ISSN: 2538-2152; ECOPERSIA 2026;14(3): 289-302.

Contribution of Non-Wood Forest Products (NWFPs) to Rural Household Income in the Forests of Sardasht County, Iran

ARTICLEINFO

Article Type
Original Research

Authors
Ayshe Esmaili, *Ph.D.*[1]
Seyed Rostam Mousavi Mirkala, *Ph.D.*[2]
Ahmad Alijanpour, *Ph.D.*[3]
Marzieh Hajjarian, *Ph.D.*[4]
Sajad Ghanbari, *Ph.D.*[5*]

How to cite this article
Esmaili A., Mousavi Mirkala S.R., Alijanpour A., Hajjarian M., Ghanbari S. Contribution of Non-Wood Forest Products (NWFPs) to Rural Household Income in the Forests of Sardasht County, Iran. ECOPERSIA 2026;14(3): 289-302.

DOI:
10.48311/ecopersia.2026.119767.82885

[1] Ph.D. in Forestry, Department of Forestry, Faculty of Natural Resources, Urmia University, Urmia, Iran.
[2] Associate Professor, Department of Forestry, Faculty of Natural Resources, Urmia University, Urmia.
[3] Professor, Department of Forestry, Faculty of Natural Resources, Urmia University, Urmia, Iran.
[4] Associate Professor, Department of Forestry, Faculty of Natural Resources, Urmia University, Urmia, Iran.
[5] Professor, Department of Forestry, Ahar Faculty of Agriculture and Natural Resources, University of Tabriz, Ahar, Iran.

**** Correspondence***
Address: Research Center of Biosciences and Biotechnology (RCBB), University of Tabriz, Tabriz, Iran.
Tel: +98-41-51297234
Email: Ghanbarisajad@gmail.com
ORCID: 0000-0002-6568-1025

Article History
Received: April 19, 2026
Revised: August 3, 2026
Accepted: August 3, 2026
Published: August 8, 2026

ABSTRACT

Aims: The main objective of this study was to quantitatively estimate the amount of harvest, consumption, and share of non-wood forest products (NWFPs) in total household income in the forests of Sardasht County. The secondary objective was to examine the effect of altitude above sea level on household reliance on forest resources.

Materials & Methods: Morgan's table was used to determine the sample size. The data collected through the questionnaire include estimates of harvest amounts, consumption patterns, income from NWFPs, income from other sources, and the share of NWFPs in total household income. The study used structured interviews and questionnaires to gather socioeconomic data and determine the share of income derived from NWFPs across different altitude classes. The Spearman-Brown formula was used to calculate the overall reliability coefficient of the test. The amount of income from the NWFP harvesting area was calculated from the total income from each harvested species. It was then added to other sources of household income.

Findings: NWFPs are crucial for livelihoods in these regions, with the highest dependency found in certain villages. The socioeconomic characteristics of the community reveal significant variations in household resources, with the mean age of the head of household being 52 years, household size averaging 4.5 people, and annual income ranging from 21.31 to 649 dollars (Each dollar is equivalent to 1,700,000 rials in 2026). Agricultural and animal husbandry are the most common occupations, with the prominence of each varying by altitude. The study also highlights the economic value of different NWFPs, such as turpentine, Gala, and White Mazoj, providing the highest mean economic value at 892.47 Dollars per household per year. The share of NWFPs in household income in the study area was 24.93%. The results also showed that the share of NWFPs in household income in the second altitude class was higher than in the first and third altitude classes.

Conclusion: NWFP income made a measurable contribution to total household income, with greater dependence observed among households in the lower altitudinal class. The significant difference between household income with and without NWFP revenues highlights the economic importance of forest products for rural livelihoods. Developing local processing facilities, strengthening rural cooperatives, improving market access, and establishing online marketing channels could increase the economic benefits derived from NWFPs.

Keywords: Livelihood; Non-Wood Forest Products; Poverty Reduction; Rural Development; Zagros Region.

CITATION LINKS

[1] Pullanikkatil D., Shackleton C. M. ... [2] Ibrahim Y., Aminu S., Kumar H. Cont... [3] Ghanbari S., Sasanifar S. Agrofores... [4] Chamberlain J.L., ... [5] Sõukand R., Quave C.L., Pieroni A.,... [6] Vacik H., Hale M., ..., [7] Abdollapour J., ... [8] Mabvurira V., ... [9] Shackleton C. M., De Vos A. How man... [10] Mondo J.M., Chuma G.B., Muke M.B., ... [11] Ingram V.J. Win-wins in forest prod... [12] Adam Y.O., Pretzsch J., Pettenella ... [13] Amadu F. O., ... [14] Shackleton C.M., Pandey A.K., Tickt... [15] Pandey A., Kori D. ... [16] Chavan S.A., Uthappa... [17] Shackleton C.M., Pandey A.K. Positi... [18] Newton P., Miller D.C., Byenkya M.A... [19] Nerfa L., Rhemtulla J.M., Zerriffi ... [20] Wale E., Nkoana M.A., Mkuna E. Dete... [21] Delgado T.S., McCall M.K., López-Bi... [22] Fu Y., Chen J., Guo H., Hu H., Chen... [23] Stryamets N. Non-wood forest produc... [24] Mahdavi A.A., Shamekhi T., Sobhani ... [25] Henareh Khalyani ... [26] Endamana D., Angu K., Akwah G., She... [27] Dash M., Behera B. Determinants of ... [28] Saifullah M.K., Kari F.B., Othman A... [29] Hussain A., Ali S., ... [30] Esmaili A., Namiraniyan M., Atarod ... [31] Osewe E.O., Popa B., Vacik H., Kago... [32] Habibi B., Alipour H., Kiadaliri H.... [33] Ghanbari S., Aghai M. The way towar... [34] Heubach K., Wittig R., Nuppenau E.A... [35] Sarmad Z., Bazerghan A., Hejazi E. ... [36] Cai M., Pettenella D., Vidale E. In... [37] Saha D., Sundriyal... [38] Zenteno M., Zuidema P.A., de Jong W... [39] Völker M., Waibel H. Do rural house... [40] Chama E., Shibru S., Gebre T., Demi... [41] Ghanbari S., ... [42] Babulo B., Muys B.,... [43] Rahman M.H., ... [44] Kamanga P., Vedeld ... [45] Mamo G., Sjaastad E., Vedeld P. Eco... [46] Rayamajhi S., ... [47] Hogarth N. J., Belcher... [48] Boyapati T., Muthukumarappan K. Non...

