

## Patterns and Determinants of Rural Income Diversification in North-East India: Evidence from NSSO Survey

Souradipta Das<sup>1</sup>, Laishram Priscilla<sup>1</sup>, Nivetina Laitonjam<sup>2</sup>, Ph. Romen Sharma<sup>3</sup>, Priyajoy Kar<sup>3</sup>, Oinam Krishnadas Singh<sup>4</sup> and Kamal Vatta<sup>1</sup>

### ABSTRACT

This study examines income diversification strategies among agricultural households in northeast India, utilizing data from the 77<sup>th</sup> round Situation Assessment Survey by NSSO. Focused on agricultural and non-agricultural income sources, the research employs multivariate Probit and Tobit regression models to analyse diversification patterns and influencing factors. The findings revealed that while agriculture remains central, regions like Assam and Tripura increasingly rely on wage and salary income. The study reports substantial income disparity and low-income diversification across states. Key determinants of diversification include socio-economic characteristics and household income levels, suggesting a shift towards non-farm activities as income increases. The study underscores the importance of enhancing agricultural productivity and infrastructure to support sustainable economic growth and diversification in the North-eastern states of India.

**Keywords:** Income diversification, North-east India, gini coefficient, multivariate Probit, tobit

**JEL codes:** D13, D31, O12, Q12

### I

#### INTRODUCTION

Income diversification has become a vital strategy in developing economies to bolster rural livelihoods and combat poverty and hunger (Ellis, 1998; Vatta and Sidhu, 2007; Vatta *et al.*, 2018). The changing global economic landscape, characterized by market liberalization and globalization, has introduced formidable challenges to the economic sustainability of smallholder farmers (Bhalla and Singh, 2009; Vatta *et al.*, 2018). The creation of multiple streams of income has emerged as a pragmatic risk mitigation approach that provides resilience against agricultural uncertainties, such as crop failures and economic downturns (Fantini, 2013; Newman and Kinghan, 2015; Danso-Abbeam *et al.*, 2020). Moreover, bolstering the rural non-farm sector could reciprocally benefit the agricultural domain by enhancing productivity and farm revenues (Lay and Schöler, 2008; Vatta and Sidhu, 2010).

The drivers of income diversification can be segmented into 'pull factors', which refer to opportunity-led diversification, and 'push factors', which denote survival-led diversification (Asmah, 2011). Despite its rich natural endowments, India's North-east region (NER) lags in economic progression compared to other

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<sup>1</sup>Punjab Agricultural University, Ludhiana – 141 004. 2. Central Agricultural University, Imphal, Manipur – 795 004. 3. ICAR- Indian Institute of Maize Research, Ludhiana – 141 004. 4. Centers for International Projects Trust, New Delhi – 110 017.

regions. Predominantly rural, with over 80 per cent of its populace residing in countryside areas, the region's agricultural sector is marked by low output, unemployment, inadequate income, and pervasive poverty, attributable to traditional farming practices and the limited adoption of modern agricultural techniques (Barah, 2007; Birthal *et al.*, 2006; Kumar *et al.*, 2007).

The NER's industrial and services sectors compound these agricultural challenges, which struggle to generate substantial employment and income opportunities (Srivastav, 2010; Loitongbam, 2018). Regional impediments, including an underdeveloped transportation network, geographical isolation, challenging topography, high operating costs, and an inefficient market mechanism, further curtail the region's economic potential. In light of these conditions, income diversification is critically advocated, as reliance solely on agriculture is unlikely to yield the necessary employment and income opportunities for the region's inhabitants. This study, thus, explores the various income sources of NER's agricultural households and delineates the determinants that shape income diversification within this context.

## II

### DATABASE AND METHODOLOGY

#### *Data*

This study utilizes data from the 77<sup>th</sup> National Sample Survey Office (NSSO) round titled 'Situation assessment of agricultural households in rural India, 2019' (NSSO, 2021). It encompasses data from 44,770 households across 5,940 villages, employing stratified multistage random sampling for 2018-2019. Focusing on eight states in India's NER, the study analyzes income sources and socio-economic features of 5,885 agricultural households, considering income from crop cultivation, livestock rearing, non-farm business, wages & salaries, land leasing, and remittances.

#### *Empirical Method*

This research focuses on the composition of income sources, the factors driving household decisions regarding these sources, and the proportion of income derived from each.

