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Medicinal NTFP dependent tribal communities in South west India-livelihood vulnerability, its determinants and constraints

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Abstract

The study assessed the livelihood vulnerability of tribal communities dependent on medicinal Non-Timber Forest Products (NTFPs) in the Wayanad district of Kerala, India. Livelihood Vulnerability Index (LVI) was used to evaluate vulnerability across three panchayats: Noolpuzha, Thirunelli, and Meppadi. Survey of 90 randomly selected tribal households dependent on medicinal NTFPs was undertaken and LVI was constructed using ten indicators categorized under sensitivity and adaptive capacity. Key findings revealed varying degrees of vulnerability among the surveyed panchayats, with Noolpuzha showing the highest vulnerability, followed by Thirunelli and Meeppadi. Major drivers of vulnerability included marginalized landholdings, non-irrigated land, limited access to clean drinking water, and inadequate institutional support. A logistic regression analysis identified gender, education, number of earning members, land ownership, and marketing expenditure as significant factors influencing NTFP dependency. Constraint analysis found that warnings from the forest department ranked highest at 81% followed by limited employment schemes (78%) and other basic facilities (51%) as least ranked. The study highlighted the complex interplay between socio-economic factors and medicinal NTFP reliance, offering insights for targeted interventions to reduce vulnerability in forest-dependent communities.

Keywords: Livelihood vulnerability, medicinal NTFPs, sensitivity, adaptivity, dependency

1. Introduction

India's diverse ecosystem spanning from tropical rainforests to semi-arid woodlands, supports a vast array of NTFPs that hold both domestic and global value. Medicinal NTFPs play a crucial role in the livelihoods of millions of people, both in rural and urban areas worldwide. Kerala forests are a home to a variety of NTFPs, such as bamboo, medicinal herbs, and aromatic plants, which have long served as sources of food, medicine and income. The Government of Kerala (2023) assessed the vulnerability of the state's 14 districts to climate variability. Nine out of the 14 districts were highly vulnerable, with Wayanad ranking first. Livelihood Vulnerability Index (LVI) of tribals in Wayanad, particularly those dependent on medicinal NTFPs, highlighted significant challenges faced by these communities. LVI assesses vulnerability through various indicators, revealing that tribal households are highly sensitive to climate risks and lack adequate adaptive capacity. This situation is exacerbated by socio-economic factors and the overexploitation of medicinal NTFPs.

Wayanad is one of the largest forested regions in Kerala, with 74.19 percent of its total geographical area covered by forests (Forest Survey of India, 2019) [9]. The district is also home to a significant portion (31%) of the state's total tribal population, accounts for the highest proportion (55.01%) of medicinal NTFP collection in the state (KSFSDCL, 2020) [15]. The dense forests and high concentration of tribal population, has a deep-rooted tradition of medicinal NTFPs collection.

IPCC defines vulnerability as the likelihood of being negatively impacted. This concept of vulnerability comprises the idea including sensitivity to damage and lack of ability to cope with and adapt (IPCC, 2001a) [13]. Denton (2002) [7] observed that unequal power dynamics between men and women lead to disparities in access to natural resources and opportunities for income diversification. As a result, environmental vulnerability and security affect men and women differently. Vulnerability has multiple definitions in this context (Füssel, 2007; Gallopín, 2006) [10, 11], and the results of any effort to assess vulnerability depends on the concepts and metrics applied (Hahn, Riederer, & Foster, 2009) [12]. In this study, vulnerability is defined based on the IPCC's (2007) [14] description as "the degree to which a system is susceptible to or unable to cope with the adverse effects of climate change, including climate variability and extremes." Here vulnerability is typically broken down into three key components: exposure, sensitivity, and adaptive capacity (IPCC, 2007; Adger, 2006) [14, 1].

Livelihood vulnerability refers to the susceptibility of households to adverse impacts from environmental changes, particularly climate change, which can disrupt their means of subsistence (Das,2024) [6]. Livelihood Vulnerability Index (LVI) serves as a practical tool for public health professionals, development organizations, and policymakers to assess the health, socioeconomic, and demographic factors contributing to climate vulnerability at the community or district level. By leveraging adaptive capacity, development planners can prioritize and refine their evaluations to address the specific needs of a given region. Sectoral vulnerability scores can also be extracted from the overall composite index to identify potential areas for targeted interventions (Hahn *et al*., 2009) [12].

