



## Economic Contribution of Non-Timber Forest Products to Rural Livelihoods in the Shivalik Range of Jammu and Kashmir

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### HIGHLIGHTS

- Non-Timber Forest Products (NTFPs) contributed 29% of the total annual household income.
- Households engaged in NTFP collection often travelled long distances up to 25.69 km/day and dedicated multiple weeks per year to gathering resources.
- Regression analysis indicated that NTFP availability, collection experience, and agriculture as the main occupation positively influenced income from NTFPs.

### ARTICLE INFO

**Keywords:** Livelihood, Non-timber forest products, Economic contribution, Marketing, Off-farm income.

<https://doi.org/10.48165/IJEE.2026.62307>

**Citation:** Bagal, Y. S., Sood, S., Bhagat, V., & Anand, M. (2026). Economic Contribution of Non-Timber Forest Products to Rural Livelihoods in the Shivalik Range of Jammu and Kashmir. *Indian Journal of Extension Education*, 62(3), 40-46. <https://doi.org/10.48165/IJEE.2026.62307>

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### ABSTRACT

This research was carried out to examine the importance and economic value of identified Non-Timber Forest Products (NTFPs) in supporting the livelihoods of forest dwellers East Forest Circle of Jammu and Kashmir. The NTFPs were identified and documented with the help of participatory rural appraisal methods. Multi-stage random sampling method was used to identify the ultimate sampling units. The study revealed that NTFP income contributed 29%, on-farm 16% and off-farm 55% of total household income. It was found that ten NTFPs, were collected by the forest dwellers which significantly contributed to their livelihoods. By applying regression analyses, it was found that NTFP availability, agricultural occupation, NTFP collection experience and on-farm-income had a positive impact on NTFP income. From the research, it was recommended to teach and organize capacity building programs for the forest dwellers in order to improve their level of competence in NTFP collection, storage and grading.

### INTRODUCTION

Forests have long played a crucial role in sustaining human livelihoods by providing a wide range of goods and ecosystem services that support both economic and socio-cultural needs. Among these, Non-Timber Forest Products (NTFPs) are defined as all biological materials other than timber extracted from forests are particularly significant for rural and forest-dependent communities (Vantomme, 2003; Forestry). NTFPs include a diverse array of products such as medicinal plants, fruits, fodder, resins,

fibres, and fuelwood, which are essential for subsistence as well as income generation.

Globally, it is estimated that nearly 1.6 billion people depend on forest resources for their livelihoods, with a substantial proportion relying on NTFPs for food security, healthcare, and income (Derebe et al., 2023). In developing countries, more than 80 per cent of the population depends on plant-based resources derived from forests for nutritional and medicinal purposes (Nautiyal & Kaul, 2003; Duong, 2008). These products serve as a critical safety net, particularly for economically marginalized

communities, by providing supplementary income during periods of agricultural uncertainty (Ibrahim et al., 2020; Tiwari et al., 2022). In many regions of Asia and Africa, NTFPs contribute significantly to household economies and play a vital role in sustaining traditional knowledge systems and cultural practices (Arnold et al., 2011; Sills et al., 2003; Belem et al., 2007).

In the Indian context, NTFPs form an integral component of rural livelihoods, especially among tribal and forest-dependent populations. The annual contribution of NTFPs to the Indian economy is estimated to be approximately USD 2.7 billion, supporting more than 55 per cent of employment in the forest sector. Nearly one-third of the rural population in India derives a portion of their household income from NTFPs (Sharma, 2019; Ahmad et al., 2021). These products not only provide direct economic benefits but also contribute to livelihood diversification, risk reduction, and resilience against climate and market shocks (Gupta et al., 2023; Pathania & Negi, 2022).

The Union Territory of Jammu and Kashmir possesses rich forest resources, covering approximately 20,230 square kilometers, which constitutes about 20 per cent of its total geographical area. In this region, NTFPs serve as a vital livelihood strategy, particularly for landless households and economically weaker sections. Forest dwellers depend on these resources for subsistence needs such as food, medicine, and fuel, as well as for generating cash income through market channels. Despite their importance, the economic contribution of NTFPs is often undervalued due to inadequate documentation, lack of organized markets, and limited policy support.

Although several studies have examined the role of NTFPs in livelihood security across different regions of India, there is a notable research gap concerning the Shivalik range of Jammu and Kashmir. Existing literature largely focuses on other states such as Himachal Pradesh, Chhattisgarh, and Tamil Nadu, with limited empirical evidence available for the Jammu region. Furthermore, the socio-economic determinants influencing NTFP dependence and income generation remain underexplored in this specific geographical context.

