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Patterns and Determinants of Farm Income Diversification in India: Evidence from Three Survey Rounds

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Abstract

Income diversification is crucial for Indian farmer households owing to the inherent risks associated with agriculture. This article investigates the patterns and determinants of income diversification among farmer households across 18 Indian states utilizing data from three rounds of the NSS Situation Assessment Survey (2002–2003, 2012–2013 and 2018–2019). The Herfindahl index (HI) was estimated to study the pattern of income diversification, and a regression analysis was conducted to study its determinants. To distinguish structural diversification from distress-driven shifts, the HI was calculated both with and without wage income. A gradual decline in HI at the national level over time suggested modest improvements in income diversification. State-level trends revealed considerable disparities in HI, with states such as Gujarat, Rajasthan and Haryana showing significant and sustained diversification driven by increased contributions from livestock and non-farm activities. Conversely, Madhya Pradesh, Chhattisgarh and Bihar states continued to exhibit high or fluctuating HI values, reflecting ongoing dependence on cultivation income. Regression analysis confirmed that landholding size, irrigation and rural infrastructure are important determinants of diversification, while wage income consistently emerged as the most critical factor influencing the extent of income diversification. The analysis also highlighted the growing importance of wage income in reducing HI, implying a distress-induced form of income diversification.

JEL Classification: Q12, Q13, Q15, Q18

Keywords

Crop cultivation, crop income, farm income, Herfindahl index, income diversification, non-farm business

Introduction

Farm income diversification is essential in India to reduce farmers' dependence on unstable crop earnings and protect them from risks of price shocks, droughts and crop failures. The diversification of income—a process by which rural households engage in multiple income-generating activities both within agriculture (crop production, livestock and horticulture) and outside it (wage labour, salaried jobs and self-employment)—is increasingly recognized as a critical mechanism for reducing risk and improving resilience (Ellis, 2000). While earlier studies (Agarwal & Agrawal, 2017; Bathla & Kumar, 2019; Birthal et al., 2014, 2015;Chand, 2017; Satyasai, 2016) largely focused on documenting income levels or disparities across different states, this study sought to go beyond outcomes, and examined the underlying determinants of diversification, thereby offering insights into the household and infrastructural factors that influence livelihood choices.

The absence of reliable household-level data on farm income from official sources limited the scope of research on income diversification in the past. Most earlier analyses relied on the data on cost of cultivation surveys published by the Commission for Agricultural Costs and Prices, which by design captured only crop income, but failed to reflect the full income portfolio of farm households (Dev & Rao, 2010; Narayanamoorthy, 2006, 2013, 2017; Narayanamoorthy et al., 2014, 2024; Sen & Bhatia, 2004). Recognizing this limitation, the National Sample Survey Office (NSSO) introduced the Situation Assessment Survey (SAS) in 2002–2003 and conducted two more rounds in 2012–2013 and 2018–2019. These three rounds provided comprehensive and comparable data on household incomes, including crop cultivation, livestock, wage labour, non-farm business and land leasing, thereby enabling a more holistic analysis of diversification. The availability of these datasets helped researchers to

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examine a wide range of issues, including viability of farming, indebtedness and household consumption (Agarwal & Agrawal, 2017; Bathla & Kumar, 2019; Birthal et al., 2014, 2015; Chand, 2017; Chandrasekhar & Mehrotra, 2016; GoI, 2007; Gulati et al., 2019; Satyasai, 2016). However, a systematic examination of the pattern and drivers of income diversification using SAS data remains limited.

The literature underscores that multiple structural and contextual factors shape diversification. Vyas (1996) highlighted that small landholdings, dependence on monsoons and market risks make diversification a structural necessity for Indian agriculture. Bhalla and Hazell (2003) and Lanjouw and Shariff (2004) showed that access to rural infrastructure and education explains inter-regional disparities in non-farm income. Within agriculture, Rao et al. (2006) pointed to the importance of high-value crops and livestock in supporting smallholders, while Chand and Srivastava (2014) identified irrigation, credit, education and rural roads as key enabling factors. Kumar et al. (2017), NITI Aayog (2018) and Bhalla and Singh (2020) emphasized the growing role of non-farm employment, livestock and rural enterprises in shaping household incomes. De la O Campos et al. (2023) and Basantaray et al. (2024) revisited income diversification in developing and Indian contexts, highlighting the rising role of non-farm activities and structural transformation. Collectively, these studies suggested that income diversification is not random but strongly conditioned by household characteristics, production structures and rural infrastructure.

Despite this body of work, relatively few studies systematically analysed the determinants of farm income diversification using the SAS datasets across all three rounds. Existing studies either examined diversification at a single point in time or studied broad trends without linking them to explanatory factors. Still, understanding the determinants is crucial in the present context of agricultural distress, climate risks, rising input costs and stagnant farm incomes (GoI, 2007; MoAFW, 2017; Narayanamoorthy, 2021). This study by using the HI as a measure of income diversification and a double-log regression framework identified the household, agricultural and infrastructural factors that influence diversification across 18 major states at three time points. Specifically, the present study was planned to address: (a) What are the patterns of income diversification among farmer households, with and without wage income, across the three time points 2002–2003, 2012–2013 and 2018–2019? (b) What household, resource and infrastructural factors influence farm income diversification across Indian states? and (c) How has their importance changed over 2002–2003, 2012–2013 and 2018–2019?