#### *Estimation of Income Inequality*

Total income (I) consists of income from  $k$  different sources. Hence, the total income (I) for each household and also for the sample as a whole can be written as:

$$I = \sum_{k=1}^k I_k \quad (1)$$

The Gini coefficient measures the extent to which the distribution of wealth within a group deviates from a perfectly equal distribution, with values from 0 to 1. Its advantages include being commonly used and relatively easy to calculate, having a visual representation, and allowing comparison between populations of different sizes.

The Gini coefficient can be estimated based on the representation of the Lorenz curve, plotting cumulative income vs. cumulative population. It can also be mathematically calculated as:

$$G = cov(y, F(y) \frac{2}{\bar{y}}) \quad (2)$$

where *cov* is the covariance between income levels *y* and the cumulative distribution of the same income *F(y)*, and  $\bar{y}$  is the average income.

#### *Extent of Income Diversification*

The income diversity is quantified using the Simpson Index of Diversification (SID). The SID formula is expressed as

$$SID = 1 - \sum_{i=1}^N p_i^2,$$

where  $p_i$  is the proportionate contribution of the  $i^{th}$  income source to the household's total income.

The net income from crop cultivation and animal production was derived by deducting total expenses from the receipts.

#### *Determinants of Income Diversification*

A unique challenge in analysing rural household incomes is the possibility of multiple income sources and the potential interdependence between them. Traditional univariate analytical models, such as Probit and logit, overlook the correlations between the error terms of different income sources. These correlations could lead to skewed analyses of the determinants for choosing income sources. To avoid this, the study adopts a multivariate Probit (MVP) regression approach. The MVP model accommodates the correlations between error terms by concurrently modelling the influence of a set of covariates across various income sources. It estimates a set of binary Probit models that allow for the correlation of error terms between each source, offering a more accurate representation of household income dynamics (Kassie *et al.*, 2013).

The model excludes income from leasing out of land for practical reasons due to its rarity among the surveyed households (2.85%). Instead, the study constructs a multivariate model comprising five dependent variables: crop cultivation ( $y_1$ ), livestock rearing ( $y_2$ ), non-farm business activities ( $y_3$ ), wages & salaries ( $y_4$ ), and remittances ( $y_5$ ). The model is specified as follows:

$$\begin{aligned} y_i &= 1 \text{ if } \beta_i x' + \varepsilon_i > 0 \\ y_i &= 0 \text{ if } \beta_i x' + \varepsilon_i \leq 0 \\ i &= 1, 2, \dots, 5 \end{aligned} \quad (1)$$

Where  $x$  is a vector of the explanatory variables;

$\beta_1, \dots, \beta_5$  are conformable parameter vectors and  $\varepsilon_1, \dots, \varepsilon_5$  are random errors distributed as a multivariate normal distribution with zero mean, unitary variance, and an  $n \times n$  correlation matrix.

Additionally, the study employs a Tobit model to pinpoint i) factors determining the extent of rural households' income diversity and ii) the share of income from each source (Herrera *et al.*, 2018; Vatta *et al.*, 2018; Wanno *et al.*, 2021). To ensure robustness, clustered standard errors at the district level are utilized in the regression models for estimating parameters.

The Tobit model is specified as:

$$z_i^* = \beta_i X_i + u_i$$

$$z_i = \begin{cases} z_i^* & \text{if } z_i^* > 0 \\ 0 & \text{if } z_i^* \leq 0 \end{cases} \quad (2)$$

where  $z_i^*$  and  $z_i$  are latent and the observed values of i) the Simpson Index of Diversification and ii) the percentage share of income from each source.  $X_i$  is a vector of variables influencing income diversification and share of income from each source, and  $\beta$  is a vector of parameters to be estimated.

### III

#### RESULTS AND DISCUSSION

##### *Description of Socio-Economic Variables*

About 92 per cent of agricultural households are led by males, averaging 49 years old with a mean education level of 2.3. The households typically have four working-age members, with 40 per cent belonging to scheduled tribes. The choice of income sources and the decision to diversify these sources are strongly influenced by the age of the household head, his gender and education level, the number of earning family members, land holding, social status, and participation in government schemes like KCC and MGNREGA (Vatta *et al.*, 2018; Roy and Basu, 2020; Alemu, 2023). While 78 per cent participate in MGNREGA, few access Kisan Credit Cards (4%), public extension services (11%), or institutional loans (9.6%). Land ownership is predominantly marginal (74%) or small (21%), with only a third of land irrigated. Spending patterns show 39 per cent in the low, 37 per cent in the middle and 24 per cent in the high consumer expenditure brackets. Our study posits that household consumption expenditure is a vital indicator of economic status and financial well-

being for agricultural households and influences economic decision-making and outcomes (Kumar, 2009).

