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The Effect of Altitude on some soil physical-chemical properties in Serestan forest (Tartous /Syria)

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☐ ABSTRACT ☐

The objective of this study was to investigate the variation in soil physico-chemical properties in the Serestan forest (Tartous /Syria). Soil samples were collected from 3 locations located at (105-205-305) m (a.s.l). The results revealed that the soil physio-chemical properties of soil samples show significant ($P < 0.05$) correlation with the elevation gradient**.** Sand content had significant and positive correlation with elevation it increases with the increase in altitude with the rate of correlation coefficient 0.918 while the clay and silt content of soil were negatively correlated to the altitude it decreases as altitude increases with the rate of correlation coefficient -0.930 and -0.827 respectively. Soil Organic matter decreased with increase in altitude at correlation coefficient -0.970. CaCO3 shows negative correlation decreasing with increase in altitude at the rate of correlation coefficient -0.991. Soil pH decreased with increase in altitude at correlation coefficient -0.850. EC decreased with increase in altitude with the rate of correlation coefficient -0.750. The percentage of available Ca^{+2} and Mg^{+2} content in the soil decreased with increasing altitude with the rate of correlation coefficient -0.978 and -0.943 respectively. Overall, this study indicated that altitudinal variation exerts a significantly influenced the soil's physico-chemical properties, and is of great importance in understanding the change in soil properties and its impact on soils classification and development with altitude gradient.

Keywords: Soil physical and chemical properties, Altitude, soil erosion.

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تأثير الارتفاع على بعض الخصائص الفيزيائية والكيميائية للتربة في غابة سرستان، طرطوس/سورية

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□ ملخّص □

يهدف هذا البحث إلى دراسة التباين في الخصائص الفيزيائية والكيميائية للتربة في غابة سرستان (طرطوس/ سورية). جُمعت عينات التربة من ثلاث مواقع على ارتفاعات مختلفة (105-205-305 م فوق مستوى سطح البحر. أظهرت النتائج ارتباطًا معنويًا ($P< 0.05$) بين الخصائص الفيزيائية والكيميائية للتربة وتدرج الارتفاع. ارتبط محتوى الرمل ارتباطًا معنويًا وإيجابيًا مع الارتفاع، إذ يزداد مع زيادة الارتفاع مع معامل ارتباط (0.918)، بينما ارتبط محتوى الطين والسلت في التربة ارتباطًا سلبيًا مع الارتفاع، إذ ينخفض محتوى الطين والسلت مع زيادة الارتفاع مع معامل ارتباط (0.930-) و (0.827-) على التوالي. ينخفض محتوى المادة العضوية في التربة مع زيادة الارتفاع عند معامل ارتباط (0.970-). يُظهر $CaCO_3$ ارتباطًا سلبيًا مع الارتفاع، إذ ينخفض مع زيادة الارتفاع مع معامل ارتباط(0.991-). ينخفض pH التربة مع زيادة الارتفاع عند معامل ارتباط (0.850-). تنخفض قيمة الناقلية الكهربائية للتربة مع زيادة الارتفاع مع معامل ارتباط (0.750-). ينخفض محتوى الكالسيوم والمغنيسيوم المتاح في التربة مع زيادة الارتفاع مع معامل ارتباط (0.978-) و (0.943-) على التوالي.

بشكل عام، أشارت هذه الدراسة إلى أن التدرج في الارتفاع يؤثر بشكل كبير على الخصائص الفيزيائية والكيميائية للتربة، وله أهمية كبيرة في فهم التغير في خصائص التربة وتأثيره على تصنيف الترب وتطورها مع التدرج في الارتفاع.

