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RESEARCH PAPER

The physical structure of pistachio (*Pistacia atlantica* Desf.) and economic value of its turpentine in the Zagros region, Western Iran

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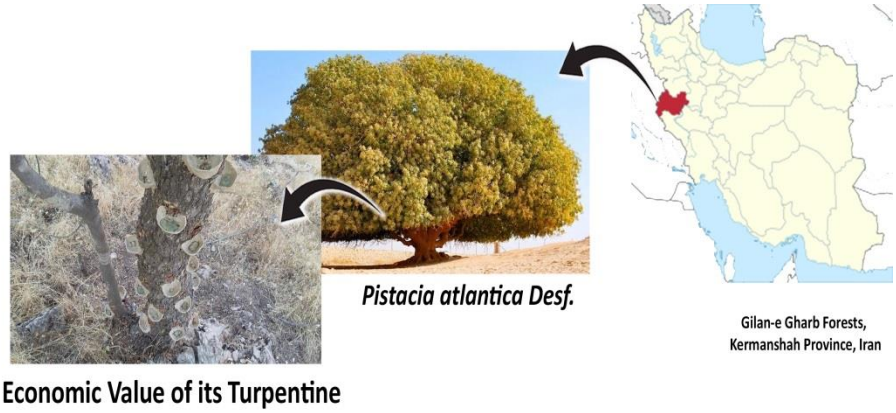
Highlights

- The exploitation of forests and pastures should be done in the form of careful, scientific and principled planning so as not to damage forest and rangeland species.
- The ecosystem value of wild pistachio species produced by raw turpentine in terms of creating employment and income of villagers and providing materials for chemical, pharmaceutical and food industries of the country is of interest to the government.

Graphical Abstract



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Abstract

The ecosystem value, wild pistachio species importance, and the product of raw turpentine in terms of creating employment, villager's income and supplying raw materials for chemical, pharmaceutical, food industries and exporting it to European countries is a main interest to the government. This study aimed to investigate the ecosystem characteristics of pistachio species and the economic value of its gum in the direction of production rise in the Zagros in the Gilan-e Gharb forests that are located in Kermanshah province. The studied forest stands with 700, 2100, 700, and 1000 hectares area, respectively, are located in Kamareh, Cheshmeh Sefid, Bapir, and Balaleh in Gilan-e Gharb in a mountainous and forested area. The desired area was determined using the available maps after field visiting. Then, for griding, the study area in 10,000-scale maps, was identified. Sampling by the regular random method was performed. In addition, the area of the sample plots is 4000 m2, have been surveyed. The results showed that the mean diameter at breast height in Kamareh, Bapir, Cheshmeh Sangi, and Balaleh areas equal 31.9, 35.5, 39.3, and 30.2 cm, respectively. Furthermore, the mean number of exploitable pistachio trees in the Kamareh, Bapir, Cheshmeh Sefid, and Balaleh areas is 30.15, 58.3, 44.45, and 32.25, respectively. The profit amount for the wild pistachio gum exploitation includes 821700000, 1623000000, 1740500000, and 2116000000 Rials in the Kamareh, Bapir, Cheshmeh Sefid, and Balaleh, respectively. Protecting valuable wild pistachio trees in the Gilan-e Gharb region's forest ecosystem and properly extracting their sap is a step towards empowering local communities and enhancing production.

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1. Introduction

Forests and pastures are among the most valuable natural resources in the country, and their basic exploitation has increased dramatically. If exploitation is unplanned and without considering their capacity and production, it will destroy forest and rangeland species. Therefore, exploitation should be done in the form of careful, scientific, and principled planning so as not to damage forest and rangeland species (Mansoori and Badehyan, 2014). One of the important goals in forest and rangeland resource management will be the preservation and rehabilitation of natural resources by obtaining potential facilities and production in potential and actual areas by applying exploitation mechanisms. Plans for the basic exploitation of forest and rangeland by-products as well as the need to use the basic and technical methods in order to maintain, develop and sustainably exploit them. The ecosystem value and importance of wild pistachio and economic products of raw turpentine in terms of creating employment and income of villagers and supplying raw materials for chemical, pharmaceutical, and food industries and exporting it to European countries is of interest to the government. In this regard, pistachio trees are considered by users due to the harvest of turpentine extract (Ghahari et al., 2016). Which have an area of 2.4 million hectares in Iran.

