



## Can non-timber forest products (NTFPs) contribute to the sustainable livelihoods of rural communities? Case study: Central Zagros, Iran

Sohrab Moradi<sup>1\*</sup>, Naser Ahmadi Sani<sup>2</sup>, Majid Pato<sup>3</sup>

1. Department of Agricultural & Natural Resources Development, Faculty of Engineering, Payame Noor University, Tehran, Iran

2. Faculty of Agriculture and Natural Resources, Mahabad Branch, Islamic Azad University, Mahabad, Iran

3. Forest and Rangeland Research Department, West Azerbaijan Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization, Urmia, Iran

\* Corresponding author's E-mail: Moradi\_4@pnu.ac.ir

### ABSTRACT

Non-timber forest products (NTFPs) can play important role in the sustainable use of forests and improving the livelihood of forest-dependent people. The present study was conducted in the Zemkan basin, Kermanshah Province, Iran with the aim of investigating the economic role and contribution of NTFPs in the lives of villagers. The statistical population included households of forest and forest outskirts dwelling villages. The research tool was a semi-structured questionnaire that was completed through face-to-face interviews. Descriptive and analytical statistics were used for data analysis. The results showed that the average annual net income of households from different livelihood strategies is USD 1118. Agriculture is the most important strategy with average 41.9% of the total annual net income of each household. About 61.4% of the households get a part of annual income through NTFPs, which on average accounts for 14.4% of the households' net annual income. The most important non-timber products in these forests include livestock grazing, wild pistachio resin (Saqez), wild pistachio seed, oak seed, oak syrup (Shokeh Manna) and other NTFPs. Livestock grazing in the forest accounted for the highest frequency among NTFPs with 60.58%; However, the exploitation of Saqez, due to high price, by allocating 38.6% of the total net income, allocated the highest amount of income among types of NTFPs. Generally, the results confirm the impact of NTFPs on the economic income and livelihood of the households in the study area and show the necessity of implementing multipurpose and cooperative programs for the sustainable use of NTFPs, increasing the income of local communities and forest protection.

**Keywords:** Agriculture, Livelihood strategy, Livestock grazing, Zemkan basin, Wild pistachio resin (Saqez).

**Article type:** Research Article.

### INTRODUCTION

In both national and international levels, forests have various benefits such as biodiversity protection, carbon sequestration, water and soil protection, pollution reduction and industrial wood production (Khosravi *et al.* 2014). In addition, by hosting a series of complex ecological processes, they cause the formation and continuous flow of products and services which both directly and indirectly affect human's livelihood (Panahi *et al.* 2007). Forests are among the main resources lowering poverty level of millions of villagers in developing countries (Rasmussen *et al.* 2017; Awono & Levang 2018). Direct values of forests include consumptive uses such as non-timber forest products (NTFPs) and non-consumptive uses, such as recreation and entertainment. NTFPs include any type of products and services obtained from forests other than timber production, including fruits, seeds, vegetables, fish, birds, mushrooms, medicinal plants, gums and resins, wild animal products, perfumes and a wide range of skin and fibers (Ingram 2010). Firewood is also a subtype of NTFPs (Ingram 2010; Khosravi *et al.* 2014). Non-timber forest products are those derived from plants and animals. During the human history, these products have been