LVI was developed and applied to rural households in an environmentally sensitive region of the country, characterized by diverse factors such as geographic location, household income, labour education levels, livelihood diversification, and the extent of non-agricultural activities. This is further broken down into its three primary dimensions, 16 components, and 23 vulnerability indicators. Vulnerability indicators help to identify the processes contributing to vulnerability, guide the development of vulnerability-reduction strategies, and assess the effectiveness of these strategies in diverse ecological and social contexts (Adger *et al*., 2009; Dow, 1992) [2, 8]. The study also seeks to demonstrate the extent, reliance, and livelihood significance of medicinal NTFPs for people relying on forests medicinal plants such as *Sida rhombifolia* (local name-Kurunthotti), *Solanum torvum* (local name-Chunta), *Cyclea peltate* (local name: Padakkizhangu), *Parmelia dilatate* (local name: Kalpasam) and *Phyllanthus embilica* (local name: Kattunellikka) In furtherance of providing chances for livelihood for the most underprivileged segments of society, it examined the difficulties and management strategies of medicinal NTFPs that could support the sustainable use of resources.

2. Methodology

2.1. Study area

The present study was conducted in the tribal settlements of Wayanad district in Kerala, India. Wayanad spans a geographical area of 2,132 square kilometers and comprises one revenue division, three taluks, 49 villages, 25 Gram Panchayats, three Block Panchayats, and one municipality. The district lies between 11°27′ and 11°58′ north latitude and 75°47′ and 76°27′ east longitude. It is bounded on the east by the Nilgiri Hills and Mysuru district of Karnataka, to the north by Kodagu (Coorg) district, to the south by Malappuram district, and to the west by Kozhikode and Kannur districts. A significant portion of Kerala's reserve forests—approximately 76.66% of the district's total area—is located in Wayanad, highlighting its ecological importance.

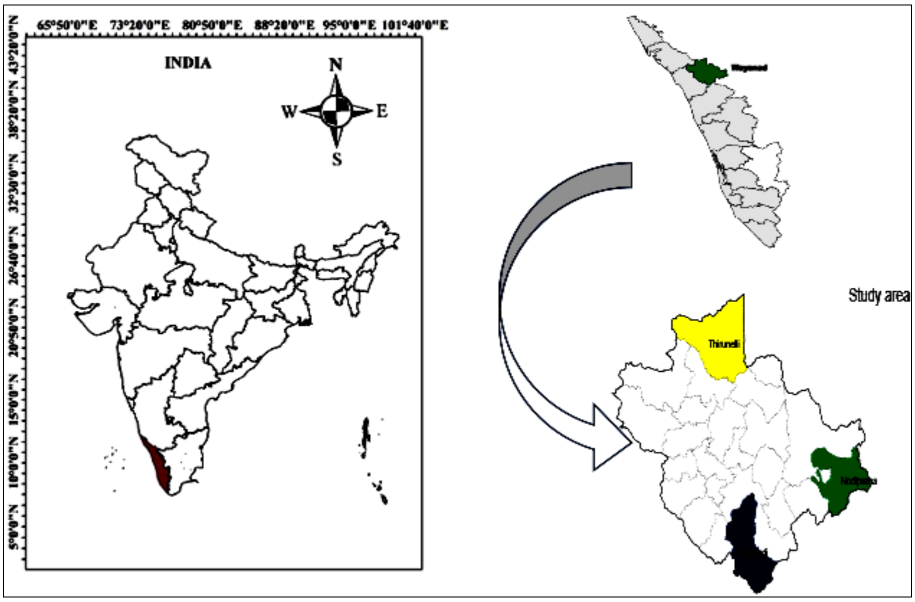

Fig 1: Map of the study area

the 3 Taluks namely, Vythiri, Mananthavady and Sulthan Bathery of Wayanad, one panchayath each was purposively selected based on the highest tribal population of the respective panchayaths. Hence, Meppadi panchayath from Vythiri, Thirunelli panchayath from Mananthavady and Noolpuzha panchayath from Sulthan Bathery were selected based on the population-based data received from Integrated Tribal Development Project (ITDP) office at Kalpetta.

The total of 90 households 30 from each taluks using a pre-tested and structured interview schedule. Data regarding collection, utilization, and role of NTFPs in household income, marketing channels and constraints were collected. Secondary data was collected from authenticated sources like Kerala Institute for Research Training & Development Studies of Scheduled Castes and Scheduled Tribes (KIRTADS), Kerala Forest Department, Kerala State SC ST Federation.

2.2. Vulnerability Index

Vulnerability arises from the interplay between biophysical hazards and social responses, typically within a defined geographic area or zone. To understand the linkages, interactions, and interdependencies between biophysical and socio-economic or institutional systems, it is essential to adopt an integrated approach to vulnerability assessment. This holistic perspective is particularly useful for reducing vulnerabilities in systems such as agriculture, water resources, livestock, and forest management. Vulnerability consists of two primary components: sensitivity (S) and adaptive capacity (AC). These components represent intrinsic system properties that cannot be directly observed, measured, or quantified. Sensitivity increases vulnerability, whereas adaptive capacity reduces it, with each reflecting unique aspects of vulnerability. Based on their proportional relationships, it can be stated that sensitivity and adaptive capacity are directly and inversely proportional to vulnerability, respectively.

