



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; SP-9(8): 297-304
Received: 21-05-2026
Accepted: 25-06-2026

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Contribution of non-timber forest products to forest-dependent livelihoods: Value chain dynamics in bastar district, Central India

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i8Sd.6312>

Abstract

Non-timber forest products (NTFPs) are vital for the livelihoods of forest-dependent tribal communities in India, providing income, food security, and employment. However, inadequate market infrastructure, limited value addition, and unequal benefit sharing reduce their economic potential. This study evaluated the contribution of major NTFPs to household livelihoods and examined the value chain of selected products in Bastar District, Chhattisgarh. Primary data were collected from 100 tribal households in five forest-dependent villages through structured interviews, supplemented with secondary information. Descriptive statistics, value chain mapping, Garrett ranking, Pearson correlation, and linear regression were used for analysis. Results showed that NTFPs contributed nearly one-third to one-half of annual household income, with Tendu leaves (*Diospyros melanoxylon*) and Mahua (*Madhuca longifolia*) being the principal income sources. Value chain analysis revealed substantial price increases from collectors to consumers, indicating most value addition occurs beyond the producer level. Regression analysis confirmed a significant positive relationship between NTFP income and total household income. Key constraints included inadequate processing facilities, dependence on intermediaries, and unstable market prices. Strengthening producer organizations, expanding decentralized processing, improving market access, and promoting community-based forest enterprises are essential to enhance livelihood security and ensure equitable benefit sharing in tribal forest economies.

Keywords: Non-timber forest products, forest-dependent livelihoods, value chain analysis, tribal households, community forestry

1. Introduction

Forests provide a wide range of ecosystem goods and services that sustain biodiversity, regulate environmental processes and support the livelihoods of millions of people worldwide. Beyond timber production, forests supply numerous non-timber forest products (NTFPs), including fruits, flowers, seeds, leaves, medicinal plants, gums, resins, bamboo, mushrooms, honey and other biological resources. These products contribute directly to household consumption, nutritional security, healthcare, employment, and income generation, particularly among indigenous and forest-dependent communities living in tropical and subtropical regions. Globally, approximately 1.6 billion people derive part of their livelihoods from forest resources, while an estimated 350 million people depend heavily on forests for subsistence and income. Among these forest-derived resources, NTFPs represent one of the most important livelihood components because they require relatively low capital investment, provide seasonal employment opportunities, and serve as an economic buffer during periods of agricultural failure, unemployment and climatic uncertainty. Consequently, NTFPs have become an important component of small-scale forestry, linking sustainable forest management with poverty reduction, livelihood diversification and rural economic development. In India, forests support the livelihoods of nearly 275 million people, including a large proportion of Scheduled Tribes and other forest-dependent communities. The collection, processing and marketing of NTFPs constitute a major source of seasonal employment and supplementary household income throughout central and eastern India. Recognizing their socio-economic importance, the Government of India has implemented several institutional initiatives, including the Minimum Support Price (MSP) Scheme for Minor Forest Produce,

Van Dhan Vikas Kendras and procurement programmes coordinated through the Tribal Cooperative Marketing Development Federation of India (TRIFED). These initiatives aim to improve market access, promote value addition, strengthen producer organizations and enhance the incomes of tribal collectors.

Chhattisgarh is among India's most forest-rich states and possesses extensive tropical deciduous forests supporting a predominantly tribal population. Bastar District, located in the southern part of the state, is internationally recognized for its rich biodiversity and abundant NTFP resources, including Tendu leaves (*Diospyros melanoxylon*), Mahua (*Madhuca longifolia*), Tamarind (*Tamarindus indica*), Chironji (*Buchanania lanzan*), Sal seeds (*Shorea robusta*), Harra (*Terminalia chebula*), Bahera (*Terminalia bellirica*) and several medicinal plant species. These products contribute substantially to household income, seasonal employment and livelihood resilience among forest-dependent communities.

