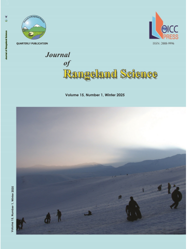

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Impact of abiotic environmental factors on *Pistacia vera* L. density in woody rangelands: a case study in Northeastern Iran

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Original Research

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Abstract:

Khaje Kalat woody rangelands, located in northeastern Iran, represent one of the few remaining Sicilian pistachio rangelands worldwide. Understanding the ecological processes shaping pistachio communities is crucial for effective management and restoration efforts. This study aimed to investigate the impact of abiotic environmental factors on *Pistacia vera* L. density, a research study was conducted during 2018-2019. And 162 quadrats (25 m^2 each) were established across three geological formations, two aspects (northern vs. southern), and three classes of Terrain Niche Index (*TNI*). The two-way analysis of variance (ANOVA) was employed to analyze the impact of geological formation, topographic attributes, and soil parameters on pistachio density. Significant findings ($p<0.05$) underscore the pronounced influence of geological formation, *TNI*, and their interactions on pistachio density. These findings showed distinct patterns across formations and elevations. Moreover, an analysis of soil parameters highlights the pivotal roles of phosphorus and geological formations in influencing pistachio density. Notable associations between phosphorus levels and density emerged, along with substantial variations in soil properties among different formations. While recognizing the significance of soil fertility, particularly in nutrient-rich lowlands, the study suggests that it may not be the primary limiting factor for mature pistachio trees. However, the presence of such nutrient-rich lowlands may potentially hinder pistachio establishment. In conclusion, these insights underscore the importance of analytical ecosystem management for preserving and restoring *Pistacia vera* rangelands effectively.

Keywords: Ecological processes; Geological formation; *TNI* (terrain niche index); Northeastern iran

Introduction

Forest ecosystems have high levels of terrestrial biodiversity, play a crucial role in global climate regulation, regulating the global carbon cycle, regulating streamflow, storing water, reducing floods, preventing soil erosion, recovering degraded land, and making up more than 70% of terrestrial biomass (Abbasi-Kesbi et al., 2016; Mahmoudi et al., 2021). Pressures from human activities, such as deforestation and desertification, cause deforestation and the transmutation of natural forests into agricultural land, altering ecological processes and combining flowers and plants in plant communities (Morris, 2010). Deforestation is causing the extinction of tree species and, as a result, the loss of plant diversity is increasing. Therefore, the protection of tree species has become one of the most important research topics in the conservation debate (Pretzsch et al., 2012). The structures of forest ecosystems are codetermined by natural processes (tree growth, death of one or more trees and disorders such as fire and wind), human disturbances (land-cover changes for industrial agriculture, deforestation, afforestation, selective logging), as well as by environmental constraints (Seydack et al., 2012; Rahmanian et al., 2023). Climate has different effects depending on the spatial and temporal scale. Diversity and structural patterns at regional and global scales are regulated by the range of species tolerance to climatic and environmental factors, and at the local scale, potentially species distribution, structure, and dominance patterns are influenced by edaphic or topographic factors (elevation, direction, slope, etc.) (Goraghani et al., 2014). Therefore, one of the most vital factors for recognition of plant species distribution changes as well as understanding the ecological needs of species for ecological regeneration and the establishment of farms is the environmental factors (Toledo et al., 2012).

The establishment of plant species depends on edaphic, biologic, and climatic conditions, which is not a random phenomenon (Kolahi and Atri, 2014; Boogar et al., 2022). Understanding the patterns and relationships between the current geographical distribution of species and their interactions with environmental factors is essential for proper habitat management (Hosseininasab et al., 2017; Boogar et al., 2019). Environmental variables such as soil, topography, geomorphology, and biological factors affect the distribution, pattern, and abundance of plant species (Enright et al., 2005). For example, some studies have shown important impacts of topographic (e.g., altitude, slope, and aspect), edaphic and geological factors on vegetation distribution (Zhang and Dong, 2010; Ehsani et al., 2015). The effect of physiographic factors such as slope, aspect, and height on some quantitative and qualitative characteristics of this species (crown area, survival, and freshness) has been investigated and the results showed that aspect, slope, and altitude have a significant effect on the crown area of pistachio. Slope and aspect showed a significant effect on the pistachio vigor. Other studies have found that altitude, aspect, and slope had little influence on viability (Khosrojerdi et al., 2009).