Data and Methodology

The core analysis in this study was derived from the SAS data of farmer households, available for three reference periods: 2002–2003, 2012–2013 and 2018–2019 (NSSO–SAS, 2005, 2014, 2021). While information on farmer households' income and related variables was available for as many as 28 states for 2012–2013 and 2018–2019, comparable data for 2002–2003 were limited to only 18 states. To maintain consistency and ensure comparability across the three rounds of surveys, the analysis was confined to these 18 states. It is worth noting that these states together represented nearly 93.90% of India's estimated rural households and about 94.70% of the country's total cropped area in 2018–2019, thereby providing a representative coverage.

The SAS dataset was particularly valuable as it goes beyond reporting total household income to provide a source-wise disaggregation of monthly income under five broad categories: (a) income from wages, (b) net receipts from crop production, (c) net receipts from farming of animals, (d) net receipts from non-farm business and (e) income from leasing out of land (available only for 2018–2019). To arrive at annual income estimates, the reported monthly income under each head was multiplied by 12. In order to enable meaningful comparisons across the three survey periods, all income values were deflated and expressed in constant prices using the Consumer Price Index for Agricultural Labourers with 2004–2005 as the base year.

One of the objectives of this study was to assess whether and to what extent income diversification happened among farmer households across different states. In the literature, income diversification is typically measured using the HI or the Simpson index (SID), both of which are closely related but differ in interpretation. The HI ranges from 0 to 1, where higher values reflect greater concentration of income sources, implying lower diversification. By contrast, the SID is computed as 1 minus the HI, with higher values denoting greater diversification. Although both indices provide useful insights, this study used the HI to quantify the extent of income diversification. Mathematically, the HI is defined as follows:

$$HI = \sum_{i=1}^{n} \left(\frac{Y_i}{\mathrm{Y}} \right)^2$$

where Y_i is income from the ith source (crop cultivation, livestock, wages and non-farm business); Y is the total income of the farmer household (i.e., $Y = \sum Y_i$) and n is the number of income sources.

Although the SAS data for 2018–2019 provide income details under five heads (wages, crop production, farming of animals, non-farm business and leasing out of land), the component on leasing out of land is not available for the earlier two rounds (2002–2003 and 2012–2013). To maintain uniformity and ensure comparability across all three time periods, the HI was calculated using only four sources of income. An important trend observed over the years was the steady rise in the contribution of wage labour to the income of farmer households. However, this growth in wage income may not necessarily indicate genuine structural diversification; rather, it could reflect distress-driven diversification, where

households were compelled to depend on wage employment due to limited opportunities in agriculture or allied activities. To distinguish structural diversification from distress-induced shifts, the HI was computed in two ways—one including wage income and another excluding wage income, thereby facilitating an assessment of the extent to which wage income affected the diversification index.

After examining the patterns of income diversification across states, the study explores the determinants of farm income diversification at all three time points using a double-log regression framework. Since the value of the dependent variable HI lies between 0 and 1, the double-log functional form has been employed to interpret the regression coefficients more effectively. A total of eight explanatory variables have been considered for the regression analysis, and their detailed descriptions are provided in Table 1. Given the observed expansion of wage income in farm households, it is hypothesized that wages would exert a significant influence on the degree of income diversification across states. Accordingly, regression models have been estimated separately for the HI computed with wage income and for the HI computed without wage income. The double-log regression model employed in this study is specified as follows[1]:

$$\ln\left(\mathrm{HI}/\mathrm{HI}_{wi}\right) = \alpha + \beta 1\ln(\mathrm{CI}) + \beta 2\ln(\mathrm{ELEC}) + \beta 3\ln(\mathrm{FACA}) + \beta 4\ln(\mathrm{HPLO}) + \beta 5\ln(\mathrm{IRRI})\beta 6\ln(\mathrm{LITE}) + \beta 7\ln(\mathrm{ROAD}) + \varepsilon, \quad (1)$$

where HI is the Herfindahl index of income diversification estimated with wage income; HI_{wi} is the Herfindahl index of income diversification estimated without wage income; CI is the cropping intensity (in %); ELEC is the percentage of villages electrified (in %); FACA is the foodgrain area to cropped area (in %); HPLO are agricultural households possessing land less than 1 ha (%); IRRI is the irrigated area to total cropped area (%); LITE is the literacy rate of agricultural households (%); ROAD are villages with pucca road connectivity (%) and ε is the error term.

It is pertinent to emphasize that the extent of farm income diversification among agricultural households is influenced by a combination of agro-economic as well as social factors. Accordingly, seven independent variables were selected for the regression analysis, each of which was expected, in one way or another, to shape the diversification of farm income. Among these, the data on the agricultural households possessing land less than 1 ha (HPLO) were compiled from the SAS reports. Information on road connectivity (ROAD), the percentage of electrified villages (ELEC) and rural literacy rate (LITE) were drawn from various publications of the Census of India, released by the Ministry of Home Affairs, Government of India, New Delhi.[2] In addition, data relating to CI, the percentage of foodgrain area to cropped area (FACA) and irrigated area to total cropped area (IRRI) were compiled/estimated from the publication *Land Use Statistics at a Glance* (Government of India, various years), brought out by the Ministry of Agriculture and Farmers Welfare.