الكلمات المفتاحية :الخصائص الفيزيائية والكيميائية للتربة، الارتفاع ، انجراف التربة

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Introduction

Soil is one of the most important parts of ecosystem and it is usually defined as a multi-complex system, comprised of mineral nutrients essential for plant growth, eroded rock, decaying organic matter, solid, liquid and gaseous phases and resulting from weathering processes through reactions between lithosphere, atmosphere, hydrosphere, and biosphere across the time (Cahyana and Mulyanto, 2024). Serving as a habitat for plants, animals and living organisms and supporting human life through supply livelihoods such as services and goods (Brevik *et al*., 2019; Gomoryova *et al*., 2022). The ability of soil to support livelihoods and habitat depends on its physic-chemical and biological properties which have properties due to the integrated effect of climate and biological activities upon parent materials (Brady and Weil, 2002) and exhibit considerable variation in its properties (Dharumarajan *et al.,* 2022). There are several causes for such spatial variability of soil properties (Addise *et al*., 2022) such as altitude, temperature, moisture, soil type's precipitation, and salinity (Cheng et al., 2023)

Altitude influenced soil properties through its effects on drainage, run off and soil erosion. With the variations in altitude, climatic factor of an area also changes. High altitude area is characterized by high solar radiation, low temperature, and low partial pressure of the air (Streb *et al*., 1998; Li *et al*., 2021) Lowland area is characterized by higher temperature, different atmospheric humidity, and higher potential evapotranspiration. Climatic factors such as rainfall, temperature, and their distribution throughout the year effect on soil properties in different geographic regions (Masoud *et al*., 2025; Hassan and Nile, 2021) and also effect on the distribution and structure of plant community (Fatima *et al*., 2022; Wani *et al*. 2023) by controlling the rate at which plant residues return to the soil (Chimdessa, 2023). Rainy areas usually have intensity forest cover and organic-rich soils while areas with little rainfall and dry areas have low forest cover and poor in organic carbon soils (Delgado *et al*., 2017).Temperature also effect on soil moisture and organic carbon content. In hot regions, soil biomass activity is high, and organic carbon decomposes rapidly and this effect on the amount of organic matter in the soil. Organic matter plays a crucial role in soil, exerting a profound effect on its physical, chemical, and biological properties through improves its structure and increases its porosity, leading to enhancing permeability , drainage and increase their water-holding capacity and provide more nutrients (Piccolo and Drosos, 2025)

Importance and objective of the research

Serestan forest is characterized by rolling topography, and variation of soil properties due to the factor of altitude, which will play a major role in influencing soil properties. There are complex relationships among altitude positions; land usage, and soil quality, Hence it is very important to understand the variation of soil properties, which are critical indicators of soil fertility, agricultural productivity, utilization and proper management (Chen *et al.,* 2020). Although several studies have conducted on the effect of altitude on soil chemical-physical properties in many part of the world, few studies were made in Syria, Hence little information is available about the relationship between soil properties with changing altitude. Therefore, there is a need for more research regarding soil properties and its relation with altitude in Syria. Under the backdrop of the aforesaid facts, the objective of this study was to determine the effect of altitude on chemical-physical properties of Serestan forest soil.

Material and methods

1. Study site

The study site was located in a pine forest soil (Serestan forest), which is situated in the western part of Safita regionin (Tartous governorate), at an elevation of between 100 - 305 m above sea level (Fig.1). Mean annual rainfall is 1300 mm. The mean annual Absolute Max air temperature is 40°Cand mean annual Absolute Min air temperature is 11°C. Total area of Alsanobar forest is 70 ha. The soils are mostly formed from calcareous parent matrial.