employed for different purposes like Food, fodder, traditional medicine, fibers, agricultural equipment, household appliances, building materials and so the like (Talukdar *et al.* 2021). Exploitation of non-timber products of forests and pastures has been in the focus of attention as long as the history of human-being life (Ghanbari *et al.* 2011). The economic value potential of NTFPs has often been underestimated or ignored in the past both in terms of exploitation and market value. Simultaneous with the expansion of the concepts of social forestry and sustainable development, it was concluded that NTFPs can positively and significantly help improve rural livelihoods and natural resource management (Murthy *et al.* 2005). During the past decades, non-timber products have played a great role in improvement of livelihood condition for about 1.6 billion people around the world, through cash income, food security, health cares, nutrition improvement and other ecosystem services (Rahman *et al.* 2021). Nowadays, non-timber forest products are known to be as a key resource to livelihood revival in forest stable management. Over 150 different types of NTFPs are transacted at international level and millions of people trust it (Zhu & Lo 2021). Conservatively, there are between 3.5 to 5.8 billion NTFP users globally (Shackleton & de Vos 2022). NTFPs, not only because of their high economic potential and the capability to improve the welfare of rural communities (Ghanbari *et al.* 2011; Steele *et al.* 2015), but also because of their role in the development and protection of forests (Saha & Sundryiyal 2012) and the high economic dependence of the villagers in forest outskirts on these products, are of great importance such that their economic, social and cultural roles are more and more highlighted (Malekmirzaei *et al.* 2018). Estimates by the World Food and Agriculture Organization show that 80% of developing countries depend on non-timber products for their health and nutrition needs (Sharma *et al.* 2019). Therefore, planned and organized exploitation of NTFPs, through raising the value of forest resources and increasing the income of rural communities, would lead to stable development and provide a very strong motivation to protect forest resources (Saha & Sundryiyal 2012). The role of NTFPs in improvement of local livelihood and reducing the deforestation has been discussed for a long time. There is consensus that NTFPs can be productive element in rural livelihood (Lopes *et al.* 2019). Various studies have been conducted in relevance to the role and importance of non-timber forest products and the livelihood dependence of local communities on them in the world, most of which are carried out in the tropical forests of Latin America (Stanley *et al.* 2012) and in the last decade in African countries (Heubach *et al.* 2011; Mutenje 2011) and Asian countries (Sarmah & Aruncachalam 2011) to estimate the value of NTFPs at the local level and sometimes at the national level. Most of the researchers have highlighted the role of NTFPs in decreasing poverty throughout the different areas of the world (Talukdar *et al.* 2021). Surveys suggest the dependence on the forest and its products in most forest areas of the world. However, the rate of this dependence is different in different areas. Often, the amount of income resulted from harvesting non-timber products is regarded as the rate of dependence on the forest. The share of non-timber forest and pasture products is different in different parts of the world based on the areas of study (less than 10% to over 50%), however anyway, it forms part of the income of rural households (Moradi *et al.* 2021). Iranian Zagros forests cover 11 provinces in Iran with a total area of 4,749,000 ha (20% of total forests in Iran) (Beygi Heidarlou *et al.* 2020), which play a critical role in improving climatic condition, water supply, economic and social balance of the region. One of the main functions of Zagros forests is the social - economic function of these forests and their role in livelihood and economy of rural households and forest dwellers. During the recent decades, along with the population growth and the elevated number of livestock in Zagros, forests destruction with the purpose of farmland development and fuel supply has increased as well. On the other hand, Simultaneous with the increased demolitions, local societies' poverty and unemployment has paved the way towards the intensification of over-exploitations of forest resources, which in turn are among the main reasons of forest destruction in the Zagros vegetation zone. Notably, in the stable management procedure that has been formed on the basis of the concept of sustainable development, there has been emphasis on employment of local societies in management of natural resources and its key role in management (Henareh Khalyani *et al.* 2015). Although, due to ecological condition, production of commercial wood in Zagros forests is not possible, they play undeniable role in sustainability of the ecosystem and the livelihood of local residents in terms of environment, protection of water and soil resources, wildlife shelter and production of NTFPs. The forests of the Zemkan basin in Kermanshah Province are also an important part of the Central Zagros forests, which have the function of producing NTFPs such as forest fruits, gums and manna for rural residents. The life of the local people inside and on the outskirts of the forests in Zemkan basin is very complicated and difficult, with a strong dependence on these forests to provide part of their livelihood needs. Non-timber products of the forests in this basin have long been in the focus of attention and also the source of income for the residents inside and on the outskirts of these

forests. The importance of NTFPs in the production of food, medicine, health and industrial materials, has stimulated the local people to harvest a large amount of non-timber products from these forests annually and exported it to the local, national and rarely international markets. Thus it becomes a part of the income portfolio of households. Therefore, planning and organizing the use of NTFPs and formulating the correct methods of exploiting them by the participation of local people will make the production of these products continue. Also, estimating the economic value and recognizing the economic role of NTFPs in the livelihood of rural households in the studied area can be considered an important step towards appropriate policy-making with the aim of achieving sustainable management of this basin and improving the livelihood of its residents. Ignoring the economic role of forests and particularly NTFPs in these areas would lead to the inappropriate policies in rural development and protection of forests. Identification of non-timber forest products and estimation of the economic value of these products in the study area, in addition to its impact on the livelihood of villagers and local communities have not been considered in research literature. Therefore, the focus of this study is on identification of non-timber forest products in Zemkan basin, estimation of the economic value of these products and the calculation of economic share of these products in the livelihood of local and rural communities. So, the present study has been designed to understand important NTFPs of the area in terms of their importance in rural livelihood, to assess the dependency of different job categories to NTFPs, condition and economic importance of NTFPs and people's attitude towards the use of NTFP. As stated in other studies (Rahman *et al.* 2021; Moradi *et al.* 2021), the types of NTFPs available in the area of study, patterns of main NTFPs consumption by local villagers, the degree of dependence of different job categories on NTFPs, determination of the role of non-timber products in income amount, the degree of villagers' dependency to these products along with the identification of usable non-timber products types and the effective factors in harvesting these products would all be found out.