Vulnerability (V)= f [Sensitivity (S), Adaptive Capacity (AC)]…….(1)

$V \infty S$ and $V \infty \frac{1}{AC}$, $therefore\ V = f\ [S, \frac{1}{AC}]$

A Tier I approach, which follows a top-down methodology and primarily relies on primary data, was used for village-level vulnerability assessment. This approach aimed to generate preliminary information to identify the degree of vulnerability, the key drivers of vulnerability, and to raise awareness in three panchayats of Wayanad district in Kerala.

2.3. Livelihood Vulnerability index (LVI)

The determinants of livelihood vulnerability revealed varying degrees of sensitivity and adaptation among the surveyed villages. The livelihood vulnerability among the villages were classified into three categories including not vulnerable, moderate and highly vulnerable. The analysis with equal weight to indicators resulted in Noolpuzha panchayat falling in very high category, Thirunelli in moderate category and Meppadi in low category (Fig.1). A range of indicators is essential for conducting a vulnerability assessment. The selected indicators represent their type (sensitive/positive or adaptive/negative) and nature (socio-economic or biophysical, encompassing physical, social, economic, and environmental information), as this is the most critical step in the assessment (Table 1). The chosen indicators and their descriptive statistics are presented in Table 2. Identifying drivers for adaptation planning is equally important, as it helps policymakers and relevant departments design targeted adaptation programs to mitigate vulnerability. Quantifiable data were utilized, and the indicators were aggregated through normalization based on their relationship with vulnerability. A decrease in an indicator's value corresponds to an increase in vulnerability, indicating a positive relationship with it.

$$\text{Normalised Value} = \frac{Actual\ indicator\ Value - Minimum\ Indicator\ Value}{Maximum\ Indicator\ value - Minimum\ indicator\ Value} \quad \text{………(2)}$$

$$\text{Normalised Value} = \frac{Maximum\ Indicator\ Value - Actual\ Indicator\ Value}{Maximum\ indicator\ value - Minimum\ indicator\ Value} \quad \text{……… (3)}$$

Vulnerability increases with an increase in the value of the indicator. Equal weights were assigned to the indicators if there are difficulties in obtaining weights from the stkeholders. The vulnerability index was constructed by taking a simple average for all the normal

2.4. Logistic Regression

The logistic model was fit to delineate factors influencing the livelihood dependency on medicinal NTFPs. The function was hypothesized by taking socioeconomic aspects of the collectors such as gender, education, experience in the collection of medicinal NTFPs, number of earning members in the family, land ownership, distance travelled for the collection of medicinal NTFPs, total expenditure for marketing of medicinal NTFPs, percentage share of wage and agriculture in the total income. The specified functional form is as follows:

$$Logit(P(Y=1) = \ln(1-P(Y=1)/P(Y=1)) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9$$

Where, P (Y =1) represents the probability of livelihood dependency on NTFPs occurring when income from medicinal NTFPs is greater than 25 per cent of the total household income.

β_0 is the intercept and

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9$ are the regression coefficients

X_1 - Gender - Categorical variable (Male = 0, Female = 1).

X_2 - Education

X_3 - Experience in the collection of medicinal NTFPs (Years)

X_4 - Number of earning members in the family (No.)

X_5 - Land ownership

X_6 - Distance travelled for the collection of medicinal NTFPs (km)

X_7 - Total expenditure for the marketing of medicinal NTFPs (in INR)

X_8 - Percentage share of wage in the total income

X_9 - Percentage share of agriculture in the total income

Spearman's rank correlation was used to identify the relation between average medicinal NTFP income and socioeconomic factors. The dependent variable taken was average medicinal NTFP income, while the independent variables included age, gender, education level, household size, landholding size, and alternative income sources.

Ranks were assigned to all variables, and for tied values, average ranks were used to mitigate ranking bias. The differences in ranks (d) for paired observations were computed, and the Spearman's rank correlation coefficient (ρ) was calculated using the formula:

1-(6Σd^2)/(n^3-n)

where d represents the rank difference, and n is the number of observations. A hypothesis test was conducted to assess

the significance of the correlation, with null hypothesis (H_0) assuming no correlation and the alternative hypothesis (Ha) indicating a significant correlation. A significance level (α) of 0.05 was used to evaluate statistical relevance.
The interpretation of ρ values provided insights into the relationship's strength and direction, with values close to +1 indicating strong positive correlation, -1 indicating strong negative correlation, and values near 0 suggesting no correlation.

2.5. Garrett's Ranking Technique.

The ranks given by the respondents were then converted into percentage position with the help of formula given by Garrett. Garrett's formula for converting ranks into percent is

$$\text{Percent position} = \frac{100\,(Rij - 0.5)}{N}$$

Where,
R_{ij} is the rank given to the i^{th} item by the j^{th} respondent, and N is the number of items ranked by that respondent.