TABLE 1. HOUSEHOLD LEVEL DESCRIPTIVE STATISTICS

Variable	Descriptive	Mean	SD	Expected sign for income diversification
Age	Age of household head (years)	49.32	12.72	+/-
Gender	Dummy = 1 if the household head is male, 0 otherwise	0.92	0.27	+
Education	Education level of the household head*	2.31	2.09	+
Working household members	No. of family members between 15- 64 age group	3.49	1.49	+
Scheduled Tribe (ST)	Dummy = 1 if household belongs to ST category, 0 otherwise	0.40	0.49	-
Work at MGNREGA	Dummy = 1 if the household member works at MGNREGA, 0 otherwise	0.78	0.42	-
KCC	Dummy = 1 if the household has KCC, 0 otherwise	0.04	0.21	+
Households with lower monthly consumer expenditure	Dummy = 1 if the household belongs to lower monthly consumer expenditure (less than Rs. 7733), 0 otherwise	0.39	0.49	+/-
Households with middle monthly consumer expenditure	Dummy = 1 if household belongs to middle monthly consumer expenditure (Rs. 7733-Rs. 11230), 0 otherwise	0.37	0.48	+/-
Households with higher monthly consumer expenditure	Dummy = 1 if the household belongs to high monthly consumer expenditure (more than Rs. 11230), 0 otherwise	0.24	0.43	+/-
Marginal land holding HH	Dummy = 1 if household's operational landholding is <1 ha, 0 otherwise	0.74	0.44	-
Small land holding HH	Dummy = 1 if the household's operational landholding is 1-2 ha, 0 otherwise	0.21	0.41	-
Semi-medium land holding HH	Dummy = 1 if the household's operational landholding is 2-4 ha, 0 otherwise	0.05	0.21	+/-
Medium land holding HH	Dummy = 1 if household's operational landholding is > 4 ha, 0 otherwise	0.003	0.05	+/-
Irrigated land	The proportion of irrigated land to the total cultivated land	32.97	52.22	-
Public extension contacts	Dummy = 1 if a household has access to public extension, 0 otherwise	0.11	0.31	+
Access to institutional loan	Dummy = 1 if a household has access to an institutional loan, 0 otherwise	0.096	0.19	+

\*Illiterate: -00, literate: below primary-01, primary -02, upper primary/middle -03, secondary -05, higher secondary -05, diploma /certificate course (up to secondary)-06, diploma/certificate course (higher secondary)-07, diploma/certificate, graduation & above-08, graduate -09, post-graduate and above -10

### *Composition of Rural Household Income*

An in-depth examination of rural household incomes across the North-eastern states highlights notable income levels and sources of disparities. The average annual net household income is approximately ₹ 1,56,008, with Tripura recording the lowest at ₹ 1,23,760 and Meghalaya the highest at ₹ 3,54,245 (Table 2). Crop production is the primary income source in Sikkim, Manipur, Mizoram, and Meghalaya, followed

by earnings from wages and salaries. Conversely, in Arunachal Pradesh and Nagaland, income is predominantly derived from crop cultivation and livestock farming. In more urbanized or industrialized states like Assam and Tripura, wages and salaries are the principal income source, followed by crop production. The increasing prominence of wage labour and salaried workers may be probably due to broader economic transformation, potentially driven by urban migration, and growing job opportunities in sectors like construction, education, and tourism supported by government policies promoting skill development and industrialization in these states.

Arunachal Pradesh's higher income from non-farm activities (12.75 per cent) highlights the diversification of rural livelihoods, possibly due to infrastructure improvements and policy interventions that encourage entrepreneurship. Meanwhile, the remittance peak in Sikkim (3.35 per cent) may be attributed to rapid urbanization and industrialization, which has led to a large-scale migration of people to urban areas, especially East Sikkim

Considering the whole North-east region, longitudinal comparison with data from the NSSO's 70<sup>th</sup> round survey (2012-13) illustrates a decrease in the share of crop cultivation income from about 57 per cent to 43 per cent, driven by environmental degradation and shrinking landholdings. At the same time, income from wages and salaries has risen from 27.3 per cent to 38.22 per cent, with Assam witnessing the sharpest increase, signalling a shift towards non-farm employment and diversification strategies. Additionally, non-farm business income has slightly increased across most states, suggesting incremental progress in entrepreneurial activities. While crop income has generally declined, especially in more agriculturally dependent states, income from livestock has improved in Arunachal Pradesh and Nagaland, reflecting adaptive strategies to counter declining agricultural income and cope with changing economic conditions (Priscilla *et al.*, 2021b).