In the traditional method of harvesting turpentine, a large number of grooves are created in the bark of the trunk and main branches of pistachio trees with a diameter of more than 20 cm, and the exuded extracts are collected in flower bowls. This work is done by forestry villagers with 3-4 year rotation and on each exploitation, on average, about 300 grams of turpentine sap is extracted from each pistachio tree (Bordbar et al., 2006). Harvest of turpentine extract begins in mid-June and continues until mid-August (Ghahari et al., 2016). A gum extracted from the trunks of pistachio trees with the scientific name of *Pistacia atlantica*, which is called raw turpentine, is extracted during special stages of exploitation of the main trunks of trees. When cooked traditionally, it is offered in the form of a soft white substance called turpentine. In addition, raw turpentine can be converted into two materials, turpentine and colophony, under industrial cooking operations, each of which is the source of various derivatives and compounds (Ojeda-Amador et al., 2018). In recent years, the study of various aspects of wild pistachio, from quantitative and qualitative characteristics to the evaluation of its gum has been the subject of various studies, some of which are addressed:

The results of studies conducted in Rad and Fattahi (2005) showed that the condition of the forest in most types is degraded and the forest class is sparse (Rad and Fattahi, 2005). The highest number of pistachio trees belongs to the pistachio-almond type and the lowest to the Zygophyllum-pistachio type. The number of accompanying plant species is over 62 species, of which 16 species are trees and shrubs and the rest are herbaceous and shrub species. About 16 species of pests and one type of disease were identified on pistachio trees. The reproductive rate is low in most species and is better in the pistachio- Montpellier maple type. 55.4% of the bases are female and 42.3% are male trees. The results of the research of Bordbar et al., (2006) showed that the distribution range of trees was between 1845-2030 meters above sea level (Bordbar et al., 2006). The number of trees is 70-100 trees per hectare and the average height of trees is 3.81 meters, the maximum height is 5 meters. The height of the tree trunk is 1.19 meters and the average height of the canopy is 2.69 meters. The average diameter of 16.7 cm and the average height of large and small canopy diameters are 4.56 and 2.93 meters, respectively, of which 33% are branching.

The results of Negahdar-Saber et al., (2009) showed that 57% of pistachio expansion sites at an altitude of 1000 to 2000 meters above sea level and 25.5% of them are located on the slope 15 to 30% (Negahdar-Saber et al., 2009). The geographical direction in these habitats is north and south. The results of Bagheri et al., (2014) showed that the highest number of trees, regeneration height and the best condition of tree leaves and pistachio regeneration is located on the northern slopes at an altitude of 1600-1500 meters (Bagheri et al., 2014). The highest height and diameter of pistachio trees and the highest number of regenerations were recorded at an altitude of 1400-1500 meters. The results of the study of Montazeri et al., (2014) in Fars province showed that the most important climatic element affecting the distribution of pistachio-oak species is the precipitation element (Montazeri et al., 2014). Which has obtained the highest scores of positive components in the western part of

Fars province with a height of 1601 meters. Temperature component scores in Pistachio-Montpellier maple show the lowest values compared to other species.

The results of Ghahari et al., (2016) showed that the habitat of coriander species in temperate, semi-warm and semi-arid, warm and semi-arid, and hot and dry areas (Ghahari et al., 2016). The range of altitude changes in the habitat of this type in this basin is 900 to 2600 meters above sea level. The results of Javanmiri Pour et al. (2013) showed that the frequency of pistachio trees in the north and northwest of Ghalajeh forests were 36.4% and 1%, respectively (Javanmiri Pour et al., 2013). Maximum (32%) and minimum (13%) abundance of wild pistachio trees were present in the slope of 60−30% and more than 60%. The highest number of pistachio trees existed at altitudes of 1200-1100 and 2300-2300 meters, respectively. The average canopy cover of pistachio trees is 10%, the number of pistachio trees with a diameter of more than 20 cm in diameter classes is equal to 5 and the average number of pistachio trees per hectare is about 8.