3. Results and Discussion

Table 1: Indicators of vulnerability index are chosen based on their category and rationale

Indicators	Category	Rationale
% of Household dependent on NTFP's	Positive	It provides additional and alternate source of income
Marginalized land holder	Positive	Marginal farmer are more vulnerable
% of non-irrigated land	Positive	Sensitive to drought
Distance from hospital (Km)	Positive	Better health care facilities reduce vulnerability
Household without stable income sources	Positive	Lack of access to credit is an indication of lack of adaptive capacity
Literacy rate	Negative	Higher rate has better adaptability
Livestock intervention	Negative	Adds as additional source of income
Stable income source	Negative	Higher income indicates better living
Presence of village level institution	Negative	People become more aware and accessible to credit & other facilities
% of households accessible to safe drinking water	Negative	Better drinking water facilities indicates better adaptive capacity

Table 2: Descriptive statistics of the indicators used in constructing the vulnerability index

Districts	Sensitivity					Adaptive capacity				
	% of Household dependent on NTFP's	Marginalised land holder	% of non-irrigated land	Distance from hospital (Km)	Household without stable income sources	Literacy rate	Livestock intervation	Stable income source	Presence of village level institution	% of households accessible to safe drinking water
Noopuzha	80.00	100	90.00	12.00	90.00	43.34	0.3	10	10	26.67
Meppadi	40.00	86.67	60.00	16.00	93.34	26.67	23.33	6.66	20	30.00
Thirunelli	46.67	40.00	93.33	15.00	100	56.67	20	0.00	50	26.67

3.1. Vulnerability Status

In Wayanad district, Kerala, the integrated vulnerability assessment focused on three taluks: Vythiri, Sultan Bathery, and Mananthavady. Among these, three panchayats—Meppadi, Noolpuzha, and Thirunelli—were chosen through purposive sampling. These panchayats were identified as having the highest dependence on medicinal NTFPs by tribal communities, based on insights gathered through primary data.

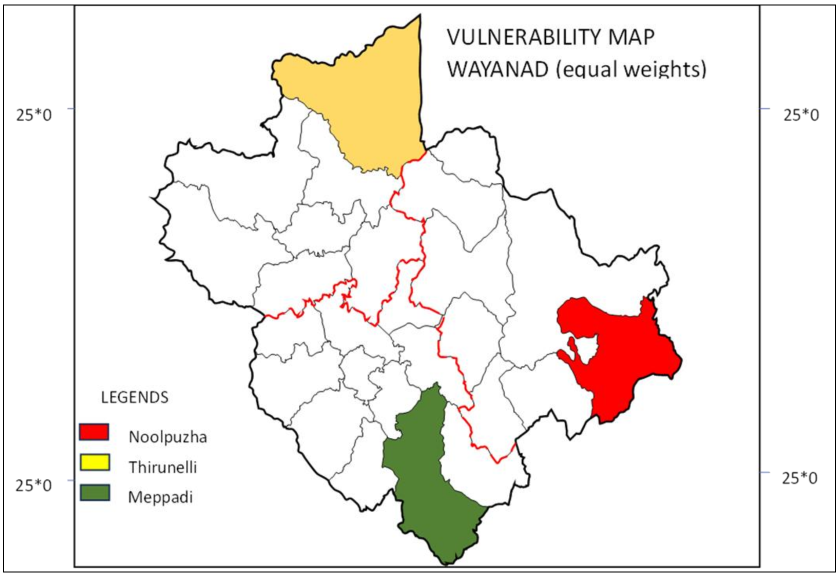

Fig 2: Map showing the vulnerability ranks in panchayats of Wayanad

Table 3: Normalized scores and vulnerability indices for equal weight

District	Sensitive					Adaptive capacity					Vulnerability Index	Rank
Noolpuzha	1	1	0.90	0	0	0.44	1.17	0	1	1	0.65	1
Meppadi	0	0.78	0	1	0.106	1.00	0.00	0.33	0.75	0	0.39	3
Thirunelli	0.167	0	1	0.75	0.035	0.00	0.17	1	0	1	0.42	2