Soil reflects the interactions of geological, hydrological, geomorphic, and biosphere processes, so soil spatial diversity is a vital issue for earth sciences, and the understanding and soil patterns and diversity interpretation is essential to use paleosols to reconstruct environmental changes and to understand current surface systems (Rodrigo-Comino et al., 2020). There are transparent and reciprocal relationships between plant communities and soil properties, so creating a sustainable forest and preserving soil nutrients are important (Onyekwelu et al., 2006). The effect of non-living factors viz. soil moisture, water, and soil pH, inhibitory potential, dissolved oxygen, nitrate, and phosphate concentration has been studied in the distribution of woodland species and transparent relationships have been found between physical environmental variables, soil chemical properties, and human degradation (Enright et al., 2005). Land train shape may affect soil moisture and nutrient chemistry and accessibility that may cause significant effects on the distribution of plant species and their diversity (Englisch, 2000).

The existence of a close relationship between vegetation and geomorphological factors (Lithology and the type of formation, tectonics, topographic factors of land shape, erosion form) causes a particular habitat in the formation of a plant community (Cottle, 2004). The type of formations and their rock compositions can cause changes in soil properties due to differences in minerals. These changes can affect the growth, establishment, and, ultimately, vegetation distribution (Cottle, 2004). The geological structure has been introduced as one factor affecting vegetation distribution (Yang et al., 2018).

Pistacia L. is a perennial woody plant in the Anacardiaceae family. The natural habitat of this genus originally located in Central and Southwest Asia (Bozorgi et al., 2013). *Pistacia vera* L., is the only cultivable and economically important species among 600 species of this genus (Bozorgi et al., 2013). The xerophilic woodlands of *P. vera* remnants are exist as several isolated stands in Central Asia. The Kopet-Dagh Mountain in northeastern Iran, is the westernmost distribution range of this species (Atashgahi et al., 2022). *Pistacia vera* is one of the native Iranian plants with a myriad of valuable characteristics, like traditional medicine applications (Bozorgi et al., 2013), and various pharmacological properties such as antioxidants (Tomaino et al., 2010), anti-nociceptive, and anti-inflammatory effects (Gentile et al., 2015). *P. vera* act as a keystone species, providing habitat, food, and support for other species, contributing to nutrient cycling and soil stabilization, and fostering mutualistic interactions. These combined effects make them essential for maintaining and conserving species diversity in their woody rangeland ecosystems. In addition to its ecological significance, *P. vera* plays a crucial role in supporting the livelihoods of local inhabitants in Iran, as the cultivation and trade of its valuable pistachio nuts provides a significant source of income for many communities in the region. (Kholdi et al., 2011). However, lack of regeneration of indigenous populations due to high human consumption and overgrazing have endangered Sicilian pistachio woodlands in Iran (Kolahi and Atri, 2014). Extensive woodland of *pistacia vera* has been severely damaged by overgrazing. Severe grazing generally hinders the germination of pistachio seeds and limits sexual reproduction and reduces genetic diversity. Given the vital role of plants in ecosystem balance and the various uses that humans make directly or indirectly from them, we inevitably need to understand the relationship between plants and environmental factors. Since the significant abiotic factors, e.g., topography and soil properties, cause similar effects on plants worldwide, hence results of this research can also be helpful for the management and restoration of pistachio rangelands in other parts of the country, precious biomes that are highly under the distinction threats. Therefore, this study was carried out to evaluate the possible effects of main stable environmental factors, such as geological formation, topographic characteristics, and soil parameters, on the pistachio's natural density.

