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Pedological Parameter Analysis In The Ghardaia Region

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ABSTRACT

Description of the subject: Ghardaia, located in an arid zone, is characterized by several environmental constraints, including severe drought and increasing soil degradation, respectively due to low rainfall and intense wind erosion.

Objective: The aim of this study is to assess the influence of physico-chemical characteristics such as texture, salinity, alkalinity, pH, electrical conductivity, etc., of soils on the flora and vegetation of the Ghardaia region.

Methodology and Results: 36 soil profiles were described, with two profiles per station. Physico-chemical analyses particle size distribution, pH, electrical conductivity, etc. were carried out on soil samples from the different profiles. The floristic composition and the structure of the plant communities around the environment of each of the 36 soil profiles were determined.

Principal component analysis of the matrix consisting of the 36 described soil profiles, the seven analyzed physico-chemical parameters, and the vegetation recorded in the different stations revealed three groups of soils based on physico-chemical parameters and three groups of plant species along the transect.

Conclusion and application of the results: This study shows that soil salinity, alkalinity, and high sand content are the main constraints to plant production in this Saharan environment.

Keywords: Salinity, pH, ACP, Physico-chemical properties, Soil.

INTRODUCTION

The context of this study is a specific arid zone where environmental conditions are characterized by low rainfall, high temperatures, and limited vegetation. The soils are generally shallow, with a coarse texture and low organic matter content. These factors create particular conditions that have a direct impact on the characteristics of the soils in the region. Understanding the context of the study will allow us to better grasp the issues and challenges of soil characterization in an arid zone, as well as the implications of this analysis on local natural resource management.

Materials & Methods

- **Sampling**

The study used a systematic sampling methodology to collect data on Saharan plant biodiversity. Soil samples were taken from different areas of the Sahara to assess pedological parameters.

Table 1: Selected Stations

	Station	Date	Geographical Positions		Altitude	Exposure
1	**Iourighnou**	18/03/2023	32°64’66793"N	3°7225276"E	561 m	N/S
2	**Oued-Nechou**	18/03/2023	32°57'736,3"N	3°86'319,4"E	480 m	N/S
3	**Kaf-Eddoukhane**	18/03/2023	32°42’46,70"N	3°87’86,75"E	480 m	N/S
4	**Oued-Soudan**	19/03/2023	32°93’12,04"N	3°69’6343"E	640 m	N/S
5	**Berriane**	19/03/2023	32.849867"N	3°879772"E	518 m	NE/SW
6	**Oued-Madagh**	19/03/2023	32°71’01,88"N	3°73’2693"E	586 m	N/S
7	**Oued Nsa-Berriane**	21/03/2023	32°836806"N	3°972089"E	471 m	N/S
8	**Ain Kobisse**	21/03/2023	32°778739"N	4°376946"E	336 m	N/S
9	**Ain Kabrite**	21/03/2023	32°69.4834"N	4°751759"E	286 m	N/S
10	**Oued Mask**	22/03/2023	32°16’52.9"N	3°24’03.5"E	514 m	N/S
11	**Oued Drine**	22/03/2023	32°348066""N	3°806428"E	432 m	S/W
12	**Zalfana**	15/05/2023	32°22’5.364"N	4°14’0.983"E	335 m	N/S
13	**Atteuf**	15/05/2023	32°24'18"N	3°46'51"E	458 m	NE/SW
14	**Oued Metlili**	15/05/2023	32°14'345998"N	3°47'38.2"E	418 m	E/W
15	**Oued Nsa Zalfana**	16/05/2023	32°38’40.4"N	4°17’0"6.6"E	370 m	E/W
16	**Sebseb1**	21/05/2023	32°8’36.983"N	3°43’7.108"E	431 m	SE/NW
17	**Sebseb2**	21/05/2023	32°8’19.743"N	3°39’33.139"E	414 m	N/S
18	**Daia**	23/05/2023	32°34’40.2096"N	3°31’28.893"E	630 m	N/S
19	**Intissa**	23/05/2023	32°26'26.3688"N	3°38'41.644"E	515 m	NE/SW

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- **Analysis of Pedological Parameters**

On each site, soil samples were collected at different depths (0-10 cm, 10-20 cm, 20-30 cm). These samples were then dried, sieved, and subjected to a series of physico-chemical analyses in the laboratory. The parameters studied include texture (granulometry), salinity (electrical conductivity), pH, total limestone, active limestone, soil moisture, organic matter content, and vegetation cover.