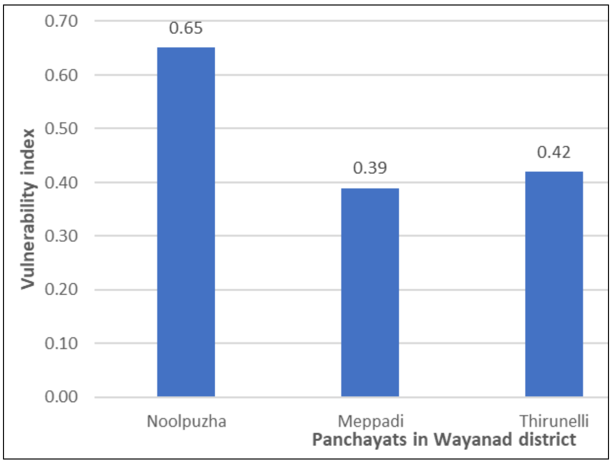

Fig 3: Socio-economic vulnerability index of panchayats in Wayanad

Three panchayats in the Wayanad district—Noolpuzha, Thirunelli, and Meppadi—have their Vulnerability Index (VI) indicated on the graph. With the highest Vulnerability Index (VI) of 0.65, Noolpuzha was the most susceptible panchayat. Thirunelli's VI of 0.42 was moderate. Meppadi was the least vulnerable of the three, with the lowest VI of 0.39. The variation in the Vulnerability Index among the panchayats can be attributed to a combination of economic dependence on medicinal NTFPs, access to resources, socioeconomic factors, infrastructure, institutional support, and environmental conditions. A greater reliance on forest resources without sufficient diversification or support systems may be the cause of Noolpuzha's increased vulnerability.

3.2. Drivers of Socio-economic vulnerability

Understanding the indicators or factors that have the greatest impact on overall vulnerability is essential for prioritizing and effectively developing and implementing adaptation strategies. Among the 10 selected indicators, the factors contributing to assessed vulnerability index value expressed as percentage are as follows (Fig. 2)

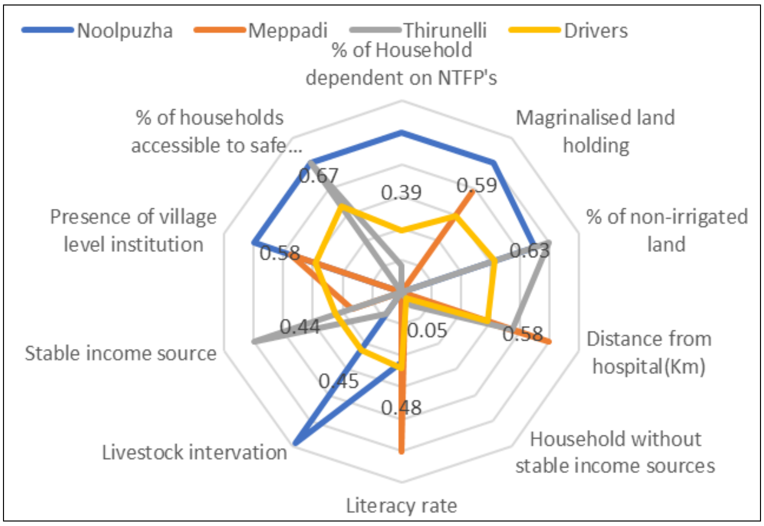

Fig 4: Drivers of Socio-economic vulnerability in Wayand district

Sixty seven percent of the people experienced difficulty in accessing clean drinking water as most of the tribal medicinal NTFP's collectors reside in hilly regions, making them particularly vulnerable due to the scarcity of drinking water. Percentage of non-irrigated land (63%) and the extent of marginalized landholdings (59%) highlighted, lack of adaptive capacity, as these landholders possess little to no financial capital, as evidenced by their small landholdings. Livelihood support institutions (58%) such as distance to healthcare facilities is also a critical driver of vulnerability, particularly during emergencies such as health issues, wild animal attacks, or snake bites. The absence of regular health check-ups and village-level institutions like banks, Krishi Vigyan Kendras (KVKs), extension offices, and pharmacies exacerbates the problem due to inadequate preparedness and risk management initiatives at both administrative and local levels.

Literacy rate (48%) was found to be the major element in reducing livelihood vulnerability. By enhancing knowledge, skills, and resilience, it creates pathways for sustainable development and empowerment among vulnerable tribal communities. Low livestock intervention (45%) exacerbates livelihood vulnerability by limiting income, food security, and resilience so strengthening livestock management through targeted interventions (e.g., veterinary services, improved breeds, training programs, and market linkages) can significantly reduce vulnerabilities and enhance sustainable development in tribal communities. Percentage of household dependent on medicinal NTFPs (39%) was an important driver of vulnerability, reflecting their reliance on forest resources for livelihood. Households without stable income sources (5%) contributed least towards vulnerability. A stable income source acts as a protective factor against livelihood vulnerability. It enhances financial security, reduces dependence on fragile resources, and provides the foundation for investments in health, education, and resilience. The goal should be to promote diverse, stable income sources at both the household and community levels to ensure sustainable development. Thus, a key purpose of vulnerability assessment is to identify the drivers or causes of vulnerability and their relative contributions.

