Simpson Index was used for calculation of diversification indices for different categories of farm households. It ranges between 0 and 1. If a complete concentration exists, the index moves towards 0. The generalized least square (GLS) regression model with random effects (RE) is used to quantify the effects of income determinants.

RESULTS AND DISCUSSION

The landholding pattern affirms the dominance of marginal landholdings in Bihar, and the marginalization of holdings seems to be persisting overtime (Table 1). In 2014–15, marginal farmers share in numbers and in land area increased substantially among the sample households. The average landholding size of sample households declined during the period. However, the pattern varied among different size classes. The average size of small landholdings increased. The average size of marginal landholdings also slightly increased during the period. A drastic decline in the average size of landholdings of medium farmers was observed, which resulted in a decline in land owned by medium farmers.

Table 1 Pattern and trends in distribution of landholdings among sample households

Year	Marginal farms	Small farms	Medium farms	All farms
	% Share in number of households			
2010–11	63.3	20.8	15.8	100.0
	(0.37)	(1.38)	(4.05)	(0.91)
2011–12	66.4	19.2	14.4	100.0
	(0.37)	(1.40)	(3.73)	(0.72)
2012–13	66.9	19.5	13.6	100.0
	(0.38)	(1.40)	(3.74)	(0.70)
2013–14	70.6	17.7	11.8	100.0
	(0.39)	(1.56)	(3.99)	(0.72)
2014–15	71.8	14.9	11.2	100.0
	(0.39)	(1.49)	(3.54)	(0.74)
	% Share in total landholdings			
2010–11	30.3	23.7	45.9	100.0
2011–12	41.9	20.9	37.2	100.0
2012–13	45.0	21.0	34.0	100.0
2013–14	44.7	23.7	31.6	100.0
2014–15	43.9	17.6	38.4	100.0

Note: Figures in parentheses indicate average size of landholdings of respective category of farm households.

Assets of farm households: Possession of household assets is strongly associated with levels of income and consumption. Table 2 depicts the value of assets of an average farm household in Bihar. It is clear that there has been about a two-fold increase in the total value of assets in this short span of five years. Interestingly, a phenomenal increase can be seen in the value of farm machineries and domestic goods in the year 2014–15 vis-à-vis four years earlier. The value of farm machineries in 2014–15 probably increased due to purchase of tractors by some farmers under the Rashtriya Krishi Vikas Yojana (RKVY) and regularization of various on-contract jobs, like teachers, in the state. The value, in absolute terms, of all household assets rose, except for means of transport vehicles. However, the composition of assets portfolio altered significantly. The share of domestic goods in total value of household assets increased dramatically, and the share of all other farm household assets declined during this five-year period. Thus, it could be inferred that the regular flow of increased income has helped farm households in Bihar improve their quality of life by allocating a major share of their incremental income on the acquisition of basic and luxurious household assets. A decline in the value of transport vehicles during 2010–11 to 2014–15 can be attributed to the availability of alternative and affordable means of travel and transport due to continuous improvements in the rural–urban road connectivity and private and public transportation.

Livestock have always been well embedded in the agricultural production systems in India. The livestock

Table 2 Value of assets, per household and per capita with sample farm households in Bihar

Asset type	2010–11	2011–12	2012–13	2013–14	2014–15
	Per household asset value ('000 ₹/household)				
Farm assets	44.2	39.1	40.0	40.6	45.6
	(10.3)	(8.2)	(8.2)	(7.9)	(5.8)
Livestock	21.2	13.7	15.6	19.2	19.7
	(5.0)	(2.9)	(3.2)	(3.7)	(2.5)
Transport vehicles	20.8	14.7	21.1	17.0	15.7
	(4.9)	(3.1)	(4.3)	(3.2)	(2.0)
Domestic goods (including means of communication)	113.3	131.2	132.8	149.8	293.7
	(26.5)	(28.1)	(27.2)	(29.0)	(37.5)
Residential houses	227.9	268.7	278.8	289.9	408.4
	(53.3)	(57.5)	(57.1)	(56.1)	(52.2)
Total	425.4	467.4	488.3	516.5	783.1
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Source: Authors' estimates based on VDSA Field Survey, 2010/11–2014/15. Notes: Values are at 2004–05 constant prices. Figures in parentheses indicate %.

provide cushion against production risks and serve as liquid assets. However, among our sample farm households, livestock assets in terms of value have remained stagnant from 2010–11 to 2014–15. Proliferating labor problems (scarcity of both hired and family labor), due to alternative employment opportunities, and the out-migration of adult males are constraining the scaling-up of livestock (Kumar *et al.* 2016, Singh *et al.* 2018).