Materials and methods

Study area

Khajeh Kalat woodland is an isolated xerophilic woodland of the *Pistacia vera*. This subtropical semi-savanna is situated in Kopet-Dagh, Iran, between Chahchaheh and Sarakhs and adjacent to the Turkmenistan border (Karimi et al. (2009), figure 1). The area stretches from 60°20′30″ to 60°29′25″ E and from 36°32′12″ to 36°37′40″ N. The region's elevation is variable, with a minimum of 527 m

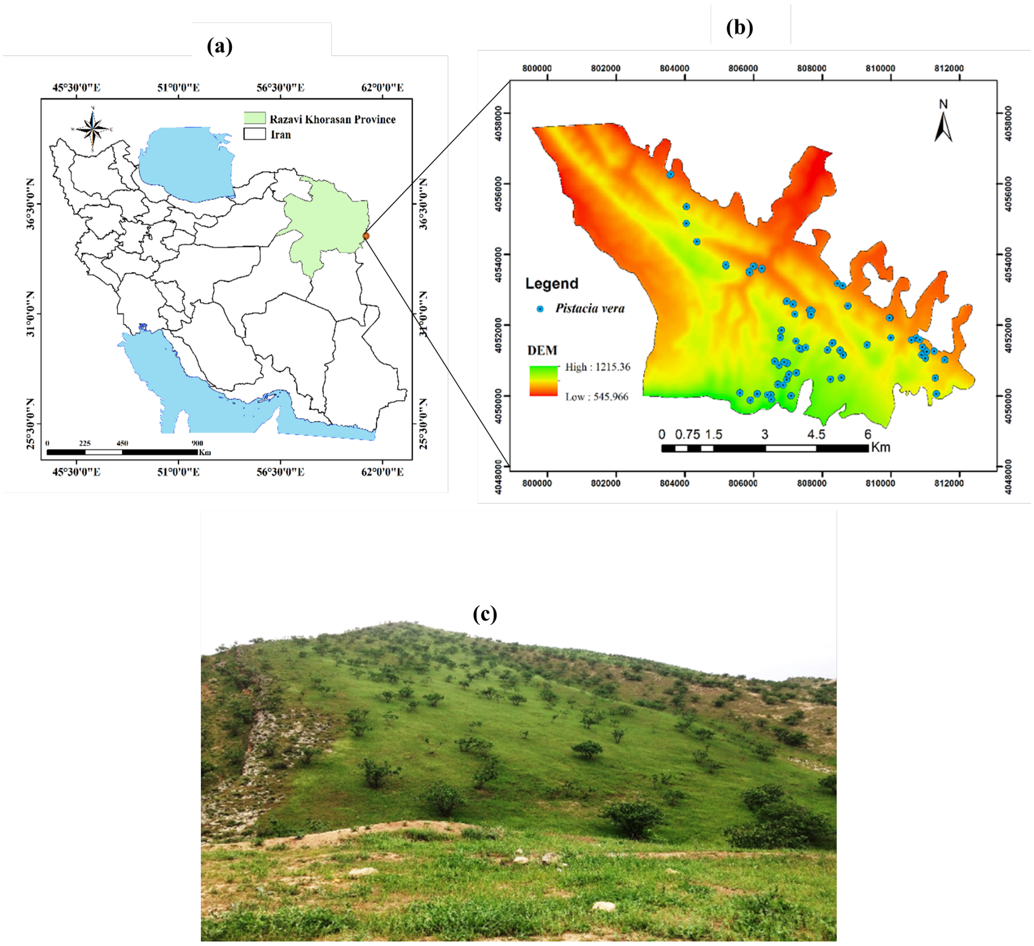

Figure 1. Map of the study area in NE Iran. a) location map of the study area in Razavi Khorasan province in Iran showing the Khajeh Kalat woodland, b) the circles representing the individual sampling areas, and c) habitat of *Pistacia vera* L.

to a maximum of 1232 m a.s.l. On an annual basis, the average temperature and precipitation are 17.9 °C and 255 mm, respectively (20-yr data).