The results of the study of Iranmanesh et al., (2019) showed that the average production of turpentine in the forests of Chaharmahal and Bakhtiari province is 571.9 grams on average. Mean canopy diameter, diameter, and the total height of trees showed a significant effect on turpentine production (Iranmanesh et al., 2019). Tree material also showed a significant effect on turpentine production, so the average turpentine production in male trees was 608.1 g and female trees were 435.8 g.

Economic and social problems in the Zagros and the significant presence of villagers and foresters and their direct impact on forest habitats in these areas have led to the adoption of new approaches. One of these approaches is to economize the forest and provide a livelihood for forest dwellers according to the potential of the region's ecosystem and based on the principles of sustainable use is one of the most important management issues that can play an important role in protecting forest cover. At present, there is no scientific information about the production capacity of forests in Kermanshah province in the field of turpentine production and its evaluation. Therefore, this study aimed to investigate the quantitative and qualitative characteristics of pistachio species and their quantification. In addition, the economic value of its products, including its gum and its uses for local communities in the Zagros in the forests of Gilan-e Gharb city located in Kermanshah province. The question that arises here is what are the quantitative and qualitative characteristics of the species in the study areas? In addition, what is the value of gum produced by pistachio trees in the study areas?

2. Materials and methods

2.1. Area of study

The studied forest stands with areas of about 700, 2100, 700, and 1000 hectares are located in Kamareh, Cheshmeh Sefid, Bapir, and Balaleh in Gilan-e Gharb city in a mountainous and forested area, respectively. The maximum altitude is 2000 meters above sea level and the minimum altitude is 1400 meters. It is on the northern slope and the general slope of the region is about 35%. The climate of the region is temperate to temperate cold, the average annual rainfall is about 445 mm, the maximum temperature of the hottest month of the year is about 45 °C in August and the minimum temperature of the coldest month of the year -5 °C is related to February. The study area is mountainous and plain and has forest and rangeland lands. The pH of the soils of this region is between 2.7-7.5, their electrical conductivity is 0.3-0.4 ds/m, their salinity is very low and their fertility is moderate. Vegetation of this area includes species such as tree species *Quercus persica*, *Pistachio*, *Pyrus communis*, *Prunus incana*, *Crataegus*, *Acer monspessulanum*; Shrub species are *Prunus dulcis*. Also includes herbaceous species *Bromus*, *Agropyron desertorum* L, *Festuca*, *Stipa barbata* Michx, *Avena fatua*, *Alfalfa*, *Vicia*, etc.

2.2. Methods of study and field operations

After visiting the forest, using the available maps, the desired area was determined with the cooperation of experts of the Natural Resources and Watershed Management Department of Gilan-e Gharb city. Then, for griding, the study area in 10,000-scale maps was identified. In order to start sampling and field operations, in addition to using all available facilities such as GPS, an attempt was made to determine a specific point on the

map. Regular random sampling has been performed the sampling. The dimensions of the grid are 4×5 cm on the map with a scale of 1: 10,000. The surface of the sample parts that have been surveyed is 4000 m^2.

35 specimens were sampled in Kamareh, of which 5 specimens lacked pistachio trees. Twenty specimens of pistachio trees with a diameter of more than 20 cm were identified, which were present in ten other specimens of pistachio trees with a diameter of less than 20 cm. Out of 2400 pistachio trees in the study area, 1200 are more than 20 cm in diameter and can be used. In Cheshmeh Sefid, 60 specimens were sampled, of which 50 specimens had pistachio trees. Forty specimens were identified as having pistachio trees with a diameter of more than 20 cm, and in other specimens, there were pistachio trees with a diameter of less than 20 cm. Of the 3,000 pistachio trees in this area, 2,400 are over 20 cm in diameter and can be used.

In Bapir, 60 specimens were sampled, of which 10 specimens lacked pistachio trees, and 40 specimens with pistachio trees with a diameter greater than 20 cm were identified. The other 10 specimens contained pistachio trees less than 20 cm in diameter. Out of 5000 pistachio trees in the study area, 4000 with a diameter of more than 20 cm and can be used.

In Balaleh, 120 specimens were collected, of which 80 specimens were found to have pistachio trees with a diameter of more than 20 cm, of which 50 specimens were pistachio trees with a diameter of more than 20 cm. Out of 6240 pistachio trees in the study area, 3900 with a diameter of more than 20 cm and can be exploited. Other information such as diameter, tree height, canopy height, small and large diameters of the trees were also measured.