Farm household income: Pattern, trends, diversity, and inequality

Pattern and trends: The trends describing the household income of farm households during the five-year period from 2010–11 to 2014–15 have been also studied (Table 3). In general, the income of a farm household in sample villages was low. The total income of a farm household has grown at an average rate of about 6 % per annum, which is quite impressive. In 2013, the average monthly income per agricultural household in Bihar has been estimated as ₹ 3558, much below the national average of ₹ 6426 (NSSO 2016).

The level of income has exhibited a direct relationship with farm size; income increases as we move from marginal- to medium-sized farm households. However, the growth rate in household income did not display any relationship with farm size. Per capita household income registered the highest growth rate for small-farm households, followed by medium and marginal farm households. At the existing growth rate, the marginal and medium farm households would require about 10 years to double their per capita household income, while small-farm households would double their income in only seven years. However, the scenario can change with the injunction of appropriate technological, policy, and institutional interventions, and the period required for doubling farmers' income can be reduced. The government goal of doubling farmers' income by 2022 seems to be achievable, even in one of the most poverty-stricken and agriculturally important states of India, if appropriate measures are taken.

Diversity in farm household income: The disaggregation of income sources is useful to examine the relative importance of different activities in farm household income. The village economies in Bihar seem to be diverse, and the households get income from various sources (Table 4). Cultivation is common among all the households. The households opt for cultivation primarily to meet their domestic food requirements and to generate income for living. About one-fourth of the total household income comes from cultivation. Surprisingly, agriculture is not the primary source of income for the farm households in Bihar, implying that rural and agriculture are no longer synonymous in Bihar. There is apparently a decline in the percentage of households offering labor for farming.

The percentage of households obtaining income through family farm labor has come down sharply, from 12 % in 2011–12 to 6 % in 2014–15, indicating a steep decline in household income from this activity. The contribution of income through family farm labor wages in total farm household income in 2014–15 was merely 1.1 %. Similarly, there has been a noticeable reduction in the income share of non-farm workers, along with a corresponding decline in the percentage of farm households receiving income from this source.

The most interesting feature of the village economies in Bihar is the share of household income from salaried jobs. In 2014–15, about 37% of households had salaried job that constituted nearly 37% of the household income. Better education, employment opportunities in teaching, social welfare, and agricultural services are creating salaried job opportunities that rural households are taking advantage of the proportion of farm households getting remittances has come down by 14.2 basis percentage points, from 50.8 % in 2010–11 to 36.6 % in 2014–15. The income contribution of farm households from remittances has also fallen correspondingly by 3 basis percentage points during the reference period. This data provides enough evidence to draw the inference that *in situ* employment opportunities have resulted in retardation in the pace of out-migration from farm households in Bihar. The spread of the social safety net has expanded, as the number of farm households with some sort of transfer income and the income share of transfer payments have both increased.

To understand the extent of income diversification in farm households, we have computed diversification indices for different categories of farm households of the selected villages in Bihar for five years, from 2011 to 2015. Table 5 depicts the diversification indices for the marginal, small, and medium categories of farm households. Altogether, the farm households in Bihar seem to be moderately diversified in terms of income. The marginal-farm households are more diversified than the small- and medium-farm households.

The extent of income diversification among small farms has been decreasing, and these households are becoming more and more specialized. The small-farm households had more diversified income in 2010–11 compared with 2014–15 after a continuous tapering. It may be that the small households are able to combine their farm resources and family labor (particularly labor) more judiciously, while medium-farm households are constrained by labor resources, and marginal and sub-marginal farmers have

Table 3 Trends in per capita household income among farm households

Year	Per capita income (₹/person/month)			
	Marginal farms	Small farms	Medium farms	All farms
2010–11	635	839	1904	865
2011–12	667	1332	2520	937
2012–13	710	1216	2544	945
2013–14	765	1248	2840	989
2014–15	831	1423	2519	1134
CAGR (%)	6.97	10.42	7.03	6.12

Table 4 Sources of contribution to farm household income in Bihar: 2010–11 to 2014–15

Year	% contribution in household income						
	Cultivation	Farm labor	Non-farm labor	Salary	Remittances	Transfer income	Income from non-farm activities
2010–11	21.4	0.4	15.0	44.2	9.1	3.5	6.5
2011–12	24.9	3.8	20.2	31.1	8.0	3.8	8.2
2013–14	27.7	1.9	18.5	32.0	4.0	4.3	11.5
2013–14	24.0	0.6	17.9	34.7	5.4	2.6	14.7
2014–15	23.6	1.1	14.7	36.7	6.1	4.8	13.0

Table 5 Extent of diversification and Gini coefficient across different categories of farm households: 2010–11 to 2014–15

Year	Marginal farms	Small farms	Medium farms	All farms
2010–11	0.44 (0.445)	0.44 (0.326)	0.30 (0.345)	0.39 (0.382)
2011–12	0.46 (0.290)	0.44 (0.309)	0.32 (0.356)	0.48 (0.340)
2012–13	0.46 (0.323)	0.36 (0.284)	0.34 (0.328)	0.45 (0.334)
2013–14	0.38 (0.280)	0.32 (0.345)	0.35 (0.300)	0.37 (0.328)
2014–15	0.42 (0.327)	0.31 (0.380)	0.41 (0.242)	0.44 (0.346)

Note: Figures in parentheses indicate the gini coefficient

landholdings that are too small.