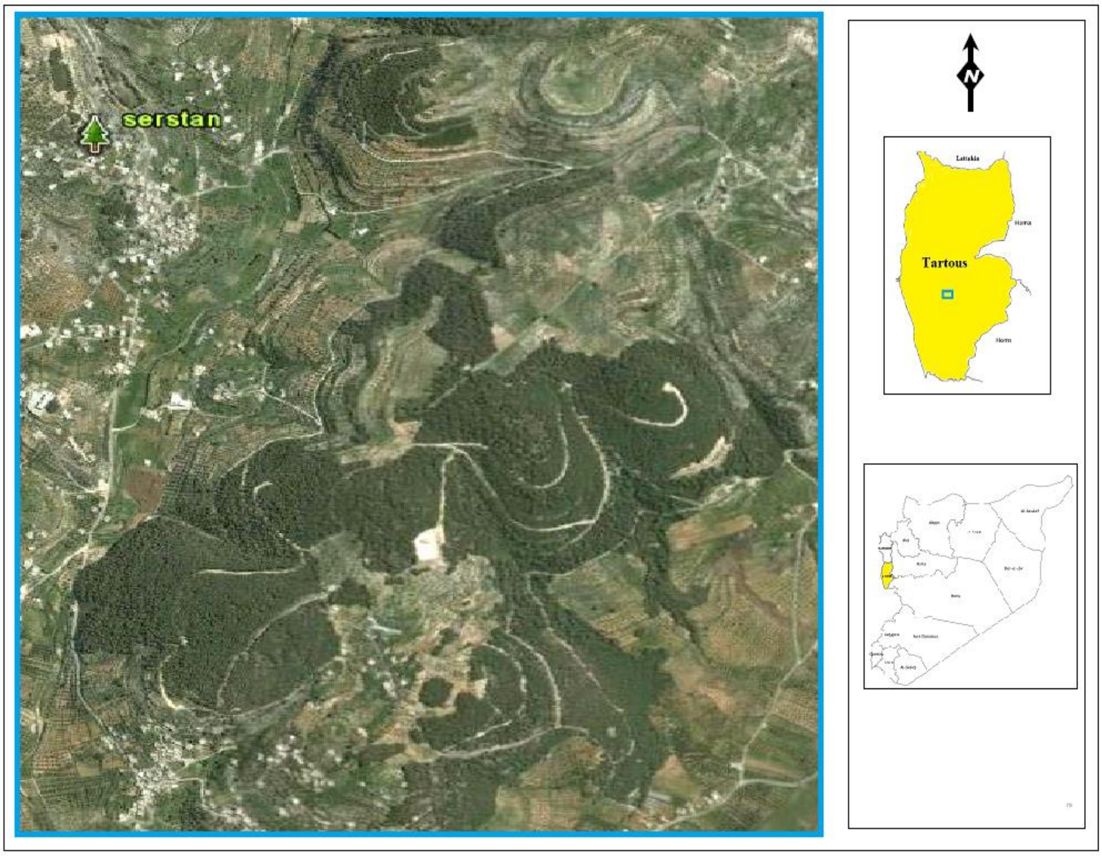

Figure.1. Map of location of the study areas

2. Sampling Protocol

Three sites were selected with different elevations. Three composite soil samples were collected from the surface layer (0 - 20 cm depth) soils of each site. Elevation of the sampling points varied from 100 to 305 meters above sea level (Table 1).

Table1: Characteristics of the sampling sites.

Sampling Site	Latitude N	Longitude E	Altitude (m)
1	34˚. 52′ 01″	36˚ 02′ 15.6″	305
2	34˚. 51′ 49″	36˚ 02′ 18.5″	205
3	34˚. 51′ 33″	36˚ 02′ 21.8″	105

3. Soil samples analysis

The composite surface (0 - 20 cm depth) soil samples collected were air-dried and ground to pass through a 2 mm sieve. Physical and chemical analyses were carried out including. Soil texture was determined by hydrometer method (Elfaki *et al.*, 2016).Bulk density (BD) (g/cm^3) was calculated by (De Feudis *et al.*, 2022). Electrical Conductivity (EC) (dS m-1) was measured by Electrical Conductivity meter using soil saturation paste (Rhoades, 1993). Soil reaction pH of soil samples was determined by pH meter of 1:5 suspensions (Faria *et al.*, 2023). The total organic matter (TOM) (%) was determined by wet combustion method (Dong *et al.*, 2020). Mg^{+2} (meq/100 g) and Ca^{+2} (meq/100 g) were determined by Staff (2014). CaCO3 (%) was determined by following (Drouineau, 1942).

4. Statistical analysis

Data generated through the study were analyzed for mean and standard error (SE). Significance level (p<0.05) was generated among the different altitudinal study sites by one way ANOVA. Pearson correlation coefficient was done for the analysis of correlation in different physico-chemical properties of soil with altitudes using the computer program SPSS statistical software17.0 versions for Windows.