2.3. Harvest of turpentine

In order to harvest turpentine, first, suitable trees with a diameter of at least 20 cm are selected. Then they make wounds at a distance of 10 to 15 cm from the crown of the tree by 5 cm and a depth of 1 cm in a zigzag manner and at a distance of 50 cm from each other on the trunk of the tree. After the wounds are made, small clay bowls are made with clay and placed on the tree under the wounds. Clay is the most suitable soil for making clay bowls due to its high adhesion properties. After the bowls are filled with the extract, the bowls are collected. Collecting bowls begins early in the morning at sunrise and continues until the air is still cool. Because with the warming of the air, turpentine juice becomes thin and sticky and its collection will cause a lot of waste. After collecting the bowls, while the extract has hardened due to the coolness of the air and has a state similar to bread dough, the extract is separated from the bowls.

Because the raw extract is very thin and has problems carrying it, the extract is often poured into containers in Aleppo after collection. Then, after adding a certain amount of water, it is boiled, which concentrates the extract and removes the impurities that have stuck to it during the collection of the extract. At the end of the boiling process, the extracts are poured into bags made of special cloth and placed in cold water. Finally, the exploitation of the trees is completed and white turpentine is obtained.

3. Results and Discussion

The census was performed at a level with 95% probability and relatively low error. The relative error of the census is calculated as follows.

Sample Mean: $\bar{X} = \frac{\sum X}{X}$ (1)

Where ∑ x is the sum of the values of a data set, x is the number of values.

Standard Deviation: $SX=\frac{\sqrt{\sum(x_i-\bar{x})^2}}{N-1}$ (2)

In this formula, xi is the productivity of all observations, x is the mean of all observations or data, and N is the number of observations.

Standard Error $S_{\bar{x}}$: $S_{\bar{X}} = \frac{SX}{\sqrt{N}}$ (3)

Where, S_X^{-} is the standard error, SX is the standard deviation of the sample and N is the total number of samples.

Sampling Error (E): $E = \pm t.\ S_{\bar{X}}$ (4)

In this formula, t is a coefficient that is extracted from a t-student table for a given probability, such as 95%.

Relative Error Percentage: $\%E = \frac{E.100}{\bar{X}}$ (5)

Confidence Interval: $X = E \pm \bar{X}$ (6)

The results of pistachio tree diameter, the total number of trees, number of oak trees, frequency of pistachio trees, and number of usable pistachio trees in Kamareh, Bapir, Cheshmeh Sefid, and Balaleh are presented in tables (1-4). In Kamareh, the mean diameter is about 31.9 cm, the number of trees is 197.9, the number of oak trees is 153.3, the number of pistachio trees is 44.5 and the number of usable pistachio trees is 30.15 per hectare (Table 1).

Table 1. Statistical characteristics of diameter, number of trees, the total number of pistachio trees and number of usable pistachio trees in the study area of Kamareh.

Kamareh	**Diameter (cm)**	**N.T. (ha)**	**N.O.T. (ha)**	**N.P.T. (ha)**	**N.U.P.T. (ha)**
Mean	31.9	197.9	153.3	44.5	30.15
Standard Deviation	21.26	75.9	26.06	29.64	21.97
Standard Error	0.48	12	4.12	4.68	3.47
Confidence Interval	31.42-32.38	199.17-739.9	144. 9-161.54	35.21-53.36	37.09-21.23

NT: Number of trees, NOT: Number of oak trees, NPT: Number of pistachio trees, NUPT: Number of usable pistachio trees

In the Bapir study area, the mean diameter is about 35.5 cm, the number of trees is 268.7, the number of oak trees is 196.38, the number of pistachio trees is 72.35 and the number of usable pistachio trees is 58.3 per hectare (Table 2).

Table 2. Statistical characteristics of diameter, number of trees, the total number of pistachio trees and number of usable pistachio trees in the study area of Bapir.