Despite some shifts towards non-agricultural activities, income diversification in the northeast remains limited, as reflected by a regional SID (Simpson Index of Diversification) average of 0.343, with considerable variation among states. Nagaland reports the highest SID at 0.418, signalling a relatively diversified income base, while Sikkim shows the lowest at 0.298, indicating a higher reliance on fewer income sources. These disparities highlight the varying degrees of economic reliance across states. Overall, the low SID suggests that while there are efforts toward economic diversification, much of the population still depends on agriculture-based livelihoods.

Marchang (2019) points out that traditional agricultural practices in the region face significant challenges, including subsistence farming, inadequate infrastructure, inefficient market mechanisms, fragmented landholdings, and widespread terraced farming. These barriers have hindered agricultural diversification and limited growth within agriculture and its allied sectors. Consequently, the economy remains strongly dependent on cereal crops, particularly paddy, contributing to stagnant farmer incomes

and overreliance on agriculture (Priscilla *et al.*, 2021a). Off-farm activities, such as wage labour or small enterprises, could stabilize household income by offering supplemental earnings independent of agricultural cycles (Hoogeveen, 2001; Yang, 2009). Given these constraints, livestock rearing has become a crucial alternative income source for farmers in the region (Priscilla and Chauhan, 2019).

Income inequality in the region remains relatively high, with a Gini coefficient of 0.55 for the northeast and coefficients of 0.5 or higher in each of the eight states, highlighting significant disparities across the population. These structural challenges within agriculture and persistent income inequality underscore the need for more robust policies to support economic diversification and equitable growth.

TABLE 2. COMPOSITION OF RURAL HOUSEHOLD INCOME ACROSS NORTHEASTERN STATES

State	Sample size (No.)	Overall household income (₹ /annum)	Share in overall household income (%)						Simpson Index of Diversity (SID)	Gini ratio
			Crop cultivation	Livestock rearing	Wage and salary	Non-farm business	Remittance	Income from land leasing		
Arunachal Pradesh	464	2,35,754	55.94	21.42	9.05	12.75	0.83	-	0.302	0.59
Assam	1,776	1,33,677	41.05	9.51	41.68	5.73	1.67	0.35	0.339	0.48
Manipur	893	1,36,575	48.36	20.21	22.09	8.77	0.34	0.23	0.341	0.55
Meghalaya	658	3,54,246	55.52	4.81	37.13	1.44	0.69	0.41	0.329	0.60
Mizoram	406	2,20,501	58.65	7.78	29.51	3.15	0.82	0.1	0.383	0.46
Nagaland	389	1,24,749	36.16	34.95	25.16	0.83	2.89	0.01	0.418	0.56
Sikkim	366	1,55,958	42.61	13.36	38.49	1.96	3.56	0.03	0.298	0.47
Tripura	933	1,23,760	37.38	9.24	42.07	8.47	2.73	0.11	0.383	0.49
NER	5,885	1,56,008	43	11.2	38.22	5.65	1.62	0.3	0.343	0.55

The net income disparities between the wealthiest and poorest quintiles starkly depict the economic stratification within rural households in these states. The top quintile boasts a net income of ₹ 4,98,417 and a per capita income of ₹ 1,54,126, while the bottom quintile struggles with a net annual income of ₹ 26,663 and per capita income of just ₹ 10,133 (Table 3). Income distribution analysis further reveals that 80 per cent of the poorest households' income is derived from agriculture—specifically, 69.57 per cent from crop cultivation and 11.84 per cent from livestock rearing, with a minor 15.41 /per cent from wages and salaries.

In sharp contrast, the wealthiest households earn most of their income (45.74%) from wages and salaries. As income levels ascend from the lowest to the highest quintile, there is a noticeable shift from dependence on agriculture to increased shares from non-farm business and wage earnings. This trend is consistent across the bottom two quintiles, where crop production remains the primary income source. However, for the middle to top quintiles, wages & salaries significantly contribute to household income, overtaking agriculture.

This transition from agriculture to non-farm income sources as households move up the income ladder is a testament to a broader economic shift. Households generally migrate from less profitable agricultural endeavours to more remunerative non-farm activities, underscoring a dynamic economic landscape where income diversification aligns with increasing wealth.