3.3. Determinants of livelihood dependency on medicinal NTFPs

Correlation analysis

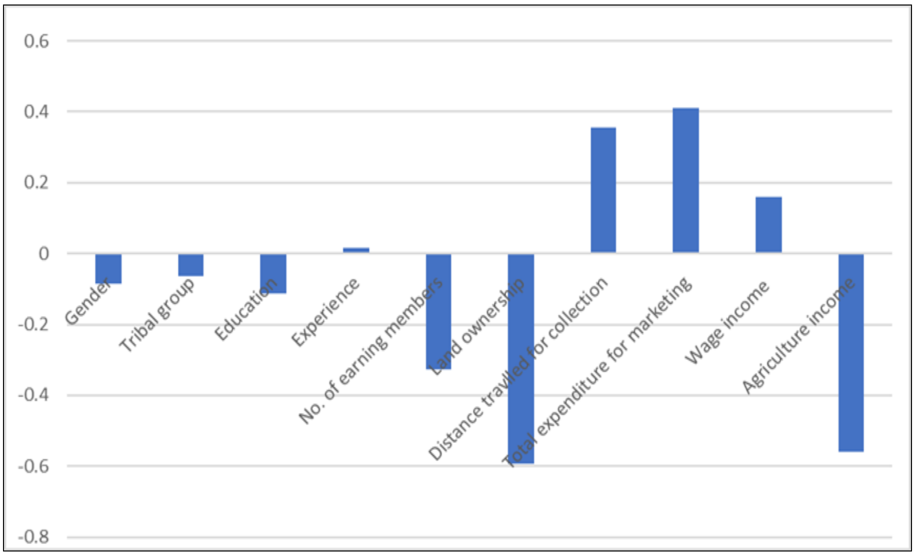

Fig 5: Correlation between Socio-economic variables and medicinal NTFP livelihood dependency

The information showed a number of factors that affect overall revenue from medicinal NTFPs, and each of these elements had a unique correlation with medicinal NTFPs income, as shown by its corresponding coefficient. The results showed that Gender, tribal group, education, experience, number of earning members, land ownership and agricultural income were negatively correlated to the medicinal NTFPs income whereas, distance travelled for collection, experience in the medicinal NTFPs collection, total expenditure for marketing and wage income were positively correlated.

Table 4: Socio-economic factors influencing medicinal NTFP dependency

Sl. No.	Variable	Coefficient	Std. Error	P value
1	Intercept	7.786	4.03	-
2	Gender	-2.904*	1.33	0.03
3	Tribal group	-0.496	0.50	0.32
4	Educational qualification	-1.078*	0.53	0.04
5	Experience in collection	-0.060	0.04	0.17
6	No. of earning members	-2.040**	0.68	0.00
7	Land ownership	-1.565**	0.59	0.00
8	Distance travelled for collection	-0.009	0.03	0.76
9	Total expenditure for marketing	0.006*	0.00	0.01
10	Share of wage income in total income	0.036	0.02	0.08
11	Share of agriculture in total income	-0.019	0.03	0.47
12	McFadden's pseudo R -squared	58.86		

Level of significance $p<0.05$* Level of significance $p<0.01$**

3.4. Logistic regression analysis

The factors impacting tribal populations' reliance on medicinal NTFPs for subsistence were evaluated using a logistic regression model. The dependent variable medicinal NTFPs household dependency is binary; a value of "0" indicates no livelihood dependency on NTFPs (i.e., NTFPs' contribution to households is less than 25%), while a value of "1" indicates an exact livelihood dependency (i.e., medicinal NTFPs' contribution to households is greater than 25%) on NTFPs. The findings indicated that the chosen variables account for a sizable amount of the variation in medicinal NTFP dependence. The results of this logistic regression analysis revealed that gender, education, number of earning members, land ownership, and marketing expenditure were the key factors determining medicinal NTFP dependence among tribal communities. Women, less-educated individuals, households with fewer earners, and those without land were more likely to rely on medicinal NTFPs for their livelihoods.

Medicinal NTFPs income and gender had a weak negative correlation (-0.0857). This implied that women relied on medicinal NTFPs more than men do. Likewise, membership in a tribal group was linked to the negative value (-0.0632). The Kattunaikka were the most dependent on forest resources. Higher education appeared to be associated with lower earnings from medicinal NTFPs, as indicated by the negative coefficient (-0.1127). Other options outside forest-based livelihoods within people with high level of education were not dependent on NTFPs for their income. Formally educated people went for other, better-paying jobs, which reduced the share of their income from medicinal NTFPs. Experience had a positive effect (0.0163), which meant that those who had more medicinal NTFP collection had a relatively higher income. To optimise profits, seasoned collectors were knowledgeable about high-value items, seasonal fluctuations, or the subtleties of sustainable collecting methods. However, the effect was relatively small, suggesting that experience alone might not increase the income share.