Bapir	**Diameter (cm)**	**N.T. (ha)**	**N.O.T. (ha)**	**N.P.T. (ha)**	**N.U.P.T. (ha)**
Mean	35.5	268.7	196.38	72.35	58.3
Standard Deviation	18.2	46.48	11.59	24.03	19.7
Standard Error	0.25	6	1.49	3.1	2.54
Confidence Interval	35.25-35.75	256.7-280.7	199.37-193.38	66.14-78.55	53.39-63.39

In the study area of Cheshmeh Sefid, the mean diameter is about 39.27 cm, the number of trees is 190.7, the number of oak trees is 135.16, the number of pistachio trees is 55.55 and the number of usable pistachio trees is 44.45 per hectare (Table 3).

Table 3. Statistical characteristics of diameter, number of trees, total number of pistachio trees and number of usable pistachio trees in the study area of Cheshmeh Sefid.

Cheshmeh Sefid	**Diameter (cm)**	**N.T. (ha)**	**N.O.T. (ha)**	**N.P.T. (ha)**	**N.U.P.T. (ha)**
Mean	39.27	19.07	135.16	55.55	44.45
Standard Deviation	21.07	51.1	53.4	4.5	1.95
Standard Error	0.38	6.6	6.9	0.58	0.25
Confidence Interval	38.89-39.65	177.5-203.9	121.36-148.96	54.39-56.71	43.95-44.95

In the Balaleh study area, the mean diameter is about 30.2 cm, the number of trees is 188.7, the number of oak trees is 138.7, the number of pistachio trees is 49.95 and the number of usable pistachio trees is 32.25 per hectare (Table 4).

Table 4. Statistical characteristics of diameter, number of trees, total number of pistachio trees and number of usable pistachio trees in the study area of Balaleh.

Balaleh	Diameter (cm)	N.T. (ha)	N.O.T. (ha)	N.P.T. (ha)	N.U.P.T. (ha)
Mean	30.2	188.7	138.7	49.95	32.25
Standard Deviation	17.99	145.05	74.97	47.6	30.5
Standard Error	0.23	13.24	6.8	4.34	2.78
Confidence Interval	29.97-30.43	175.46-201.94	131.9-145.5	45.61-54.29	29.47-35.03

The total height of pistachio trees, trunk height, canopy height, large diameter, small diameter, and canopy surface are presented in Table 5. For example, the highest total height (6.1 m^2) is among the pistachio trees in the study area in the Bapir region, and the lowest total height (4.2 m^2) is in the study area of Balaleh. In addition, the highest canopy level of coriander trees is related to the Kamareh region (41 m^2) and the lowest is related to the Balaleh region (29.6 m^2); (Table 5).

Table 5. Total height, trunk height, canopy height, large and small canopy diameters and canopy surface in the study areas Kamareh, Bapir, Cheshmeh Sefid and Balaleh.

Characteristics	Kamareh	Bapir	Cheshmeh Sefid	Balaleh
Total height	5.6	6.1	5.4	4.2
Trunk height	2.1	2.1	2.1	2.3
Canopy height	3.5	4	3.3	1.9
Canopy surface	41	34.3	30.9	29.6
Large canopy diameters	4.5	4.2	4.1	3.2
Small canopy diameters	3.9	2.6	2.4	2.7

The frequency distribution of pistachio trees in the study areas is presented in 5 cm diameter classes (Fig. 1). In general, the number of pistachio trees in each study area in the diameter classes of 5 and 10 cm in each of the 4 study areas is small and in the diameter classes of 15, 20, 25, and 30 cm are highest. Then, in the higher diameter classes, the number of trees decreases, and a downward trend chart is taken (Fig. 1).