## METHODOLOGY

The study was conducted in the East Forest Circle of Jammu and Kashmir, which encompasses diverse agro-climatic zones, namely subtropical, intermediate, and temperate regions. The area is characterized by rich forest biodiversity and significant dependence of local communities on forest resources, particularly Non-Timber Forest Products (NTFPs), for subsistence and income generation. The East Forest Circle comprises seven forest divisions, providing a suitable setting to examine variations in NTFP availability and utilization. A multistage sampling design was employed to ensure representativeness of the study area. In the first stage, three forest divisions Basholi, Ramnagar, and Udhampur were selected from the total seven divisions using a simple random sampling technique without replacement. In the second stage, forest ranges, blocks, and beats with relatively higher NTFP collection activities were identified in consultation with forest department officials. This purposive selection at intermediate stages was necessary due to the absence of a comprehensive sampling frame of NTFP collectors. At the final stage, NTFP collectors were

selected as the ultimate sampling units. Since no official records of collectors were available, a snowball sampling technique was adopted. The initial respondents were identified with the help of local resource persons and forest officials, and subsequent respondents were contacted through referrals. A total of 150 NTFP collectors were surveyed, with 50 respondents selected from each of the three forest divisions. The sample size was considered adequate to capture variability in socio-economic characteristics and NTFP dependence across the study area. Primary data were collected during the agricultural year through personal interviews using a structured and pre-tested interview schedule. Secondary data were obtained from published literature, government reports, and forest department records to supplement the primary findings. Household income was categorized into three major components viz; on-farm income (income derived from agricultural and allied activities); off-farm income (income from wage labor, services, and other non-agricultural sources) and NTFP income (income generated from the collection and sale of non-timber forest products). The total household income was computed as the sum of these three components.

Total household income =  $\Sigma$ (On-farm income + Off-farm income + NTFPs income)

The collected data were coded and analyzed using Microsoft Excel (2010) and SPSS (Version 18). Both descriptive and inferential statistical techniques were employed. Descriptive statistics such as mean, percentage, standard deviation, and frequency distribution were used to analyze: patterns of NTFP collection and utilization; income distribution across different livelihood sources; contribution of individual NTFPs to household income. To identify the socio-economic factors influencing NTFP income, an Ordinary Least Squares (OLS) regression model was employed. The model specification is as follows:

$$Y = \beta_0 + \Sigma\beta_1 X_i + u$$

Where, Y= Income derived from NTFPs,  $\beta_0$  = Intercept,  $\beta_i$  = Coefficients of explanatory variables,  $X_i$  = Socio-economic characteristics of households (e.g., NTFP availability, occupation, experience, income sources),  $u$  = Error term, The regression model was used to estimate the direction and magnitude of influence of explanatory variables on NTFP income.

## RESULTS

The utilization of Non-Timber Forest Products (NTFPs) in the study area was influenced by several factors, including resource accessibility, species diversity in nearby forest ecosystems, and market availability. However, the pattern of utilization varied considerably across locations and among households within the same community, reflecting differences in resource availability and livelihood strategies.

The findings presented in Table 1 indicate that a majority of respondents depend on forests for basic subsistence needs such as fodder and fuelwood collection. Approximately 63 per cent of the respondents reported collecting fodder for livestock, with an average travel distance of  $4.43 \pm 3.69$  km from their residences. Similarly, fuelwood collection was practiced by 86 per cent of the respondents, who travelled an average distance of  $6.74 \pm 2.29$  km.

**Table 1.** Status of collection of fodder and fuel wood from the forests

Parameter	Total (n=150)
Fodder	63
Distance travelled (km)	4.43±3.69
Fuelwood	86
Distance travelled (km)	6.74±2.29

The relatively higher engagement in fuelwood collection, along with the greater distance travelled, suggests a stronger and more consistent dependence on forest resources for energy requirements, highlighting the critical role of forests in sustaining rural livelihoods in the region.