- **Statistical Analysis**

A statistical analysis was performed to determine the relationships between pedological parameters and Saharan plant biodiversity.

This study aims to better understand the complex interactions between pedological parameters and plant biodiversity in the Ghardaïa region. Our main objectives are as follows:

1. To characterize in detail the physico-chemical properties of the soils in the region, including their texture, structure, and salt content.
2. To analyze the statistical correlations between the measured pedological parameters and the richness, composition, and abundance of vegetation, in order to highlight the edaphic factors that are critical for biodiversity.
3. To propose recommendations for sustainable soil and vegetation management, with the goal of conserving this fragile ecosystem in the face of environmental and anthropic threats.

Results & Discussion

The results of the study on the influence of pedological parameters on Saharan plant biodiversity revealed several important findings:

- Pedological parameters such as soil pH and organic matter content have a significant impact on Saharan plant diversity. Alkaline soils were associated with greater plant diversity, while acidic soils showed a decrease in biodiversity.
- Soil organic matter content was also a key factor, with soils rich in organic matter supporting a greater diversity of plants.

Table2: Summary Table of the Percentages of Each Edaphic Parameter for Each Station.

Recordings	VG	Soil Moisture	pH	EC	O.M	Total Lime	Active Lime	Clay	Silt	Sand
IOURIG R1	22,18	0,83	8,57	0,35	2,09	15,25	6,40	20	12	68
IOURIG R2	64,40	0,93	8,73	0,33	2,74	37,50	5,85	25	38	37
NECHOU R1	15,16	0,59	8,27	0,47	2,54	13,25	7,10	19	6	75
NECHOU R2	14,40	0,70	8,44	0,37	2,32	13,00	7,20	20	8	72
KAF R1	22,84	0,23	8,63	0,91	0,86	4,50	6,90	20	7	73
KAF R2	27,40	0,17	8,82	0,36	0,69	6,50	8,50	20	7	73
SOUDAN R1	16,33	0,79	8,80	0,24	2,36	21,50	6,65	19	10	72
SOUDAN R2	17,52	0,38	8,82	0,20	1,21	7,00	7,05	20	5	75
BERRIANE R1	21,42	0,45	8,78	0,22	1,67	17,25	6,55	19	10	72
BERRIANE R2	9,00	0,82	8,60	0,46	3,00	37,00	7,15	19	6	75
MADAGH R1	9,45	0,95	8,68	0,32	3,15	28,75	7,75	25	63	12
MADAGH R2	27,18	0,64	8,60	0,22	2,37	16,00	8,95	23	5	72
NSA-BERR R1	14,31	0,28	8,79	0,25	0,93	6,00	6,40	20	6	74
NSA-BERR R2	10,80	0,51	8,72	0,37	1,82	9,75	7,25	20	7	73
KOBISSE R1	25,98	0,32	8,61	0,57	1,14	20,25	6,50	20	7	73
KOBISSE R2	30,67	0,72	8,67	0,47	2,83	16,00	6,95	20	27	53
KABRITE R1	15,07	0,36	8,62	0,29	1,48	13,75	7,35	20	5	75
KABRITE R2	12,81	0,29	8,71	0,31	0,98	7,25	6,95	18	6	75
MSK R1	9,41	4,05	8,86	0,22	0,70	2,00	8,05	20	5	75
MSK R2	14,75	0,18	8,85	0,16	0,71	2,50	8,50	20	8	72
DRINE R1	26,45	0,50	8,85	0,29	1,77	10,00	6,40	19	10	72
DRINE R2	25,76	0,22	8,59	0,77	0,68	4,75	8,20	20	7	73
O- METLILI R1	23,66	0,31	8,72	0,23	1,35	4,25	6,70	20	5	75
O- METLILI R2	15,16	0,40	8,72	0,26	1,42	5,00	7,65	20	5	75
ATTEUF R1	45,93	0,90	8,30	4,55	3,83	33,25	6,50	20	7	72
ATTEUF R2	64,12	0,57	0,00	0,00	1,91	34,25	8,45	20	7	73
ZALFANA R1	45,00	0,41	0,00	0,00	1,43	3,00	7,30	18	10	72
ZALFANA R2	11,04	0,60	8,77	0,36	1,92	12,00	6,90	19	6	75
NSA-ZALFA R1	29,60	0,43	8,10	0,37	1,91	11,25	6,80	23	5	72
NSA-ZALFA R2	19,44	0,31	8,72	0,24	0,98	5,25	6,45	20	8	72
SEBSEB1 R1	36,11	0,32	8,87	0,19	1,14	8,75	7,85	20	6	74
SEBSEB1 R2	26,34	0,41	8,76	0,32	1,80	8,75	6,90	19	6	75