## **MATERIALS AND METHODS**

### **Study site and data collection**

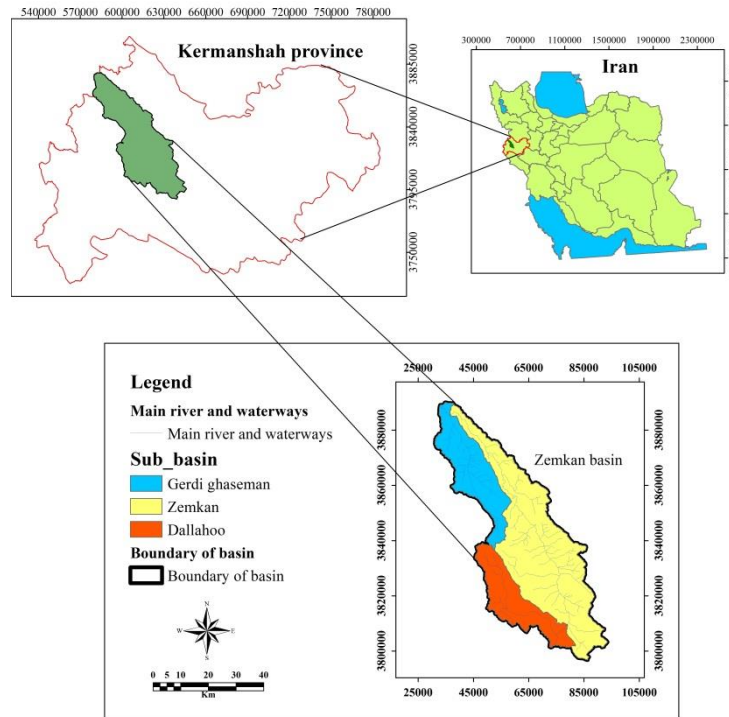
#### **Site selection**

Zemkan is one of the largest basins in Kermanshah Province, located between 45°52'10" and 46°35'05" E and 34°13'45" and 35°02'45" N. Its area covers 2338 km<sup>2</sup> with circumference of 314 km (Fig. 1). The average altitude of this basin is 1502 m a.s.l. (maximum 2547 m and minimum 514 m). Zemkan basin consists of three sub-basins including Zemkan, Gerdiqhaseman and Dalahoo with the surface areas of 1414, 503 and 421km<sup>2</sup>, respectively. The main river (Zemkan) of this basin with length of 125 km drains the whole area of the basin and joins Sirwan River in Iraq (Moradi *et al.* 2015). The vegetation of Zemkan basin is mostly treed (42% of the basin area) and its forest habitat includes three forest classes of Closed Forest (601 ha), Semi - Closed Forest (36868 ha), and Open Forest (59446 ha) that consist of tree species of oak (*Quercus* spp.), wild pistachio (*Pistacia atlantica* Desf), almond (*Amygdalus* spp.), Montpellier maple (*Acer monspessulanum*) and other species. Selection of this area for this study is due to the high dependence of the local people on the forest as a source of fodder for livestock (grazing livestock in the forest), using forest seeds and fruits, and the exploitation of the resin of wild pistachio trees in the form of an approved plan by Natural Resources and Watershed Management Organization, and the employment of medicinal plants with its vital role in the livelihood economy of villages.

#### **Field data collection and descriptive statistics**

The present study is descriptive -analytical in terms of method and field - based in terms of data collection, and applied in terms of purpose. The statistical population of the research includes the villagers dwelling in forests or outskirts of forests in Zemkan basin located in Kermanshah Province. Using various information sources such as field surveys, opinions and experiences of natural resources experts and local knowledgeable people, we identified the forest and forest outskirt dwelling villages, which had significant reliance on the forest and forest products for their livelihood. Out of a total of 207 villages in this basin, 126 villages with a total of 5345 households were some parts of the villages that earn from non-timber forest products. In order to collect data, 25 villages (20%) were randomly selected from 126 ones (Talukdar *et al.* 2021). Therefore, based on the number of households in the studied villages, 285 households were sampled according to the population of each village to fill out the questionnaire using Morgan's Karjesi table (Larawai *et al.* 2020; Kamwi *et al.* 2020). The research tool was a semi - structured questionnaire (Kamwi *et al.* 2020; Lepcha *et al.* 2022) which was completed through face-to-face interviews. Questionnaire validity was obtained using the opinions of respective professors and specialists

(Larawai *et al.* 2020; Moradi *et al.* 2021). Reliability was measured using Cronbach's alpha coefficient (Epanda *et al.* 2020; Moradi *et al.* 2021).



**Fig. 1.** Location of the study area in Iran and Kermanshah Province.

Using the questionnaire, all harvested non - timber forest products (NTFPs) were first identified. The questionnaire used in this study included three parts: The first part included the demographic characteristics of the households, such as the occupation of the head of the household, the level of education and the number of family members. In the second part, the type and price of products, the amount of harvest and the time spent for it, fixed and variable cost and the sale procedure were investigated. In the third part, the livelihood conditions, income and income sources of the household were questioned. Finally, regarding the items of the questionnaire and the conducted interviews, the data were classified and analyzed in the Excel environment.