Introduction

One of the critical indicators of sustainable rural development is poverty reduction. In this context, forests play an important role. A significant proportion of the world's poor live in rural areas and depend on land-based activities for their livelihoods. One such activity is the collection of non-wood forest products (NWFPs) [1]. For local communities, NWFPs are essential in meeting both basic and economic needs, thereby supporting welfare [2, 3]. Beyond their material value, these products provide intangible cultural, spiritual, and recreational benefits (e.g., aesthetic, therapeutic, recreational, and tourism facilities) [4, 5, 6] and hold local, regional, and sometimes international significance. NWFPs encompass all forest-derived materials except timber, including various plant and animal materials such as flowers, leaves, stems, roots, fruits, sap, gums, and fungi. These resources are used for medicinal, industrial, dietary, decorative, and ritual purposes [7,8], which contribute significantly to local economies and well-being [9,10]. In many countries, NWFPs represent an important source of employment [11]. They possess considerable economic potential to enhance community welfare and contribute significantly to food security and biodiversity conservation [12, 13]. As such, they form an economic foundation for millions of households worldwide [14, 15]. Nearly 80% of people in developing countries rely on NWFPs to help meet their basic health and nutritional needs [16].

Research indicates that the degree of household dependency on NWFPs, measured by the share of income derived from these products, varies globally from less than 5% to over 90% [17]. Several studies refer to this relationship between forests and communities' reliance on NTFPs as forest dependency [18, 19, 20]. In many developing countries, NTFPs significantly contributed to local economies, providing employment and financial stability for rural populations [21]. For instance, smallholder families living near forests earned between 10% and 25% of their household income from NTFP activities [22]. Therefore, these products play an important role directly and indirectly in household economies and, more broadly, in national economies, and are considered a way for economic growth and poverty reduction in rural areas with abundant forest resources worldwide and in Iran [23]. In Iran, particularly in the forested Zagros region, local communities and forest dwellers regularly harvest NWFPs. These products constitute a key source of livelihood and income for forest-adjacent populations, with these ecosystems supplying a wide range of essential goods and services.

In the Zagros vegetation area, nearly every tree species provides NWFPs of value to humans and animals, granting these forests a privileged position among Iran's vegetative regions [24]. Legal and technical restrictions on timber harvesting, coupled with the high diversity and value of NWFPs in this region—including Sardasht forests—have directed the focus of local communities and forest users toward these resources. Prominent trees and shrubs yielding NWFPs in Zagros include various oak species (producing acorns and galls), hawthorn, wild walnut, wild pear, almond, raspberry, wild pistachio, and fig.

Empirical studies highlight the significant economic role of NWFPs for Zagros communities. Studies in the region report varying income shares: approximately 3.8% of annual household income in Kamiyaran,

primarily from turpentine [24], and up to 25% in northern Zagros communities [25]. Abdollapour et al. (2020) noted that NWFPs including turpentine sap, gazo (*Astragalus* gum), galls, medicinal plants, acorns, firewood, and charcoal contribute 15.12% to annual household livelihood profits [7]. This underscores that the principal importance of Zagros forests lies not in timber production, but in soil and water conservation, the provision of diverse NWFPs, and air pollution mitigation, necessitating their careful management and preservation. Globally, the contribution of NWFPs to household income varies substantially by region. Studies report levels of dependence on NWFPs of around 50% in Central Africa [26]; 6% in India [27]; 24% in Malaysia [28]; and 8.3% in other settings [2]. Recent research continues to show this variation. In Pakistan, riverine forest resources accounted for 67%, 53%, and 43% of median household income for low-, middle-, and high-income households, respectively [29]. In Kenya, the annual monetary value of total tangible ecosystem services from the Kakamega forest was estimated at US$283,362 [30]. Taken together, these studies confirm that the economic role and relative importance of harvested NWFPs vary considerably in different regions of the world. This difference may be due to the density of NWFPs in the region, access to forests, demand, presence or absence of intermediaries, etc.

Studies on the exploitation of NWFPs of the Zagros forests have been conducted in other areas of the Zagros with different physiographic, silvicultural, edaphic, and climatic characteristics than the Sardasht region. Therefore, it is necessary to conduct similar studies in the Sardasht region regarding the economic feasibility of harvesting NWFPs, as well as the contribution of these products to household livelihoods, which is unknown. Therefore, the purpose of this research is to examine the role of NWFPs in the livelihood of rural households across different altitude classes. Specifically, it aims to assess the economic contribution of these products to household income, exploring variations in income from NWFPs based on socioeconomic factors and elevation. The research involves a comprehensive survey, utilizing structured questionnaires and interviews with household heads, to collect data on harvesting practices, household income, and socioeconomic characteristics. The research hypothesis is that the role of non-timber products in the livelihoods of rural households is equal in different altitude classes.