Considering the meteorological data, it has a cold and dry climate (Khosrojerdi et al., 2008). The flora is predominantly short-living perennial herbs and grasses, and ephemerals that terminate their growth in early June, except a few shrub species that grow until mid-October. The dominant species is *Pistacia vera* L., accompanied by some species viz. *Artemisia kopetdaghensis* Krasch., Popov & Lincz. ex Poljakov, *Zygophyllum atriplicoides* Fisch. & C.A. Mey, *Poa bulbosa* L., *Bunium persicum* (Boiss.) B. Fedtsch, *Amygdalus spinosissima* Bunge, and *Ephedra foliata* Boiss. ex C.A.Mey. (Ejtehadi and Soltani, 2007).

From a geological point of view, the study area is a part of the Kopet-Dagh basin in northern Khorasan, Iran. The geological formations have different outcrops and belong to the upper Cretaceous and Paleogene systems. The oldest outcrops belong to the Abtalkh Formation (K_{ab}). The sandstone Neyzar Formation (K_{ny}), thickly layered sandstones, Gluconite and limestone and shale are gradually located in the Abtalkh Formation and followed continuously by the carbonate/shaly Kalat Formation (K_{lk}), the last Formation of the Upper Cretaceous (Uppermost Maastrichtian). Pestehligh Formation (Pe_p) is the first sedimentary succession of the Paleogene system (Early Paleocene), mainly composed of red siliciclastic rocks of terrestrial sequences, the Cretaceous-Paleogene disconformity. In a transgressive trend, the Pestehligh Formation is overlaid by the marine carbonate rocks of Chehelkaman Formation (Pe_c) in the late Paleocene and so on the Khangiran Formation (E_{kh}) in the Eocene-Oligocene (Table1). Formation is the last marine succession in the stratigraphic history of the Kopet-Dagh Basin (Salahi et al., 2018).

Sampling method

Field work was carried out in 2018 and 2019 (from April to June). We first prepared basic maps of topography (slope aspect), three classes of terrain niche index (*TNI*) (0.24-0.6, 0.6-1, and 1-1.35), and three geological formations (Neyzar formation, Kalat formation, Chehelkaman formation) using Arcview software. The three maps were combined to prepare a composite map. The sample parts were randomly determined from the study units created by the composite map, and they were implemented using a GPS device (Khosrojerdi et al., 2009). In the context of the investigation, there were 18 study units, and within each work unit, three points were randomly established as 50×50 m macroplots (figure 2), a total of 54 points. Three 5×5 m subplots were placed inside the macroplots. The mean distance between each subplot was 20 m. within the macroplot. A total number of 162 individual plots have been established in

Table 1. Essential characteristics of the study area.

Formation	Terrain niche index (*TNI*)	Elevation(m)	Latitude	Longitude
Neyzar (K_{ny})	Level 1=0.24–0.60	940-1059	36.56 - 36.54 N	60.42 - 60.42 E
	Level 2=0.60-1.00	978-1027	36.55 - 36.55 N	60.42 - 60.43 E
	Level 3=1.00-1.35	993-1037	36.56 - 36.54 N	60.42 - 60.42 E
Chehelkaman (Pe_c)	Level 1=0.24-0.60	648-751	36.60 - 36.55 N	60.39 - 60.47 E
	Level 2=0.60-1.00	741-829	36.55 - 36.55 N	60.47 - 60.47 E
	Level 3=1.00-1.35	813-927	36.55 - 36.55 N	60.47 - 60.45 E
Kalat (K_{lk})	Level 1=0.24-0.60	678-1009	36.57 - 36.55 N	60.42 - 60.44 E
	Level 2=0.60-1.00	696-999	36.55 - 36.58 N	60.44 - 60.41 E
	Level 3=1.00-1.35	718-1028	36.57 - 36.55 N	60.41 - 60.43 E