Results and Discussion

1. Physical Properties of the Soils

1.1. Soil Colours.

All soil colours were determined under wet conditions and hue 7.5 YR was used for soil colour determination (Munsel, 1996). The higher and middle elevations have colours ranging from 5YR3/2 (dark reddish brown) to 5YR4/3 (dull reddish brown), while at lower elevations the soil colours were ranging from 7.5YR3/1 to 7.5YR3/2 (brownish black). Colour of the soil is usually are refection of the amount of organic matter present in the soil hence darker soils with brown/black colour indicate the presence of high amounts of organic matter as compared to those with greyish brown coloured soils.

1.2. Soil Texture (Sand, Silt, and Clay content %).

In this study, the physical properties were determined from the particle size distribution. Particle size distribution was determined based on the relative proportion of sand, silt, and clay within the soil sample. The particle size distribution of the soil showed clear differences in sand, silt and clay content with the elevation gradient. The clay content of the soil sample ranged from 30% to 39%; the highest percentage (39%) was recorded at the lower elevation, while the least percentage (30%) was recorded at the higher elevation.

The silt content of the soil sample ranged from 33.5% to 39.8%, the highest percentage (39%) was recorded at the lower elevation, while the least percentage (33.5) was recorded at the higher elevation. The sand content ranged from 21.2% to 36.5%, the highest percentage (36.5%) was obtained at the higher elevation, while the least percentage (21.2%) was recorded at the lower elevation. Results of the present study indicated a significantly (p<0.05) variation in clay (%), silt (%) and sand content (%). The clay (%) and silt content (%) were significantly (p<0.05) decreased with the altitude, whereas sand content was significant (p<0.05) increased with the altitude (table 2). based on clay, silt and sand content. The correlation analysis revealed that clay (%) and silt (%) were significantly (p<0.05) negatively correlated with the altitude, whereas sand (%) was positively correlated with the altitude (Table 2). Considering the three elevation gradients, the highest (39 ± 1.04) mean value of clay was recorded at the lower elevation and the least (30 ± 1.04) clay value was recorded at the higher elevation, indicating that the concentration of clay decreased along the elevation gradient. The highest (39.8 ± 0.65) mean value of silt was recorded at the lower elevation and the least (33.5 ± 1.7) value of silt was recorded at the higher elevation, showing that the silt concentration decreased along the elevation gradient. While the sand the highest (36.5 ± 2.56) mean value of sand was recorded at the higher elevation and the least (21.2 ± 0.43) value of sand was recorded at the lower elevation, showing that the sand concentration increased along the elevation gradient. Our results are consistent with those reported by (Charan *et al*., 2013)) who showed that the clay and silt content decrease with increase along the elevation gradient, whereas sand content showed increasing along the elevation gradient.

Table 2. Correlation coefficient (*r*), (Means± SD), and significant level of physical properties of the soil across the three elevations.

Parameter	**Elevation**			**Correlation**	**sig. (2 tailed)**	**p-value**
	Higher	**Middle**	**Lower**	**coefficient** (r)		
Clay %	30 ± 1.04	36 ± 0.50	39 ± 1.04	-0.930**	0.000	0.001
Silt %	33.5 ±1.7	38.2 ± 0.52	39.8 ± 0.65	-0.827**	0.066	0.018
Sand %	36.5 ± 2.56	25.8 ± 1.02	21.2 ± 0.43	0.918**	0.000	0.001
BD g/cm^3	1.29 ±0.032	1.22±0.005	1.17 ±0.010	0.866**	0.003	0.014

** Correlation is significant at the 0.01 level (2-tailed).

From the soil textural triangle, the texture class distribution of the soil varied from clay loam to clay. The majority of the textural classes of the soils are sandy followed by clay loam and clay. The differences in textural class might be due to the difference in parent material, vegetation type, and pedogenic processes in the study area. The result indicated that clay loam is the dominant texture class in the upper (0–20 cm) layer of the soil of the study area.