The number of earning members in a household had a negative effect (-0.3264) on medicinal NTFP income, implying that as the number of income earners rose, NTFP income decreased. This reflected a household's diversification away from medicinal NTFP dependency, as more members contributed income from other sources thus reducing the per capita income share from medicinal NTFPs in larger families. Land ownership also showed a negative impact (-0.5945), which indicated that landowners were less dependent on medicinal NTFPs as they engaged in alternative land-based income sources, such as agriculture. Land ownership allowed for agricultural pursuits that provided a primary income source, reducing the time and need for medicinal NTFP collection. Conversely, individuals who travelled greater distances for collection had a positive impact (0.3562). Traveling farther provided access to more abundant or higher-quality resources, allowing for better earnings, even though it involved increased time and transportation costs.

Expenditure on marketing had positive correlation with medicinal NTFP income (0.4108), highlighting those individuals who invested in marketing secured higher earnings from NTFPs. Wage income showed a positive coefficient (0.1584), suggesting that wage-earning households had a steady supplementary income, thus allowing them to enhance their medicinal NTFP-related activities. Agricultural income had a strong negative effect (-0.5594) on medicinal NTFP income, indicating that individuals or households with significant agricultural earnings were relatively less reliant on medicinal NTFPs, potentially because agriculture required significant time, labour, and focus, thereby reducing engagement in forest-based income activities. The results underscored the complex interplay between various factors and medicinal NTFP income, with both positive and negative influences shaping economic outcomes in forest-dependent communities.

The logistic regression analysis showed valuable insights into the socio-economic variables that impact individuals' dependency on medicinal NTFPs. The findings indicated several key relationships, particularly concerning gender, education, land ownership, and the number of earning members within a household. The negative coefficient associated with gender showed that males were relatively less dependent on medicinal NTFPs. This finding aligns with existing literature, which indicated that men often have greater access to alternative income sources, such as employment in non-farm sectors, compared to women, who may be more reliant on local resources like medicinal NTFPs for household sustenance (Cavendish, 2000) [4]. This reflected broader societal roles where men typically engaged in activities that diversify income, whereas women weretied to traditional resource collection and household management.

The negative relationship between educational qualification and dependency on medicinal NTFPs emphasized the importance of education in shaping livelihood strategies. Higher education levels were likely to provide more lucrative employment opportunities, reducing their reliance on medicinal NTFPs. This finding was consistent with Neumann and Hirsch (2000) [17], who highlighted that education facilitated access to alternative livelihoods, ultimately leading to a decrease in dependency on forest resources. Therefore, enhancing educational access in rural tribal areas shall empower individuals to seek diverse income-generating activities beyond medicinal NTFP collection.

Land ownership also influenced dependency on medicinal NTFPs. The negative coefficient indicated that those with more land area tend to rely less on NTFPs. This relationship could be attributed to the fact that land ownership enabled individuals to engage in agricultural production and other income-generating activities that provided financial security (Yadav *et al.*, 2017) [19]. Access to land is often associated with increased opportunities for economic diversification, allowing individuals to shift away from reliance on medicinal NTFPs for their livelihoods. The number of earning members in a household showed a negative coefficient. This suggested that households with more earners were less dependent on medicinal NTFPs, likely due to the combined income from multiple sources. Research reports showed that households with diverse income streams buffer against economic shocks, thus reducing their reliance on any single resource, including medicinal NTFPs (Adhikari, 2005) [3]. Encouraging multiple income-generating opportunities within households were beneficial in reducing dependency on forest resources.

The medicinal non-timber collectors faced varied constraints as follows.

Table 5: Constraints in medicinal NTFP collection

Sl. No.	Constraints	Frequency (Percentage)	Rank
1	Other basic facilities	51(51.00)	VII
2	Unfavourable policy by Govt.	52(52.00)	VI
3	Restriction	74(74.00)	III
4	Accessibility to food	69(69.00)	IV
5	Employment scheme	78(78.00)	II
6	Warning by forest officers	81(81.00)	I
7	Jurisdiction	64(64.00)	V

It was found that warnings from the forest department ranked highest at 81%, followed by limited employment schemes (78%), restrictions by the forest department to tribals residents, limited access to food (69%), jurisdiction-related issues (64%), Unfavourable policy by the government (52%) and the constraints faced by other basic facilities (69%) such as food, clothing etc got the least rank.