#### **Income calculation via different livelihood strategies**

To calculate the total net income, first the different income sources were specified and then for each source of income, the rate of production and cost in an annual time range (from the September 20, 2020 to September 20, 2021) were calculated. Net income means the total gross income minus total costs. Gross income of different income sources was calculated using their average price in local markets and the rate of production (Khosravi *et al.* 2014). The different livelihood strategies that make up the annual income of the studied households include six groups, which are agriculture (rainfed and irrigated agriculture, traditional livestock husbandry, horticulture), laboring, governmental employment, transfer receipts, exploitation of NTFPs and other occupations (Zhu & Lo 2021; Rahman *et al.* 2021). To estimate the net income in the rainfed and irrigated agriculture sector, first the gross income resulted at the end of the harvest period during the last year was calculated for each household, followed by calculating the cost of fertilizers, seeds, laborers, tractor and combine harvester renting, then subtracting from the amount of gross income. In addition, the opportunity cost of the land was calculated based on the price of renting for the intended land use (Khosravi *et al.* 2014). Wheat, peas and barley are the most important agricultural products in the area of study in the order of importance and abundance. Incomes from livestock including selling them, their meat and other products together with annual expenses including fodder supply, keeping place, veterinary services and employing shepherd were calculated. Moreover, the opportunity cost of livestock maintenance was added to the total costs (FAO 2018). Given that in the area of study, livestock grazing in the forest takes at least ten months of the year, the straw and fodder cultivated by the household (part of the income resulted from agriculture) or purchased from elsewhere will allocate a trivial cost for the households.

Therefore, the incomes from livestock grazing in the forest and collecting oak seeds, which is mostly used for the livestock, were added to the total income. Regarding the net income from horticulture sector, incomes from fruit trees like walnuts, grapes, apples and apricots were calculated for the previous year, followed by subtracting them from the costs of cultivating, harvesting and also the opportunity cost of land exploitation. Finally, the total net income from rainfed and irrigated agriculture, traditional livestock husbandry and horticulture were considered as the net income from the agricultural sector (Edwards & Demaine 1997). By transfer receipts, we mean governmental payments or grants to households the most important of which include subsidies. Other payments by the governmental organizations like Imam Khomeini Relief Foundation, Welfare organization, Foundation of Martyrs and Veterans Affairs are also included in this group. The annual net income from laboring, governmental employment and other jobs (driving, shop keeping, border trades, etc.) was also calculated. One of the sources of non-timber income in the region is livestock grazing in the forest. In many households under the study engaged in livestock husbandry, the animals are taken to the forest for daily grazing for about 9-10 months of the year. The value of livestock grazing in forest was not available in the local market. Therefore, to estimate the income of this part, substitute commodity approach, i.e., fodder was used (Mamo *et al.* 2007; Khosravi *et al.* 2014), in such a way that the cost of fodder needed for each animal was calculated for one month and then multiplied by the number of months cattle taken to forest grazing. The resulted number was considered as the income of this section. Net income from other NTFPs was also calculated using the substitute commodity approach (Khosravi *et al.* 2014) or using their prices in local and national markets (Murthy *et al.* 2005; Jafarzadeh *et al.* 2020).

## RESULTS

### Demographic characteristics of households

The studied forest dwelling villages and the number of their households have been given in Table 1, while the demographic characteristics of the households such as age, level of education and occupation of the household heads, as well as the number of family members in Table 2. As shown in these tables, the age group of 76-90 with a frequency of 2.1% exhibited the lowest frequency and that of 31-45 with 40.2% has the highest, indicating the middle-agedness of people. In terms of education level, the literate people displayed the highest frequency (50.4%), while the lowest (4.2%) was related to those with university education, indicating the low level of literacy. In addition, the occupation highest frequency was observed in the agricultural group (including irrigated and rainfed agriculture, traditional animal husbandry and horticulture) with frequency of 38.4%, while the lowest in the governmental employee with 5.6%, exhibiting that the agriculture is the most popular occupation of the people in these villages. In terms of the number of family members, most families had over 4 members (42.6%), while the lowest had 2 members (8.5%), exhibiting the large population of the households in the villages of the basin under study.

**Table 1.** Forest-dwelling villages of Zemkan basin and their number of households.

Village name	Number of household	Village name	Number of household
Abdol Khakhi-ye Olya	21	Hashamar	96
Baba Kuseh-ye Olya	32	Havandaran	35
Bakhsh Now Khas	38	Homajegeh	60
Bani Pariab	28	Howz-e Sheykh-e Zemkan	11
Cham Zeresk-e Sofla	50	Jujar	34
Chenar	69	Kezi	4
Dashti Leyl-e Hoseynabad	44	Khomgaran	25
Davaleh-ye Olya	27	Kisaleh	6
Deh Huleh-ye Olya	39	Meydan Tfli	19
Dushmian	145	Neyrezh-e Sofla	56
Eshki	10	Tut Shami	86
Gorisheh-ye Sofla	52	Zemkan-e Olya	101
Haramian-e Sofla	18		

### Non-timber forest products (NTFPs) of the basin

After investigating, observing, visiting and collecting the necessary information through interviews and questionnaires from 25 forest and forest outskirts dwelling villages in Zemkan basin, non-timber products were identified in these forests including livestock grazing, wild pistachio resin (Saqez), *Pistacia atlantica* seed, oak

seed, oak syrup (Shokeh Manna) and other NTFPs, in addition to using wood for making hedges, tree fruits such as wild pear, wild cherry, hawthorn and almond, medicinal plants, acanthus harvest, as well as birds and animals hunting (Fig. 2). Livestock grazing in the forest is one of the sources of non-timber income in the region (Fig. 2a). Another non-timber product in Zemkan basin is oak seed.