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SEBSEB2 R1 seul	25,33	0,29	8,84	0,19	1,14	3,50	6,80	20	4	76
DAIA R1	16,44	3,24	8,53	0,54	8,97	33,50	6,80	18	10	72
DAIA R2	29,28	2,00	8,66	0,42	5,63	17,50	6,90	40	40	20
INTISSA R1 seul	39,63	0,55	8,83	0,30	1,86	10,25	8,10	20	7	73

VG: Vegetation Cover**, Soil Moisture:** Soil Moisture**, pH:** Hydrogen Potential**, EC:** Electrical Conductivity**, O.M:** Organic Matter**, Total Lime:** Total Lime**, Active Lime:** Active Lime

❖ **Descriptive Analysis**

✓ **Vegetation Cover (VG)**

- Average: 22.8% **.** Range: 9.0% - 64.4%

The available water reserve is highly variable across the sites, ranging from very low to relatively high.

✓ **Soil Moisture**

- Average : 0,76 % **.** Range : 0,17 % - 4,05 %

Soil moisture is generally low, characteristic of arid environments.

✓ **pH**

- Average: : 8,61 **.** Range : 7,2 - 8,86

The soils are alkaline, with high pH values.

✓ **Electrical Conductivity (EC)**

- Average: : 0,51 dS/m **.** Range : 0,16 dS/m - 4,55 dS/m

Salinity is variable across the sites, ranging from low to high.

✓ **Organic Matter (OM)**

- Average: : 1,95 % **.** Range : 0,68 % - 8,97 %

The organic matter content is relatively low, consistent with the arid nature of the environment.

✓ **Soil Texture**

• Predominantly sandy-clay, with a variable proportion of sand, silt, and clay.
• Some sites exhibit a clayey-sandy or clayey-silty-sandy texture.

Table 3. Pearson (n) Correlation Matrix Table

Variables	VG	Soil Moisture	pH	EC	O.M	Total Lime	Active Lime	Clay	Silt	Sand
VG	**1**	-0,1308	**-0,5470**	0,2063	0,0520	**0,3452**	-0,0024	0,1808	0,1336	-0,1556
Soil Moisture	-0,1308	**1**	0,0659	0,0498	**0,5747**	0,2581	0,0167	0,2375	0,2031	-0,2271
pH	**-0,5470**	0,0659	**1**	0,1134	0,0289	-0,1376	-0,2163	0,0805	0,0482	-0,0600
EC	0,2063	0,0498	0,1134	**1**	0,2372	0,3217	-0,1975	-0,0019	-0,0306	0,0257
O.M	0,0520	**0,5747**	0,0289	0,2372	**1**	**0,6389**	-0,2082	**0,3518**	**0,3740**	**-0,3967**
Total Lime	**0,3452**	0,2581	-0,1376	0,3217	**0,6389**	**1**	-0,1957	0,1700	**0,4236**	**-0,3919**
Active Lime	-0,0024	0,0167	-0,2163	-0,1975	-0,2082	-0,1957	**1**	-0,0005	-0,1163	0,0960
Clay	0,1808	0,2375	0,0805	-0,0019	**0,3518**	0,1700	-0,0005	**1**	**0,6217**	**-0,7636**
Silt	0,1336	0,2031	0,0482	-0,0306	**0,3740**	**0,4236**	-0,1163	**0,6217**	**1**	**-0,9805**
Sand	-0,1556	-0,2271	-0,0600	0,0257	**-0,3967**	**-0,3919**	0,0960	**-0,7636**	**-0,9805**	**1**

The analyses of the physico-chemical properties of the soils in Ghardaïa highlighted their determining role in the distribution and composition of the local flora. The sandy or silty-clayey texture of the soils, which influences the dynamics of water and nutrients, results in a specific adaptation of the vegetation. Thus, succulent species and drought-tolerant plants dominate the well-drained sandy soils, while more silty and clayey areas, with better water retention, host denser and more diverse vegetation, including shrubs and perennial herbaceous plants.

Correlation Analysis between Variables

1- Relationship between Parameters

The correlation analysis between the various pedological parameters measured in the Ghardaïa region (Table 3) reveals strong links between certain soil properties. For instance, a strong positive correlation is observed between clay content and organic matter content, indicating that soils with higher clay content are also richer in organic matter. Similarly, total lime is strongly correlated with the silt fraction, highlighting the role of silt in the dynamics of lime in these arid environments. (See Figure 1)

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2- Related Chemical Properties

On the other hand, electrical conductivity, which reflects soil salinity, is closely linked to pH. The more saline the soils, the more they tend to be alkaline, reflecting the processes of salt redistribution in these dry environments.