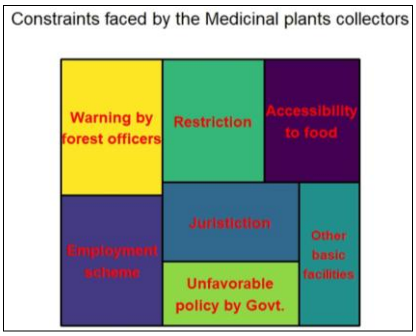

Fig 6: Tree map based on Garrette ranking

4. Conclusion

The study provided valuable insights into the livelihood vulnerability of tribal communities dependent on medicinal NTFPs in Wayanad. Critical drivers of vulnerability, included limited access to clean drinking water, high percentage of non-irrigated land prevalence of marginalized landholdings, inadequate livelihood support institutions, low literacy rates, limited livestock interventions. There is an urgent need therefore for targeted interventions to improve access to clean drinking water and healthcare facilities in vulnerable areas. Efforts should be made to enhance irrigation facilities and support sustainable land management practices. Promoting education and skill development could help diversify livelihood options and reduce dependency on medicinal NTFPs. Strengthening local institutions and improving access to credit and other support services could enhance adaptive capacity. Gender-sensitive approaches are crucial, given the higher dependence of women on medicinal NTFPs. Addressing livelihood vulnerability in forest-dependent communities requires a multifaceted approach considering the complex interplay of socio-economic and environmental factors. Future research and policy initiatives should focus on developing sustainable strategies that balance conservation efforts with the livelihood needs of tribal communities.

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6. References

1. Adger WN. Vulnerability. Glob Environ Change. 2006;16:268-81. doi:10.1016/j.gloenvcha.2006.02.006
2. Adger WN, Dessai S, Goulden M, Hulme M, Lorenzoni I, Nelson DR, *et al*. Are there social limits to adaptation to climate change? Clim Change. 2009;93:335-54. doi:10.1007/s10584-008-9520-z
3. Adhikari B. Biodiversity conservation and poverty alleviation: The case of non-timber forest products. For Policy Econ. 2005;7(2):405-18.
4. Cavendish W. Empirical regularities in the poverty-environment relationship of rural households: Evidence from Zimbabwe. World Dev. 2000;28(11):1979-2003. doi:10.1016/S0305-750X(00)00066-8
5. Chambers R, Conway G. Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. Brighton (UK): Institute of Development Studies; 1992.
6. Das S. Determinants of livelihood vulnerability to climate change among the agrarian community: Empirical evidence from the coastal region of Indian Sundarban Biosphere Reserve. Reg Stud Mar Sci. 2024;78:103777. doi:10.1016/j.rsma.2024.103777
7. Denton F. Climate change vulnerability, impacts and adaptation. What does gender matter? Gend Dev. 2002;10(2):10-20. doi:10.1080/13552070215903
8. Dow K. Exploring differences in our common future(s): the meaning of vulnerability to global environmental change. GeoForum. 1992;23(3):417-36. doi:10.1016/0016-7185(92)90052-6
9. Forest Survey of India [FSI]. India State of Forest Report 2019 [Internet]. Dehradun: FSI; 2019 [cited 2025 Apr 26]. Available from: http://www.fsi.nic.in
10. Füssel H-M. Vulnerability: A generally applicable conceptual framework for climate change research. Glob Environ Change. 2007;17:155-67. doi:10.1016/j.gloenvcha.2006.05.002
11. Gallopín GC. Linkages between vulnerability, resilience, and adaptive capacity. Glob Environ Change. 2006;16:293-303. doi:10.1016/j.gloenvcha.2006.02.004
12. Hahn MB, Riederer AM, Foster SO. The Livelihood Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change—A case study in Mozambique. Glob Environ Change. 2009;19(1):74-88. doi:10.1016/j.gloenvcha.2008.11.002
13. IPCC. Climate Change 2001: Impacts, Adaptation and Vulnerability. Summary for Policymakers. Geneva: WMO; 2001.
14. IPCC. Summary for policymakers. In: Parry ML, Palutikof JP, van der Linden PJ, Hanson CE, editors. Climate Change 2007: Impacts, Adaptation and Vulnerability. Cambridge (UK): Cambridge University Press; 2007. p. 7-22.
15. Kerala State Forest Development Corporation Limited [KSFSDCL]. Annual Report 2020 [Internet]. KSFSDCL; 2020 [cited 2025 Apr 26]. Available from: http://www.ksfsdcl.com
16. Naess L, Wolf J, Wreford A. Are there social limits to adaptation to climate change? Clim Change. 2009;93(3-4):335-54.
17. Neumann RP, Hirsch E. Commercialisation of Non-Timber Forest Products: Review and Analysis of Research. Bogor (Indonesia): CIFOR; 2000.
18. United Nations General Assembly. Programme for the Further Implementation of Agenda 21. 19th Special Session; 1997 Jun 23-27; New York.
19. Yadav A, Sharma P, Kaur K. The role of land ownership in promoting income-generating activities in rural areas. Indian J Agric Econ. 2017;72(1):61-78.
20. Zhang Q, Zhao X, Tang H. Vulnerability of communities to climate change: Application of the livelihood vulnerability index to an environmentally sensitive region of China. Clim Dev. 2019;11(6):525-42.