**Table 2.** Demographic characteristics of the investigated households in the study area.

Characteristic	Group	Frequency (%)
Age	15-30	7.5
	31-45	40.2
	46-60	30.6
	61-75	19.6
	>76	2.1
Family size	2	8.5
	3	12.5
	4	36.4
	>4	42.6
Main job	Agriculture	38.4
	laboring	30.5
	governmental employment	5.6
	Use of NTFPs	7.1
Education	Other jobs	18.4
	Illiterate	34.2
	Reading and Writing	50.4
	Diploma	11.2
	College education	4.2

It is used for feeding animals and sometimes for medicinal purposes. The seed either directly after harvesting or after converting to concentrate, is mostly used as animal food (Khosravi *et al.* 2014). Since the ancient times, the forest-dwelling people in Zemkan basin, due to poverty and lack of access to sufficient food such as grains and cereals, have collected oak seeds for making local bread (Moradi *et al.* 2017). Currently, in the forest villages of Zemkan basin, oak seeds are collected and kept as an animal food for the times animals are not taken out for grazing due to snowing, frosting, etc. (Fig. 2b). Therefore, during snow and frost, oak seeds together with other fodders are fed to livestock. The time of collecting oak seeds starts from almost the middle of May and lasts for 5 months until almost the end of October. Manna is another non-timber product in Zemkan basin. It is a kind of sugar material produced on young plant organs during some insect activities or reaction of plant mechanical factors or temperature out of plant tissues. It has high medicinal, nutritional and commercial values, considered as important by-product of forests and rangelands in some areas (Mohammadi & Dini 2003). Production triangle of Manna includes special ecological conditions, special insect and specific host plant. The presence of all of which guaranties the production of Manna (Takavar & Mohammadi 2008). Manna at the beginning of expelling from the insect's body is in syrup form. However, after a while, it hardens in the vicinity of the air, converting to a kind of sugar. Oak syrup (Shokeh Manna), which is called Shokeh by the local people in Zemkan basin, is in form of small and large particles, sweet and nectar like, on the Persian oak (*Quercus persica*) caps and seeds before exploitation and processing (Fig. 2c). After processing, it is transformed into almost thick sap with a dark brown color similar to grape sap with a sweet and slightly acrid taste, so-called processed Shokeh. According to the statements of local people and our experiences, it is useful for upset stomach diseases. However, it does not have high nutritional value and its main consumption is in form of food. Usually, local people eat the processed Shokeh with butter as breakfast. Shokeh is traditionally exploited by mainly villagers doing it by picking the seeds with caps on them and usually by cutting the branches and sub-branches of trees from almost the beginning of November for about three months. Another non-timber product in this region is *Pistacia atlantica* seed. It is a tree, 2-5 m in length. The branches of the tree are grayish-white and have leaves composed of 9 to 11 leaflets. Oleoresin is secreted by the trunk featuring a yellowish-green color and a mild smell. This plant is single-sex and has 5 sepals with no petals (Mozaffarian 1996). *P. atlantica* from ten years old onwards, are clustered every year



with abundant tiny fruits in the spring. In terms of botany, it is a kind of drupe fruit, 3.5 by 5.8 mm in size which is either egg- or pointed pill- shaped exhibiting an aromatic pericarp and oily seed (Yousefi 2015). Its outer shell is soft and white and partially red when it is young. However, it becomes gradually green and hard once ripen (Fig. 2d). The use of wild pistachio seeds is spreading in various industries. For instance, the green color of these seeds is used in ice cream and confectionery industries (Kashaninejad *et al.* 2006). It is also widely used in local communities (Goujani *et al.* 2016); In villages of Zemkan basin, wild pistachio seeds are used in making syrup, adding fragrant to yoghurt, flavoring rice, dyeing, making halva (a kind of sweet paste), rural nuts, pickles, making beads and making sweets as well. The utilization of *P. atlantica* trees takes place in two-time intervals. Local people collect the seeds in May and June when they are white and soft. In the second period (October, November and September), the seeds are completely ripe and hardened. Therefore, the seeds harvesting lasts for 5 months. Another important non-timber product of the region is wild pistachio resin, called Saqez, using for a variety of industrial and traditional purposes, including food and medicine (Pourreza *et al.* 2008). Saqez is the latex of wild pistachio trees, a semi-dense, sticky, and fluid resin that spews out from the trees in the growing season and becomes hard in cold seasons, getting soft and melts against warmth. The raw extract of Saqez has bitter and spicy flavoring and involves abundant turpentine, hence cannot be chewed. However, if it is boiled in water, thereby removing its impurities, its spicy flavorings will decrease and its remaining is presented as typical Saqez in market (Moradi *et al.* 2017). *P. atlantica* resin is a traditional medicinal source to relieve abdominal pain, stomach pain, indigestion, stomach ulcer, Asthma, eczema, throat infection, kidney stones, and is also considered to be anti-diarrhea, astringent, anti-fever, antibacterial and antiviral (Tohidi *et al.* 2011). In the traditional Saqez extraction, almost from the beginning of June, the teams (at least three persons) make some wounds on the tree trunks by axes. These wounds have no special direction and are totally disorderly in traditional method. The wounds are usually between 10 and 50 depending on trees' freshness, amount of their extract, trunk diameter and also trunk height. In the next step, one person is assigned to make small bowls of clay to stick under the wounds of the tree (Fig. 2e). After about 20 days of ending process of sticking the bowls under the tree wound, the stage of gathering of Saqez starts and finally it is sold in local, national, or sometimes international markets. Generally, the process of Saqez extraction from wild pistachio trees starts from the beginning of June and continues until the beginning of September, so lasting for about 3 months. Saqez Extraction in the studied area is left to the villagers living in the forest or forest outskirts every other year according to the regulations of Forests, Ranges and Watershed Organization in the form of ownership interest contracts.