Materials & Methods

Study Area

Sardasht city, covering an area of over 1,411 square kilometers, is located in the southwest of West Azerbaijan province, at a longitude of 40°28’45” E and latitude of 69°36’ N. The city sits at an elevation of 1,510 meters above sea level, with a mean annual rainfall of 807 mm and an annual temperature of 13.7°C. The Dumarten index for this area is 34, classifying it as one of the wetter regions. Sardasht’s forests span more than 80,000 hectares. The primary forest species in the area include three types of *Quercus*: *Quercus infectoria* Oliv., *Quercus libani* Oliv., and *Quercus brantii* Lindl, along with associated species such as *Pistacia atlantica*, *Ficus carica*, *Punica granatum*, *Prunus avium*, *Pyrus* sp., *Vitis* sp., *Crataegus* sp., *Amygdalus communis*, and *Acer monspessulanum* [31]. The density of three types of *Quercus* species and *Pistacia atlantica* per hectare is higher

than that of other species in the region.

Data Collection and Analysis

In this study, considering the altitudinal distribution of Sardasht forests and the smaller range of changes in these forests, the forests of this region were first divided into three altitude classes: less than 1000 meters, between 1000 and 1400 meters, and more than 1400 meters. In each altitude class, the customary forests of two villages whose residents used NWFPs were selected as samples, and a total of six villages were studied. It was ensured that other conditions such as access to the forest, access to the market, access to the road, etc. were also similar in these villages (Figure 1).

After selecting the villages, Morgan's table, a commonly used tool in social sciences, was applied to determine the sample size at the village level. Table 1 specifies the appropriate sample size for each population size to ensure the minimum required accuracy [24, 32].

Table 1) Estimated sample size in altitude classes and the whole area

Elevation above Mean Sea Level (m)	Site	Total Number of Households (N)	Estimated Sample Size (n)
<1000	Arzane	13	12
	Garvis	42	37
1000 – 1400	Gandke	23	22
	Banazer	45	40
>1400	Sostan	18	17
	Bobane	22	21
Total		153	149

The total estimated sample size across the three altitude classes was 149 samples. Since the sample size for each elevation class was similar to the total number of households in that class, all households were selected for the study, resulting in the completion of 153 questionnaires.

To collect socioeconomic data, a questionnaire and structured interviews with household heads were used [33, 24, 34]. The validity of the questionnaires was ensured

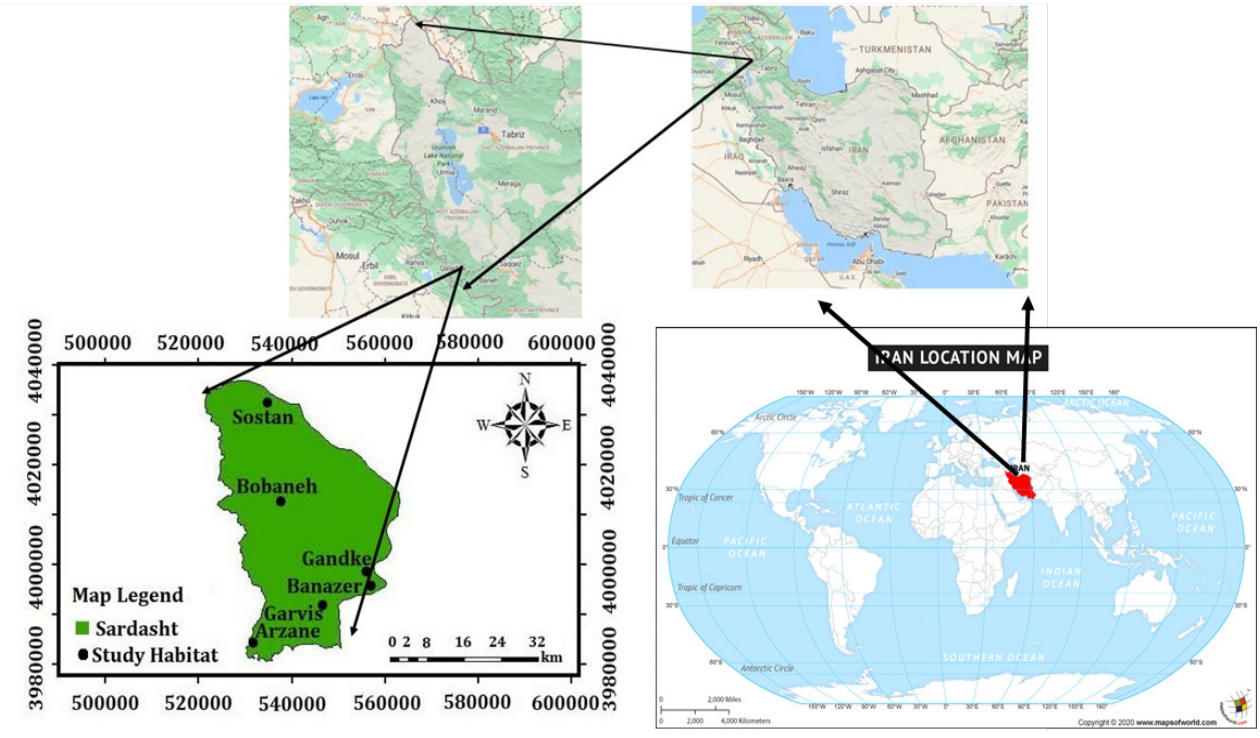

Figure 1) Location of the investigated area in Zagros forests, Sardasht, West Azerbaijan Province.

through the evaluation of professors and experts. The reliability was assessed using Guttman's bisection method, and Spearman-Brown's formula was applied to calculate the reliability coefficient for the entire test [35].

$$R=\frac{2r_{11}}{(1+r_{11})}=\frac{2\times0.74}{(1+0.74)}=0.85 \qquad \text{Eq. (1)}$$

where r_{11} is the correlation coefficient between the two halves, and R is the reliability coefficient of the entire questionnaire or test Questionnaires were completed at two levels: village (6 questionnaires) and household (153 questionnaires). The village questionnaire addressed general questions, while the household questionnaire focused on questions specific to the household. The household questionnaire collected data on various characteristics, including the personal and professional details of the household heads, the types of harvested products, their prices, the methods of processing, the costs of harvesting and processing, the quantities harvested and consumed, as well as information on selling, marketing, and household income sources. The term includes occupations such as drivers, shopkeepers, and repair workers. For price and cost information for each kilogram of fruit, the mean market price of fruits sold in the local market was used for the calculations [36, 37]. To assess the role of NWFPs in household livelihoods, the share of income from NWFPs was calculated by determining the proportion of household income derived from the collection of NWFPs. To compare dependence on NWFPs across different altitude classes, this share was calculated for each class and for all villages combined [34,27].

$$Tln=\left(\sum_{i=1}^{n}P_I\times Q_I+\sum_{i=1}^{n}I_i\right)-\sum_{i=1}^{n}C_i \qquad \text{Eq. (2)}$$

where Tln is total household income, P_I is product price, Q_I is product quantity, I_i is income from other activities, and C_i is harvest costs.