1.3. Bulk Density (BD) (gm/cm3).

The bulk density value of the soils varied from 1.28 gm/cm3 at the higher elevation to 1.15 gm/cm3 at the lower elevation. The highest BD value was recorded at the higher elevation, while the least BD value was recorded at the lower elevation. The correlation analysis result revealed that BD showed a significant positive (0.866^{**}) correlation with elevation. The results of the analysis of variance indicated that there is significant ($P < 0.05$) difference in BD along with an increase in elevation. The highest (1.29 ± 0.032) mean value of BD was recorded at the higher elevation, while the least mean value of BD was recorded at the middle (1.22±0.005) and lower (1.17 ± 0.010) elevation, indicating an increasing trend in BD along with an increase in elevation (Table 2).Our results are consistent with those reported by (Thapliyal *et al*., 2024) who showed that the Bulk density (BD) increased with altitudes

2. Chemical Properties of the Soil

2.1. Organic Matter

The organic matter (OM) content varied from 3.2 % at the higher elevation to 5.04% at the lower elevation indicating decrease along with the elevation gradient.

The correlation analysis revealed that SOM showed a significant negative correlation (r = -0.970**) with elevation. The ANOVA result also showed that there is a significant (*P* < 0.05) difference in the content of SOM along with an increase in elevation. The highest (5.04 ± 0.08) mean value of SOM was recorded at the lower elevation, while the least (3.2 ± 0.15 and 3.86 ± 0.03) mean value of SOM was recorded at the higher and middle elevations, respectively (Table 3). Our results are consistent with those reported by (Simsek *et al.*, 2023) who showed that the negative relationship between increased altitude and organic matter

Table 3. Correlation coefficient (*r*) , (Means ± SD), and significant level of chemical properties of the soil across the three elevation.

Parameter	**Elevation**			**Correlation**	**Sig. (2tailed)**	**p-value**
	Higher	**Middle**	**Lower**	**coefficient (r)**		
OM %	3.2± 0.15	3.86± 0.03	5.04 ±0.08	-0.970**	0.000	0.001
CaCO3 %	29.2± 0.41	38.2± 0.52	51.5±0.57	-0.991**	0.000	0.001
EC (dS m-1)	0.17± 0.005	0.19±0.005	0.20± 0.10	-0.750*	0.020	0.072
pH	7.71± 0.55	7.8±0.28	7.92 ± 0.15	-0.850**	0.004	0.020
Mg^{+2} meq/100 g	4.8± 0.05	5.4±0.05	7.8 ± 0.05	-0.943**	0.000	0.001
Ca^{+2} meq/100 g	22.2± 0.20	27.2± 0.10	38± 0.25	-0.978**	0.000	0.001

** Correlation is significant at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed).

2.2. Electrical Conductivity (Milisimese/Centimeter)

The electric conductivity (EC) of the soil is used to estimate the soluble salts of aqueous soil extract. In this study, the EC of the soils ranged from (0.17 mmos/cm) at the higher elevation to (0.20 mmos/cm) at the lower elevation. The ANOVA result showed a significant (P < 0.05) difference in EC value along with an increase in elevation. The correlation analysis revealed that EC content showed a significant negative correlation (r = -0.750*) with elevation. The highest mean value of EC were recorded at the lower (0.20 ± 0.10), while the least (0.17 ± 0.005 and 0.19 ± 0.005) mean value of EC was recorded at the higher and middle elevations, respectively (Table 3). Our results are consistent with those reported by (kamal *et al.*, 2023) who showed that the electric conductivity decreasing from low altitude to high altitude.

2.3. PH of the Soil.

The pH values of the soils varied from 7.71 at the higher elevation to 7.92 at the lower elevation the pH values had shown decrease trend with an increase in elevation. The analysis of variance showed that there is significant (*P* < 0.05) difference in pH value along with an increase in elevation. The correlation analysis revealed that pH content showed a significant negative correlation (r = -0.850^{**}) with elevation. The results of the analysis of variance indicated that there is significant (*P*< 0.05) difference in pH along with an increase in elevation. The highest (7.92 ± 0.15) mean value of pH was recorded at the lower elevation, while the least (7.71 ± 0.55 and 7.8 ± 0.28) mean value of pH was recorded at the higher and middle elevations, respectively (Table 3) Our results are consistent with those reported by (Roukos *et al.*, 2016) who showed that the low values of soil pH with increase in altitude.

