

**Sultanate of Oman**  
**Ministry of Education**  
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**Um Salim Al-Ansariyah School (Grades 5–10)**



**A Study of Soil Changes in the Tytam Area and Their  
Relationship to Soil Erosion in the Region**

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## Abstract:

This research aims to identify the factors that have led to soil erosion in the Tytam area and to study and apply suitable solutions to reduce soil erosion. Several research questions were addressed, including: Has an environmental change occurred in the soil properties of the Tytam area (using comparative analysis and field observation)? What natural factors have contributed to these changes in soil properties? What is the relationship between soil characteristics (soil structure, permeability, salinity, slope angle, vegetation cover, calcite content, and pH) and soil erosion in the study area? To what extent does vegetation cover, specifically Rhodes grass (*Cenchrus ciliaris*), contribute to reducing soil erosion and improving soil cohesion (experimental approach)?

This study examined the environmental changes occurring in the soils of the Tytam area and their relationship to soil erosion, based on the soil protocols of the **GLOBE Program**. A comparative analysis was conducted between two sites with different levels of erosion exposure by measuring rainfall amount, slope angle, vegetation cover, and soil color, in addition to analyzing soil structure, cohesion, permeability, salinity, pH, and calcite content.

The results showed that the erosion-prone site was characterized by a steeper slope, limited vegetation cover, and high soil permeability, which contributed to increased soil loss, particularly during the khareef season when the highest rainfall amounts were recorded. In contrast, the non-eroded site exhibited greater soil cohesion, darker soil color indicating higher organic matter content, and higher calcite levels. Calcite acted as a binding agent between soil particles, improving soil structure and reducing water permeability.

To address soil erosion, Rhodes grass (*Cenchrus ciliaris*), a local plant species suitable for the soil conditions of the area, was cultivated. The results demonstrated an improvement in soil cohesion and an increase in calcite content after cultivation, which is attributed to root activity and soil-microorganism interactions. The study concludes that soil erosion in the Tytam area results from the interaction of several natural factors and highlights the importance of local vegetation cover as a sustainable environmental solution for reducing soil erosion.

## Key terms:

### 📖 **Environmental Change:**

Refers to the transformation that occurs in the components of the natural environment, such as soil and vegetation cover, as a result of natural or human factors, affecting the balance and stability of the ecosystem over time.

### 📖 **Soil Structure:**

The arrangement and bonding of soil particles into aggregates, which directly influence soil cohesion, permeability, and its ability to resist erosion and land degradation.

### 📖 **Soil Erosion:**

The movement of soil particles from their original location due to natural factors such as rainfall or wind, leading to the loss of topsoil and reduced soil stability.

### 📖 **Comparative Analysis:**

A scientific approach based on comparing data and characteristics between two or more areas in order to identify similarities and differences and determine the factors influencing the studied phenomenon.

### 📖 **Field Observation:**

The process of collecting direct information from the study site through observation and recording, including monitoring soil properties, vegetation cover, and related environmental phenomena

## Research Questions:

1. Has an environmental change occurred in the soil properties of the Tytam area?
2. What natural factors have contributed to the changes in soil properties?
3. What is the relationship between soil properties (structure, permeability, salinity, and pH) and soil erosion in the study area?
4. To what extent does vegetation cover contribute to reducing soil erosion and improving soil cohesion?

## **Introduction:**

Soil is one of the fundamental components of the natural environment, playing a crucial role in the stability of ecosystems, supporting vegetation, and facilitating human activities. Its physical and chemical properties are influenced by several natural factors such as climate, topography, and vegetation type, which in turn affect soil behavior and stability (1).

Soil erosion is considered one of the most significant environmental problems, leading to the loss of fertile topsoil, land degradation, and reduced plant productivity, especially in areas exposed to seasonal rainfall or surface runoff (2). The severity of erosion is closely related to soil physical properties, such as structure, cohesion, and permeability, as well as the nature of surface runoff and rainfall intensity (3).