Findings

In this section, the results are presented regarding the variety of harvested species, mean harvest quantities, the economic value of harvested products at the household level, the share of income derived from harvesting NWFPs relative to total household income, and the processing status.

Descriptive Information of the Studied Community:

According to the results, the mean age of the household head was 51.81 years. The mean household head owned 1.67 hectares of agricultural land and 36.4 livestock heads. The mean annual household income was $1,473.39 (Table 2).

The results of the survey of the occupations of household heads showed that in the villages studied, agriculture, animal husbandry, beekeeping, employees and others (driver, shopkeeper and repairman) are prevalent (Figure 2). Most people in the region are engaged in agricultural and animal husbandry activities, and there are also side activities such as beekeeping. In the survey of the main occupation, the results showed that agriculture has the lowest rate and animal husbandry has the highest rate in the third class. With increasing altitude above sea level, the possibility of agriculture decreases and, on the other hand, the opportunity for animal husbandry increases.

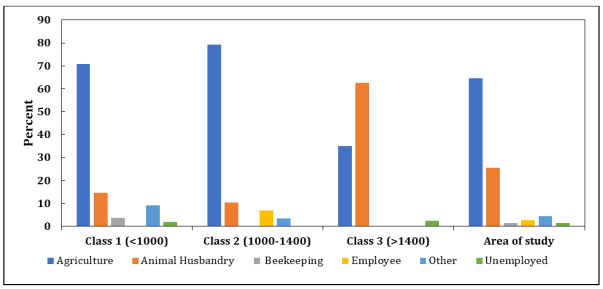

Figure 2) The main occupation status of the household heads in the altitude classes and the whole region

Table 2) Descriptive information of the investigated rural community.

Characteristic	Minimum	Mean	Maximum	St.d
Age of Head of Household (years)	22	51.81	85	14.13
Household Dimension (person)	1	4.52	18	2.29
Household Agricultural Land (hectares)	2	1.67	18.5	3.28
Number of Household Livestock (Heads)	2	36.04	275	48.44
Annual Household Income (Dollar)	34	1473.39	5492.26	251.95

Table 3) Mean price, harvest, and economic value of harvested products.

Product Name	Number of Households	Mean Price of the Product (Dollar)	Mean total Annual Harvested Product of the household (kg)	Mean Economic Value of Harvested NWFPs (Dollar.$HH^{-1}.Y^{-1}$)
Oak Seeds	35	0.09	394.29	35.49
Pistacia Seeds (P. atlantica)	89	0.18	118.37	21.31
White Mazoj (Q. infectoria)	120	0.87	103.67	90.2
Turpentine (P. atlantica Desf.)	113	6.52	99.47	648.54
Green Mazoj (Q. infectoria)	117	1.4	62.14	87
Gala (Q. infectoria)	36	8.7	17.67	153.73
Gaz juice (P. atlantica)	14	5.22	7.71	40.25
Gaz Engbin (Astragalus adscendens Boiss.)	14	6.96	5.97	41.55

- Economic Value of Harvested Products

The results of this study showed that in the study area, the lowest and highest economic value per kilogram of NWFPs are related to oak seeds and Gazangbin, respectively. The lowest and highest mean annual household harvest are related to Gazangbin and oak seeds, respectively. The lowest and highest mean economic value of harvested products are also related to *Pistacia* seeds and turpentine (*P. atlantica* Desf.) (Table 3).

- The Income of NWFPs in Household Income

In Figure 3, the mean income of the whole household, taking into account the income from the harvesting of NWFPs and also without considering this income, is shown in different altitude classes. According to the figure, there is a relatively large difference in the income of the whole household in terms of income from NWFPs. Income from NWFP harvesting is relatively high at the first and second altitude levels, and at the third altitude level, it is lower than at the other two levels. This means that households in the first and second altitude classes are more dependent on NWFPs

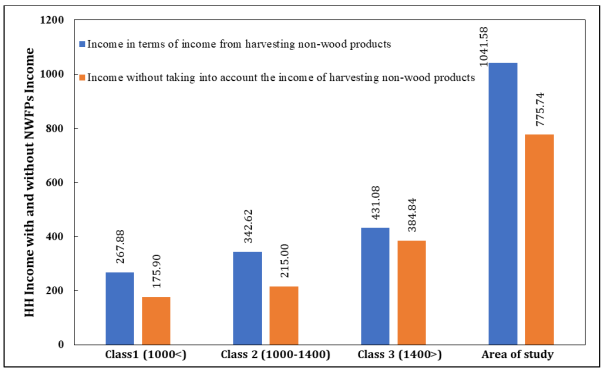

Figure 3) The mean annual income of the household in the altitude classes and the entire region in terms of the income from harvesting NWFPs and without it.

Comparison of the mean household income in two situations, with and without income from NWFPs, was done with the paired t-test. According to the results, the difference between these two situations is significant at the village level, and NWFPs have a relatively large impact on household income (Table 4). The results of the analysis of variance table show a significant difference between the income of the whole household, taking into account the income from the place of harvesting of NWFPs and without taking into account this income, in different altitude classes. The analysis of variance related to the comparison of means in altitude classes is given in Table 5.