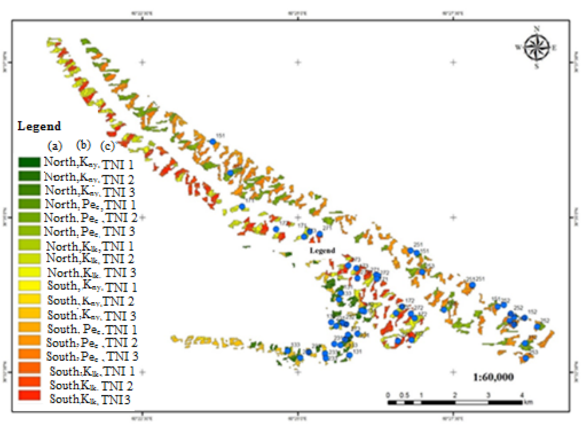

Figure 2. Work unit map and location of designated points on the map, : the circles representing the individual sampling areas; (a) North aspect, South aspect; (b) K_{ny}: Neyzar Formation, Pe_c: ChehelKaman Formation, K_{lk}: Kalat Formation; (c) *TNI* 1=0.24–0.60, *TNI* 2=0.60-1.00, *TNI* 3= 1.00-1.35.

the study area. Geographic coordinates and altitude characterized by the individual plot and pistachio density were recorded in each plot.

To describe the topographic variation, *TNI* was utilized. The *TNI* is affected by topographic conditions (Peng et al., 2012). Equation. 1 was used to estimate *TNI*. Large *TNI* values correspond to higher elevations and larger slope angles. In contrast, smaller *TNI* values indicate smaller slope angles and lower elevations. Medium *TNI* values were found in a higher elevation but slight slope angle, or lower elevation but with larger slope angles, or moderate elevation and slope angle (Tong et al., 2016).

$$TNI = \lg[(e/E+1)\times(s/S+1)] \tag{1}$$

where: e and E are the elevations of the pixel and the average elevation of the study area, respectively, whereas s and S signify the slope of the pixel and the average slope of the study area.

Soil collection and processing

Fifty-four soil samples were obtained from *Pistacia vera* habitats at depths of 0-30 cm. All soil samples were dried in room air before being filtered through a 0.2 mm screen, with visible roots and other plant debris removed. EC was measured with a conductivity meter, and pH was measured using a pH meter in saturated mud. The Walkley–Black technique was used to calculate soil organic carbon (OC) (Nelson and Sommers, 1983). Calcium was measured using atomic absorption spectroscopy and flame photometry (Berry and Johnson, 1966). Miller and Keeney (1982) techniques were used to determine soil accessible nitrogen (N), phosphorus (P), and potassium (K).

Statistical analyses

In preparation for the statistical analysis, the authors assessed the assumptions required for parametric tests. Notably, Levene's test was conducted to assess homogeneity of variances, which is essential for the validity of linear regression. Then, multivariate regression analysis was used in "nlme" R package (version 4.03) to assess the impacts of topographic (i.e., altitude, slope, Formation, and aspect) and soil parameters on species density. Topographic and soil parameters were considered as independent variables. To determine the most crucial factor affecting pistachio density, we developed linear model (LM) analysis to study the effect of *TNI*, aspect, formation (represented as topographic factors) and soil factors. To better understand pistachio trees' density, we carried out the relationship between the geology, formation, and soil factors by Linear Models (LM) (Team, 2013).

Results

Effect of environmental factors on pistacia vera density

This study employs a statistical model grounded in linear regression analysis to examine the relationship between various parameters and the density of pistachio species. The findings, detailed in Table 2, underscore the outcomes of the linear regression analysis. The regression equation reveals the significance of *TNI* and formation, as evidenced by p-values less than 0.05. Furthermore, the overall model is deemed statistically significant ($p<0.05$). To gauge the predictive efficacy of the regression model, the adjusted coefficient of determination (R^2) was utilized, indicating that 12% of the variations in the dependent variable within this model are explicable by the independent variables.

The results of Levene's test (p-value =0.227) indicated the absence of significant variance heterogeneity among the experimental groups, thereby confirming the assumption of homogeneity of variances. Subsequently, the statistical

Table 2. Summary of statistical model based multiple linear regression analysis.