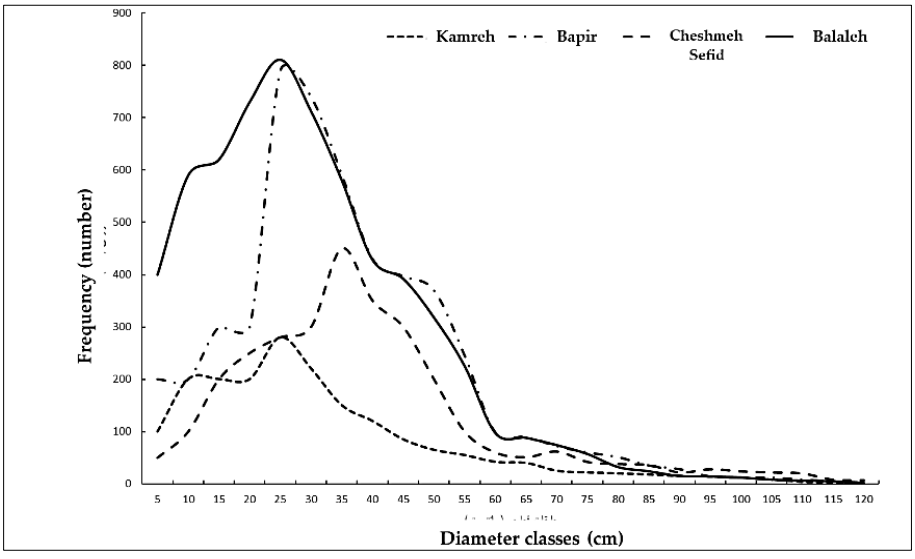

Fig. 1. distribution of pistachio trees in diameter classes in the study areas.

In general, the predominant species in the study areas is oak, which has 75, 70.9, 67.9, and 70% abundance in the study areas of Kamareh, Bapir, Cheshmeh Sefid, and Balaleh (Fig. 2). Pistachio species on average account for 25% of the specific frequency in the study areas and its frequency in the mentioned areas is 22.5, 26.9, 29.1, and 26.5%, respectively (Fig. 2). The frequency of other species is about 4%.

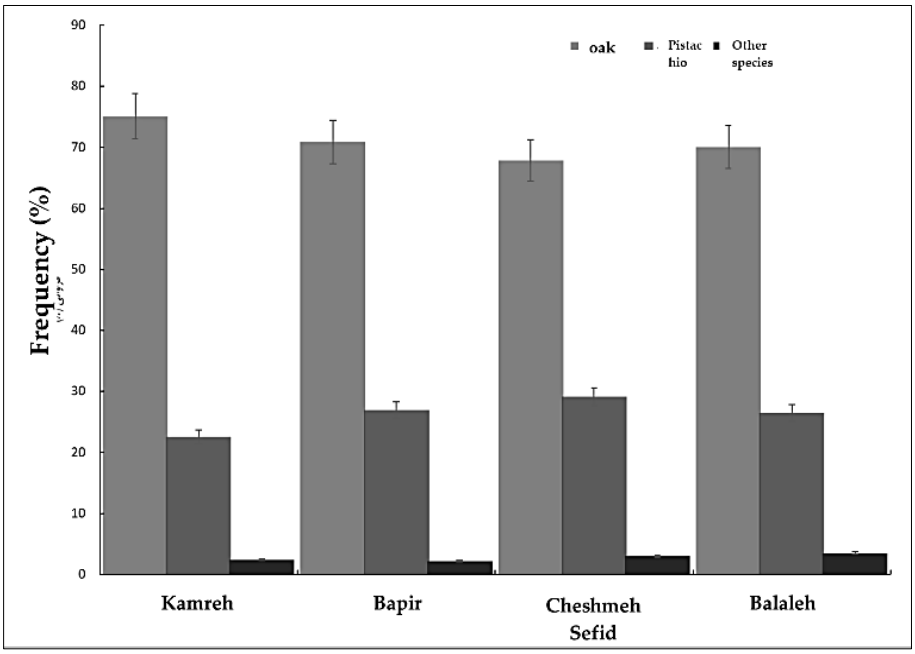

Fig. 2. Relative frequency of Pistachio species in the study areas.

Among Pistachio trees, the frequency of Pistachio usable in the study areas of Kamareh, Bapir, Cheshmeh Sefid, and Balaleh is 58.9, 55.4, 55.55, and 60.76%, respectively (57.65% on mean) (Fig. 3). Also, the frequency of unusable Pistachio in Kamareh, Bapir, Cheshmeh Sefid, and Balaleh areas is 41.18, 44.6, 44.45, and 39.4%, respectively (42.3% on mean) (Fig. 3).