Table 6 presents the results of an analysis of variance (ANOVA) on the percentage of NWFPs in household income. This suggests that the contribution of NWFPs to household income differs significantly across groups. The results of this survey showed that the income from agriculture and animal husbandry in the third altitude class has the largest share in household income.

Agriculture was the dominant occupation in the study area (64.71%), followed by animal husbandry (25.49%). Livelihoods varied with altitude. In the lower (<1000 m) and middle (1000–1400 m) elevation classes, agriculture was the primary occupation, accounting for 70.9% and 79.3% of households, respectively. In contrast, at higher elevations (>1400 m), animal husbandry became the main livelihood (62.5%), while agriculture declined to 35.0%. Beekeeping, salaried employment, other occupations, and unemployment represented only a small proportion of households across all altitude classes, indicating a clear shift from crop farming to livestock production with increasing elevation (Figure 4).

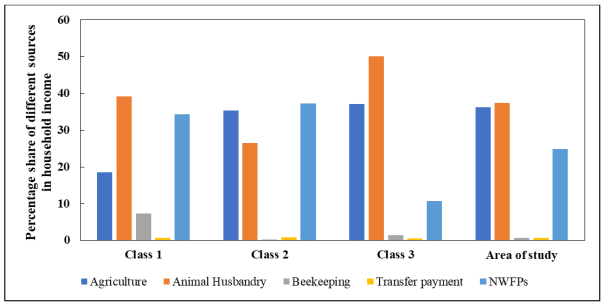

Figure 4) The percentage share of different activities in the total household income in different classes.

The results of the analysis of variance related to the percentage share of each household income-generating activity in total household income show a significant difference in the contribution of these activities across different altitude classes and the entire study area. The analysis of variance comparing the means across altitude classes is provided in Table 7.

Socioeconomic Characteristics and NWFP Income

Table 8 presents the Pearson correlation between income from NWFPs and various household characteristics across the entire study area. The table shows the relationship between NWFP income and factors such as the number of animals, job type, education, family size, gender, and the age of the supervisor. The results reveal several significant correlations. For example, job

shows a negative and significant correlation with NWFPs' income, indicating that higher job opportunity levels are associated with lower income from NWFPs.

Discussion

The results showed that, at the regional level, the highest household harvests were from oak seeds, white Mazoj (*Q. infectoria*), and turpentine, and the highest economic value was derived from the harvest of turpentine, white Mazoj, and green Mazoj (*Q. infectoria*), which are sold raw. A study in Kamyaran forests showed that the highest economic value of harvested non-timber products was related to turpentine, which is consistent with the present study [24]. In Baneh forests, the highest amount of non-timber products harvested is for firewood, gazangbin, and oak seeds, respectively, and the highest economic value of non-timber products is for gla, gazangbin, and mazoj, respectively [25]. This difference could be due to differences in forest type, tree density in each region, and the abundance of non-timber products in the year studied in each region. It can be concluded that the selection of species for harvesting is influenced by

Table 4) t-test analysis of mean household income with and without NWFP income at the altitude classes.

Paired t-Test	Village	Mean	Standard Error	t-Value	df	Significant Level
With and without NWFPs Income	Class 1	91.98	6.87	13.39	54	0.00
With and without NWFPs Income	Class 2	127.62	10.38	12.29	57	0.00
With and without NWFPs Income	Class 3	46.24	9.87	4.68	39	0.00

Table 5) ANOVA of mean household income with and without NWFP income at the altitude classes.

		Sum of Squares	Mean of Squares	F-Value	Significance Level
Total Income with NWFPs	Between Groups	618086.36	309043.18	5.13	0.00
	Within Groups	9030869.17	60205.79		
	Total	9648955.53			
Total Income without NWFPs	Between Groups	1097016.74	548508.37	10.88	0.00
	Within Groups	7564757.00	50413.71		
	Total	8661773.74			

Table 6) Analysis of variance related to the percentage of NWFPs in household income.

Sum of Squares		df	Mean of Squares	F-Value	Significance Level
Between group	1799096.475	2	899548.24	20.13	0.00
Within Group	6702918.42	150	44686.12		
Total	8502014.9	152			

Table 7) Analysis of the variance of the percentage share of each of the income-generating activities of the household in the total income of the household

Characteristic		Sum of Squares	df	Mean of Squares	F-Value	Significance Level
Income Products	Between Group	157009021262.77	2	78504510631.39	18.16	0.00
	Within Group	648391614655.87	150	4322610764		
	Total	8054006359180.64	152			
Transfer Payment	Between Group	40369705.27	2	20184852.64	4.63	0.01
	Within Group	464671471.2	150	4364476.48		
	Total	695041176.5	152			
Beekeeping Income	Between Group	11003057831.87	2	5501528916	3.15	0.04
	Within Group	26172968965.52	150	1744861793		
	Total	272732326797.39	152			
Livestock Income	Between Group	418993316649.25	2	209496658324.63	6.25	0.00
	Within Group	5025430461128.53	150	33502869740.86		
	Total	544423777777.78	152			
Agricultural Income	Between group	306028466277.38	2	153014233138.69	10.65	0.00
	Within Group	2154361036990.6	150	14362406913.27		
Total		2460389503267.97	152			

Table 8) Pearson correlation between income of NWFPs and household characteristics in the study area

Characteristic	Age of the Family Head	Gender	Family Size	Education	Job	Number of Animals	NWFPs Income
Age of the Supervisor	1						
Gender	-0.11	1					
Family Size	0.13	0.15	1				
Education	-0.55**	0.18*	-0.12	1			
Job	-0.19*	0.16	0.19*	0.26**	1		
Number of Animals	0.19	0.7	0.63**	-0.22**	0.37**	1	
NWFPs Income	0.12	0.15	0.13	-0.06	-0.18*	0.08	1

Note: * shows significant at the five percent level.

the high abundance of NWFPs in the region. In the study area, *Quercus infectoria* and *Pistacia atlantica* trees have the highest density per hectare, so their NWFPs are harvested more. Also, market access and profitability are important factors that motivate people to harvest NWFPs [37,38]. Due to the ease of sale and good profitability of turpentine and Mazoj, the species producing these products, such as *Q. infectoria* and *P. atlantica*, are less susceptible to destruction and excessive harvesting than other species. Because, along with agriculture and animal husbandry, they are a source of continuous income for local people, which will create a sense of belonging in them, which will ultimately lead to the continued protection of forests. In general, people who make their living from these forests always consider forest conservation, although they consider providing for their families' livelihoods more important than forest conservation [24].