Regression cofficents	Estimate	Std.Error	T value	P value
Intercept	-24.07	115.25	-0.209	0.83
Aspect	-54.32	45.76	-1.187	0.23
Formation	53.70	14.01	3.833	0.00^{**}
TNI	70.37	28.02	2.511	0.01^{**}

R^2= 0.12, F-value=7.47, **=Significant at 1% probability level.

analysis revealed that geological formation, *TNI*, and their interactions ($p<0.05$) were significant in *P. vera* density (Table3). The study found the highest *P. vera* density (1200 m^{-2}) in the Kalat formation and the lowest density (0 m^{-2}) in the Neyzar formation (figure 3).

A positive relationship between *TNI* and *P. vera* density was observed in Chehelkaman and Kalat Formations (figure 3), indicating that pistachio density increased with higher *TNI* values, corresponding to higher elevations and steeper slopes. However, the effect of *TNI* was influenced by its interaction with geological formation, which was significant for Chehelkaman and Kalat (figure 3).

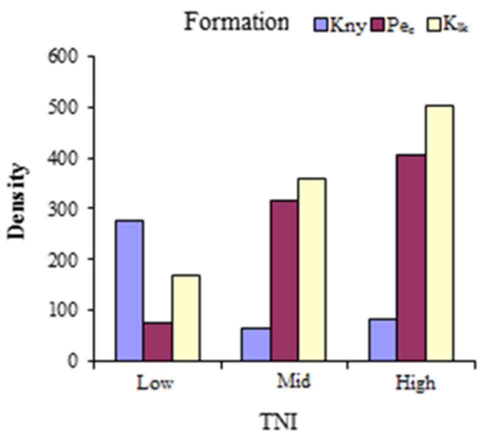

Figure 3. Impact of Formations and different *TNI* classes on pistachio density. K_{ny}: Neyzar Formation, Pe_c: ChehelKaman Formation, K_{lk}: Kalat Formation, Low: Low elevation and slopes, Mid: Medium elevation and slopes, High: High elevation and slopes.

Relationship between pistacia vera density and soil parameters

The results demonstrated that among the studied soil factors, phosphorus ($p<0.05$) was the singular factor that exhibited a statistically significant effect on *P. vera* density (Table4).

Relationship between geological formations and soil parameters

The Linear model results demonstrate that most of the measured soil parameters (available soil K, Ca, P, pH, and EC) differed significantly between three different Formations in the study area (Table5). In this regard, the soil of the Neyzar Formation had the most minerals (potassium, phosphorus, organic carbon, nitrogen, pH, and calcium) and EC compared to other Formations (figure 4). Calcium content was highest in the Neyzar Formation and the least in the ChehelKaman Formation (figure 4). As the amount of phosphorus decreases, the density increases (figure 5). This was explicitly found in the Neyzar Formation, which conferred the highest soil phosphorus and the lowest *P. vera* density (Figs. 4, and . 5).

Discussion

Effect of environmental factors on Pistacia vera density

In our study area, we emphasize the intricate interplay of environmental factors that shape *P. vera* density. Geological formations along *TNI* and their synergistic interactions exert significant influences, as confirmed by our analysis using linear models. Our findings reveal a positivee correlation between *P. vera* density and altitude, supported by studies (Zeynivand et al., 2018; Khosrojerdi et al., 2008). Altitude, represented as *TNI* in our study, plays a crucial role in shaping the distribution and abundance of mountain and hill vegetation, including *P. vera* (Valencia et al., 2004). At

Table 3. Effect of environmental factors on pistachio tree density.

Sources of variation	Df	Sum Sq	Mean Sq	F value	P-Value
TNI	2	539183	269591	3.48	0.04^{*}
Aspect	1	119493	119493	1.54	0.76
Formation	2	1250227	625114	8.07	0.00^{**}
*TNI**Aspect	2	37530	18765	0.24	0.80
*TNI**Formation	4	1801181	450295	5.81	0.00^{**}
Aspect*Formation	2	84915	42457	0.54	0.38
Aspect*Formation**TNI*	4	6285	1571.3	1.93	0.17
Error	148	11463154	77454		

*,**= Significant at 5 and 1% probability levels, respectively.

Table 4. Multiple linear regression analysis between *Pistacia vera* density as dependent variable (Y) and soil parameters as independent variables (X1-to X7).