Results and Discussion

Income of Farmer Households

While the major focus of this article was studying the diversification of income among farmer households, but it was equally important to trace the trajectory of household income over three distinct periods to better understand the direction of income diversification as measured through the HI. The analysis of SAS data showed a steady increase in the average annual income of agricultural households at the all-India level in nominal terms: from ₹25,380 in 2002–2003 to ₹77,112 in 2012–2013 and further to ₹122,616 in 2018–2019. When converted to constant 2004–2005 prices, the corresponding figures are ₹26,971, ₹38,900 and ₹45,829, respectively (Table 2). Despite this overall upward trend, notable variations persisted across states. For instance, in 2002–2003, Odisha reported the lowest real income per agricultural household (₹13,543), while Jammu & Kashmir recorded the

Table 1. Descriptions of the Variables Used in the Regression Model.

			Average of 18 States		
Variables	Description	Unit	2002–2003	2012–2013	2018–2019
CI	Cropping intensity	%	136.68 (22.58)	140.44 (24.39)	145.78 (24.85)
ELEC	Percentage of village electrified	%	49.57 (27.28)	63.27* (27.92)	63.27* (27.92)
FACA	Share of foodgrains area to cropped area	%	65.78 (21.13)	62.74 (23.54)	59.50 (22.59)
HPLO	Share of agricultural households possessing land less than 1.00 ha	%	70.62 (11.40)	78.63 (12.13)	70.12 (15.16)
IRRI	Share of irrigated area to cropped area	%	39.67 (26.14)	45.66 (25.75)	48.48 (25.55)
LITE	Literacy rate of agricultural households among persons age seven years above	%	59.89 (10.22)	68.87* (7.86)	74.12* (8.30)
ROAD	Percentage of villages having pucca road	%	62.93 (22.82)	67.62* (26.66)	67.62* (26.66)

Sources: NSSO–SAS (2005, 2014, 2021); Census of India (various years); GoI (various years).

Notes: Figures in parentheses are the standard deviation; * relates to the year 2010–2011.

Table 2. Share of Cultivation and Non-cultivation Income to Total Annual Income of Farmer Households by State.(₹ in 2004–2005 Prices)

	2002–2003			2012–2013			2018–2019		
State	Cultivation (%)	Non-cultivation Income (%)	Total Annual Income (₹)	Cultivation (%)	Non-cultivation Income (%)	Total Annual Income (₹)	Cultivation (%)	Non-cultivation Income (%)	Total Annual Income (₹)
Andhra Pradesh	45.47	54.53	20,837	33.82	66.18	36,194	26.09	73.91	47,004
Assam	56.69	43.31	40,310	62.90	37.10	40,529	30.56	69.44	47,879
Bihar	46.74	53.26	23,082	48.20	51.80	21,539	36.32	63.68	33,827
Chhattisgarh	50.12	49.88	20,633	64.65	35.35	31,339	44.81	55.19	43,402
Gujarat	43.37	56.63	34,227	37.00	63.00	47,981	34.19	65.81	56,651
Haryana	51.84	48.16	36,752	54.50	45.50	87,377	39.81	60.19	102,445
Jammu & Kashmir	44.21	55.79	69,985	24.15	75.85	76,777	10.47	89.53	84,849
Jharkhand	41.18	58.82	26,385	30.74	69.26	28,579	22.51	77.49	21,955
Karnataka	48.39	51.61	33,360	55.82	44.18	53,465	50.85	49.15	60,284
Kerala	27.97	72.03	51,060	29.70	70.30	71,965	20.31	79.69	80,351
Madhya Pradesh	69.65	30.35	18,236	64.67	35.33	37,593	51.67	48.33	37,401
Maharashtra	51.28	48.72	31,409	52.21	47.79	44,712	41.31	58.69	51,543
Odisha	31.64	68.36	13,543	28.28	71.72	30,123	30.69	69.31	22,928
Punjab	56.90	43.10	63,252	60.15	39.85	109,321	47.18	52.82	119,757
Rajasthan	23.97	76.03	19,103	42.69	57.31	44,494	29.80	70.20	56,154
Tamil Nadu	31.81	68.19	26,423	27.46	72.54	42,254	22.15	77.85	53,481
Uttar Pradesh	51.19	48.81	20,825	57.99	42.01	29,802	40.81	59.19	36,155
West Bengal	35.45	64.55	26,512	24.60	75.40	24,093	22.88	77.12	30,328
All India	45.82	54.18	26,971	47.95	52.05	38,900	37.17	62.83	45,829
Coefficient of variation (CV)	—	—	48.71	—	—	50.05	—	—	48.72

Sources: NSSO–SAS (2005, 2014, 2021).

highest (₹69,985). By 2012–2013, Bihar had the lowest household income (₹21,539), with Punjab topping the list at ₹109,321. In 2018–2019, Jharkhand registered the lowest income (₹21,955), whereas Punjab once again occupied the highest position at ₹119,757.