The results also revealed that the mean share of household income from harvesting NWFPs varies by altitude class. NWFPs contribute the highest share of household income in the second altitude class (37.25%) and the lowest in the third altitude class (10.73%) (Figure 3). This can be attributed to the high harvest of turpentine sap in the second altitude class, which is the most economically valuable product, and better access to local markets in these villages. Access to local markets greatly influences the harvest and sale of these products, as confirmed by other studies [12, 39]. In contrast, livestock farming is the primary occupation in the third altitude class, with less opportunity to harvest NWFPs, resulting in a lower share of NWFPs in total household income compared to the other two altitude classes (Figure 2). This aligns with findings from other studies that show lower household income from NWFPs when income from other sources, such as agriculture and animal husbandry, is higher [29,40].

Ghanbari et al. (2017)also found that in high altitudes, where animal husbandry is more prevalent, less attention is given to NWFPs, resulting in a lower share of these products in total household income [41]. This could be because herders have less time to harvest NWFPs. After all, they are busy tending to their livestock. Conversely, in the first and second altitude classes, mean household income from other sources is lower than in the third altitude class, which is consistent with findings that low-income households tend to earn a larger share of their income from NWFPs [19, 29, 42, 43]. However, some studies suggest the opposite [41, 44]. This could be because the main occupation in these two classes is agriculture and farmers have more free time to harvest NWFPs.

Another reason for the lower share of NWFPs in the third altitude class is the lower harvest of turpentine in this class compared to the others. Turpentine harvesting is a major contributor to the share of NWFPs in household income. Overall, the share of NWFPs in total household income for the entire region is 24.93%. This finding is consistent with a study in Baneh city [25], which reported a 25% share of NWFPs in household income. In contrast, [7] found a lower share (15.12%) in Kurdistan and West Azerbaijan, where livestock farming also plays a significant role in household income. Research [34, 45, 46] indicates that, on average, 39% of household income comes from NWFPs, while other studies, such as those by [37, 40], show the share to range from 19% to 32%.

In this study, agriculture and animal

husbandry account for 36.2% and 37.42% of total household income, respectively. These findings align with studies by [24], which indicate that income from NWFPs is generally lower than income from livestock and agriculture. However, increasing the income from NWFPs in the region can be achieved through better identification of these products and services (e.g., nature tourism), as well as addressing current challenges such as establishing sales cooperatives, enhancing links between users and sales centers, creating processing workshops, and focusing on species with increased abundance [12, 48].

While these efforts could increase household income and reduce poverty, it is important to note the potential negative side effects, such as overharvesting and unsustainable use, as demand and market access grow [17, 48].

Conclusion

The share of NWFPs in household income in the study area is 24.9 percent. This share could be much higher than this amount because, when analyzing the income from harvesting NWFPs, it should be noted that in the study area NWFPs are exploited as a source of income by people outside the area and even city residents, in addition to local communities and rural operators, which means that the users of NWFPs are far more than the local people. As a result, a part of forest income could not be recorded in this study and similar studies. The share of NWFPs in household income in the second altitude class was higher than in the first and third altitude classes. The share of NWFPs in household income can be increased by setting up processing workshops, rural cooperatives, and online markets for selling NWFPs, and by exporting products abroad. It is suggested that, in restoration plans, priority should be given to reforestation with *Pistacia atlantica* due to its special characteristics, especially in turpentine and edible fruit production, and to *Q. infectoria* due to its fruit production, Mazoj and Gala. The findings demonstrate that the contribution of NWFPs to rural livelihoods differs substantially among altitude classes, indicating that management interventions should be tailored to local ecological and socioeconomic conditions rather than applying a single strategy across the region. In the first altitude class, where agriculture and NWFP collection are both important livelihood activities, management should focus on improving the value chain of existing products. Establishing local processing and grading facilities for mazoj and wild pistachio products, strengthening producer cooperatives, and improving market access could increase household income without necessarily increasing harvesting pressure. Such measures would enhance the economic value of harvested products while encouraging sustainable forest management. In the second altitude class, where NWFPs contributed the largest share of household income (37.25%), management efforts should prioritize the sustainable harvesting of economically valuable products, particularly turpentine from *P. atlantica* Desf. ex Poir. and white and green mazoj (galls of *Q. infectoria* G.Olivier). Since these products generate the highest economic returns, implementing harvesting guidelines, monitoring extraction intensity, and providing training on sustainable collection techniques are essential to prevent resource depletion while maintaining local livelihoods.

In contrast, the third altitude class exhibited

the lowest dependence on NWFPs (10.73%) because livestock production constitutes the dominant livelihood. In these areas, management should not focus on increasing harvesting intensity but rather on integrating NWFP conservation with sustainable grazing management. Restoration and enrichment planting of *Q. infectoria* and *P. atlantica*, combined with controlled grazing practices, could improve the long-term productivity of forest ecosystems while maintaining multiple livelihood options for local communities. Across all altitude classes, the dominance of *Q. infectoria* and *P. atlantica* in both harvest volume and economic value highlights these species as priorities for conservation and sustainable management. Their protection through community-based forest management, regeneration programs, and regular monitoring would safeguard the primary sources of NWFP income while supporting forest conservation objectives. Finally, any policy designed to increase household income through improved market access, cooperative development, or product processing should be accompanied by sustainable harvesting regulations and periodic resource assessments. Since the highest-income products are harvested directly from wild populations, increased commercialization without effective monitoring may lead to overexploitation and reduce the long-term ecological and economic sustainability of these forest resources.