Studies indicate that changes in soil properties lead to gradual environmental degradation, as soil erosion causes long-term changes in the local environment through soil loss and alterations in vegetation cover (4). Soil color is also an important indicator of prevailing environmental conditions, reflecting the soil's content of organic matter, minerals, aeration, and moisture levels (1).

Vegetation cover plays a fundamental role in reducing soil erosion, as plant roots help stabilize soil particles and decrease surface runoff, whereas a decline in vegetation increases soil susceptibility to erosion and causes noticeable environmental changes (3, 4).

Based on this, the present study aims to investigate the changes occurring in the soil of the Taytam area and their impact on soil erosion, by analyzing and comparing the soil's physical and chemical properties and linking them with field observations of vegetation cover and influencing environmental factors.

## **Research Methods:**

### **Research Plan**

1. Identify the research problem and the study area.
2. Collect soil samples from two sites in the Taytam area.
3. Use the soil protocol to determine the physical and chemical properties of the soil.

4. Use the vegetation protocol to assess the density of vegetation cover.
5. Analyze the results and perform necessary calculations.
6. Write the recommendations based on the findings

Responsible	Tasks	January 2026
All team members	Selecting the research topic	Week 1 of January
Asma & Ghaya	Determining the study site & collecting background information on the topic	Week 2 of January
Asma & Ghaya	Collecting soil and water samples from the site	Week 3 of January
Asma & Ghaya	Data collection, analyzing results, discussing findings, and formulating recommendations	Week 4 of January

**Table (1): Task Distribution**

### Study Area:



2



1

**Figure (A): Study Area (Taytam Region)**

### Data Collection and Analysis:

The soil was sieved to determine the proportion of roots and stones and to extract soil suitable for analysis.



**Figure(B): Sample sorting**

The physical properties, such as color and soil type, were measured



Figure C : Determination of soil color and type for sample 1



Figure D: Determination of soil color and type for sample 2



Figure H: Determination of salinity ,Ph and EC for samples

The permeability of the soil was studied, and the carbonate content was determined

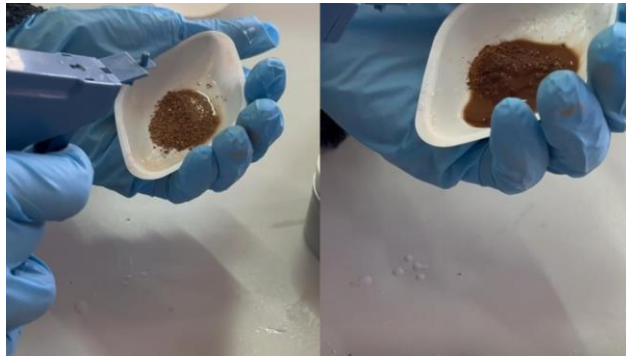
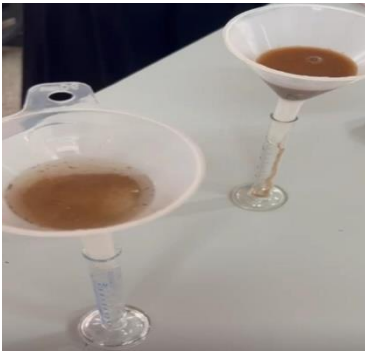


Figure F: Determination of permeability and calcite for samples

### Experiment (Application of the Rhodes Grass Cultivation Solution) :



Figure E: Rhodes Grass Cultivation

### Results:

1-the percentage of roots and stone:

Site 2 Soil (for comparison)	Site 1 Soil (subject to erosion)	Parameter
Average	Not present in the sample	Root content (%)
High	Not present in the sample	Stone content (%)

Table 2: Soil comparison between Site 1 (eroded) and Site 2 (for comparison).