The large disparity in state-level incomes was further underscored by the coefficients of variation, pointing to considerable regional inequality. To capture these differences, states were grouped according to whether their household income levels were above or below the national average. In 2002–2003, eight states (Assam, Gujarat, Haryana, Jammu & Kashmir, Karnataka, Kerala, Maharashtra and Punjab) had incomes above the national average (₹26,971), while the remaining 10 fell below it. By 2012–2013, Rajasthan and Tamil Nadu had joined the above-average group, followed by Andhra Pradesh in 2018–2019. Yet, seven states (Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Uttar Pradesh and West Bengal) remained consistently below the national average in all three rounds.

To further probe the composition of farm household incomes, disaggregated data on five major income sources were examined. At constant prices, wage income per household rose from ₹12,709 in 2002–2003 to ₹18,223 in 2018–2019. Similarly, income from livestock activities grew markedly, from ₹1,994 to ₹8,132 over the same period. Income from non-farm business showed only a marginal rise, increasing from ₹3,415 to ₹3,686. In contrast, income from crop cultivation, traditionally the backbone of farm household earnings, displayed a worrying trend. While it rose from ₹14,539 in 2002–2003 to ₹21,557 in 2012–2013, it fell back to ₹18,555 in 2018–2019 at constant prices. This decline, despite an increase in overall household income, signalled persistent structural stress in crop farming.

State-level trends further highlighted this concern. Between 2002–2003 and 2012–2013, crop income rose in 14 of the 18 states under study. However, in the subsequent period (2012–2013 to 2018–2019), the pattern reversed, with

12 states experiencing a decline in crop-based income. To examine this more systematically, the share of crop income in total household income was computed. At the all-India level, this share increased marginally from 45.82% in 2002–2003 to 47.95% in 2012–2013, before dropping sharply to 37.17% in 2018–2019. Between 2002–2003 and 2012–2013, seven states recorded a decline in the share of crop income, whereas during 2012–2013 to 2018–2019, the number rose to 16 states. This widespread contraction underscores a significant weakening in the role of crop cultivation in farm household earnings. These patterns point towards a deeper structural transformation in rural livelihoods, with crop income steadily losing ground as a primary source of sustenance for farm households across most states. With this background on income trajectories and sources, we assessed the extent of income diversification across the 18 states.

Patterns of Income Diversification

Understanding how farmer households derive income from different sources was central to studying the ongoing rural transformation in India. In an agrarian economy increasingly characterized by fragmented landholdings, volatile markets and ecological uncertainty, sole dependence on cultivation income became both economically unsustainable and risky. Consequently, rural households sought to diversify their livelihoods by turning to alternative income streams such as livestock rearing, non-farm enterprises and wage labour. This study examined the nature and extent of such diversification across 18 Indian states using the HI, a widely used measure of income concentration and diversification. As noted earlier, drawing on SAS data for 2002–2003, 2012–2013 and 2018–2019, the index was computed using income from four major sources, namely, cultivation, animal farming, non-farm business and wages. To distinguish between genuine structural diversification and distress-driven shifts, the HI was estimated both with and without wage income. This distinction is critical, as it reveals whether diversification reflected meaningful economic reorientation or simply greater dependence on insecure, low-return wage work concealing stagnation in agricultural incomes.

At the national level, the results suggested a gradual and consistent improvement in income diversification (Table 3). When wage income was included, the all-India HI declined from 0.374 in 2002–2003 to 0.354 in 2012–2013 and further to 0.333 in 2018–2019. We observed a similar trajectory when wage income was excluded: the HI fell from 0.597 in 2002–2003 to 0.545 in 2012–2013 and further to 0.478 in 2018–2019. The higher absolute values of HI in the wage-excluded scenario reflected greater concentration among the remaining sources, yet the overall direction remained consistent, pointing towards a broadening of income portfolios even within the non-wage segments. Importantly, the decline was sharper between 2002–2003 and 2012–2013, while the more recent period showed signs of stagnation, suggesting a slowdown in the pace of diversification.

State-level trends, however, revealed considerable heterogeneity, reflecting the varied agro-economic environments across regions. Some states, such as Rajasthan, Gujarat and Haryana, showed clear progress in diversifying their rural income bases. For instance, in Rajasthan, the HI (including wages) declined from 0.462 in 2002–2003 to 0.317 in 2018–2019, while the HI (excluding wages) fell from 0.529 to 0.408, indicating a more balanced mix of income sources. Haryana demonstrated an even sharper shift, largely due to the expansion of livestock-based income. Its HI (excluding wages) dropped from an extremely high 0.927 in 2002–2003 to 0.487 in 2018–2019, pointing to a substantial reduction in income concentration. Gujarat, though starting from a relatively low HI, maintained consistently favourable levels throughout the period, reflecting the presence of an inherently diversified rural economy with strong crop, livestock and non-farm components.