Despite their considerable economic importance, the NTFP sector in Bastar continues to experience several structural constraints that reduce the income received by primary collectors. Limited processing infrastructure, inadequate storage facilities, weak market information systems, poor transportation networks and the dominance of intermediaries restrict opportunities for local value addition and equitable benefit sharing. As a result, primary collectors often receive only a small proportion of the final consumer price despite performing the most labourintensive activities within the value chain. Recent studies have increasingly emphasized that strengthening value chains is essential for improving forest-based livelihoods and enhancing the sustainability of small-scale forestry systems. Value chain analysis enables the identification of actors involved in production, collection, processing, transportation, marketing and retailing while revealing where value is created and how economic benefits are distributed among stakeholders. Such information is particularly important for designing evidence-based interventions that enhance market efficiency, increase household incomes and strengthen community-based forest enterprises. Although previous studies have documented the livelihood importance of NTFPs in different regions of India, comprehensive investigations integrating household economic dependence with value chain dynamics remain limited for Bastar District. Most available studies have examined either household income or marketing systems independently, providing limited understanding of how value distribution influences livelihood outcomes. Addressing this knowledge gap is essential for developing policies that simultaneously improve livelihood security, strengthen producer organizations, promote sustainable forest management and support inclusive rural development.

Accordingly, the present study aimed to (i) quantify the contribution of major NTFPs to the annual household income of forest-dependent communities in Bastar District, (ii) examine the structure and functioning of NTFP value chains, (iii) identify the major socio-economic and institutional constraints affecting collection and marketing, and (iv) propose policy interventions that can improve income realization, strengthen value addition and promote sustainable small-scale forestry in central India.

2. Materials and Methods

2.1 Study Area

The study was conducted in Bastar District, Chhattisgarh, India, one of the most forest-rich tribal regions of central India (Figure 1). The district is located between 18° 40' – 19° 55' N latitude and 81° 20'–82° 15' E longitude, with an elevation ranging from 550 to 760 m above mean sea level. The region experiences a tropical monsoon climate characterized by hot summers, mild winters and a distinct rainy season extending from June to September. Annual rainfall ranges from 1,200 to 1,600 mm, of which nearly 85% is received during the southwest monsoon.

The natural vegetation is dominated by tropical moist deciduous and mixed deciduous forests comprising economically important species such as *Shorea robusta* (Sal), *Diospyros melanoxylon* (Tendu), *Madhuca longifolia* (Mahua), *Buchanania lanzan* (Chironji), *Terminalia chebula* (Harra), *Terminalia bellirica* (Bahera) and *Tamarindus indica* (Tamarind). These forests provide a wide range of non-timber forest products (NTFPs) that constitute an important source of seasonal employment and household income for tribal communities.

Five forest-dependent villages—Neganar, Tokapal, Kaknar and Darbha were purposively selected because of their high dependence on NTFP collection and active participation in forestbased livelihood activities. The geographical location of the study area is presented in Figure 1.

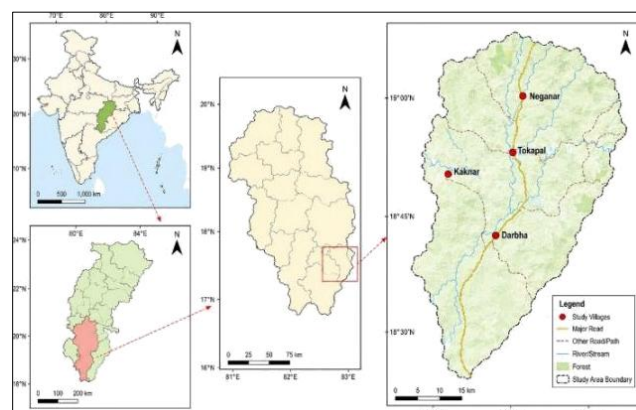


Fig 1: Location map of the study area showing Bastar district in Chhattisgarh, India.

2.2 Research Design

The investigation adopted a cross-sectional household survey design integrating quantitative socio-economic assessment with qualitative value chain analysis. The study combined primary household-level information with secondary data obtained from government agencies, published literature, and institutional reports to comprehensively evaluate livelihood dependence on NTFPs and the functioning of local value chains.