These findings, which resonate with research by Kung and Lee (2001), Pavithra and Vatta (2013), and Priscilla *et al.* (2021b), illustrate that crop cultivation (43%) and wages and salary (38.22%) constitute the primary income sources across households. The differences in income portfolios among rural households can be attributed to disparate levels of landholdings, market access, education, and skill sets. This study encapsulates the economic complexity of rural livelihoods, highlighting how varying resources and opportunities influence households' economic pathways and income diversification in North-east India.

TABLE 3. SOURCES OF RURAL HOUSEHOLD INCOMES BY INCOME QUINTILES

Quintile	Net income (Rs/annum)	Per capita income (₹ /annum)	Share in overall household income (%)					
			Crop Cultivati on	Livestock rearing	Wage and salary	Non- farm business	Remittance	Income from land leasing
Bottom	26,663	10,133	69.57	11.84	15.41	2.27	0.39	0.52
Second	64,954	24,535	47.46	12.07	35.92	3.88	0.58	0.09
Third	1,04,651	36,007	35.53	9.82	45.32	7.17	1.86	0.31
Fourth	1,78,629	53,314	34.38	10.53	46.93	6.47	1.38	0.32
Top	4,98,417	1,54,126	28.19	12.52	45.74	8.66	4.62	0.27
Overall income	1,56,008	50,004	43.00	11.2	38.22	5.65	1.62	0.3

Note: Per capita income is estimated as total income ÷ total household members in the working-age group (15-64 years)

#### *Determinants of Access to Income Sources*

A comprehensive examination of rural household income in Northeastern India using a multivariate Probit (MVP) model has revealed a complex interplay of factors influencing the choice of income sources (Table 4). The likelihood ratio test of rho ( $\rho$ ) is highly significant (p-value=0), confirming the MVP model's robustness, which negates the independence of error terms, signifying that various income sources are interrelated. This interdependence validates the model's appropriateness for our analysis. The model elucidates the synergy between income streams, such as crop-livestock and wages and salary/non-farm business, where a positive relationship implies that success in one may benefit the other. This critical complementarity suggests that diversification strategies are interconnected rather than independent in the rural economy.

Age is a notable determinant; as household heads age, there is a marked increase in the likelihood of relying on remittances. This trend suggests older heads



may utilize wider family networks rather than solely depending on labour-intensive income sources. Interestingly, female-headed households are more inclined to engage in livestock farming, potentially due to the role's lower mobility requirements than other income-generating activities.

Educational attainment has a dual impact. While it decreases the likelihood of selecting crop production—presumably because the educated seek opportunities beyond traditional agriculture—it acts as a catalyst for diversifying into more profitable non-farm activities. Higher levels of education enhance human capital productivity, pulling individuals towards sectors that promise higher economic returns.

Financial inclusion shapes income source choices. Access to formal loans is inversely related to choosing crop production, highlighting a trend where financial services enable households to pursue diverse, more profitable activities beyond agriculture.

Larger household sizes present a paradox. On the one hand, they are associated with lower disposable incomes due to higher consumption, which can reduce the surplus for investment in non-agricultural endeavours. On the other hand, they have a greater labour pool, increasing the potential for engaging in non-farm income diversification.

Scheduled Tribe (ST) households, typically engaged in subsistence farming in challenging terrains, show a lower propensity to engage in non-farm businesses. Predominantly involved in crop production, these households face historical underdevelopment and marginalization, as outlined by Srivastava (2008) and the Ministry of Tribal Affairs (2013). Government program participation, such as the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), influences income sources, with a noted increase in the likelihood of remittances but a decrease in the tendency towards non-farm income. This could indicate that the safety net provided by MGNREGA reduces the urgency of seeking non-farm income or limits the time available for such pursuits.

The influence of Kisan Credit Card (KCC) usage is significant, positively affecting decisions to engage in crop and livestock production. This demonstrates the role of agricultural credit in supporting conventional agricultural activities. Monthly consumer expenditure levels reveal that those with medium expenditures are more involved in crop production than their higher-spending counterparts, who, conversely, are less likely to run non-farm businesses. Landholding size is intricately linked to income choice. Smaller landholders are often pushed towards crop production due to their inability to sustain themselves, whereas semi-medium landholders are likelier to engage in livestock production. This aligns with findings by Adams (2001) and Micevska and Rahut (2008), who reported an inverse relationship between non-farm income and landholding size.