By contrast, states such as Madhya Pradesh, Chhattisgarh, Bihar and Karnataka continued to exhibit high or fluctuating HI values, reflecting their dependence on a narrow set of income sources. Madhya Pradesh is particularly noteworthy, with an HI of 0.833 in 2002–2003 (excluding wages), reflecting near-total reliance on crop cultivation. Although this figure improved to 0.604 in 2018–2019, it still remained among the highest in the country, underscoring limited structural change. Chhattisgarh showed a similar trend, with the HI peaking at an extraordinary 0.999 in 2012–2013 and moderating to 0.714 by 2018–2019, which nonetheless indicated limited diversification. These patterns suggested that in such states, income concentration is closely tied to structural constraints such as subsistence farming, weak market integration and limited non-farm opportunities.

To further explore the relationship between income diversification and household earnings, states were classified into two groups: less diversified (HI above the all-India average) and more diversified (HI below the all-India average) (Table 4). This classification revealed no clear or consistent association between higher household income levels and greater diversification. While some states with relatively high incomes, such as Gujarat and Kerala, consistently appeared in the more diversified category, others like Punjab and Maharashtra (also among the higher-income states) fell into the less diversified group. Conversely, low-income states such as Bihar and Jharkhand shifted between categories depending on whether wage income is included in the HI computation. Moreover, the correlation coefficient between HI and average annual income was very weak. These findings indicated that higher incomes did not necessarily correspond to higher diversification across states. The differences observed when wage income was excluded further underscored the pivotal role of wage earnings in shaping the overall income structure. Thus, while diversification is an important

Table 3. Estimated Value of the HI by State, 2002–2003, 2012–2013 and 2018–2019.

	With Wage Income			Without Wage Income		
States	2002–2003	2012–2013	2018–2019	2002–2003	2012–2013	2018–2019
Andhra Pradesh	0.374	0.323	0.336	0.595	0.442	0.409
Assam	0.425	0.457	0.384	0.689	0.665	0.483
Bihar	0.328	0.381	0.306	0.480	0.616	0.438
Chhattisgarh	0.447	0.545	0.420	0.808	0.999	0.714
Gujarat	0.338	0.313	0.318	0.511	0.454	0.463
Haryana	0.484	0.390	0.328	0.927	0.577	0.487
Jammu & Kashmir	0.354	0.411	0.467	0.546	0.428	0.334
Jharkhand	0.381	0.313	0.408	0.592	0.432	0.442
Karnataka	0.402	0.413	0.396	0.673	0.661	0.645
Kerala	0.365	0.331	0.401	0.452	0.436	0.395
Madhya Pradesh	0.643	0.479	0.386	0.833	0.701	0.604
Maharashtra	0.382	0.376	0.338	0.607	0.580	0.503
Odisha	0.408	0.280	0.381	0.552	0.376	0.479
Punjab	0.421	0.442	0.372	0.671	0.688	0.550
Rajasthan	0.462	0.328	0.317	0.529	0.487	0.408
Tamil Nadu	0.398	0.296	0.382	0.519	0.361	0.400
Uttar Pradesh	0.393	0.409	0.337	0.638	0.603	0.505
West Bengal	0.342	0.376	0.390	0.487	0.416	0.401
All India	0.374	0.354	0.333	0.597	0.545	0.478
Correlation value between HI and annual income	−0.242^{ns}	0.131^{ns}	0.061^{ns}	0.014^{ns}	0.197^{ns}	0.207^{b}

Source: Computed using NSSO–SAS (2005, 2014, 2021).

Note: HI: Herfindahl index; ns, not significant; b, significant at the 5% level.

dimension of rural transformation, it cannot alone account for interstate variations in farm household income.

Farm Income Diversification: With and Without Wage Income

A central insight emerging from this analysis was the pivotal role of wage income in shaping the diversification profile of rural households. Across all states and survey rounds, HI values were consistently lower when wage income was included, underscoring the growing dependence on wage labour. For example, in 2018–2019, the HI for Uttar Pradesh decreased from 0.505 (excluding wages) to 0.337 when wages were included. Bihar showed a similar decline from 0.438 to 0.306, while Chhattisgarh recorded a drop from 0.714 to 0.420. This recurring pattern across states highlighted the function of wage employment as a stabilizing income source, enabling households to expand their income portfolios beyond farming.

However, this apparent improvement in diversification due to wage income must be interpreted with caution. While the inclusion of wages lowered measured concentration, it often signalled a turn towards distress-driven livelihood strategies, particularly in areas where agriculture failed to deliver adequate or stable returns. In many states, the rising share of wages reflected not expanding opportunities rather shrinking profitability of cultivation, land fragmentation and seasonal underemployment. Therefore, although wage income contributed to statistical diversification, it did not necessarily represent sustainable or desirable structural transformation. Genuine diversification should ideally stem from growth in remunerative and resilient activities such as livestock rearing, horticulture, agro-processing and rural non-farm enterprises rather than from insecure casual or migratory wage labour.

The variation in HI across states can be explained by a mix of structural, institutional and policy-related factors. In states where HI values remained persistently high, particularly Madhya Pradesh, Chhattisgarh, Bihar and Jharkhand, agriculture continued to dominate with limited integration of allied or non-farm activities. These regions often faced deficits in rural infrastructure, weak market and financial linkages and an absence of enabling conditions for entrepreneurship or value addition. Moreover, their demographic composition included a large share of small and marginal farmers, landless

Table 4. Classification of Less Diversified States and More Diversified States by the HI, 2002–2003, 2012–2013 and 2018–2019.