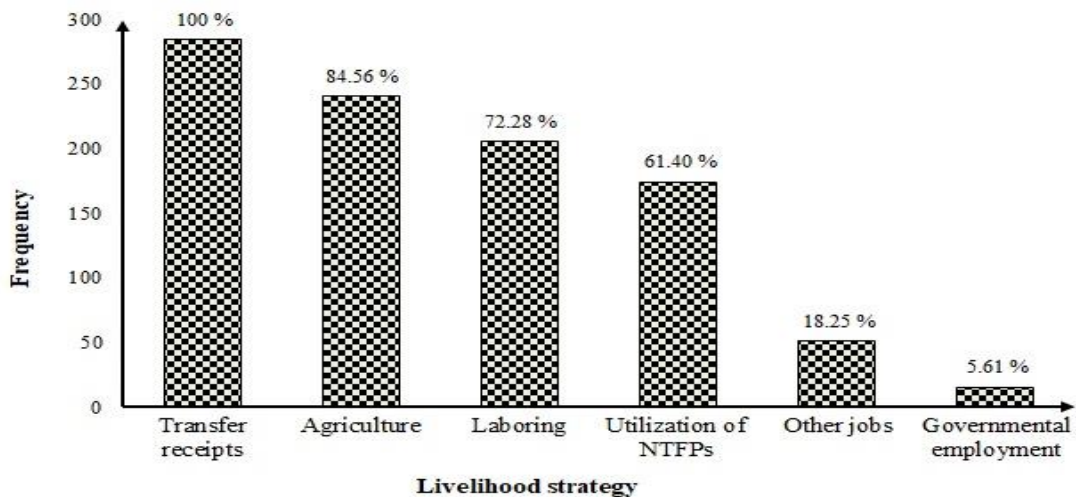


**Fig. 2.** Some of non-timber forest products (NTFPs) in the forests of Zemkan basin.

### Household income from different livelihood strategies

The annual income of households in the area of study is earned through different livelihood strategies. But during the interview with the household heads, they introduced one of the jobs in question as their main job. Different

livelihood strategies for the annual income of households in the study area include agriculture (rainfed and irrigated agriculture, traditional livestock husbandry, horticulture), laboring, governmental employment and transfer receipts (governmental payments or grants to households the most important of which include subsidies and other payments by the governmental organizations like Imam Khomeini Relief Foundation, Welfare organization, Foundation of Martyrs and Veterans Affairs are), and other jobs (driving, shop keeping, border trades, etc.). In Fig. 3, frequency and percentage of households that each of these livelihood strategies as one of the resources they selected an income, it is shown. According to figure 3, due to the receipt of cash subsidies by all the households, transfer receipts are a part of everyone's income forms households. Also, in more than 84 percent in the studied households, a part of the household's income is earned through agriculture, which is in the second place. Laboring and utilization of NTFPs respectively with a frequency of 206 (72.28%) and 175 (61.40%) households are in the third and fourth ranks.



**Fig. 3.** Frequency and percentage of income resources of Zemkan basin households for different livelihood strategies.

Table 3 shows the economic role of each livelihood strategy in the annual net income of the households. The average annual net income of villagers from different livelihood strategies is USD 1118. Annual net income from agriculture with USD 468.44 (41.9%), laboring with USD 226.95 (20.3%) and the utilization of NTFPs with USD 160.99 (14.4%), are ranked from the first to the third order respectively. Income from governmental transfer receipts, other jobs and governmental employments with 10.7, 9.9 and 2.8% are in the other orders respectively.