Acknowledgments

None declared by Authors.

Authors' Contribution: All authors contributed to the study conception and design. **A Esmaili, R Mousavi Mirkala, A Alijanpour, M Hajjarian,** and **S Ghanbari** performed material preparation, data collection, and analysis. **A Esmaili** and **S Ghanbari** wrote the first draft of the manuscript. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding/ Support: None declared by Authors.

Conflicts of Interest: None declared by Authors.

AI Use Declaration: ChatGPT 4 was used for language editing. The authors have reviewed and edited the output and take full responsibility for the content of the publication.

References

1. Pullanikkatil D., Shackleton C.M. Poverty reduction strategies and non-timber forest products. In: Poverty Reduction through Non-Timber Forest Products: Personal Stories. Cham: Springer; 2018. p. 3–13.
2. Ibrahim Y., Aminu S., Kumar H. Contribution of non-timber forest products to rural household income and livelihood security in Jakusko Local Government Area of Yobe State, Nigeria. J. Pharmacogn. Phytochem. 2018; 7(6):509–513.
3. Ghanbari S., Sasanifar S. Agroforestry systems in Arasbaran region: Obstacles and opportunities for farmers in combating climate change. ECOPERSIA 2024; 12(4):363–377.
4. Chamberlain J.L., Cunningham A.B., Nasi R. Diversity in forest management: Non-timber forest products and bushmeat. Renew. Resour. J. 2004; 22(2):11–19.
5. Sõukand R., Quave C.L., Pieroni A., Pardo-de-Santayana M., Tardío J., Kalle R., Łuczaj Ł., Svanberg I., Kolosova V., Aceituno-Mata L. Plants used for making recreational tea in Europe: A review based on specific research sites. J. Ethnobiol. Ethnomed. 2013; 9(1):58.
6. Vacik H., Hale M., Spiecker H., Pettenella D., Tomé M. Non-Wood Forest Products in Europe: Ecology and management of mushrooms, tree products, understory plants and animal products. Outcomes of the COST Action FP1203 on European NWFPs. Norderstedt: BoD; 2020. p. 416.
7. Abdollapour J., Akbari H., Valipour A., Lotfalian M. The role of forest products in the livelihoods of the local communities of North Zagros (Case

study: Kurdistan and West Azerbaijan Provinces). Iran. J. For. Ecol. 2020; 7(14):90–100.
8. Mabvurira V., Makhubele J.C. Children of the forests: Child gatherers and traders in non-wood forest products in the Mazowe Valley area in Zimbabwe. Int. J. Mod. Anthropol. 2018; 2(11):48–62.
9. Shackleton C. M., De Vos A. How many people globally actually use non-timber forest products? For. Policy Econ. 2022;135:102659.
10. Mondo J.M., Chuma G.B., Muke M.B., Fadhili B.B., Kihye J.B., Matiti H.M., Sibomana C.I., Kazamwali L.M., Kajunju N.B., Mushagalusa G.N. Utilization of non-timber forest products as alternative sources of food and income in the highland regions of the Kahuzi-Biega National Park, eastern Democratic Republic of Congo. Trees For. People. 2024; 16:100547.
11. Ingram V.J. Win-wins in forest product value chains? How governance impacts the sustainability of livelihoods based on non-timber forest products from Cameroon [dissertation]. Amsterdam: University of Amsterdam; 2014: 361 p.
12. Adam Y.O., Pretzsch J., Pettenella D. Contribution of non-timber forest products livelihood strategies to rural development in drylands of Sudan: Potentials and failures. Agric. Syst. 2013; 117(1):90–97.
13. Amadu F. O., Miller D. C. The impact of forest product collection and processing on household income in rural Liberia. For. Policy Econ. 2024; 158:103098.
14. Shackleton C.M., Pandey A.K., Ticktin T. Ecological Sustainability for Non-Timber Forest Products. Milton Park: Taylor & Francis; 2015.
15. Pandey A., Kori D. Non-destructive harvesting practices of *Terminalia arjuna* (Arjuna), *Phyllanthus emblica* (Aonla) and *Andrographis paniculata* (Kalmegh). Indian For. 2011; 137(11):1269–1276.
16. Chavan S.A., Uthappa A., Sridhar K., Keerthika A., Handa A., Newaj R., Kumar N., Kumar D., Chaturvedi O. Trees for life: Creating sustainable livelihood in Bundelkhand region of central India. Curr. Sci. 2016; 111(6):994–1002.
17. Shackleton C.M., Pandey A.K. Positioning non-timber forest products on the development agenda. For. Policy Econ. 2014; 38:1–7.
18. Newton P., Miller D.C., Byenkya M.A.A., Agrawal A. Who are forest-dependent people? A taxonomy to aid livelihood and land use decision-making in forested regions. Land Use Policy. 2016; 57(1):388–395.
19. Nerfa L., Rhemtulla J.M., Zerriffi H. Forest dependence is more than forest income: Development of a new index of forest product collection and livelihood resources. World Dev. 2020; 125:104689.
20. Wale E., Nkoana M.A., Mkuna E. Determinants of rural household livelihood dependence on non-timber forest products: A case study from Inanda Community, KwaZulu-Natal, South Africa. Front. For. Glob. Change. 2022; 5:788815.
21. Delgado T.S., McCall M.K., López-Binnqüist C. Non-timber forest products: Small matters, big significance, and the complexity of reaching a workable definition for sustainability. Small-Scale For. 2023; 22(1):37–68.
22. Fu Y., Chen J., Guo H., Hu H., Chen A., Cui J. Rain forest dwellers' livelihoods: Income generation, household wealth and NTFP sales, a case study from Xishuangbanna, southwest China. Int. J. Sustain. Dev. World Ecol. 2009; 16(5):332–338.
23. Stryamets N. Non-wood forest products for livelihoods. IUFRO Landscape Ecology Conference: Sustaining Humans and Forests in Changing Landscapes. Bosque. 2012; 33(3):329–332.
24. Mahdavi A.A., Shamekhi T., Sobhani H. The role of non-wood forest products in the livelihood of forest dwellers (Case study: Kamyaran County, Kurdistan Province). Iran. J. For. Poplar Res. 2011; 19(3):370–379.
25. Henareh Khalyani J., Namiranian M., Khodayee Tehrani V., Javanmiripour M. Investigation of non-timber forest products and their contribution to poverty alleviation of rural communities in northern Zagros forests (Force field analysis of issues and problems). Iran. J. For. Poplar Res. 2015; 23(2):307–319.
26. Endamana D., Angu K., Akwah G., Shepherd G., Ntumwel B. Contribution of non-timber forest products to cash and non-cash income of remote forest communities in Central Africa. Int. For. Rev. 2016; 18(3):280–295.
27. Dash M., Behera B. Determinants of household collection of non-timber forest products (NTFPs) and alternative livelihood activities in Similipal Tiger Reserve, India. For. Policy Econ. 2016; 73(1):215–228.
28. Saifullah M.K., Kari F.B., Othman A. Income dependency on non-timber forest products: An empirical evidence of the indigenous people in Peninsular Malaysia. Soc. Indic. Res. 2018; 135(1):215–231.
29. Hussain A., Ali S., Dilawar A., Jiang X., Tanveer A., Khan S. Exploring economic dependence of rural communities on Indus riverine forest resources for livelihoods in Sindh, Pakistan. Sustain. Futures. 2025; 10:101250.
30. Esmaili A., Namiraniyan M., Atarod P. Allometric models for estimating biomass and leaf area index of Quercus infectoria in the Zagros forests