Year	Classification	With Wage Income	Without Wage Income
2002–2003	Less diversified states (Above India's average in HI)	Madhya Pradesh, Haryana, Rajasthan, Chhattisgarh, Assam, Punjab, Odisha, Karnataka, Tamil Nadu, Uttar Pradesh, Maharashtra, Jharkhand. (12)	Haryana, Madhya Pradesh, Chhattisgarh, Assam, Karnataka, Punjab, Uttar Pradesh, Maharashtra. (8)
	More diversified states (Below India's average in HI)	Andhra Pradesh, Kerala, Jammu and Kashmir, West Bengal, Gujarat, Bihar. (6)	Andhra Pradesh, Jharkhand, Odisha, Jammu and Kashmir, Rajasthan, Tamil Nadu, Gujarat, West Bengal, Bihar, Kerala. (10)
2012–2013	Less diversified states (Above India's average in HI)	Chhattisgarh, Madhya Pradesh, Assam, Punjab, Karnataka, Jammu and Kashmir, Uttar Pradesh, Haryana, Bihar, Maharashtra, West Bengal, Rajasthan. (12)	Chhattisgarh, Madhya Pradesh, Punjab, Assam, Karnataka, Bihar, Uttar Pradesh, Maharashtra, Haryana. (9)
	More diversified states (Below India's average in HI)	Kerala, Andhra Pradesh, Gujarat, Jharkhand, Tamil Nadu, Odisha. (6)	Rajasthan, Gujarat, Andhra Pradesh, Kerala, Jharkhand, Jammu and Kashmir, West Bengal, Orissa, Tamil Nadu (9)
2018–2019	Less diversified states (Above India's average in HI)	Jammu & Kashmir, Chhattisgarh, Jharkhand, Kerala, Karnataka, West Bengal, Madhya Pradesh, Assam, Tamil Nadu, Odisha, Punjab, Maharashtra, Uttar Pradesh, Andhra Pradesh. (14)	Chhattisgarh, Karnataka, Madhya Pradesh, Punjab, Uttar Pradesh, Maharashtra, Haryana, Assam, Odisha. (9)
	More diversified states (Below India's average in HI)	Haryana, Gujarat, Rajasthan, Bihar. (4)	Gujarat, Jharkhand, Bihar, Andhra Pradesh, Rajasthan, West Bengal, Tamil Nadu, Kerala, Jammu and Kashmir. (9)

Source: Constructed using Table 2.

Note: Figures in parentheses are the number of states in each category.

labourers and socially disadvantaged groups who face systemic barriers to access land, credit and information. Such constraints sharply restrict their capacity to diversify incomes in meaningful and sustainable ways.

By contrast, states such as Kerala, Tamil Nadu and Gujarat displayed relatively low and stable HI values across all three rounds, reflecting more balanced and diversified rural economies. For instance, in Kerala, the HI excluding wage income remained below 0.452 throughout, while in Tamil Nadu it consistently ranged between 0.361 and 0.400. These patterns suggested the presence of multiple viable income streams for farm households. The underlying factors included a stronger tradition of mixed livelihoods, higher levels of human development, better infrastructure and greater integration with domestic and international labour markets. In Kerala, migration and remittances played a key role in sustaining diversified income sources, while Tamil Nadu benefited from proactive state interventions in livestock development, rural employment schemes and promotion of non-farm enterprises, despite relatively low income from crop cultivation.

Determinants of Farm Income Diversification

A major objective of this study is to find out the determinants of farm income diversification, for which the regression analysis was carried out. The regression analysis based on the double-log specification provided valuable insights into the factors shaping farm income diversification among agricultural households. The results (Table 5) showed that diversification was neither random nor uniform, but was influenced by household structure and basic infrastructure, with the nature of these influences shifting across time. The regression results estimated with wage income included as part of household earnings provided a more comprehensive picture of the structural forces shaping diversification. In 2002–2003, none of the explanatory variables were statistically significant, underscoring that diversification was still weak, unsystematic and not closely tied to household characteristics or infrastructural development. However, by 2012–2013, some weak associations began to emerge. The share of marginal agricultural households (HPLO) carried a negative coefficient, suggesting that an increasing proportion of land-poor households was associated with greater diversification, as these households were more likely to supplement farm income with non-farm sources. CI was weakly significant with a positive coefficient, indicating that a higher intensity of land use within agriculture was linked to less diversification, possibly because more intensive farming left little scope for pursuing non-farm options.

By 2018–2019, the determinants of diversification became sharper. HPLO turned significantly positive, showing that a larger share of marginal farmers was now associated with lower diversification, reflecting possible constraints in shifting towards non-farm earnings. Foodgrain crops dependence

Table 5. Determinants of Farm Income Diversification: Double-log Regression Results.