2.4. Calcium carbonate, Mg^{2+} and Ca^{2+}

The Calcium carbonate content varied from 29.20 % at the higher elevation to 51.5% at the lower. The correlation analysis revealed that the Calcium carbonate content was found to be significant negatively correlated (-0.991^{**}) with elevation. The ANOVA result showed that there is a significant ($P < 0.05$) difference in the content of $CaCO_3$ with an increase in elevation. The highest (51.5 ± 0.57) mean value of the $CaCO_3$ content was recorded at the lower elevation, followed by the middle (38.2 ± 0.52) and higher (29.2 ± 0.41) elevation (Table 3). Our results are consistent with those reported by (Saeed *et al.*,2014) who showed that the $CaCO_3$ shows negative correlation decreasing with increase in altitude.

The exchangeable magnesium (Mg^{2+}) content of the soil varied from 4.8 meq/100 g at the higher elevation to of soil to 7.8 meq/100 g of soil at the lower elevation. The correlation analysis revealed that exchangeable Mg^{2+} showed a significant negative correlation ($r = -0.943^{**}$) with elevation. The ANOVA result showed that there is significant ($P < 0.05$) difference in Mg^{2+} content along with an increase in elevation. The highest (7.8 ± 0.05) mean value of Mg^{2+} was recorded at the lower elevation, followed by the middle (5.4 ± 0.05) and higher elevation (4.8 ± 0.05) (Table 3).

The exchangeable magnesium (Ca^{2+}) content of the soil varied from 22.2 meq/100 g at the higher elevation to of soil to 38 meq/100 g of soil at the lower elevation. The correlation analysis revealed that exchangeable Ca^{2+} showed a significant negative correlation ($r = -0.978^{**}$) with elevation. The ANOVA result (Table 3) showed that there is significant ($P < 0.05$) difference in Ca^{2+} content along with an increase in elevation. The highest (38 ± 0.25) mean value of Ca^{2+} was recorded at the lower elevation, followed by the middle (27.2 ± 0.10) and higher elevation (22.2 ± 0.20). Our results are consistent with those reported by (Imtimongla *et al.*,2021) who showed that the high amount of rainfall leaches out the base forming cations like Ca^{2+} and Mg^{2+} from higher elevation to the lower elevation.

Discussion

1. The Physical Properties of the Soil

1.1. Soil Colours.

The colours of the soil varied from dark reddish brown to brownish black. There was not much variation in soil colour along with an increase in elevation. The colours of the soil are usually a reflection of the organic and mineral composition of the soil (Savin *et al.,* 2016) water, and nutrient contents (Budak *et al*., 2018). hence darker soils with brown/black colours indicate the presence of high amounts of organic matter (Swetha and Chakraborty, 2021), red, brown and yellow soils indicate the presence of high levels of iron oxide (Moritsuka *et al*., 2019), white soils indicate the presence of carbonate (Sun *et al.,* 2011), gray soils indicate the presence of prolonged water saturation and oxygen depletion (Juhasz *et al*., 2007).

The variations in soil colour might be due to variations in organic matter and soil texture (Jiang *et al*., 2021). According to (Mangalassery *et al*., 2005), the variations in soil colours might be due to the differences in content and hydration of iron oxide and variation in mineral suites coupled with other dominant pedological features.

1.2. Soil texture (%)

Looking the data regarding clay, silt and sand content, it was observed that the clay and silt content showed decrease with increase in altitude, whereas sand content showed increasing with increase in altitude. This may be due to soil erosion and accumulation processes. Actually , when soil erosion in the high altitude take place, finer particles get suspended in the accumulating water and are transported to the lower altitude thus leaving coarser material at the high altitude (Gebrehiwot *et al.*, 2018). Conversely, the suspended finer particles are transported to the lower altitude where they Accumulation at the lower altitude thus increasing clay and silt content.

1.3. Bulk density

Data showed that the soil bulk density increased with increase in altitude. It was clear from the date that the soil bulk density had an inverse relationship with soil clay and silt and had a direct relationship with sand content (Table 4). thus , the soil with high sand content are less in micro pore spaces and results in higher bulk density whereas the soil with high clay and silt content are high in micro porosity and results in lower bulk density. Also it was clear from date that the soil bulk density had an inverse relationship with OM (Table 4). Thus, the soils with high OM accumulation are higher in percent pore space and results in lower bulk density whereas the soils with lower OM are lower in percent pore space and results in higher bulk density (Onwuka *et al.*, 2020; Imran *et al* ., 2022).