2-The Characteristics of soil in two location:

Soil Sample	Structure (Soil Type)	Color	pH	Salinity (ppt)	Electrical Conductivity ( $\mu\text{S}/\text{cm}$ )
Sample 1	Sandy	5YR 5/8	8.04	0.469	0.754
Sample 2	Granular Silty	10YR 3/4	8.47	0.524	0.785

Table3: Physical and Chemical Properties of the Soil Samples

3- Permeability and Carbonate Content:

Soil Sample	Permeability	Carbonate Content
Sample 1	Very high	Low

Sample 2	Moderate	Moderate
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**Table (4) :** Permeability and Carbonate Content

#### 4- Analysis of Vegetation Cover Percentage and Slope Angle Based on Field Observation:

Site	Slope Angle	Vegetation Cover
Site 1	Moderate	Limited (grasses only)
Site 2	Low	Moderate (shrubs + grasses)

Table(5):slope angle and land cover

#### 5-Implementation of Rhodes Grass Cultivation and Analysis of Soil Properties After Cultivation:

Parameter	Before Application	After Application
Electrical Conductivity ( $\mu\text{S}/\text{cm}$ )	0.754	0.764
Salinity (ppt)	0.469	0.512
Calcite Content	None	Yes there is
pH	8.04	7.14

Table 6: Comparison of Site Soil Properties Before and After Rhodes Grass Cultivation