	Dependent Variable HI Estimated with Wage Income			Dependent Variable HI Estimated Without Wage Income		
Variables	2002–2003	2012–2013	2018–2019	2002–2003	2012–2013	2018–2019
CI	0.170 (0.545)^{ns}	0.728 (2.116)^{c}	−0.111 (−0.569)^{ns}	0.318 (0.79^{ns}	0.759 (1.630)^{d}	0.050 (0.139)^{ns}
ELEC	0.106 (1.355)^{ns}	−0.011 (−0.124)^{ns}	0.155 (3.017)^{a}	0.148 (1.468)^{d}	−0.147 (−1.242)^{ns}	−0.075 (0.785)^{ns}
FACA	0.019 (0.145)^{ns}	0.070 (0.743)^{ns}	0.103 (1.970)^{a}	0.193 (1.135)^{ns}	0.064 (0.505)^{ns}	0.065 (0.674)^{ns}
HPLO	−0.293 (−0.983)^{ns}	−0.522 (−1.693)^{d}	0.442 (2.852)^{a}	−0.173 (0.453)^{ns}	−1.376 (−3.302)^{a}	−0.469 (1.632)^{d}
IRRI	−0.041 (−0.720)^{ns}	−0.111 (−1.112)^{ns}	−0.089 (−1.734)^{d}	−0.079 (1.092)^{ns}	−0.134 (−0.992)^{ns}	−0.040 (0.419)^{ns}
LITE	0.041 (0.090)^{ns}	0.033 (0.058)^{ns}	0.235 (0.976)^{ns}	0.060 (0.102)^{ns}	0.251 (0.324)^{ns}	0.660 (1.479)^{d}
ROAD	−0.193 (−1.355)^{ns}	0.067 (0.541)^{ns}	0.002 (0.030)^{ns}	−0.136 (0.744)^{ns}	0.221 (1.321)^{ns}	0.102 (0.938)^{ns}
Constant	−0.210 (−0.098)^{ns}	−2.551 (−1.039)^{ns}	−4.033 (−2.655)^{a}	−2.076 (−0.755)	0.465 (0.140)^{ns}	−2.082 (0.740)^{ns}
R^2	0.53	0.52	0.62	0.51	0.61	0.55
F-value	1.58^{a}	1.55^{b}	2.36^{a}	1.50^{a}	2.18^{b}	1.72^{b}
D–W statistics	2.47	1.971	2.31	2.34	1.92	2.49
N	18	18	18	18	18	18

Sources: Computed using data from NSSO–SAS (2005, 2014, 2021); Census of India (various years); GoI (various years).

Notes: a, b, c and d are significant at 1%, 5%, 10% and 20% levels, respectively; ns: not significant.

(FACA) also showed a positive and significant coefficient, implying that regions dominated by staple crop cultivation experienced less diversification. Among infrastructure variables, rural electrification (ELEC) emerged as highly significant with a negative coefficient, confirming its enabling role in promoting diversification opportunities. Irrigation (IRRI) displayed a weak negative coefficient, suggesting that better irrigation may incentivize diversification. Overall, when wage income was considered, diversification appeared to be shaped by household landholding patterns, irrigation and infrastructural support.

The regressions estimated without wage income presented a different story, with weaker explanatory power and fewer consistent determinants. In 2002–2003, as in the wage-income models, no variable showed statistical significance, reaffirming the unstructured nature of diversification in the early years. By 2012–2013, the share of marginal households (HPLO) was again statistically significant but now with a negative coefficient of much larger magnitude, pointing to stronger diversification pressure among land-poor households. However, other variables, including CI and foodgrain crop dependence (FACA), remained insignificant, indicating that crop choices and land use patterns alone could not explain diversification when wage earnings were excluded.

By 2018–2019, HPLO remained significant with a negative coefficient, suggesting that even as marginal households increased in number, they were more likely to diversify their income base. Literacy (LITE) also showed weak significance with a positive coefficient, implying a tendency towards less diversification among better-educated households, possibly reflecting a preference for more stable agricultural or salaried income. Unlike the wage-inclusive models, infrastructural variables such as electrification (ELEC) and irrigation (IRRI) lost explanatory strength, indicating that these factors primarily influenced diversification through their impact on wage-linked opportunities.

A comparison of the two models revealed the centrality of wage income in explaining diversification. With wage income included, the explanatory power of the regressions increased substantially, particularly in 2018–2019, where the R^2 improved to 0.623. The inclusion of wage income also brought out the significance of infrastructure variables such as electrification and irrigation, highlighting their role in shaping household income portfolios. The results showed that diversification tended to increase when households face land constraints, as seen in the negative association of marginal holdings (HPLO) in 2012–2013, and when supportive infrastructure like rural electrification (ELEC) was available, which strongly promoted diversification in 2018–2019. Irrigation access (IRRI), though weakly significant also suggested that limited irrigation availability pushed households to diversify. By contrast, factors such as high foodgrain crop dependence (FACA) and greater CI reduced diversification, reinforcing household reliance on agriculture. Overall, our findings established that wage income was the most critical driver of diversification, but its effects were shaped and reinforced by land scarcity and access to infrastructure, which together enabled or compelled rural households to broaden their income base beyond farming.