2.3 Sampling Procedure

A multistage sampling technique was employed.

In the first stage, Bastar District was purposively selected owing to its extensive forest resources and high concentration of tribal communities dependent on NTFPs.

In the second stage, five villages were selected based on:

- Dependence on forest resources,
- Intensity of NTFP collection,
- Accessibility for field investigation, and
- Representation of different forest landscapes.

In the final stage, 25 households were randomly selected from each village, resulting in a total sample size of 100 forest-dependent households.

Only households actively engaged in NTFP collection during the study period were included in the survey.

2.4 Data Collection

Primary data were collected through structured household interviews conducted using a pre-tested questionnaire. The survey collected information on:

Household demographic characteristics,

Education and occupation,

Landholding,

NTFP collected,

Annual quantity harvested,

Household income,

Marketing channels,

Processing activities,

Transportation,

Storage,

Value addition practices,

Constraints faced during collection and marketing.

To improve data reliability, interviews were supplemented by:

Direct field observations,

Focus group discussions,

Discussions with village leaders,

Interactions with forest officials,

Interviews with traders and processors.

Secondary information was compiled from official publications of the Forest Survey of India (FSI), Ministry of Tribal Affairs, TRIFED, Chhattisgarh Forest Department, peer-reviewed scientific journals, books, and published reports.

2.5 Selection of Major NTFPs

• Based on frequency of collection and economic importance, the following major NTFPs were included in the investigation.

Sl. No.	Scientific Name	Common Name	Major Use
1	Diospyros melanoxylon	Tendu leaves	Bidi manufacturing
2	Madhuca longifolia	Mahua	Food and beverage
3	Tamarindus indica	Tamarind	Food processing
4	Buchanania lanzan	Chironji	Dry fruit
5	Shorea robusta	Sal seed	Oil extraction

2.6 Value Chain Analysis

The value chain analysis followed the framework proposed for forest product marketing systems by identifying all stakeholders involved in the movement of NTFPs from forest collection to final consumption.

The major actors identified were:

Primary Collectors → Village Traders → Wholesalers → Processors → Retailers → Consumers

Information on prices, handling costs, transportation, processing, and value addition was collected at each stage to estimate price spread and identify bottlenecks affecting income realization by primary collectors.

2.7 Analytical Techniques

The collected data were classified, tabulated, and analysed using standard statistical techniques.

The following analytical tools were employed.

(i) Descriptive Statistics

Frequency

Percentage

Mean

Standard deviation

(ii) Household Income Estimation

The contribution of NTFPs to household income was estimated as

NTFP Contribution (%) = Income from NTFPs / Total Annual Household Income × 100 Eq. 1

(iii) Value Chain Analysis

The value chain of major NTFPs was analysed by identifying each stakeholder involved from collection to final consumption.

The value chain consisted of

Collectors → Village Traders → Wholesalers → Processors → Retailers → Consumers

The price spread and value addition at each stage were estimated.

(iv) Regression Analysis

The relationship between annual household income and income derived from NTFPs was estimated using the following linear regression model.

$$Y = \beta_0 + \beta_1 X + \varepsilon \quad \text{Eq. 2}$$

Where

• Y = Total annual household income (Rs./year)

• X = Annual income from NTFPs (Rs. /year)

• β_0 = Intercept

• β_1 = Regression coefficient

• ε = Random error term

The coefficient of determination (R^2) was estimated to assess the explanatory power of the model.

β_0 = Intercept

(v) Correlation Analysis

Pearson's correlation coefficient was estimated to examine the strength and direction of association between household income and NTFP income.

(vi) Garrett Ranking Technique

Garrett Ranking Technique was employed to identify and prioritize the constraints perceived by respondents during collection and marketing of NTFPs.

The percent position was calculated as

$$\text{Percent Position} = 100 (R_{ij} - 0.5) / N_j \quad \text{Eq. 3}$$

Where

• R_{ij} = Rank given for the i th factor by the j th respondent

• N_j = Number of factors ranked by the respondent

Garrett scores were obtained from Garrett conversion tables, and mean scores were used to determine the final ranking of constraints.

