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NON-TIMBER FOREST PRODUCTS AND THEIR CONTRIBUTION TO TRIBAL HOUSEHOLDS' INCOME OF WEST TRIPURA, INDIA

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ABSTRACT

The importance of non-timber forest products (NTFPs) to livelihoods, development, and poverty reduction among the rural population has garnered growing interest in recent years. As communities living near forest areas heavily depend on NTFPs for their livelihoods, efforts to protect these resources must begin with an understanding of how the host communities relate to them. The study was conducted in the state of Tripura, India, located in the northeastern part of the country. A representative sample of 120 households was selected through the multistage sampling method. Data collected from the primary survey were analyzed using descriptive statistics. Male and female participation in NTFP activities was found to be 59.17% and 40.83%, respectively, with 45.93% employment in NTFPs and an annual family income of 31.30%. Household size, the gender of the household head, and employment in NTFPs all had a substantial impact on tribal families' NTFP income. As expected, the distance from the homestead to the nearest metallic road had a negative impact on tribal households' NTFP revenue. Larger household size improves the likelihood of tribal homes obtaining NTFPs. Stakeholders should prioritize technical and financial support programs for agricultural value addition, as well as conservation and commercialization support, to improve forest resource quality.

Keywords: Livelihoods, Logit model, Minor forest product, Multiple linear regression, NTFPs, Tribal communities

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Forests provide a variety of products and have been utilized for numerous household and industrial purposes (Appiah *et al*., 2009). These forest products are categorized into two groups: timber and non-timber forest products (NTFPs). Timber products are generally highly valued and used globally, while non-timber forest products (NTFPs) play a significant role in the sustainable growth and development of communities living around forest areas. NTFPs are one of the primary income-generating sources for tribal communities residing near forests. They contribute considerably to family income, food security, household healthcare, and provide a variety of social and cultural benefits (Ojea *et al*., 2016; Endamana *et al*., 2016).

Based on multiple uses, more than 3,000 species have been identified as NTFPs in Indian forests and ecosystems (Tewari, 2013). In India, NTFPs generate $2.7 billion in annual income and employ 55% of forestry labor (Shiva and Verma, 2002; Chauhan *et al*., 2008). According to Mirjam (1999), there is a high demand for NTFPs, accompanied by a greater risk of over-exploitation. NTFPs also hold entrepreneurial value across different parts of India. Despite the importance of NTFPs in livelihoods, particularly in developing countries, it is surprising that the sector continues to receive little attention in development policies, relevant government programs, forestry budgets, and forest-related product management (Shackleton and Pandey, 2014).

Non-timber forest products (NTFPs) play a significant role in ensuring the economic and nutritional security of Tripura's rural and tribal inhabitants, serving as vital resources in preventing malnutrition and alleviating poverty in these regions (Das and Prakash, 2011). In such contexts, the commercial production and utilization of NTFPs can offer income opportunities for underprivileged rural residents, thus easing their economic burdens and improving their quality of life (Lahiri, 2016). To further safeguard biodiversity, it is imperative to develop adequate conservation strategies and policies that ensure both *in-situ* and *ex-situ* protection for these NTFPs (Lahiri *et al*., 2017). The promotion of small forest products as a viable source of income could significantly aid in this endeavor.

Against this backdrop, this article aims to examine the contribution of NTFPs to household income and the socio-economic status of selected tribal communities in Tripura who rely on NTFPs for their livelihoods.

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MATERIALS AND METHODS

The study was conducted in the state of Tripura, India, located in the northeastern part of the subcontinent. The West Tripura district was selected for the study due to its higher density of tribal population compared to other districts and its relevance to the study's focus on the economy of the tribal population. Fifty per cent of the blocks, namely Mandwai, Jirania, Hezamara, and Lefunga, were selected for the study using a simple random sampling method from the West Tripura district. Proportionate random sampling was then employed to select blocks based on the representation of block-level rural tribal households. The present study determined a sample size of 120 households using the multistage sampling method. Subsequently, focused group discussions and meetings were conducted with the *Panchayati Raj* Institution (PRI) body and market functionaries to select respondents.

The study is based on both primary and secondary data collected from the selected blocks. Primary data were collected from May 2021 to January 2022 from the sample households and market functionaries through personal interviews using a semi-structured interview schedule. Secondary data were gathered from various published and unpublished government reports.