**Table 3.** The contribution of different livelihood strategies in the annual net income of the studied households.

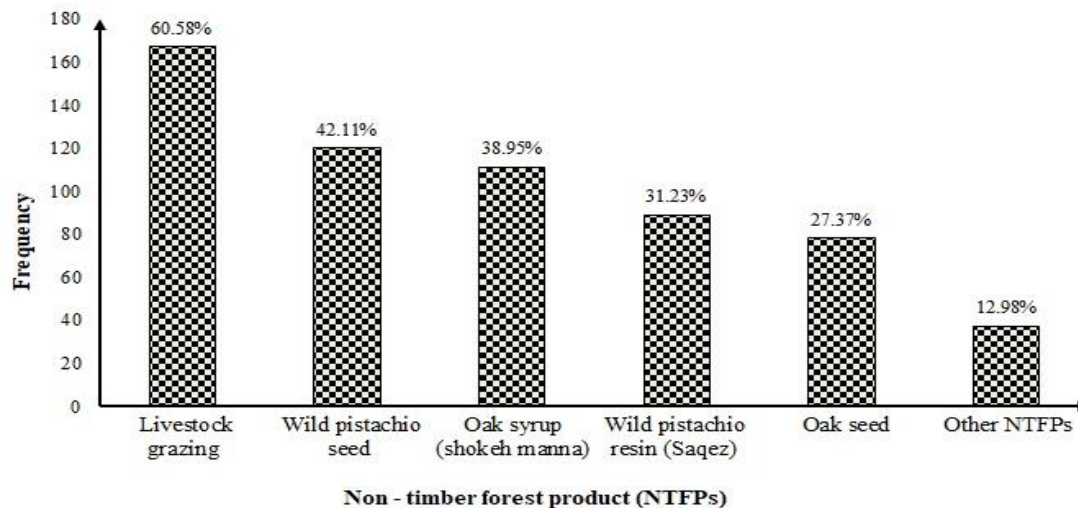
Livelihood strategy	Annual net income (USD)*	Percentage (%)
Transfer receipts	119.61	10.7
Agriculture	468.45	41.9
Laboring	226.96	20.3
Utilization of NTFPs	160.99	14.4
Other jobs	110.68	9.9
Governmental employments	31.31	2.8

\* 1.00 US Dollar = 305,750 Iranian Rials at the time of the study in the official market.

### The economic role of different types of NTFPs in households' income

Fig. 4 illustrates the frequency and percentage of households in the study area to use different types of NTFPs. The results showed that 60.58% of the households use the forest for livestock grazing as one of the 6 NTFP categories adopted by the local people in the region. In addition, the wild pistachio seed is used by over 42% of households for various purposes. The collection of oak syrup (Shokeh Manna), utilization of Saqez and the collection of oak seeds for livestock feeding as well as food and medicinal uses with 38.95, 31.23 and 27.38% are placed in the next orders respectively. Other NTFPs are used only by 12.98% of the households. The net income of the villagers in the study area from harvesting NTFPs has been shown in Table 4 for each product together with the share of each one.





**Fig. 4.** Frequency and percentage of households in Zemkan basin used different types of NTFPs.

Of the total income earned from NTFPs, 38.6 % has been allocated to the exploitation of Saqez. The share of livestock grazing in the forest was 32.3%. This means that most of the rural households use conventional territory and forest areas under their control for livestock grazing. Oak syrup (Shokeh Manna), collecting wild pistachio seeds and oak seeds, by allocating 11.2, 6.9, and 6.2% of the net income, are ranked between the third and fifth orders respectively. Other NTFPs are composed only by 4.8% of the household.

**Table 4.** Role of different types of NTFPs in the annual net income from NTFPs in the households of the study area.

NTFPs	Annual net income (USD)*	Percentage (%)
Wild pistachio resin (Saqez)	62.14	38.6
Livestock grazing	52.00	32.3
Oak syrup (Shokeh manna)	18.03	11.2
Wild pistachio seed	11.11	6.9
Oak seed	9.98	6.2
Other NTFPs	7.73	4.8

\* 1.00 US Dollar = 305,750 Iranian Rials at the time of the study in the official market.