#### - Entering the data on the program website (GLOBE.com)

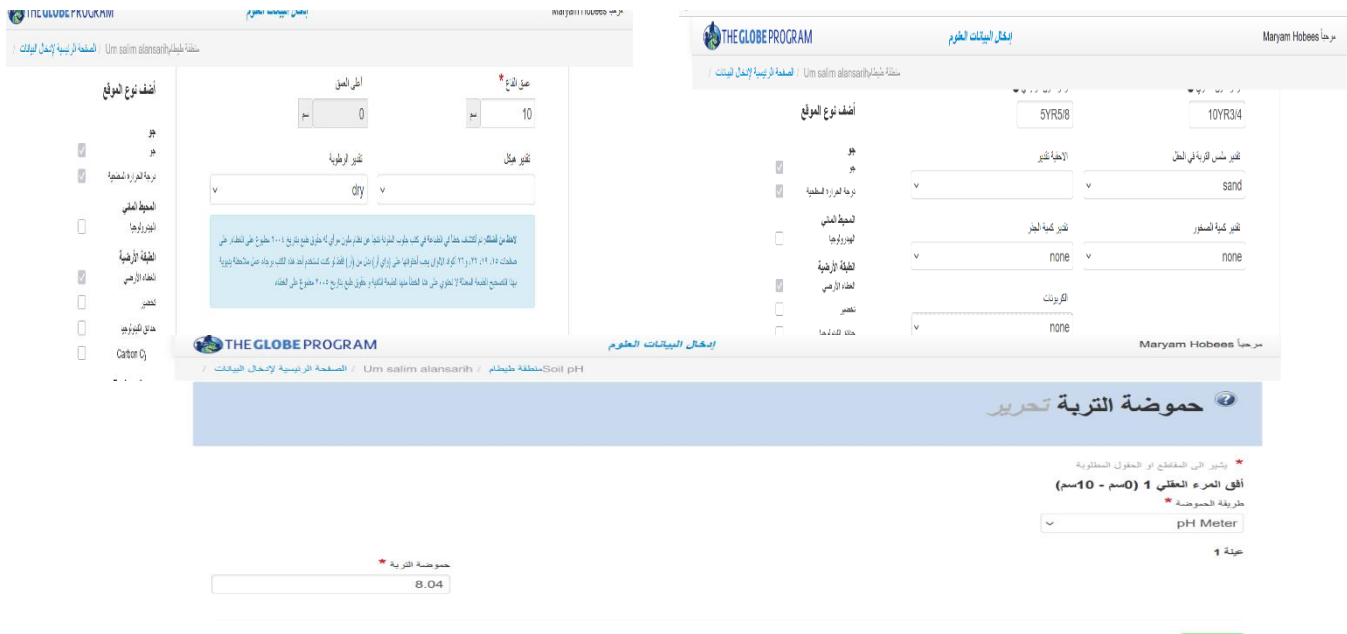


Figure (2): Illustration of the Data Entry Method on the Website

## Discussion of Results:

The results showed a clear difference between the two sites. Site 1 represents soil exposed to erosion, while Site 2 serves as the control site, not subject to any form of erosion. These results were obtained after studying several factors, including rainfall in the area. Appendix 1 shows that the highest rainfall recorded by the Kanzir station, located in the study area, occurred in the fall of 2024. Rainfall can contribute to surface erosion, especially when groundwater levels are high or when the kinetic energy of raindrops is strong enough to dislodge soil particles, facilitating erosion.

Slope angle is another contributing factor. Table 5 shows that Site 1 has a steeper slope than Site 2, increasing the likelihood of erosion at Site 1. Moreover, Tables 2 and 5 indicate that vegetation cover at Site 1 is limited compared to Site 2, leaving no natural barriers to prevent soil displacement.

Analysis of the physical and chemical properties of the soil (Table 3) revealed that the soil color at Site 1 is lighter than at Site 2, indicating a lower organic matter content. Organic matter contributes to soil cohesion and reduces particle detachment. Additionally, the pH of the soil at the eroded site is lower than that of the stable site, explaining the higher carbonate and salt content observed in the non-eroded soil. This was confirmed through carbonate testing using vinegar, which indicated a higher calcite content in the more stable soil (Table 4). Calcite acts as a binding agent between soil particles, enhancing cohesion, improving soil structure, and reducing permeability. Permeability tests (Table 4) confirmed these findings; however, high permeability may contribute to slow internal erosion over time, especially in sloped areas.

To mitigate soil erosion, Rhodes grass was cultivated at the eroded site, and soil properties were re-analyzed. This plant was chosen due to its **dense and deep root system** and its use as fodder for livestock. The results presented in Table (6) show the changes that occurred in the soil of Site 1 after the cultivation of Rhodes grass. The findings indicate an increase in the level of the cementing material, calcite, in the soil after cultivation. This increase is attributed to a decrease in soil pH resulting from root–microorganism interactions, which led to the decomposition of organic matter in the soil and the production of carbon dioxide. The interaction of water with carbon dioxide enhances the formation of carbonic acid, and the reaction of carbonic acid with calcium compounds subsequently leads to the formation and precipitation of calcite.

## Conclusion:

This study aimed to analyze environmental changes in the soil of the Taytam area and their effect on soil erosion, using the **GLOBE program protocols** to study soil properties. Field measurements included soil color, structure, cohesion, permeability, salinity, and pH, along with field observations of vegetation cover and slope.

The results showed significant differences between the soils studied. Sandy soils with high permeability were more prone to erosion than silty soils with higher cohesion, rich in calcite and roots. Rhodes grass cultivation, following the recommended protocols, demonstrated a positive effect in enhancing soil stability. Overall, the study concluded that the **GLOBE protocols provide a reliable scientific framework** for understanding the relationship between soil properties and erosion, emphasizing the importance of local vegetation as a sustainable environmental solution to reduce erosion.

## Acknowledgements:

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9. GLOBE Teacher’s Guide.

### Badge descriptions:

The badge	I am a GLOBE Researcher	I am collaborator	I am a STEM professional
<b>Why ?</b>	Because we use GLOBE protocols such as pedosphere, land cover and Atmosphere	The team members demonstrate clear and effective collaboration during the implementation of the project .we collect the data by our self and we got help from our supervisor.	The team applied GLOBE protocols accurately, analyzed the soil data using tables, and interpreted the results using scientific reasoning, demonstrating professional STEM practices

## Appendix 1: Rainfall Data

Year	Rainfall (ml)
2014	499
2024	759.8

Source: Oman Meteorological Station (Kanzir Station)