This close relationship between soil chemistry and salinity highlights the importance of climatic factors in the differentiation of the pedological properties in the Ghardaïa region.

3- Texture and Hydrodynamics

Finally, soil texture, characterized by grain size fractions, has significant links with moisture and organic matter content. The sandier soils generally show the lowest values of organic matter and moisture, while more clayey or silty soils are associated with higher levels of these parameters.

This interdependence highlights the major role played by texture in the hydric and agronomic properties of the soils in Ghardaïa.

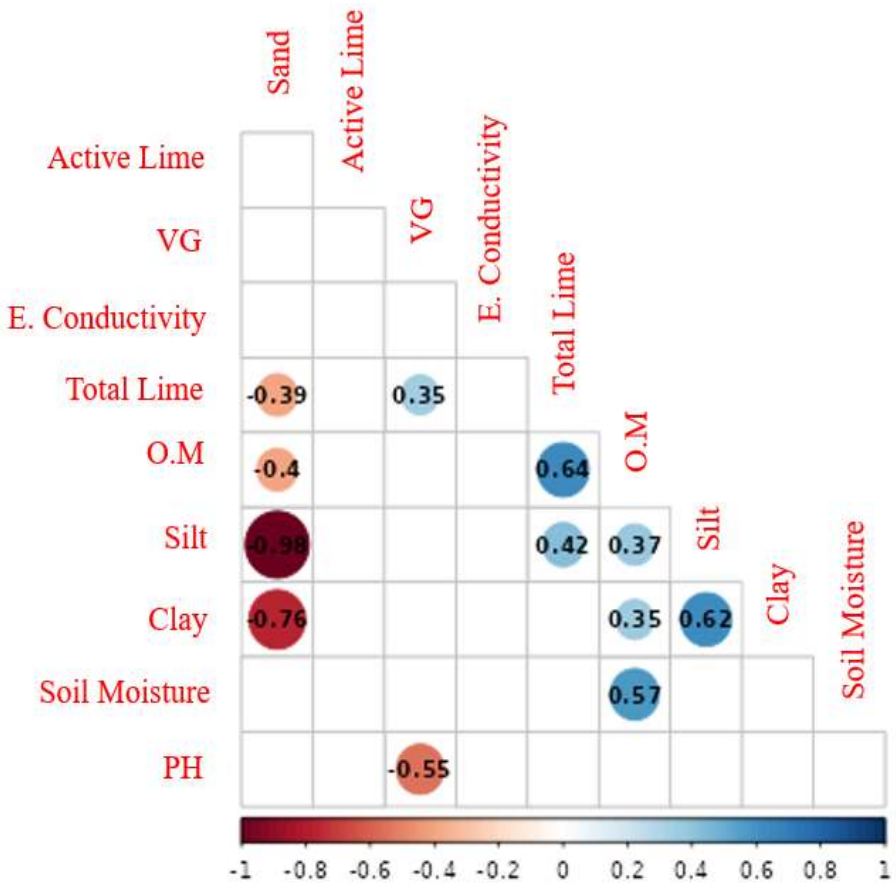

Figure 1: Correlation between the variables.

❖ **Identification of Homogeneous Groups**

The principal component analysis (PCA) conducted on the pedological parameters of the Ghardaïa region revealed several homogeneous soil groups (Table 3 4), reflecting the diversity of these ecosystems in this arid zone of southern Algeria. Identifying these homogeneous groups is essential for better understanding the main types of soils present and their specific characteristics, with a view to the appropriate management of agricultural and natural lands.

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Table 4. Homogeneous soil groups of Ghardaia.