The workforce characteristics of the sampled households are presented in Table 2. The total family size of the 150 sampled households was 903 members, of which 66 per cent constituted adult members, while 38 per cent were actively engaged in income-

**Table 2.** Workforce status of respondents' household

Parameter	Total (n=150)
Total family members	903
Total number of adults (% farmers)	66
Total number of earning members (off- farm activities) (% farmers)	38
Dependency ratio (off- farm activities)	1:2.96
Households solely dependent on NTFP income (% farmers)	3
Households solely dependent on farming	0
Households having other sources of income including NTFP and Agriculture	97
Labour	64
Private	9
Shop	6
Labour + Government service	2
Labour + Shop	4
Labour + Private	9
Government service	0
Any other	3

generating activities. The dependency ratio was estimated at 1:2.96, indicating a relatively high burden on earning members. The findings further reveal that only 3 per cent of the households were solely dependent on Non-Timber Forest Products (NTFPs) for their livelihood, while none of the households relied exclusively on farming. A majority (97%) of the households exhibited diversified livelihood strategies, combining NTFP collection with other income sources. Among these, wage labour emerged as the dominant source of income (64%), followed by private employment (9%) and a combination of labour and private jobs (9%). A smaller proportion of households were engaged in business activities such as shopkeeping (6%), while others combined labour with government service (2%) or other minor occupations (3%). These findings indicate that forest-dependent households in the study area rely heavily on livelihood diversification, with NTFPs serving as a supplementary rather than a primary source of income.

The results (Table 3) reveal substantial variation across different NTFPs in terms of collection duration, quantity harvested, distance travelled, participation patterns, and marketing channels. Among the identified NTFPs, *patis* (*Aconitum chasmanthum*) and *gucchi* (*Morchella esculenta*) were the most commercially significant products. Collection of *patis* involved relatively long travel distances (25.69 ± 8.07 km per day) and was entirely group-based, with an average group size of 2.67 ± 1.23 persons. Collectors participated in this activity for about 28.69 ± 10.99 days annually, harvesting an average of 10.79 ± 8.85 kg per household, all of which was sold through agents. Similarly, *gucchi* collection required moderate travel distances (14.97 ± 6.62 km per day) and longer participation (33.25 ± 11.72 days annually). Unlike *patis*, *gucchi* collection exhibited both individual (56%) and group-based (44%) participation. The entire harvested quantity (1.27 ± 1.11 kg per household) was also marketed through intermediaries.

In contrast, *kasrot* (*Diplazium esculentum*) demonstrated a mixed subsistence and commercial role. Although collectors harvested relatively large quantities (115.37 ± 297.75 kg), only a portion (49.30 ± 16.58 kg) was sold, primarily through local shops, while the remaining was consumed domestically. The collection of

**Table 3.** Collection and marketing of NTFPs

Parameter	Patis (n=103)	Gucchi (n=148)	Kasrot (n=20)	Bnafsaha (n=48)	Nag chhatri (n=104)	Kaud (n=35)	Dhoop (n=48)	Mushkbala (n=84)	Zakham-e-hiyat (n=32)
Number of collection days	28.69 ±10.99	33.25 ±11.72	17.31 ±9.48	43.19 ±11.35	33.95 ±10.90	18.73 ±3.62	15.89 ±8.77	23.63 ±6.36	7.50 ±2.47
Quantity collected (kg)	10.79 ±8.85	1.27 ±1.11	115.37 ±297.75	0.28 ±0.16	16.16 ±16.98	18.53 ±27.89	26.18 ±20.29	30.71 ±21.08	45.93 ±12.14
Quantity sold (kg)	10.79 ±8.85	1.27 ±1.11	49.30 ±16.58	0.28 ±0.16	16.16 ±16.98	18.53 ±27.89	26.18 ±20.29	30.71 ±21.08	45.93 ±12.14
Quantity consumed (kg)	0	0	67.89 ±217.07	0	0	0	0	0	0
Distance (km)	25.69 ±8.07	14.97 ±6.62	6.30 ±4.24	18.22 ±5.21	27.19 ±8.42	17.94 ±4.10	28.53 ±10.79	10.03 ±5.07	11.47 ±4.43
Collected Individually (%)	0	56	100	22	0	0	5	27	22
Collected in Groups (%)	100	44	0	78	100	100	95	73	78
Number of persons in group	2.67 ±1.23	2.48 ±1.35		2.69 ±0.78	2.97 ±1.09	2.70 ±0.90	2.7 ±2.03	2.67 ±0.78	2.20 ±0.41
Sold to Local shops	0	27	100	0	0	0	0	0	0
Sold to Agents	100	73	-	100	100	100	100	100	100