Both descriptive and analytical (inferential) statistics were utilized for the statistical analyses. Descriptive statistics, including percentages and frequencies, were employed to summarize the contribution of NTFPs to households' lives, as well as the relative contribution of NTFPs to families' incomes.

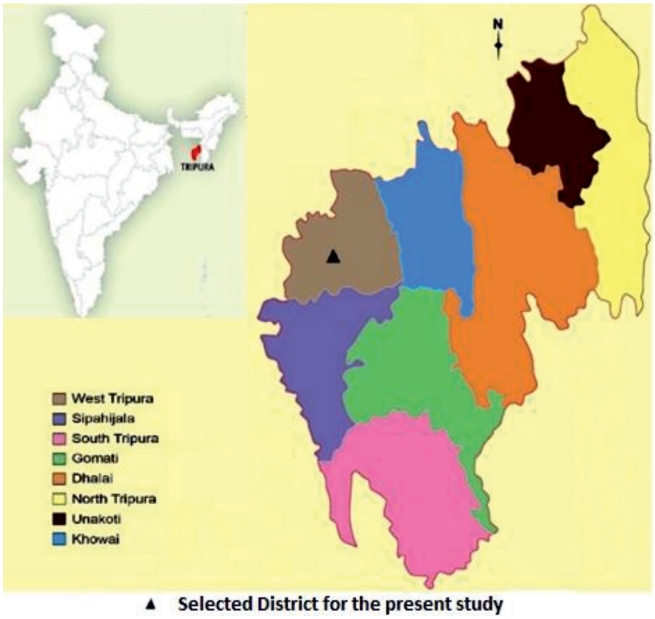


Fig. 1. Map illustrating the study area's geographical location

Descriptive analysis of household income and NTFPs

The household income was calculated as the total income earned by all individuals within the household. This encompassed earnings from various sources, including agriculture (income from crop sales), livestock (income from livestock sales), non-timber forest products (income from the sale of such products), fisheries (income from the sale of fishery products), wage employment (salaries and wages), formal services, business activities (such as trading, tailoring, carpentry, and crafts), and other sources (such as money sent by children or relatives). This computation, as described by Endamana *et al*. (2016), can be expressed mathematically as follows:

$$THI = A+L+N+F+WE+FS+B+O$$

where,

THI=Total household income.

A=Income from agriculture.

L=Income from livestock.

N=Income from non-timber forest products.

F=Income from fishery.

WE=Income from wage employment.

FS=Income from formal service.

B=Income from business.

O=Income from others sources.

Analytical model for the determinants of NTFPs collection and utilization

Factors influencing households' dependence on Non-Timber Forest Products (NTFPs) within tribal communities were identified using a multiple linear regression model. Income from NTFPs served as the dependent variable, while independent variables included family size, education level, gender, age of household head, types of ration cards, distance from the homestead to the nearest metallic road (in kilometers), total landholding size, agricultural income (in Rs/Year), and NTFP employment days (in man-days/annum). These variables were estimated through Ordinary Least Squares regression (OLS) (Maddala, 1983a; Adesina *et al.*, 2000).

Furthermore, a multiple linear regression model was employed to ascertain the factors influencing the collection and utilization of NTFPs by households. Additionally, a logit model was utilized to assess the probability of a particular tribal household engaging in the collection of NTFPs given a set of socioeconomic backgrounds. Prior to the logistic regression analysis, normality and multicollinearity tests were conducted. The data were found to be regularly distributed, and any

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multicollinearity issues were addressed by eliminating variables that were associated with others, considering their importance and explanatory power in relation to the dependent variable.

In this context, it was anticipated that a household's choice of livelihood, influenced by its socioeconomic and demographic characteristics, would impact the collection of NTFPs. This relationship can be briefly summarized as:

$Y_i = f(X_i, E_i)$

The conceptual model based on logistic function is given as:

$$Y_{ik} = f(X_i) = \frac{e^{Zik}}{1+e^{Zik}}$$

For $Z_{ik} = X_{ik}\beta ik$ and $-\infty < Z_{ik} < +\infty$

where Y_i is the dependent variable that takes a value of 1 for the i^{th} household who collects NTFP and 0 if otherwise, X_i is a matrix of explanatory variables related to collection and utilization of NTFPs, β_{ik} are the vector of parameters to be estimated and Ei is the error term with a logistic distribution.