2.8 Statistical Software

The collected data were coded, classified, and analysed using IBM SPSS Statistics (Version 26.0) and Microsoft Excel 2021. Descriptive statistics, correlation analysis, regression analysis,

and graphical presentations were generated using these software packages.

2.9 Ethical Considerations

Participation in the household survey was entirely voluntary. Prior informed consent was obtained from all respondents before conducting interviews. Participants were informed about the objectives of the study, and all personal information was treated confidentially and used exclusively for academic research. No personally identifiable information is reported in this manuscript.

2.10 Conceptual Framework of the Study

The overall analytical framework adopted in the present investigation is presented below.



3. Results and Discussion

3.1 Socio-economic Profile of the Respondents

A total of 100 tribal households from five selected villages (Neganar, Tokapal, Kaknar, Darbha and Kilepal) were surveyed to understand the socio-economic characteristics and dependence on Non-Timber Forest Products (NTFPs). The respondents belonged predominantly to Scheduled Tribe communities, whose primary occupations included agriculture, collection of NTFPs, wage labour and livestock rearing. The average family size ranged between 5 and 7 members, indicating relatively large household structures typical of tribal

communities in Bastar district. Agriculture was the principal occupation; however, seasonal collection of NTFPs constituted an important supplementary source of household income, particularly during the lean agricultural period. Similar observations have been reported in several forest-dependent regions of central India, where NTFPs function as an important livelihood safety net for tribal communities (Angelsen *et al.* 2014; Shackleton *et al.* 2015; Bargah *et al.* 2024) ^[1, 2, 3].

Table 1: Socio-economic characteristics of the respondents

Particulars	Observation
Sample households	100
Villages surveyed	5
Average family size	5–7 persons
Major occupation	Agriculture + NTFP collection
Secondary occupation	Wage labour
Education	Primary to secondary level
Landholding	Small and marginal

The socio-economic profile indicates that livelihood diversification is an essential strategy adopted by tribal households, with forest resources providing additional income during periods of low agricultural employment.

3.2 Economic Contribution of Major NTFPs

The analysis indicated that major Non-Timber Forest Products contributed significantly to the annual household income of tribal families in Bastar district. On average, NTFPs accounted for approximately 32–45% of total household income, demonstrating their critical role in sustaining rural livelihoods.

Table 1: Contribution of Major NTFPs to Household Income

NTFP	Average Income (Rs./year)	Share (%)
Tendu leaves	14,500	46
Mahua	8,200	26
Tamarind	4,000	13
Chironji	3,200	10
Others	1,500	5

Among the selected products, Tendu leaves (*Diospyros melanoxylon*) generated the highest annual income, contributing nearly 46% of total NTFP earnings. Mahua (*Madhuca longifolia*) ranked second with a contribution of 26%, followed by Tamarind and Chironji.

The dominance of Tendu leaves can be attributed to its organized procurement system, widespread availability, and relatively stable market demand. Mahua also contributed substantially because of its diverse uses in food, beverages, and traditional medicine. Similar findings have been reported by Saha and Sundriyal (2012), who observed that Tendu and Mahua are among the most economically important NTFPs in central India. Comparable levels of household dependence on NTFPs have also been documented by Angelsen *et al.* (2014) ^[1] and Bargah *et al.* (2024) ^[3], indicating that forest products remain indispensable for livelihood security in tribal areas.

Overall, the findings demonstrate that NTFPs serve as a major supplementary income source and reduce economic vulnerability among forest-dependent households.