1	2	3
IOURIGHNOU R1	IOURIGHNOU R2	DRINE R1
NECHOU R1	MADAGH R1	ATTEUF R2
NECHOU R2	ATTEUF R1	ZALFANA R1
KAF R1	DAIA R1	ZALFANA R2
KAF R2	DAIA R2	NSA-ZALFANA R1
SOUDAN R1		NSA-ZALFANA R2
SOUDAN R2		SEBSEB1 R1
BERRIANE R1		SEBSEB1 R2
BERRIANE R2		SEBSEB2 R1 seul
MADAGH R2		
NSA-BERRIANE R1		
NSA-BERRIANE R2		
KOBISSE R1		
KOBISSE R2		
KABRITE R1		
KABRITE R2		
MSK R1		
MSK R2		
DRINE R2		
OUED METLILI R1		
OUED METLILI R2		
INTISSA R1 seul		

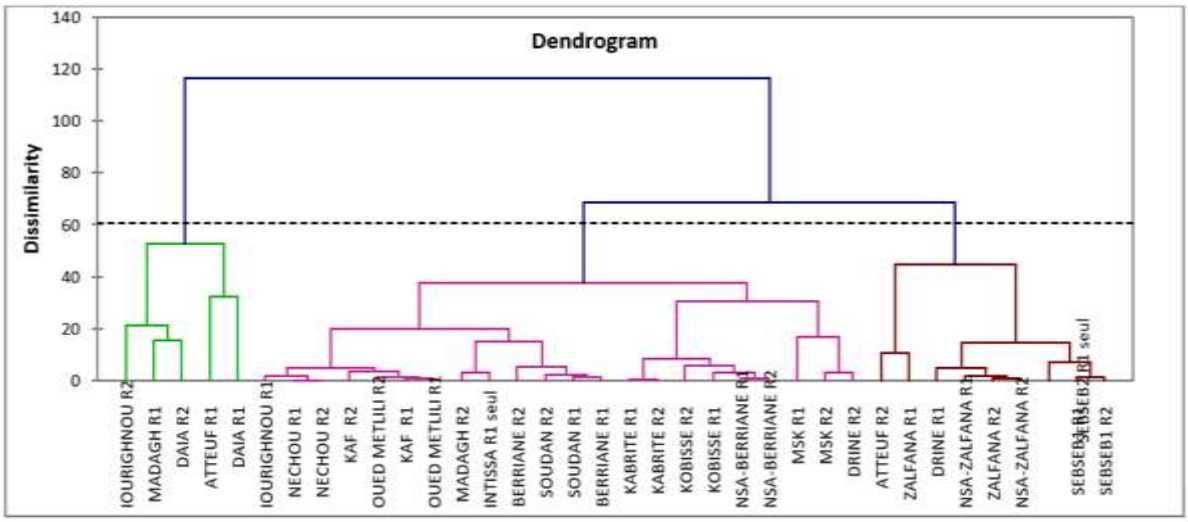

Figure 2: Dendrogram tree of soil groups.

Group 1: Rich and Clayey Soils

The first group identified includes the most fertile soils in the region, characterized by high levels of clay, organic matter, and total lime. These soils, mainly found in low-lying areas and depressions, benefit from better water and nutrient supply, making them suitable for more intensive and diversified agriculture. Their clayey-silty structure provides good water retention and better resistance to erosion.

Group 2: Sandy and Poor Soils

In contrast, the second group includes the poorest soils, dominated by the sandy fraction. Their low clay and organic matter content make them vulnerable to wind and water erosion, with a low potential for water and nutrient retention. These soils, typical of higher and exposed areas, will require specific management practices, such as the addition of organic matter or the implementation of agroforestry systems, to improve their fertility and stability.

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Group 3: Saline and Alkaline Soils

A third group is distinguished by specific chemical properties, with high values of electrical conductivity and pH.
These saline and alkaline soils, often located in depression areas or near temporary watercourses, present significant limitations for agriculture. Their management will require specific techniques, such as leaching of salts or the addition of amendments, to reduce the constraints related to salinity and alkalinity.

Conclusion

This analysis of pedological data highlights the typical characteristics of soils in arid environments: alkalinity, low organic matter content, variable salinity, and a dominant sandy-clay texture. Vegetation cover is closely linked to the grain size composition. These results will help better understand the functioning of this ecosystem and guide land management practices.

References

1. https://equipedia.ifce.fr/elevage-et-entretien/alimentation/gestion-des-prairies/comment-interpreter-une-analyse-de-sol Pauline DOLIGEZ (2016).
2. OUICI Hourria (2019). Analysis and Evaluation of the Phytodiversity of Mount Tessala (Sidi Bel Abbès Province, Western Algeria)
3. DUCHAUFOUR (1968) in Ouici H. (2019). Analysis and Evaluation of the Phytodiversity of Mount Tessala (Sidi Bel Abbès Province, Western Algeria)
4. RIEU and CHEVERRY (1976) in BOUZIANI K. and ZITOUNI I (2021). Physicochemical Characterization of a Soil Under Lentil Cultivation in the Sebain Region – Tiaret Province.