The dependency of households on forests and the factors influencing the collection of Non-Timber Forest Products (NTFPs) were estimated using the logit model. This model is typically employed to predict how changes in independent variables affect the probability of response within a particular group or category (Aldrich and Nelson, 1984; Maddala, 1983b)

RESULTS AND DISCUSSION

The socioeconomic attributes of the respondents are summarized in Table 1. The average household size was 3.40, ranging from a minimum of 2 members to a maximum of 8. The average count of male, female, and child members was 1.73, 1.68, and 0.85, respectively. Regarding the gender of the household heads, 102 (85%) were male and 18 (15%) were female. In terms of participation in NTFP activities, 71 (59.17%) males and

Table 1. Household attributes and demographic characteristics of selected respondents

Sr No	Household attributes	*f*	%	Minimum	Maximum	Mean	± SD
a	Average size of the family			2.00	8.00	3.40	1.38
b	Average no of male members in the family			1.00	4.00	1.73	0.74
c	Average no of female members in the family			0.00	4.00	1.68	0.85
d	Average no of children in the family			0.00	4.00	0.85	0.91
e	House hold head sex						
	Male	102.00	85.00				
	Female	18.00	15.00				
f	House hold head age			18.00	73.00	42.57	12.74
	Young (18 ≤ 35 years)	13.00	10.83				
	Middle (>35-45 years)	39.00	32.50				
	Old (> 45 years)	68.00	56.67				
g	House hold head education						
	Degree	4.00	3.33				
	Secondary school	20.00	16.67				
	Middle school	37.00	30.83				
	Primary school	38.00	31.67				
	Illiterate/others	21.00	17.50				
h	Wellbeing status						
	APL	10.00	8.33				
	BPL	75.00	62.50				
	Antyodaya	35.00	29.17				
i	Participation of people in plantation of NTFPs						
	M	71.00	59.17				
	F	49.00	40.83				
j	Distance (KM) from homestead to district town			1.00	38.00	17.15	8.43
k	Distance (KM) from homestead to metallic road			0.10	8.50	3.65	1.87

Source: Field study by authors, 2021-22

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Table 2. Distribution of annual employment days across various sectors among the respondents

Sr No	Activity	Employment generated (days/HH/year)	%
1	Agriculture	45.32	18.71
2	Livestock	28.30	11.68
3	NTFPs	111.24	45.93
4	Fishery	5.08	2.10
5	Wage employment	21.86	9.02
6	Services	12.75	5.26
7	Business	12.42	5.13
8	Others	5.25	2.17
9	Total	242.22	100.00

Source: Field study by authors, 2021-22

49 (40.83%) females were involved. Cultural barriers in the research area hindered women's participation in forest gathering, leading to a higher proportion of men undertaking the risk of venturing into the forest. Consequently, male-headed households were more reliant on forest resources compared to female-headed ones.

The average age of household heads was 42.57 years, with a range from 18 to 73 years. The majority (56.67%) fell into the category of over 45 years (old), followed by middle-aged (35-45 years) at 32.50% and young (18 ≤ 35 years) at 10.83%. In terms of education, 31.67% had primary school education, followed by middle school (30.83%), illiterate (17.50%), secondary school (16.67%), and graduate (3.33%). Higher education levels were associated with reduced extraction of NTFPs, as it opened up alternative career opportunities (Shively and Pagiola, 2004; Newton, 2016).

The majority of respondents (62.50%) were classified as below the poverty level (BPL), followed by *Antyodaya* (29.17%) and above the poverty level card (8.33%). The average distance from the homestead to the district market was 17.15 km, with a range of 1–38 km for forest-dwelling communities. Similarly, the distance from the homestead to the nearest metallic road ranged from 0.10 to 8.50 km, with an average of 3.65 km.

Non-Timber Forest Products (NTFPs) contributed to the highest employment rate at 45.93%, followed by agriculture (18.71%), livestock (11.68%), wage employment (9.02%), services (5.26%), and other sectors. Prakash *et al.* (2006) also reported similar findings, attributing the increased employment in NTFPs to the tribal communities' marginal land-holding patterns and reliance on forest products.

In terms of annual family income, NTFPs accounted for 31.30%, followed by agriculture (25.62%), livestock (10.98%), services (10.16%), wage employment (8.64%), business (7.80%), fishing (1.20%), and other sources (4.30%). Detailed income contributions from various sectors are presented in Table 3. Although all respondents in the study area depended on NTFP collection for their subsistence, tribal communities couldn't rely solely on this single source for income and employment, as NTFP collection provided employment for only 120 days per year. Hence, they diversified their income sources across multiple sectors.