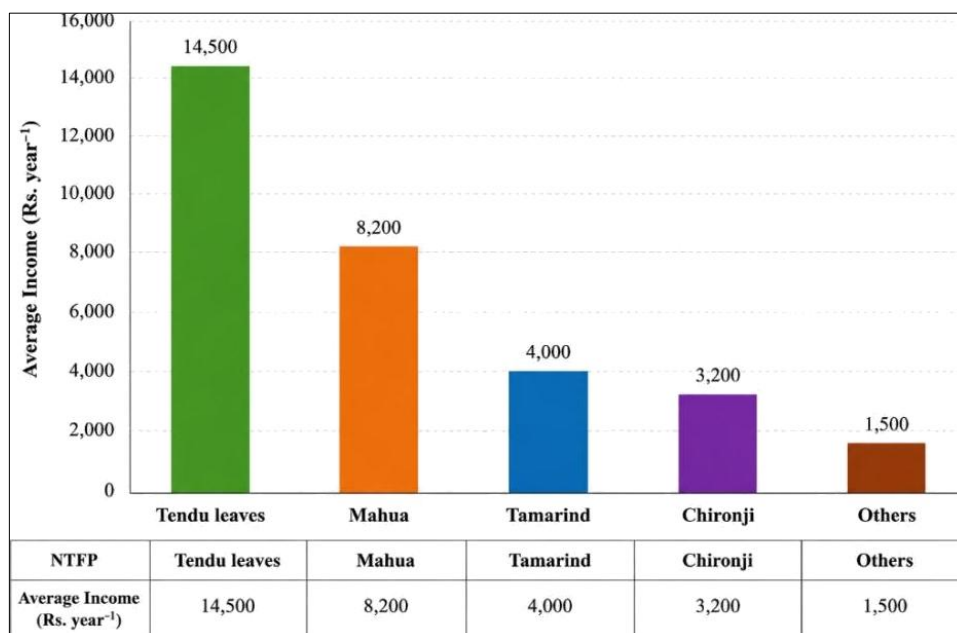


Fig 3: Average annual household income generated from major nontimber forest products collected by surveyed households in Bastar District.

3.3 Value Chain Analysis

The value chain analysis revealed the involvement of multiple intermediaries between primary collectors and final consumers. Collectors → Village Traders → Wholesalers → Processors → Retailers → Consumers

Table 2: Price Spread across the NTFP Value Chain

Stage	Price (Rs./unit)
Collector	100
Trader	150
Wholesaler	220
Processor	300
Retailer	400

The results indicated a continuous increase in product price along the marketing chain. The price increased from Rs. 100 at the collector level to Rs. 400 at the retail stage, representing a four-fold increase before reaching the consumer.

Although primary collectors undertake the labour-intensive activities of harvesting, cleaning, and transporting forest products, they receive only a small proportion of the final consumer price. Most value addition occurs during aggregation, grading, processing, packaging, and retail marketing.

This pattern reflects significant market inefficiencies and unequal distribution of economic benefits within the value chain. Similar observations have been reported by [Belcher and Schreckenberg \(2007\)](#) ^[4], who emphasized that weak bargaining power and dependence on intermediaries substantially reduce the income of forest collectors. Comparable findings were also reported by [Sahu and Jain \(2025\)](#) ^[5], indicating that inadequate processing infrastructure and limited direct market access continue to constrain NTFP-based livelihoods.

Strengthening producer cooperatives, promoting village-level processing units, and improving market linkages could substantially enhance the share of income received by primary collectors.