*kasrot* involved shorter travel distances ( $6.30 \pm 4.24$  km) and was carried out individually. Other NTFPs, including *banafsaha* (*Viola odorata*), *nag chhatri* (*Trillium govonianum*), *kaud* (*Picrorhiza kurroa*), *dhoop* (*Jurinea macrocephala*), *mushkbala* (*Valeriana jatamansi*), and *zakhm-e-hayat* (*Bergenia ciliata*), exhibited varying collection patterns. These products were largely collected in groups, with participation ranging from 73 to 100 per cent. The duration of collection varied from 7.50 to 43.19 days annually, while travel distances ranged between 10.03 and 28.53 km per day. In most cases, the entire quantity collected was sold through agents, indicating a strong reliance on intermediary-based marketing systems. Overall, the findings highlight that NTFP collection in the study area is labor-intensive, often involving long travel distances and group participation. High-value NTFPs such as *patis* and *gucchi* are predominantly commercial in nature, whereas others like *kasrot* serve both subsistence and income-generating functions. The dominance of agent-based marketing further reflects limited direct market access for collectors.

The distribution of household income from different sources is presented in Table 4. The results indicate that the average annual household income of the sampled NTFP collectors was Rs.  $173,650 \pm 120,575$ . Among the various income sources, off-farm income constituted the largest share, with an average of Rs.  $110,440 \pm 110,438$ , accounting for 55 per cent of the total household income.

In comparison, income from NTFPs contributed an average of Rs.  $58,584.40 \pm 49,705.70$ , representing 29 per cent of total household income. On-farm income was relatively lower, averaging Rs.  $31,773 \pm 19,486.40$ , and contributed 16 per cent to the total income. These findings indicate that while off-farm activities remain the primary source of livelihood, NTFPs play a significant supplementary role in supporting household income among forest dwellers in the study area.

The results indicate that *patis* (*Aconitum chasmanthum*) contributed the highest share (32.04%) to total NTFP income, followed by *gucchi* (*Morchella esculenta*) (26.49%) and *nag chhatri*

(*Trillium govonianum*) (15.77%). Together, these high-value NTFPs accounted for a substantial proportion of total income derived from forest resources (Table 5). Moderate contributions were observed from *banafsaha* (*Viola canescence*) (9.46%), *kaud* (*Picrorhiza kurroa*) (5.22%), *dhoop* (*Jurinea macrocephala*) (4.63%), and *mushkbala* (*Valeriana hardwickii*) (4.03%). In contrast, products such as *kasrot* (*Diplazium esculentum*) (1.13%), wild honey (0.65%), *zakhm-e-hayat* (*Bergenia ciliata*) (0.35%), and *jungli thome* (*Allium sativum*) (0.16%) contributed marginally to household income. In terms of household participation, *gucchi* collection showed the highest engagement (99%), followed by *patis* and *nag chhatri* (69% each), indicating their widespread economic importance. Other NTFPs exhibited relatively lower participation levels, reflecting variation in resource availability, market demand, and collection feasibility. Overall, the findings suggest that a limited number of high-value NTFPs dominate income generation, while several others play a supplementary role, highlighting the uneven distribution of economic benefits across different forest products.

#### Factors driving households for collection of NTFPs

The relationship between household characteristics (independent variables) and the percentage share of NTFP income (dependent variable) was analyzed using a regression model. The results presented in Table 6 indicate that all five predictors were significant and played an important role in determining the dependent variable. Among these, NTFP availability, experience in NTFP collection, and occupation as a farmer showed a positive influence on NTFP income share. In contrast, off-farm income and source of information exhibited a negative relationship with NTFP income.

These findings are in line with the results reported by Sharma (2015), who observed that socio-economic factors such as landholding, literacy index, and age of the household head significantly influence dependence on NTFPs in Himachal Pradesh. The study highlighted that households with smaller landholdings

**Table 4.** Source of income of sampled households

Type of Income	Average annual income (Rs)	Standard error	Income share (%)
Average annual off farm income	110440.00±110438	7.51	55
Average annual on farm income	31773.00±19486.40	1.59	16
Average annual NTFP income	58584.40±49705.70	4.06	29
Average annual household income	173650.00±120575	9.94	