Soil factors	Df	F value	p-value
Available soil Calcium (meq/L)	1	1.62	0.20
Organic carbon (%)	1	3.68	0.051
Potassium (mg/100 g)	1	0.01	0.96
Phosphorus (mg/100 g)	1	4.07	0.04*
Nitrogen (mg/100 g)	1	0.95	0.32
EC (dS/m)	1	0.70	0.42
pH	1	0.03	0.85

*= Significant at 5% probability level.

Table 5. Multiple linear regression analysis between geological formations as dependent variables (Y) and soil parameters as independent variables (X1-to X7).

Soil factors	Df	F value	p-value
Available soil Calcium (meq/L)	2	22.12	3.34e-09**
Organic carbon (%)	2	2.519	0.0837
Potassium (mg/100 g)	2	12.2	1.18e-05**
Phosphorus (mg/100 g)	2	7.168	0.00105**
Nitrogen (mg/100 g)	2	1.809	0.167
EC (dS/m)	2	9.038	1.92e-04**
pH	2	25.89	1.85e-10**

*,**= Significant at 5 and 1% probability levels, respectively.

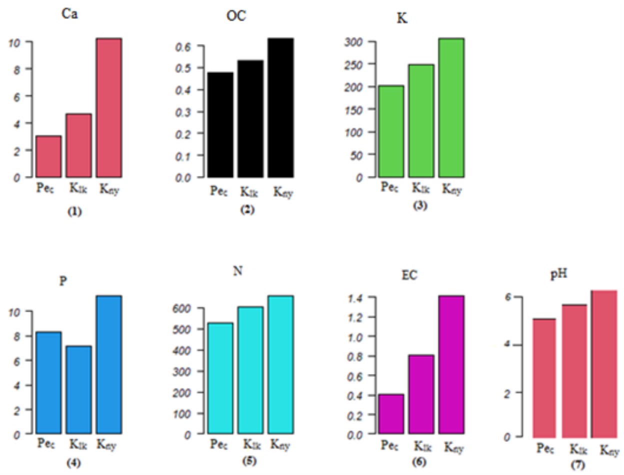

Figure 4. Comparison of soil chemical properties within different geological formations; K_{ny}: Neyzar Formation, K_{lk}: Kalat Formation, Pe_c: ChehelKaman Formation; (1): Calcium (meq.L^{-1}), (2): Organic carbon (%), (3): Potassium (mg/100 g), (4): Phosphorus (mg/100 g), (5): Nitrogen (mg/100 g), (6): EC (dS.m^{-1}), (7): pH.

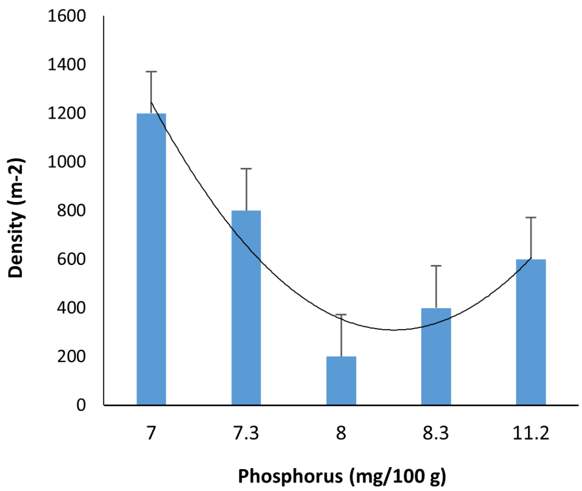

Figure 5. Effect of phosphorus content on *P. vera* density.

lower elevations, we observed a noticeable decline in *P. vera* density attributed to heightened human activities, including logging, chewing gum extraction, and livestock movement (Zeynivand et al., 2018). These activities contribute to land degradation and soil erosion, ultimately reducing the density of *P. vera* trees (Khosrojerdi et al., 2008). The impact of altitude on vegetation distribution is particularly evident in regions like the Chinese loess plateau (Zhang and Dong, 2010), affecting the distribution of *P. vera* and other vegetation (Zhang et al., 2006).