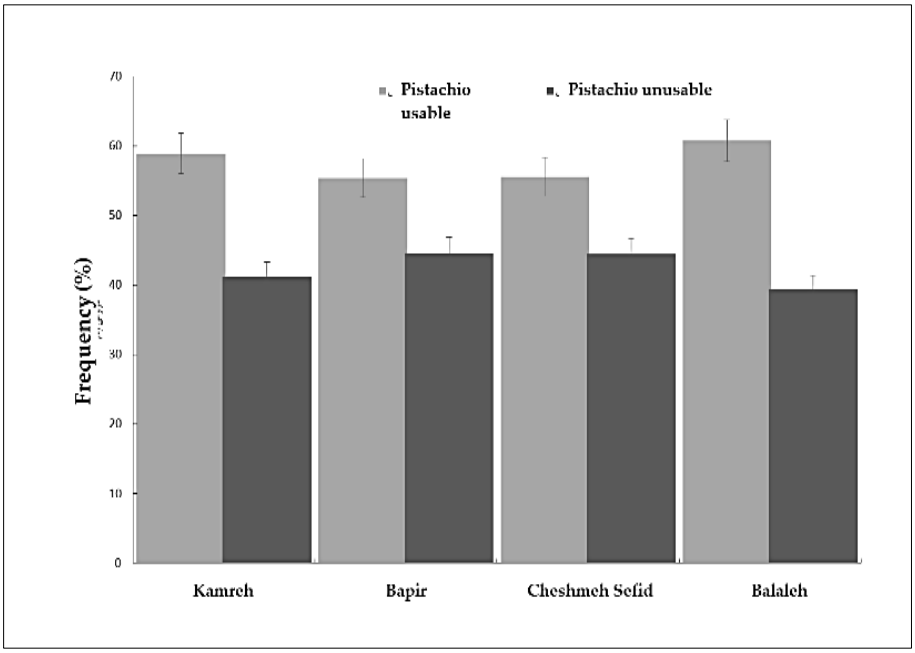

Fig. 3. Relative abundance of Pistachio usable and unusable in the study areas.

The results of the analysis of variance of frequency of pistachio tree diameters in the studied areas show a significant (0.000) difference between the means at the level of 99% (P=1%) (Table 6).

Table 6. Analysis table of variance of frequency of Pistachio trees in the studied areas.

	Sum of Squares (SS)	Degrees of Freedom (df)	Mean of Squares (MS)	F	Significance
Between groups	190	23	8.26	7.3	*0.000
Within groups	18279.2	16166	1.13		
Total	18469.2	16189			

Table 7 shows the cost, income, and profit from the operation of Pistachio in the study areas, which are equal to 821.7, 1623, 1740.5, and 2116 million rials in Kamareh, Bapir, Cheshmeh Sefid, and Balaleh areas, respectively.

Table 7. Cost, income and benefits calculations for Pistachio exploitation in the study areas.

	Unit price (Rials)	Kamareh	Bapir	Cheshmeh Sefid	Balaleh
Production amount (kg)	3573	480	989	924	1180
Price (kg)	2500,000				
Estimated amount based on design booklet (kg)	5630	480	2000	1200	1950
Duration of exploitation (days)	50	50	50	50	50
Number of workers (persons)	3	3	3	3	3
The daily wage of each worker (million Rials)	1.5	225	225	225	225
Other expenses (million Rials / person)	0.15	4.5	4.5	4.5	4.5
Property interest (kg)	180,000	84400000	360000000	216000000	351000000
Supervising expert supervision fee (kg)	30,000	14400000	60000000	3600000	58500000
Rehabilitation cost (million Rials)	0.1	48	200	120	195
Total costs (million Rials)		3783	849.5	569.5	834
Income (million Rials)		1200	2472.5	2310	2950
Benefit (million Rials)		821.7	1623	1740.5	2116

The pistachio tree as one of the trees adapted to different climatic regions has always had great ecological and economic value. Today, in the developed countries of the world, it is a more valuable species that has three characteristics of stability, quality, and suitable biological power (Bordbar et al., 2006). Pistachio (*Pistacia atlantica* (subsp. Mutica), however, lacks timber due to its location in arid and semi-arid regions of the country. However, due to its compatibility with the environment, the economics of gum and seeds produced are of considerable species. On the other hand, the protection of forest and rangeland areas is one of the most important tasks and goals of all-natural resource projects, the condition of which is to maintain, rehabilitate and develop habitats in the assignments and involvement of area residents. According to research, the annual yield of turpentine varies between 50 to 100 tons per hectare in the total forests of the Zagros (Mansoori and Badehyan, 2014).