**Table 5.** Contribution of various NTFPs to cash income

NTFPs	Average annual income per household (Rs)	Per cent of households engaged
Dhoop ( <i>Jurinea macrocephala</i> )	8472.92±5537.87	32
Gucchi ( <i>Morchella esculenta</i> )	15626.38±16000.72	99
Kasrot ( <i>Diplazium esculentum</i> )	4422.63±3425.71	13
Banafsaha ( <i>Viola canescence</i> )	12224.26±7577.23	32
Wild honey	14375.00±6574.89	3
Patis ( <i>Aconitum chasmanthum</i> )	27339.81±16132.15	69
Nag chhatri ( <i>Trillium govonianum</i> )	13198.1±8745.12	69
Kaud ( <i>Picrorhiza kurroa</i> )	13497.06±19366.88	23
Junglithome ( <i>Allium sativum</i> )	14000.00	1
Muskbala ( <i>Valeriana hardwickii</i> )	4215.48±2389.06	56
Zakhm-e- hiyat ( <i>Bergenia ciliata</i> )	962.50±268.56	21

**Table 6.** The socio-economic variables determining the cash income generated by the households from NTFP collection

Model	Coefficients	Standard error	t-value	Significance
(Constant)	8.89	4.72	1.88*	0.06
NTFP availability ( $X_{17}$ )	1.81	0.32	5.69***	0.01
R <sup>2</sup>	0.18	Adjusted R <sup>2</sup>		0.17
(Constant)	19.41	4.81	4.04***	0.01
NTFP availability ( $X_{17}$ )	1.61	0.29	5.40***	0.01
Off-farm income ( $X_{14}$ )	-6.87	0.00	-5.15***	0.01
R <sup>2</sup>	0.30	Adjusted R <sup>2</sup>		0.29
(Constant)	9.64	5.36	1.79*	0.07
NTFP availability ( $X_{17}$ )	1.48	0.28	5.14***	0.01
Off-farm income ( $X_{14}$ )	-6.98	0.00	-5.44***	0.01
NTFP collection experience ( $X_3$ )	0.67	0.18	3.61***	0.01
R <sup>2</sup>	0.36	Adjusted R <sup>2</sup>		0.35
(Constant)	6.48	5.38	1.20 <sup>NS</sup>	0.23
NTFP availability ( $X_{17}$ )	1.72	0.29	5.80***	0.01
Off-farm income ( $X_{14}$ )	-6.92	0.00	-5.50***	0.01
NTFP collection experience ( $X_3$ )	0.59	0.18	3.18***	0.01
Occupation ( $X_9$ )	14.21	5.35	2.65***	0.01
R <sup>2</sup>	0.39	Adjusted R <sup>2</sup>		0.37
(Constant)	33.39	12.46	2.68***	0.01
NTFP availability ( $X_{17}$ )	1.72	0.29	5.87***	0.01
Off-farm income ( $X_{14}$ )	-6.76	0.00	-5.45***	0.01
NTFP collection experience ( $X_3$ )	0.55	0.18	2.96***	0.01
Occupation ( $X_9$ )	15.22	5.28	2.88***	0.01
Source of information ( $X_{10}$ )	-4.17	1.75	-2.38***	0.01
R <sup>2</sup>	0.41	Adjusted R <sup>2</sup>		0.39

\*\*\* and \* Significant at one and 10 per cent levels, NS: Non-significant

tend to rely more on NTFPs, whereas those with larger landholdings show relatively lower dependence. Similarly, households with lower literacy levels were found to be more dependent on NTFP collection compared to those with higher literacy levels. Furthermore, older household members possess greater knowledge of economically valuable NTFPs, thereby increasing reliance on forest resources among experienced households.

The adjusted R<sup>2</sup> values indicate a progressive increase in the explanatory power of the model with the inclusion of additional variables. NTFP availability alone explained 17 per cent of the variation in NTFP income share. When off-farm income was included, the explained variation increased to 30 per cent. Further inclusion of NTFP collection experience increased the explanatory power to 35 per cent. Similarly, the addition of occupation as the main source of livelihood raised it to 37 per cent, while the inclusion of source of information resulted in a final explanatory power of 39 per cent. The OLS estimates indicate that a unit increase in NTFP availability ( $X_{17}$ ) leads to a 1.72 unit change in NTFP income share. Conversely, a unit decrease in off-farm income ( $X_{14}$ ) results in a 6.76 unit increase in NTFP income share. Similarly, a unit increase in NTFP collection experience ( $X_3$ ) and agriculture as the primary occupation ( $X_9$ ) increases NTFP income share by 0.55 and 15.22 units, respectively. In contrast, a unit increase in the source of information ( $X_{10}$ ) reduces NTFP income share by 4.17 units. Easily availability of NTFPs was found to be the main reason for collection as it was reported by all the collectors and was ranked number one. Source of income, to meet food requirement and profitable activity were reported by 95, 93 and 88 per cent of the collectors (Table 7).