Table 3. Annual household income from various activities (in Rs.)

Sr No	Activities	Income generated (Rs./HH/year)	%
1	Agriculture	28171.48	25.62
2	Livestock	12075.83	10.98
3	NTFPs	34419.71	31.30
4	Fishery	1324.79	1.20
5	Wage employment	9499.17	8.64
6	Services	11166.67	10.16
7	Business	8575.00	7.80
8	Others	4725.00	4.30
9	Total	109957.64	100.00

Source: Field study by authors, 2021-22

Regarding annual cash expenditures, a significant portion (75.10%) was allocated to food items, followed by savings (8.41%), miscellaneous expenses (5.71%) such as cultural or religious events, transportation (4.29%), medical expenses (4.29%), and entertainment (3.46%). Among land-owning tribal households, a portion (10%) did not cultivate their land, and all farmers fell into the category of marginal farmers, with an average landholding of 0.40 hectares. Consequently, farm production did not fully meet household requirements, necessitating the purchase of food items from the market, with cereals being the most significant expenditure.

Factors Influencing households' dependence on NTFPs:

Tribal communities continue to rely on Non-Timber Forest Products (NTFPs) for their livelihood. Therefore, understanding the factors influencing their collection and utilization is crucial. To assess the significance of NTFPs in the economy of tribal communities, a multiple linear regression model was employed. Income from NTFPs served as the dependent variable, while independent variables included family size, education, gender, age of household head, well-being status,

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Table 4. Household expenditure status (In Rs. per year)

Sr No	Particulars	Expenditure (Rs./HH/year)	%
1	Food	82575.43	75.10
2	Medicine	4720.13	4.29
3	Education	3328.75	3.03
4	Entertainments	3809.71	3.46
5	Savings	9249.14	8.41
6	Miscellaneous	6274.48	5.71
7	Total Annual cash expenditure	109957.64	100.00

Source: Field study by authors, 2021-22.

distance from homestead to the nearest metallic road, landholding size, agricultural income (Rs/Year), and NTFP employment days (man-days/annum). These variables were estimated using Ordinary Least Squares (OLS) regression. The resulting equation is presented below:

$Y=-13445.30 + 4339.88X_1^{***} -1001.86\ X_2 +743.96X_3 -4147.992X_4^{**} -442.408X_5 +12137.08X_6^{***} -1048.46X_7 + 0.025\ X_8 + 357.46\ X_9^{***}$

Y= Income from NTFPs (Rs/Year)
X_1=Size of the family
X_2=Education of Household head
X_3=Wellbeing status
X_4=Distance from homestead to metallic road (km)
X_5=Total landholding size (ha)
X_6=Gender of the Household head
X_7=Age of Household head
X_8=Agricultural income (Rs/Year)
X_9=Employment of NTFP (man-days/annum)

Table 5 illustrates the factors influencing households' reliance on NTFP income. The independent variables accounted for 87.8% of the variation (adjusted R^2 = 0.878) in the dependent variable. Among the nine variables in the model, only family size, distance from the homestead to the nearest metallic road, gender of the household head, and NTFP employment (man-days/annum) significantly impacted NTFP collection among tribal communities. Larger family sizes, male-headed households, and higher NTFP employment positively contributed to NTFP income earned by tribal families. Conversely, greater distance from the homestead to the metallic road had a negative effect on NTFP income. This study aligns with previous research by Ravi *et al.* (2006) and Suleiman *et al.* (2017).

A logistic model was utilized to assess the likelihood of tribal households engaging in NTFP collection given their socioeconomic backgrounds. Omnibus Tests of Model Coefficients indicated a significant improvement in fit compared to the null model, with Nagelkerke R Square at 0.556, suggesting a 55.6% predictability in the criterion variable. The classification table demonstrated a high accuracy rate of 80.0%, indicating good model sensitivity. Additionally, 74.0% of primary NTFP income sources were predicted accurately.