TABLE 4. DETERMINANTS OF INCOME SOURCES: MULTIVARIABLE PROBIT MODEL

Socio-economic variables	Crop cultivation	Livestock rearing	Wages & salary	Non-farm business	Remittance
Age	-0.097 (0.253)	0.21 (0.138)	-0.285 (0.211)	0.186 (0.2)	1.715 (0.29) <sup>a</sup>
Gender	-0.054 (0.157)	-0.261 (0.118) <sup>b</sup>	-0.195 (0.151)	0.146 (0.149)	-0.492 (0.139) <sup>a</sup>
Education	-0.065 (0.031) <sup>b</sup>	-0.019 (0.023)	-0.006 (0.026)	0.023 (0.024)	0.054 (0.046)
HH members in working age group	0.007 (0.04)	0.064 (0.024) <sup>a</sup>	0.168 (0.041) <sup>a</sup>	-0.073 (0.04) <sup>c</sup>	-0.139 (0.043) <sup>a</sup>
Scheduled Tribe (ST)	0.475 (0.176) <sup>a</sup>	-0.026 (0.14)	0.107 (0.115)	-0.344 (0.139) <sup>b</sup>	0.112 (0.184)
Work in MGNREGA	0.073 (0.215)	0.018 (0.114)	0.157 (0.122)	-0.24 (0.107) <sup>b</sup>	0.419 (0.147) <sup>a</sup>
Kisan Credit Card(KCC)	0.813 (0.3) <sup>a</sup>	0.321 (0.151) <sup>b</sup>	-0.297 (0.308)	0.32 (0.271)	0.059 (0.363)
Lower monthly consumer expenditure HH	0.164 (0.16)	-0.155 (0.115)	-0.024 (0.151)	-0.499 (0.147) <sup>a</sup>	-0.491 (0.173) <sup>a</sup>
Middle monthly consumer expenditure HH	0.387 (0.13) <sup>a</sup>	-0.009 (0.122)	-0.057 (0.111)	-0.317 (0.107) <sup>a</sup>	-0.098 (0.201)
<i>Base: High monthly consumer expenditure HH</i>					
Small land holding HH	0.955 (0.126) <sup>a</sup>	-0.057 (0.112)	-0.252 (0.074) <sup>a</sup>	-0.201 (0.105) <sup>c</sup>	-0.131 (0.147)
Semi-medium land holding HH	1.215 (0.229) <sup>a</sup>	0.345 (0.149) <sup>b</sup>	-0.585 (0.158) <sup>a</sup>	-0.216 (0.123) <sup>c</sup>	-0.348 (0.202) <sup>b</sup>
Medium land holding HH	4.395 (0.271) <sup>a</sup>	-0.393 (0.464)	-0.406 (0.419)	-0.675 (0.268) <sup>b</sup>	0.633 (0.431)
<i>Base: marginal land holding HH</i>					
Irrigation Area	0.006 (0.004) <sup>c</sup>	-0.001 (0.001)	-0.002 (0.001) <sup>c</sup>	-0.002 (0.001) <sup>b</sup>	0.001 (0.001)
Access to Public extension	-0.268 (0.202)	0.982 (0.202) <sup>a</sup>	0.145 (0.152)	0.245 (0.166)	0.16 (0.246)
Access to formal loan	-0.462 (0.216) <sup>b</sup>	-0.222 (0.149)	0.229 (0.187)	-0.28 (0.176)	-0.087 (0.197)
Constant	2.443 (0.953) <sup>b</sup>	-0.174 (0.605)	1.029 (0.898)	-0.902 (0.76)	-7.853 (1.376) <sup>a</sup>
Prob > chi2			0.000		
Log pseudo-likelihood			-790698		
Number of observations			5,885		

Likelihood ratio test of  $\rho_{21} = \rho_{31} = \rho_{41} = \rho_{51} = \rho_{32} = \rho_{42} = \rho_{52} = \rho_{43} = \rho_{53} = \rho_{54} = 0$ :  $\chi^2(10) = 1.6e+06$  Prob >  $\chi^2 = 0.0000$

Note: a, b and c indicate significance at 1%, 5%, and 10%, respectively

Figures in parenthesis are standard errors adjusted for district clusters

Irrigation access also dictates income choices; households with irrigated land prefer crop production, while those with less irrigation lean towards wage employment and non-farm businesses. Public extension services' access positively influences livestock production, suggesting that extension strategies must consider diverse farming contexts and technical needs specific to different regions, as indicated by Sharma *et al.* (2020).