## DISCUSSION

The present study was carried out in Zemkan basin located in Kermanshah Province, Iran with the aim of investigating and revealing the impact of NTFPs on the life of villagers, degree of dependence of different job categories to NTFPs for sustainable livelihood and understanding the NTFPs economic significance. The results showed that households under study earn from different livelihood strategies. The use of different sources of income by forest and forest outskirt dwellers has been reported in different studies such as those of Soltani *et al.* (2011) in Southern Zagros, Rayamajhi *et al.* (2012) in Nepal and Hogarth *et al.* (2013) in South China. The results also showed that agriculture is most important livelihood strategy in the area of study which is in consistent with Das *et al.* (2021). NTFP is ranked in the third order after agriculture and laboring. Despite the abundant use of NTFPs by the people in the study area, only 14.4% of the annual net income has allocated to this livelihood strategy which is in consistent with results obtained by Khosravi *et al.* (2014) in Kurdistan Province, Iran (13%), Moradi *et al.* (2021) in Fars Province, Iran (11%) and Kamanga *et al.* (2009) in Malawi (12%). However, in general, the share of non-timber forest products in the income of forest and forest outskirt dwelling households is different in various regions of Zagros and also in different parts of the world; such that, the income earned from forest compared to the total income of the household, has been reported to be 30% by Soltani *et al.* (2011) in Kohgiluyeh and Boyer-Ahmad Province, Southern Zagros, about 3.8% by Mahdavi *et al.* (2011) in Kamiyaran, Iran, 27% by Babulo *et al.* (2009), in northern Ethiopia, 31.5% by Hogarth *et al.* (2013), 28% in a comparative study on almost 8000 households from 24 developing countries by Angelsen *et al.* (2014), 33% by Langat *et al.* (2016) In eastern Kenya, and 6% by Dash *et al.* (2016) in India. Therefore, it is concluded that the share of non-timber forest products in the household income is different in various regions of the world, variable on average from 10 to 35% and it definitely makes up a part of the villagers' income, depending on their access to the forest,

the laws and regulations of different areas, the extent of forests destruction, the distance from the market for selling products, the different socio-economic conditions, the diversity and distribution of non-timber forest products, the geographical conditions and different job opportunities in the villages. In this study, Wild pistachio resin (Saquez) and seed, livestock grazing in the forest, oak syrup (Shokeh Manna), oak seed and other NTFPs are among the non-timber forest products used by the villagers in Zemkan basin. Livestock grazing in the forest exhibited the highest frequency among NTFPs with 60.58%, however in contrast to the results of Khosravi *et al.* (2014) in northern Zagros and Salehi *et al.* (2010) in southern Zagros who reported that the highest amount of income was related to livestock grazing in the forest, in the present study, the highest income (38.6% of the total income of NTFPs) among the different types was related to the wild pistachio resin (Saquez). Although, on average, 31.23% of the people of study area have the possibility to extract Saquez due to government laws and regulations, such as obtaining proprietary interest and periodicity of harvesting (once every two years), it provides the highest income among other NTFPs, because of its high price and also due to its wide use in various pharmaceutical industries, food and other industries. After Saquez and livestock grazing in the forest as the first and second non-timber products in terms of financial role in providing the livelihood of the rural households of the studied area, oak syrup (Shokeh Manna), wild pistachio seed, oak seed and other NTFPs are placed in the next orders respectively. Due to receiving cash subsidies by all the households under study, transfer receipts constitute some parts of their income. In fact, as also reported in Lopes *et al.* (2019), without a considerable financial support in form of subsidies and other developmental plans programs, the role of NTFPs will not be very significant. In various studies carried out in Zagros region and other parts of the world, firewood has been recognized as a non-timber forest product with a high impact on the livelihood of rural households (Mamo *et al.* 2007; Babulo *et al.* 2009; Heubach *et al.* 2011; Khosravi *et al.* 2014). However, in the present study, it was not identified and evaluated as a non-timber forest product used by the rural residents of study area, since there are other energy source alternatives in the rural areas of the region including fossil fuels (oil and gas). Besides, the forbidding laws of firewood utilization by the relevant organizations and the imposition of legal fines would have a preventive role. In general, the results showed that about 62% of local communities in the region under study are dependent on NTFPs collected from local forests for sustainable livelihoods. This rate of dependence has been reported as 62% by Adhikary *et al.* (2021) and 25% by Talukdar *et al.* (2021). Therefore, various utilizations of NTFPs are considered as some options on which the local and rural communities are dependent on for sustainable livelihood, as reported in other studies as well (Adhikary *et al.* 2021; Rahman *et al.* 2021). As mentioned in similar studies, it can be stated that NTFPs play an important role in the economy of rural households and in the case of optimum utilization, their production will be guaranteed which can in turn lead to the decreased poverty and also declined pressure on forests, since the people whose livelihood is dependent on forests, seem to have enough enthusiasm towards preserving them (Ahmadi Sani *et al.* 2017; Moradi *et al.* 2021). In addition, some analysis should be carried out by a multidimensional approach in relation to the impact of NTFPs on ecological and economic sustainability besides considering social welfare. Therefore, similar results of different investigations would more and more reveal the valuable importance of NTFPs and forests in the increased sustainability and promoting socio-ecological development (de Mello *et al.* 2020; Zhu & Lo, 2021).

## CONCLUSION

In a general conclusion, given the role and impact of NTFPs on the livelihood of native households in Zemkan basin, it can be acknowledged that the implementation of multipurpose programs and cooperative forest management in order to organize traditional utilization for protecting the forests, in addition to increasing the income of local communities, would be effective in guaranteeing the sustainability of the forests in this area. Therefore it is necessary to put more emphasis on preparing and implementing the utilization plans for prolonged employment of NTFPs. Finally, it is suggested that the relevant organizations pay more attention to the economic activities such as improving infrastructure and enhancing local sale markets to increase income from NTFPs and establishing small industries for processing and packaging them.

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