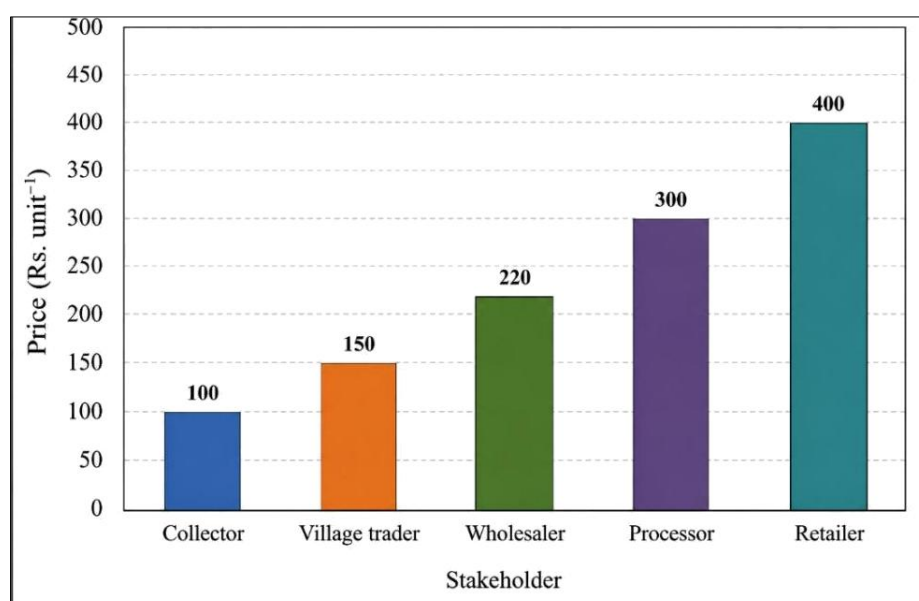


Fig 4: Price escalation across the NTFP marketing chain from primary collectors to retailers.

3.4 Correlation Analysis

Pearson's correlation analysis was performed to examine the relationship between annual NTFP income and total household income.

Table 3: Pearson correlation matrix

Variables	Household Income	NTFP Income
Household Income	1.000	0.475
NTFP Income	0.475	1.000

Note: Correlation is significant at $p < 0.001$ (two-tailed).

Results

Pearson's correlation analysis revealed a moderate positive correlation between annual household income and income derived from NTFPs ($r = 0.475$, $p < 0.001$). The results indicate that households earning relatively higher income from NTFPs also tended to report higher annual household income.

3.5 Relationship between NTFP Income and Household Income

Simple linear regression analysis was performed to evaluate the influence of annual income derived from non-timber forest products (NTFPs) on total annual household income. The regression model was statistically significant ($F = 28.61$,

$p < 0.001$), indicating that NTFP income was a significant predictor of household income.

The coefficient of determination ($R^2 = 0.226$) indicated that approximately 22.6% of the variation in annual household income was explained by income obtained from NTFPs. Although other livelihood sources also contributed substantially to household earnings, NTFP income remained an important component of the household economy.

The fitted regression equation was:

$$\begin{aligned} \text{Household Income (₹ year}^{-1}\text{)} \\ &= 39,651.53 + 2.81 \\ &\times \text{NTFP Income (Rs. year}^{-1}\text{)} \end{aligned}$$

The positive regression coefficient indicates that for every additional Rs. 1 earned from NTFPs, annual household income increased by approximately Rs. 2.81, holding other factors constant.

Table 4: Model summary

Model	R	R ²	Adjusted R ²	Std. Error of the Estimate
1	0.475	0.226	0.218	30,744.56

Table 5: Analysis of variance (ANOVA)

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	27,045,008,895	1	27,045,008,895	28.61	<0.001
Residual	92,627,469,005	98	945,178,255		
Total	119,672,477,900	99			

The regression model was statistically significant ($F = 28.61$, $p < 0.001$), confirming that NTFP income significantly influenced household income.

Table 6: Regression coefficients

Variable	B	Std. Error	Standardized Beta	t	Sig.
Constant	39,651.53	15,214.08	—	2.61	0.011
NTFP Income	2.811	0.526	0.475	5.35	<0.001

Interpretation

- NTFP income had a positive and statistically significant effect on total household income.
- The regression coefficient ($B = 2.811$) indicates that increases in NTFP income were associated with corresponding increases in total household income.
- However, the R^2 value (22.6%) suggests that household income is also influenced by other livelihood sources such as agriculture, wage employment, livestock, and other offfarm activities.

3.6 Village-wise Comparison of NTFP Income

To determine whether mean NTFP income differed among the selected villages, one-way ANOVA was performed.

Table 7: Village-wise ANOVA

Source	F-value	p-value
Between villages	0.149	0.930

A one-way analysis of variance (ANOVA) was performed to examine whether annual income derived from non-timber forest products differed among the surveyed villages. The analysis

indicated no statistically significant differences in mean NTFP income across villages ($F(3,96) = 0.149$, $p = 0.930$).