This in-depth analysis sheds light on the myriad factors that dictate the economic behaviour of rural households in the NER, contributing valuable insights into the income diversification narrative. The findings carry significant policy implications, underscoring the need for tailored interventions that account for these communities' socio-economic and demographic nuances to foster sustainable development.

#### *Extent of Income Diversification*

The complex determinants of income diversification among rural households in NER have been rigorously analysed using a Tobit regression model. According to the model's findings in Table 5, certain household characteristics notably influence the probability and intensity of diversification activities. Households with more working-age members and those with access to public extension services are more inclined to diversify their income sources. Contrastingly, households possessing medium-sized landholdings display a lower likelihood of diversifying than those with marginal landholdings, underscoring the role of the asset base in influencing economic behaviours.

Consumer expenditure patterns are also pivotal, with varying expenditure levels affecting the propensity for income diversification, revealing the impact of economic status on livelihood strategies. The age of the household head is another critical factor; as heads age, there's an increase in the share of remittance income to the total household income. This trend possibly reflects the expanded social networks and reduced physical ability for labour-intensive work with increased age. Regarding gender dynamics, households led by men are associated with a higher share of income from livestock rearing, while female-headed households have a larger share from remittances.

The influence of working-age household members shows a negative correlation with the share of agricultural income from crop cultivation and remittances, suggesting a shift from traditional farming and reliance on external financial support to potentially other income-generating activities by the active labour force.

Caste, as a social determinant, plays a substantial role. Scheduled Tribe (ST) households rely more on crop cultivation for their income and less on non-farm business activities. This reflects the socio-economic conditions and cultural inclinations of the tribes, which are heavily dependent on agriculture-based subsistence farming, often dictated by their geographical and socio-political context, as indicated by the Ministry of Tribal Affairs (2013).

Participation in government schemes like MGNREGA has a tangible impact on income composition, with a significant share of total income from remittances among participating households. The analysis reveals that in contrast to marginal landholding households, small, semi-small, and medium landholding households have a higher proportion of their income from crop cultivation. Conversely, the share of

income from wages & salary and non-farm income is lower. However, the share of income from livestock rearing is reduced for medium landholding households, possibly due to the opportunity cost of land utilization.

The study also indicates that small and semi-medium households have a smaller remittance income share than marginal landholders. Irrigated areas have a positive influence on crop income share. In contrast, access to public extension services enhances the income share from livestock rearing, potentially due to improved market access and the promotion of livestock technologies, as suggested by Sharma *et al.* (2020).

TABLE 5. TOBIT ESTIMATES OF DETERMINANTS OF INCOME DIVERSIFICATION AND INCOME EARNED FROM VARIOUS SOURCES

Socio-economic variables	Extent of income diversification	Extent of income derived for each source to the total income				
	SID	Crop cultivation	Livestock rearing	Wages & salary	Non-farm business	Remittance
Age	0.023 (0.028)	0.021 (0.049)	0.036 (0.034)	-0.112 <sup>a</sup> (0.070)	0.037 (0.194)	2.135 <sup>a</sup> (0.496)
Gender	0.003 (0.022)	0.022 (0.033)	0.043 <sup>c</sup> (0.025)	-0.009 (0.053)	0.182 (0.165)	-0.499 <sup>a</sup> (0.184)
Education	-0.004 (0.003)	-0.008 (0.006)	-0.008 (0.006)	0.008 (0.010)	0.004 (0.023)	0.049 (0.059)
HH members in working age group	0.008 (0.004) <sup>c</sup>	-0.028 <sup>a</sup> (0.009)	-0.001 (0.005)	0.060 (0.015)	-0.031 (0.044)	-0.081 <sup>c</sup> (0.046)
Scheduled Tribe (ST)	0.008 (0.02)	0.083 <sup>a</sup> (0.029)	-0.014 (0.025)	-0.062 (0.039)	-0.589 <sup>a</sup> (0.146)	-0.271 (0.251)
Work in MGNREGA	-0.007 (0.021)	-0.006 (0.034)	0.009 (0.025)	0.009 (0.037)	-0.176 (0.105)	0.359 <sup>c</sup> (0.197)
Kisan Credit Card(KCC)	0.038 (0.035)	0.044 (0.070)	0.063 (0.044)	-0.144 (0.097)	0.221 (0.186)	0.243 (0.409)
Lower monthly consumer expenditure HH	0.01 (0.017)	0.028 (0.031)	0.025 (0.032)	0.045 (0.050)	-0.263 (0.182)	-0.290 (0.212)
Middle monthly consumer expenditure HH	0.029 (0.015) <sup>c</sup>	0.024 (0.025)	0.016 (0.027)	0.010 (0.033)	-0.131 (0.124)	0.173 (0.252)
<i>Base: High Monthly consumer expenditure HH</i>						
Small land holding HH	-0.003 (0.018)	0.199 <sup>a</sup> (0.028)	0.005 (0.023)	-0.212 <sup>a</sup> (0.028)	-0.432 <sup>a</sup> (0.124)	-0.618 <sup>a</sup> (0.217)
Semi-medium landholding HH	-0.002 (0.024)	0.269 <sup>a</sup> (0.048)	0.055 (0.036)	-0.396 <sup>a</sup> (0.053)	-0.699 <sup>a</sup> (0.159)	-1.278 <sup>a</sup> (0.330)