(Case study: Parastan region, Sardasht) [Master's thesis]. Tehran: University of Tehran; 2013.
31. Osewe E.O., Popa B., Vacik H., Kagombe J.K., Osewe I., Abrudan I.V. Unlocking pathways to livelihood improvement through valuation of ecosystem services in Kakamega Forest, Kenya. Trees For. People. 2025; 101031.
32. Habibi B., Alipour H., Kiadaliri H. A study on the participation level of forest dwellers and its effective factors in forest management (Case study: Babolkenar area, Babol Township). Iran. J. For. Poplar Res. 2014; 22(1):109–120.
33. Ghanbari S., Aghai M. The way towards getting back financial benefits from agroforestry systems and improving food security (Case of Arasbaran Biosphere Reserve). ECOPERSIA 2021; 9(1):33–41.
34. Heubach K., Wittig R., Nuppenau E.A., Hahn K. The economic importance of non-timber forest products (NTFPs) for livelihood maintenance of rural West African communities: A case study from northern Benin. Ecol. Econ. 2011; 70(11):1991–2001.
35. Sarmad Z., Bazerghan A., Hejazi E. Research Methods in Social Sciences. Tehran: Aghah Publication; 2011: 405 p.
36. Cai M., Pettenella D., Vidale E. Income generation from wild mushrooms in marginal rural areas. For. Policy Econ. 2011;13(3):221–226.
37. Saha D., Sundriyal R.C. Utilization of non-timber forest products in humid tropics: Implications for management and livelihood. For. Policy Econ. 2012;14(1):28–40.
38. Zenteno M., Zuidema P.A., de Jong W., Boot R.G.A. Livelihood strategies and forest dependence: New insights from Bolivian forest communities. For. Policy Econ. 2013; 26:12–21.
39. Völker M., Waibel H. Do rural households extract more forest products in times of crisis? Evidence from the mountainous uplands of Vietnam. For. Policy Econ. 2010; 12(6):407–414.
40. Chama E., Shibru S., Gebre T., Demissew S., Woldu Z. Forest products monetary contribution to households' income: A means to improve the livelihood of a low-income rural community in South Ethiopia. Heliyon. 2023; 9(11):e21553.
41. Ghanbari S., Heshmatol Vaezin S.M., Shamekhi T. Identification and economic prioritization of non-wood forest products of Arasbaran forests based on traditional harvest statistics (Case study: Ilganachay Watershed). Iran. J. For. 2017; 9(3):411–425.
42. Babulo B., Muys B., Nega F., Tollens E., Nyssen J., Deckers J., Mathijs E. The economic contribution of forest resource use to rural livelihoods in Tigray, northern Ethiopia. For. Policy Econ. 2009; 11(2):109–117.
43. Rahman M.H., Roy B., Islam M.S. Contribution of non-timber forest products to the livelihoods of the forest-dependent communities around the Khadimnagar National Park in northeastern Bangladesh. Reg. Sustain. 2021;2(3):280–295.
44. Kamanga P., Vedeld P., Sjaastad E. Forest incomes and rural livelihoods in Chiradzulu District, Malawi. Ecol. Econ. 2009; 68(3):613–624.
45. Mamo G., Sjaastad E., Vedeld P. Economic dependence on forest resources: A case from Dendi District, Ethiopia. For. Policy Econ. 2007; 9(8):916–927.
46. Rayamajhi S., Smith-Hall C., Helles F. Empirical evidence of the economic importance of Central Himalayan forests to rural households. For. Policy Econ. 2012; 20:25–35.
47. Hogarth N. J., Belcher B., Campbell B., Stacey N. The role of forest-related income in household economies and rural livelihoods in the border region of southern China. World Dev. 2013; 43:111–123.
48. Boyapati T., Muthukumarappan K. Non-timber forest products and the bioeconomy: Linking livelihood security and biodiversity conservation (2015–2025 trends). Front. Sustain. Food Syst. 2025; 9:1714576.