Further analysis examined the impact of random variables on the likelihood of increased NTFP dependency. The average likelihood of households resorting to NTFP collection was computed based on the socio-economic characteristics of the studied households. Results revealed that well-being status, family size, proximity to a metallic road, land ownership, and total income significantly reduced the probability of tribal households engaging in NTFP collection. On the

Table 5. Factors influencing households' dependence on NTFPs income

Sr No	Variables	Unstandardized Coefficients		Standardized Coefficients	t
		B	Std. Error	Beta	
1	Size of the family	4339.88	1168.92	0.20	3.71***
2	Education of house hold head	-1001.87	1020.98	-0.04	-0.98
3	Well-being status	743.96	1892.02	0.01	0.39
4	Distance from homestead to metallic road (km)	-4147.99	1196.93	-0.26	-3.47**
5	Total landholding size (ha)	-442.41	3738.97	0.00	-0.12
6	Gender of the house hold head	12137.09	3128.34	0.14	3.88***
7	Age of house hold head	-1048.46	1748.47	-0.02	-0.60
8	Agricultural income (Rs/Year)	0.03	0.04	0.02	0.60
9	Employment of NTFP (mandays/annum)	357.46	51.51	0.51	6.94***
10	Constant	-13445.31	12365.72		-1.09

R^2: 0.888; Adjusted R^2: 0.878; F: 91.17***; N=120; Significance level***(1%), **(5%)
Source: Field study by authors, 2021-22

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other hand, larger family sizes increased the likelihood of NTFP collection. These findings echoed previous analyses, indicating that family size, total landholding, and income positively influenced NTFP income, while distance from a metallic road negatively impacted NTFP dependency. Forest-based activities served as a valuable source of employment for tribal families, providing alternative livelihoods without competing with agricultural operations (Suleiman *et al.*, 2017).

Table 6. Effects of socio-economic characteristics on the probability of being dependent on NTFPs

Sr No	Household attributes	Coefficient	Standard Error
1.	Size of the family	0.229**	0.322
2.	Education	0.333	0.260
3.	Wellbeing status	-1.307	0.551
4.	Metallic road	-.884**	0.350
5.	Participation of male or female	0.089	0.532
6.	Landholding (ha)	1.562**	0.879
7.	House head gender	0.524	0.756
8.	Age of house hold head	0.355	0.422
9.	Total income (Rs/Year)	.000***	0.000
10.	Employment days for NTFP	0.025	0.013
11.	Constant	2.955	3.394

Note: $\chi 2 = 63.96$***, log likelihood=−99.039, Cox & Snell R Square=0.413, N=120, significance level ***(1%), **(5%)
Source: Field study by authors, 2021-22

The findings from the logistic regression analysis indicate that a household's social, economic, and cultural status significantly influences its participation in primary income-generating activities. However, these effects are largely specific to the particular site and may not be readily applicable to other socioeconomic contexts or geographical regions (Belcher and Schreckenberg, 2007; Coulibaly-Lingani *et al.*, 2009). As shown in Table 6, household size emerges as a key determinant of NTFP collection among respondents. Larger households tend to have more labor available for NTFP harvesting in nearby forest areas. Similar findings were reported by Kabubo-Mariara and Gachoki (2008), who noted that families with larger households living near forestlands in Kenya benefited from shared resources due to the availability of labor, which could be allocated to various collecting activities.

CONCLUSION

The findings indicate that tribal communities residing near forest areas rely not only on various Non-Timber Forest Products (NTFPs) for household use and livelihood, but also derive a significant portion of their income from NTFP collection. This highlights the vital role of NTFPs in supporting livelihoods and providing a crucial safety net for households the year-round. The study highlights the importance of NTFPs in sustaining tribal households, providing essentials such as fuelwood, medicinal herbs, fodder for livestock, as well as vegetables, fruits, and nuts for both domestic use and income generation through sales. NTFP collection helps mitigate agricultural production shortfalls, minimizing risks and filling food deficits in the study area.

Analysis revealed a higher participation of males compared to females in NTFP activities. Furthermore, household size, gender of the household head, and NTFP employment (man-days/annum) significantly influenced NTFP income among tribal families. However, greater distance from the homestead to the nearest metallic road negatively impacted NTFP income. Larger family sizes were associated with an increased likelihood of NTFP collection.

In light of these findings, stakeholders are encouraged to prioritize technical and financial support programs aimed at promoting off-farm income-generating activities, such as value addition for forest produce and handicrafts, to further enhance the economic resilience of tribal communities.

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Authors' contribution

Conceptualization and planning of the research (SH, MK, BL); Conducting field and laboratory experiments, as well as data collection (SH); Data analysis and interpretation (SH); Manuscript preparation (SH, MK, BL).

Declarations

Ethics Approval: Not applicable

Conflict of interest: The authors declare no competing interests. With the submission of this manuscript, we would like to confirm that the above-mentioned manuscript has not been published elsewhere, accepted for publication elsewhere or under editorial review for publication elsewhere.

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