Table 5 (Contd.)

TABLE 3 (CONCLD.)

Socio-economic variables	Extent of income diversification	Extent of income derived for each source to the total income				
	SID	Crop cultivation	Livestock rearing	Wages & salary	Non-farm business	Remittance
Medium land holding HH	-0.131 (0.052) <sup>b</sup>	0.373 <sup>a</sup> (0.092)	-0.161 <sup>b</sup> (0.074)	-0.492 <sup>a</sup> (0.088)	-1.181 <sup>a</sup> (0.314)	0.348 (0.483)
<i>Base: marginal land holding HH</i>						
Irrigated area	0 (0)	0.001 <sup>a</sup> (0.000)	0.000 (0.000)	-0.001 (0.000)	-0.002 (0.001)	0.000 (0.001)
Access to public extension	0.086 (0.029) <sup>a</sup>	-0.096 <sup>a</sup> (0.022)	0.091 <sup>a</sup> (0.025)	0.002 (0.046)	0.092 (0.151)	0.070 (0.266)
Access to formal loan	-0.002 (0.034)	-0.052 (0.061)	-0.030 (0.035)	0.092 (0.068)	-0.060 (0.147)	0.345 (0.264)
Constant	0.214 (0.125) <sup>c</sup>	0.373 (0.228)	-0.092 (0.149)	0.536 <sup>c</sup> (0.319)	-0.223 (0.770)	-9.599 (2.418)
Sigma	0.209 (0.007)	0.344 (0.013)	0.267 (0.017)	0.423 (0.019)	0.707 (0.045)	0.706 (0.074)
Pseudo R <sup>2</sup>	0.0295	0.0524	0.017	0.041	0.077	0.141
Log pseudo-likelihood	-3114.22	-5750.31	-4070.33	-6521.01	-3367.44	-1906.75
F-value	2.98 <sup>a</sup>	11.41 <sup>a</sup>	2.40 <sup>a</sup>	13.27 <sup>a</sup>	6.24 <sup>a</sup>	9.60 <sup>a</sup>

Note: a, b and c indicate significance at 1%, 5%, and 10% levels, respectively  
 Figures in parentheses indicate standard error adjusted for district clusters

## IV

## CONCLUSION AND POLICY IMPLICATIONS

The study on rural income diversification in northeast India reveals significant disparities in income sources, determinants, and overall economic dependence across the states. The findings suggest that rural households in the region rely primarily on agriculture, especially crop production, contributing to economic vulnerability due to land fragmentation, lack of irrigation, and limited market access. Despite increasing income diversification, as evidenced by a shift towards wages, salaries, and livestock income, the region still shows limited non-farm income opportunities, which remain essential for enhancing household resilience and economic stability. Income inequality remains high, with a substantial economic gap between the wealthiest and poorest quintiles, reflecting the stratified nature of rural economies. The complex interplay of factors, such as household characteristics, landholding size, social status, and access to government schemes, indicates a highly heterogeneous economic environment where socio-demographic variables significantly influence income choices and diversification pathways.

The study's findings suggest policies to foster income diversification and reduce economic vulnerability in North-east India. Expanding non-farm employment and small enterprises through skill development, improved infrastructure, and market access can reduce dependence on agriculture. Enhanced support for small farmers, such as better irrigation, credit access, and public extension services, can increase agricultural productivity. Financial inclusion, particularly for marginalized groups, and support for livestock rearing as a supplemental income source are essential. Strengthening social protection schemes like MGNREGA and skill training can support economic resilience, while targeted measures to reduce income inequality would help create a more equitable rural economy.

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