Conclusion and Pointers

The study examined the patterns and determinants of income diversification among farmer households across 18 major Indian states using the HI, drawing data from the SAS of

three time points: 2002–2003, 2012–2013 and 2018–2019. The study revealed that while income diversification improved at the national level, the pace and nature of diversification varied widely across states, shaped by underlying agro-economic structures, institutional support and livelihood opportunities. At the all-India level, the HI showed a consistent downward trend, indicating a gradual broadening of income sources among farmer households. This is true even when wage income was included or excluded from the analysis. However, the values were notably higher when wage income was excluded, underscoring that diversification beyond crop income was often relied heavily on wage labour. This calls for caution in interpreting diversification trends solely based on numerical indicators, as wage-based diversification may not reflect structural transformation but only coping strategies in response to poor returns from farming.

State-level trends presented a far more heterogeneous picture. States such as Rajasthan, Gujarat and Haryana showed significant improvement in diversification over time. In contrast, states such as Madhya Pradesh, Chhattisgarh, Bihar and Karnataka continued to exhibit high or inconsistent HI values. The regression results showed that diversification was not random but shaped by household characteristics and infrastructure, with the influence of these factors changing over time. Landholding patterns emerged as important, with marginal households initially displaying greater diversification (2002–2013) but later becoming constrained by structural limitations (2018–2019). While the dependence on foodgrain crops reduces diversification, irrigation tends to increase the diversification. Most importantly, the inclusion of wage income substantially improved the explanatory power of the models and altered the significance of several variables.

A most striking insight from the analysis is the consistently lower HI values when wage income was included. In states such as Uttar Pradesh, Bihar and Chhattisgarh, the inclusion of wage income reduced HI significantly, signalling an increasing reliance on wage labour. While this appeared to improve diversification, it may be indicative of distress-induced shifts due to declining returns from farming, land fragmentation and seasonal underemployment. For states that continue to show high HI values, a multi-pronged strategy is essential to promote meaningful and sustainable diversification. First, investments in rural infrastructure, especially irrigation, roads and power supply, appeared to increase the diversification, and therefore, the states with low levels of such infrastructures should prioritize their development to support both on-farm and off-farm activities (Narayanamoorthy & Hanjra, 2006; Narayanamoorthy et al., 2015). Second, the livestock income in many states increasingly contributed to diversifying the income of farm households; therefore, it must be developed through targeted programmes, access to veterinary care, fodder support and market linkages. Third, in many states, low non-farm business income negatively affected the diversification index. Expanding rural non-farm business income through skill training, rural enterprise promotion and better access to credit can create viable income avenues beyond agriculture.

Policy interventions must also address deep-rooted structural issues such as land fragmentation, tenure insecurity and limited access to formal credit and extension services (Athreya et al., 1986; NCF, 2006). Strengthening farmer collectives, promoting agro-processing and integrating rural areas with broader value chains can play a transformative role. Importantly, rural development schemes must converge with agricultural programmes to create a coherent ecosystem that enables farm households to diversify in sustainable and remunerative ways. Ultimately, true income diversification must emerge from economic dynamism rather than distress. This calls for coordinated state-level strategies that integrate agriculture, rural development and employment generation. Only then can farm households achieve the income stability and resilience needed to navigate the uncertainties of India's agrarian economy. Income diversification is not merely a sign of rural transition but also a necessity for enhancing the resilience and economic security of farm households. Tailored state-specific interventions are imperative to address the regional disparities revealed by the HI and regression analysis.

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Notes

1. Several methodological and data-related considerations guided the choice of the present empirical framework. First, the analysis relies on three independent rounds of SAS data (2002–2003, 2012–2013 and 2018–2019) that are repeated cross-sections rather than a balanced panel. The households surveyed in each round are not identical. Therefore, employing fixed or random-effects models to exploit the panel nature of data is not advisable, may not statistically valid. Nevertheless, to minimize potential unobserved heterogeneity across states, relevant time-invariant and structural variables (such as irrigation ratio, infrastructure access and cropping pattern) were incorporated into the model. Second, possible endogeneity concerns, particularly with variables like literacy (LITE) and access to roads (ROAD), were examined using correlation diagnostics and by estimating alternative specifications excluding these variables. The results

did not materially alter the coefficients or their significance levels, indicating that the problem of simultaneity is minimal in this context. Given the macro-level, state-wise data and the absence of suitable instruments, applying an instrumental variable approach would have led to weak-instrument bias and unreliable estimates. Finally, several functional forms were tested, including linear, semi-log and double-log models. The double-log specification provided the most consistent and interpretable results, capturing proportionate elasticities between diversification and explanatory factors. Non-linear and interaction effects were explored but found statistically insignificant, and therefore, the final model retained the appropriate and well-fitting double-log form reported in the article.

2. Data for ELEC, LITE and ROAD were collected from census reports which are not available after 2010–2011. Therefore, the same data were used for 2012–2013 and 2018–2019 for the purpose of analysis. In a way, these variables can be treated as base infrastructure indicators (see Datt & Ravallian, 1996). These base-level variables, which reflect access to electricity, literacy and road connectivity, play a crucial role in facilitating farm income diversification, as they improve access to information, markets and alternative employment opportunities, thereby enabling households to engage in both farm and non-farm income-generating activities.

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