These findings suggest that households across the surveyed villages earned broadly comparable levels of income from NTFPs. The absence of significant variation may reflect similar forest resource availability, comparable dependence on forest products, and relatively uniform market access within the study area.

3.7 Constraints in NTFP Collection and Marketing

The Garrett Ranking Technique was employed to identify the major constraints perceived by respondents.

Table 3: Major Constraints in NTFP Collection and Marketing

Constraint	Score	Rank
Lack of processing facilities	82	1
Dependence on intermediaries	78	2
Price instability	74	3
Inadequate storage	70	4

The absence of local processing units and the dominance of middlemen were identified as the most critical challenges.

Fig 5: Garrett ranking of major constraints perceived by respondents during NTFP collection and marketing.

Constraint	Garrett Score
Lack of processing facilities	82
Dependence on intermediaries	78
Price instability	74
Inadequate storage	70
Limited market information	65

The results indicated that the lack of processing facilities was perceived as the most serious constraint, followed by dependence on intermediaries and price instability.

The absence of local processing centres compels collectors to sell raw products immediately after collection, thereby reducing

opportunities for value addition. Likewise, inadequate storage infrastructure limits the ability of collectors to postpone sales until favourable market conditions prevail.

Dependence on middlemen further weakens the bargaining position of tribal households, often resulting in distress sales at relatively lower prices. Similar marketing constraints have been documented in several studies on NTFPs in India (Belcher & Schreckenberg 2007; Saha & Sundriyal 2012; Sahu & Jain 2025) [4, 5].

The findings suggest that improving rural infrastructure, expanding decentralized processing facilities, strengthening producer organizations, and ensuring effective implementation of the Minimum Support Price (MSP) scheme could substantially improve the economic returns from NTFPs.