**Table 7.** Reasons for collection of NTFPs

Parameter (% Collectors)	Total (n= 150)
Source of income	95
Profitable activity	88
To meet food requirement	93
Available nearby	100

## DISCUSSION

Forest-dependent households residing in and around forest areas rely extensively on Non-Timber Forest Products (NTFPs) as an integral component of their livelihood strategies. The collection and utilization of NTFPs have traditionally supported both subsistence needs and income generation among forest dwellers. These products not only provide direct consumption benefits but also contribute to household income through market sales, thereby enhancing food security by improving purchasing capacity. The findings of the present study indicate that households in the study area adopt a diversified livelihood strategy rather than depending on a single source of income. Among the three major income sources—NTFPs, on-farm, and off-farm activities—off-farm income emerged as the dominant contributor, accounting for 55 per cent of total household income. A large proportion of respondents were engaged in wage labour (65%), reflecting limited agricultural opportunities and the increasing importance of non-farm employment. NTFPs constituted the second most important source of income, contributing 29 per cent, followed by on-farm income (16%). These findings are consistent with earlier studies, which

reported NTFP contributions of 17 per cent in West Bengal (Malhotra et al., 1991), 24 per cent in Tamil Nadu (Ganesan, 1993), and 21 per cent in Sri Lanka (Gunatilleke et al., 1993), indicating the continued relevance of NTFPs in rural livelihoods across regions.

Although a variety of NTFPs are collected in the study area, only a limited number contribute significantly to household income. Among these, *patis* (*Aconitum chasmanthum*) and *gucchi* (*Morchella esculenta*) were the major contributors, reflecting their high market value and demand. This pattern aligns with previous studies (Kant, 1997; Paloti & Hiremath, 2005; Pervez, 2002; Kanwal, 2014; Tejaswi, 2008; Choudhary, 2023), which also reported that only a few high-value NTFPs dominate income generation. Furthermore, the role of rural women in NTFP collection and processing was found to be substantial, indicating the gendered nature of forest-based livelihoods. The regression analysis further revealed that NTFP dependence is significantly influenced by socio-economic factors. Variables such as NTFP availability, collection experience, and agriculture as the primary occupation showed a positive association with NTFP income, suggesting that resource accessibility and household capabilities enhance dependence on forest products. In contrast, off-farm income and access to information exhibited a negative relationship with NTFP dependence, indicating that households with diversified income sources and better information access tend to rely less on forest resources. These findings are in agreement with Sharma (2015), who reported that landholding size, literacy level, and age of the household head significantly influence dependence on NTFPs. Households with limited land resources and lower literacy levels were found to be more dependent on forest-based livelihoods, whereas experienced household members possessed better knowledge of commercially valuable NTFPs, leading to higher engagement in collection activities. Overall, the study highlights that NTFP dependence is shaped by a complex interplay of resource availability, socio-economic conditions, and livelihood diversification. While NTFPs continue to play a vital supplementary role, the increasing importance of off-farm income suggests a gradual shift towards diversified livelihood strategies among forest-dependent households.

## CONCLUSION

The household livelihoods in the study area are supported by a combination of on-farm, off-farm, and Non-Timber Forest Products (NTFPs)-based income sources. Among these, off-farm income emerged as the dominant contributor, accounting for 55 per cent of total household income, followed by NTFPs (29%) and on-farm income (16%). Households engage in NTFP collection for multiple purposes, including consumption and commercial sale, indicating their dual economic and socio-cultural importance. Capacity-building initiatives focusing on scientific methods of collection, storage, grading, and value addition are essential to enhance income from NTFPs. Furthermore, strengthening backward and forward linkages such as improved transportation, storage facilities, processing units, and market access can help ensure better price realization and product quality. There is a need for increased awareness and sensitization regarding the economic and ecological value of NTFPs, along with institutional support to promote sustainable harvesting practices.

## DECLARATIONS

**Ethics approval and informed consent:** Informed consent was sought from the respondents and their organisations regarding the study during the course of the data collection.

**Conflict of interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The author declares that they have thoroughly reviewed, revised, and edited the content as needed. The authors take full responsibility for the final content of this publication.

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