Moreover, the study findings established a relationship between slope degree and *P. vera* density within the broader context of topography's impact on vegetation. Slope, as a prominent topographic factor, played a crucial role in shaping the functional characteristics and diversity of vegetation (Deng et al., 2007; Cadol and Wine, 2017). The existing body of research indicates a clear affirmative connection between slope degree and vegetation frequency, often serving as an indicator of the vitality and health of vegetation on sloped surfaces. The study's findings revealed that as slope steepness increased, *P. vera* density followed suit with a corresponding rise. This phenomenon was attributed to the relative inaccessibility of steeply sloped areas to human activities and livestock, contributing to improved preservation and growth of vegetation. These observations were in alignment with previous research on grazing herds in northeastern Oregon, where slope steepness significantly influenced distribution and utilization patterns(Kiet, 2000). Interestingly, the study highlighted the limited impact of aspect orientation on *P. vera* density. This suggested that other factors, such as geological formation type, altitude, and slope degree, exerted more dominant influences on plant density in the research context.

Effect of geological formation and soil parameters on pistacia vera density

In our study, among the soil factors considered, the only factor affecting the density of *P. vera* is phosphorus. Some researchers emphasize the importance of soil as an environmental factor in the distribution and establishment of plant species (Abella and Covington, 2006). We evaluated the effect of soil factors within each geological formation to understand the logical effects of Formations on the density of *P. vera* and its characteristics. The soil of Neyzar formation conferred the highest mineral concentrations (potassium, phosphorus, organic carbon, nitrogen, pH, and calcium) and more EC. Higher phosphorus concentration in Neyzar was concurrent with the highest EC. Acknowledging the importance of soil fertility, especially in nutrient-rich lowlands, this study unveils a noteworthy observation. Despite the

higher concentration of minerals and Electrical Conductivity (EC) in the Neyzar formation, the recorded density within this formation is notably the lowest. Soil salinity reduces water uptake by plants. Salinity problems are more common in arid and semi-arid areas with less rainfall and high temperatures or in areas where high-salt groundwater is used for irrigation, which causes more soluble salts to accumulate near the soil surface, resulting in high EC (Machado and Serralheiro, 2017). Higher EC hinders nutrient uptake by increasing the nutrient solution's osmotic pressure, wastes nutrients, and increases the discharge of nutrients into the environment, resulting in environmental pollution (Sonneveld and Voogt, 2009).
In summary, our study emphasizes the complex interaction of environmental factors, including geological formations, topographic attributes, and soil properties, in influencing *P. vera* density. These findings provide valuable insights for pistachio rangeland management and restoration efforts, particularly in regions facing similar environmental challenges, such as arid and semi-arid areas susceptible to nutrient imbalances.

Conclusion

We found that environmental factors can have a significant effect on *P. vera* density. Nevertheless, the impact of these factors varies. For example, although the density of *P. vera* increases with increasing slope degree and altitude, this may be more due to easier access for deforestation and livestock grazing than topography. As a result, we found the highest *P. vera* density in steep slopes and impassable areas of the Kalat formation. Another interesting finding of ours in this study was the inverse relationship between *P. vera* density and soil fertility. Despite having more fertility factors in Neyzar formation, more EC in this Formation reduced *P. vera* density. The findings of this study can be used as a basis for a specific strategy in the conservation and management of natural habitats. Although conservation of primary forests is critical to the conservation of biodiversity and conservation of ecosystem performance, natural and managed development on degraded lands can have great potential for ecosystem recovery services. Therefore, special attention should be paid to non-biological and biological factors and their interaction in species recruitment.

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Authors' contributions
Alemeh Mazangi, Hamid Ejtehadi, Mohammad Farzam, and Omid Mirshamsi designed the study. Alemeh Mazangi collected the data, performed the analysis, and wrote the manuscript. Alemeh Mazangi and Soroor Rahmanian contributed to the interpretation of the results and work on the manuscript. All authors contributed to different versions of the manuscript and discussed the results and gave final approval for its publication.

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Data accessibility
Data will be made available in the Dryad Digital Repository.

Conflict of interest
The authors declare that they have no conflict of interest.

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