These trends have several inherent policy implications. Small farms may be encouraged, supported and advised to carry on specialized farming. It is also imperative to initiate and encourage consolidation of holdings of a viable size by evolving some innovative ways to encourage agriculture. The scaling up of farm holdings size could also be encouraged through promoting contract farming and farmers' friendly land lease system (NITI Aayog 2016). It will not only enrich our food baskets but also help accelerate agricultural growth in the country (Joshi *et al.* 2003).

Inequality among farm households: In Bihar, farm households do not have a same income profile. The study examined the extent of income inequality among the farm households in Bihar for five years, from 2010–11 to 2014–15. The Gini coefficients for different categories of farm households in Bihar revealed that all categories of farm households suffered from varying degrees of inequality (Table 5). The extent of inequality is diminishing, but its pace is quite sluggish and intermittent. The inequality in distribution of farm income expressed a negative relationship with farm size. As we move from marginal- to medium-farm households, the extent of inequality diminishes. Hence, it may be inferred that inequality is higher among small-farm households.

Determinants of farm household income: A number of personal, economic, social, and physical attributes influence the income generating ability of farm households. To quantify the effects of income determinants, a generalized least square (GLS) regression model with random effects (RE) was estimated using five-year panel data from the selected households in Bihar (Table 6). The model is overall a good fit, and the value of Wald chi-square at p further confirmed the reliability of this model.

The results have revealed that age, education, diversification of income sources, asset possession and size of landholding are the major determinants that play a decisive role in generation of aggregate household income. Age of household head, which is a proxy of the experience, positively and significantly influences the ability of a household to earn income. As expected, education was found to have a significant impact on household income. Education enhances the ability of a household to make rational decisions and provides opportunities of occupational

Table 6 Determinants of income of farm households in Bihar

Variable	Coefficient	SE
ln (age of household-head) (years)	1.066***	0.239
Gender of household-head (male = 1, female = 0)	0.277	0.179
ln (size of household) (no. of members)	-0.512***	0.102
ln (maximum education) (years)	0.309*	0.176
ln (operated land) (ha)	0.113*	0.0576
Diversification index (numeric value)	0.558***	0.155
Caste (forward = 1, others = 0)	-0.155	0.155
Occupation (farming = 1, others = 0)	-0.140	0.0887
ln (value of assets) (₹)	0.223***	0.0507
Owning animals (= 1, if possesses, animal 0, otherwise)	-0.165	0.108
Access to credit (1 = yes, 0 otherwise)	0.00971	0.106
Cultivate vegetables (1 = yes, 0 otherwise)	0.0452	0.0775
Constant	2.308**	1.019
R square: within	0.1518	
between	0.3262	
overall	0.3083	
Wald chi-square (15)	137.66	

Note: ***, **, and * refer to significance at 1 %, 5 %, and 10 % levels, respectively.

diversification.

The operated landholding also plays a crucial role in household income. Large operated landholdings provide economies of scale and make mechanization techno-economically feasible and thus are helpful in increasing household income. Income diversification certainly helps the farm households enhance their incomes. However, it is imperative to consider that practicing sole farming is bound to remain non-remunerative. As indicated by its coefficient, it could be inferred that the households with farming as a primary occupation would generate less income in comparison to those who are also involved in other occupations. It is, therefore, imperative that alternative sources of non-farm employment be developed to enhance income of the farm households. Despite the positive and significant effects of several factors, the economy of rural farm households seems to be vulnerable and requires appropriate measures to reverse the negative tendency.

The study has shown that the income level of farm households in the selected villages of Bihar is low, but exhibited an impressive annual growth rate of 6 % from 2010–11 to 2014–15. The income level showed a clear positive relation with size of landholding. Further, the sources of household income are quite diverse, and cultivation contributes only one-fourth to the total income of farm households. These findings have significant implications and call for holistic rural development strategies for enhancing farmers' income. The crops alone are not likely to double the farmers' income within the stipulated time. The level of remittances showed signs of decline, while the share of transfer payments and non-farm activities increased from 2010-11 to 2014-15. Inter and intra class inequality in farm household income is also prominent but diminishing with time.

Farm assets, diversification and education level have turned out to be important drivers of farm household income. These findings suggest that an emphasis on farm and non-farm sector diversification will be crucial for enhancing farmers' income. Investment in human capital or skill development will be equally important in the endeavor to effectively and sustainably increase farmers' income.

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