According to the results of the studies, the average height of Pistachio trees is 3.5 meters, the maximum height of which is 6.1 meters in Bapir custom and the minimum is 4.2 meters in the Balaleh area. On the other hand, the average trunk height of these trees is 2.4 meters, the minimum trunk height is 2.1 meters (Kamareh, Bapir, and Cheshmeh Sefid areas) and the maximum trunk height is 3.3 meters, which is related to the Balaleh area. The average height of their canopy is equal to 3.2 meters. The average diameter is 34.2 cm and the average diameter of large and small canopies is 4 and 2.7 meters, respectively. The canopy cover of the trees in the area is 50% and most of the trees are healthy in terms of quality. The results of this study are consistent with the

results of other research (Garavand et al., 2016; Ghahari et al., 2016). Environmental stresses as well as the greater impact of global warming and climate change on pistachio species in areas with higher vulnerabilities such as Tafresh in Markazi province can also be mentioned.

Today, the use of turpentine in the west of the country is done incorrectly. According to research, the annual yield of turpentine varies between 50 and 100 tons per year. According to the statistics of the General Department of Natural Resources of the province, considering the diameter and age, and freshness of Pistachio trees, about 2 to 4 kg of raw sap is mentioned for each tree (Ojeda-Amador et al., 2018). In general, if the right plans are created for economic exploitation, it will greatly help increase the per capita income of the people of this region. Provided that the necessary training programs be implemented for the proper exploitation of the forests of this region and their products. However, in studies on the effects of turpentine exploitation on pistachio regeneration, it has been concluded that turpentine exploitation does not have a significant direct effect on the absence of natural regeneration. However, pistachio is very important due to its special properties, especially in the field of turpentine.

In some areas, due to the lack of knowledge of forest dwellers about exploitation methods and the lack of related industries, it is mostly done by non-native people to make more profit and in a completely unscientific way. This factor has weakened and even spread the disease among pistachio trees in some areas (where turpentine is exploited) and has caused concern for the health and future of these trees. It seems that paying attention to other characteristics of this species, especially its seed production, which is considered by some industries such as oil, pickles, and snacks, can be a suitable alternative for the use of turpentine in these areas (Jahanbazi and Talebi, 2006). The production and harvest of pistachio fruit and its place in the nutrition and livelihood of the inhabitants of the region, the situation of pistachio exploiters and traders, and the amount of extractable oil in Ilam have been studied. The annual fruit production was determined through statistics and the results showed that each hectare produces an average of 50 kg of fruit (Hamzehpour et al., 2006). The results of this study indicate that pistachio fruit contains 25% oil and 75% meal.

The most important issue for non-timber forest products in the region is the issue of selling products, which without any special organization, has been pouring the income of these products to brokers and intermediaries for many years. The forest dwellers of the region suffer the most hardship and cost for production and also receive the lowest interest. The upward trend of prices in the path of products from the origin to large cities reflects this issue. These findings are consistent with the results of other studies (Nejabat et al., 2017; Mansoori and Badehyan, 2014).

4. Conclusion

As the results of this study show, the total estimated production of turpentine is 3573 kg and the total profit of the studied projects is 4401.2 million Rials. Due to the relatively significant price of this product and the high potential of the region, it can play an important role in the household economy of the region, which has created permanent jobs for at least several people. The intense involvement of the people, which is due to their strong dependence, especially in the provision of basic necessities of life such as food, fuel, and livestock, has caused the surface of the Zagros forests to be exposed to physical, quantitative, and qualitative destruction. Therefore, the protection of valuable wild pistachio trees in the forest ecosystem of the region and the principled extraction of their sap based on the potential of forest areas is of particular importance. In addition, the introduction of the production capacity of its by-products can be an effective help in creating the necessary motivation for the protection and development of Zagros forests and on the other hand, the continuation of the economic and social life of the inhabitants of those areas. In order to prevent the unprincipled exploitation of trees by non-indigenous people and damage to trees, it is recommended that indigenous people be exploited in a principled manner while being educated. Affiliated industries are also created, shortening the hands of speculators and increasingly motivating local people to protect natural ecosystems from damage from any possible degradation.

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