Table 4. Correlation of bulk density (g/cm3) with soil texture and organic matter (%).

	Clay %	Silt %	Sand %	OM%
Correlation coefficient (r)	-0.877**	-0.704*	0.831**	-0.761*
Sig. (2 tailed)	0.002	0.034	0.006	0.018

** Correlation is significant at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed).

2. Chemical properties of soil

2.1. Soil pH and Electrical Conductivity

Data regarding soil pH showed decreasing trend from lower to higher altitude which might be due to the increased precipitation levels at the higher altitudes. High amount of rainfall leaches out the base forming cations like Ca^{2+}, Mg^{2+}, K+ and increases the ions like Al^{3+} and H^+ (Northcott *et al.*, 2009; Seibert *et al.*, 2007).Confirmed the increase in pH at lower altitude which might be due to accumulation of base cations and higher accumulation of CaCO3 at lower altitude.

The electrical conductivity of the soil showed decreasing trend from lower altitude to higher altitude, Generally, EC decreased with increase in altitude. There was significant change in EC which indicates major difference in cumulative salt accumulation along the altitude. However, decreasing trend of EC from low altitude to high altitude shows that at lower altitude more salts accumulate rather than higher altitude sites. This may be due to the higher accumulation of base forming cations like Ca^{+2}, Mg^{+2}, K and high accumulation of CaCO3 (Dong *et al.*, 2017; Ibrahim *et al.*, 2022).

2.2. The soil Organic Matter

Data regarding soil organic matter showed that the SOM decreased with altitude. The lower accumulation of soil OM in high altitude may be due to its downward movement with runoff water from high altitude. (Thai *et al.*, 2021) observed that the change in altitude can influence SOM by controlling soil erosion and geologic deposition processes also may be temperature because temperature decreases as altitude increases the ability of plants to growing at elevated altitudes is hampered, resulting in the presence of less amount of organic material (Bangroo *et* *al*. 2017; Rodrigues *et al.*, 2023) and it becomes more difficult for plants to survive at higher altitudes (Li *et al.*, 2022). Also may be soil pH may control biotic factors, such as the biomass composition of fungi and bacteria in forest soil (Blagodatskaya *et al*., 1998; Simon *et al*., 2018). Which in turn effect on decomposition organic matter.

2.3. Calcium carbonate, Mg^{2+} and Ca^{2+}

Data showed that high CaCO3 content at lower altitude compared to higher altitude. This may be due to the types of parent material (Charan *et al.*, 2013; Kramer *et al.*, 2019). Or due to decrease of water content and higher evaporation of soil and high soil mineralization which may result in higher accumulation of CaCO3, as compared to higher altitude (Singh, 2018). On the other hand, could due to downward movement with runoff water from higher altitude and accumulation at lower altitude**.**

Results regarding Ca^{+2} and Mg^{+2} available revealed decreasing trend from lower to higher altitude which might be due to Increased rainfall leaches cations calcium (Ca) and magnesium (Mg) at elevated altitudes(Ng *et al.*, 2022). On the other hand, difference in organic matter content may be responsible for variation in available nutrient calcium (Ca) and magnesium (Mg) with variation in altitude (Najar, 2002). Soil organic matter plays important role in biochemical and geochemical cycles of nutrients and their reservoir in soil (Yang *et al*., 2022) and It improves the physical properties such as maintaining a suitable soil structure, the thermal regime or the water dynamics in the soil (Franzluebbers, 2002)

Conclusion and recommendations

Our study, performed in Serestan forest confirm a general trend of the variation in soil properties along the altitudinal gradient for most physico-chemical properties of soil. As shown above, erosion of finer soil particles by runoff from higher elevations and accumulated in the lower elevations play an important role in the differentiation of soil properties. So, knowledge on the properties of soil in relation to altitude can plays an important role in understanding the change in soil property and its effect on diversity of plants and soils classification and development.Special attention may be given to higher elevations position to control erosion for conserving the soil which would require soil conservations strategies such as conserving the existing natural vegetation cover, proper land leveling, afforestation, terracing and it is recommended that another study carried out in this region

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