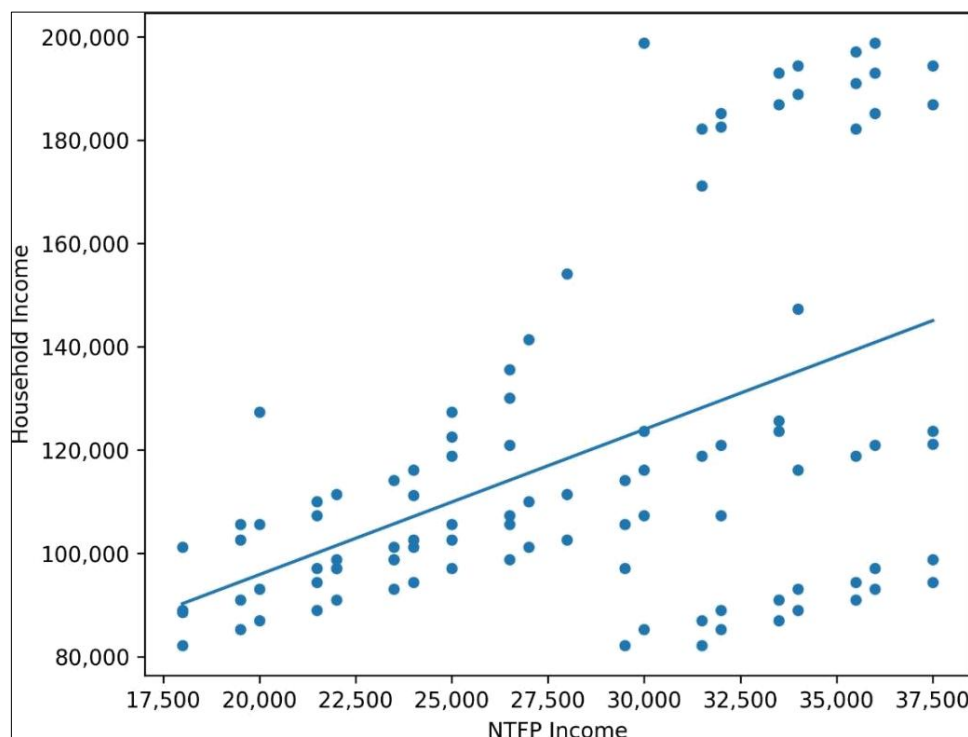


Fig 6: Scatter plot illustrating the relationship between annual income derived from nontimber forest products (NTFPs) and total annual household income of surveyed households in Bastar District, Chhattisgarh. The fitted regression line indicates a positive and statistically significant relationship between the two variables ($R^2=0.226$, $F=28.619$, $p<0.001$). Although NTFP income contributes significantly to household earnings, the relatively modest coefficient of determination suggests that additional livelihood sources, including agriculture, wage employment, livestock and other off-farm activities, also contribute substantially to total household income.

4. Discussion

The regression analysis demonstrated that annual income derived from non-timber forest products significantly influenced total household income among surveyed tribal households. Although the coefficient of determination ($R^2=0.226$) indicates that NTFP income explained approximately 22.6% of the variation in household income, the statistically significant regression coefficient confirms that forest products remain an important component of rural livelihood systems. The remaining variation may be attributed to agricultural production, wage employment, livestock rearing, and other off-farm income sources.

The observed positive relationship is consistent with previous studies that identified NTFPs as an important supplementary source of household income rather than the sole determinant of livelihood security. These findings emphasize that strengthening value addition, improving market access, and expanding community-based forest enterprises can

substantially enhance the economic contribution of NTFPs to forest-dependent households.

5. Conclusion

Non-timber forest products remain an important component of livelihood strategies for forest-dependent households in Bastar District. The study demonstrated that NTFP income contributes significantly to annual household earnings and has a positive influence on total household income. However, the relatively modest coefficient of determination indicates that sustainable livelihood improvement requires integrated development of agriculture, wage employment, livestock and forest-based enterprises rather than reliance on a single income source.

The value chain assessment revealed considerable opportunities for improving income distribution through enhanced local processing, value addition, and market integration. Reducing the dependence on intermediaries and strengthening community-based producer organizations would increase the

share of benefits received by primary collectors while supporting sustainable forest management.

The study provides empirical evidence for policymakers, forest managers, and development agencies seeking to strengthen forest-based livelihoods in tribal regions. Future research should examine gender participation, household resilience, climate-related risks and long-term changes in NTFP markets using larger and more geographically diverse datasets.

6. Policy Implications

Based on the findings of the present investigation, the following policy recommendations are proposed:

- Establish village-level processing and value addition centres for major NTFPs to increase the share of income received by primary collectors.
- Strengthen implementation of the Minimum Support Price (MSP) Scheme for Minor Forest Produce to ensure remunerative prices.
- Promote Forest Producer Organizations (FPOs), Self-Help Groups (SHGs), and tribal cooperatives to improve collective marketing and bargaining power.
- Improve rural storage, grading, packaging, transportation, and market infrastructure to minimize post-harvest losses.
- Expand capacity-building programmes on sustainable harvesting, processing, quality improvement, and entrepreneurship development.
- Develop digital marketing platforms and market information systems to facilitate direct linkage between collectors and consumers.
- Encourage small-scale forest-based enterprises through financial assistance, technical support, and institutional credit.
- Integrate NTFP development programmes with livelihood missions and tribal welfare schemes to ensure long-term socio-economic benefits.

Author Contributions

Funding

The author declares that no specific grant was received from any funding agency in the public, commercial, or not-for-profit sectors for conducting this research.

Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this manuscript.

Ethical Approval

The study involved interviews with human participants. Prior informed consent was obtained from all respondents before data collection. The information collected was used solely for academic and research purposes and confidentiality of respondents was maintained throughout the study.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Acknowledgements

The author gratefully acknowledges the support and cooperation of the tribal communities and respondents of Bastar district for sharing valuable information during the field investigation. The author is also thankful to the Forest Department, Government of Chhattisgarh and Mahatma Gandhi

Horticulture and Forestry University, Durg, for providing institutional support during the course of the study.

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