Research Title study the causes of desertification in Dhofar Governorate

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THE GLOBE PROGRAM
Global Learning and Observations to Benefit the Environment

Summary

This research aims to study the causes of desertification in Dhofar. The research team's first hypothesis, which strongly suggests the cause, is climate change (including rising temperatures, decreasing rainfall, increased evaporation and transpiration, and increased wind speeds resulting in dust storms and sand dunes). The second hypothesis is human intervention (including negative or incorrect land use and management practices that lead to the degradation of vegetation cover, increased salinity, and water and wind erosion, as well as overgrazing and premature grazing).

These hypotheses led to the following research questions:

❶ What climate changes are the region experiencing?
❷ How have climate changes affected the environment ?
❸ What human activities are taking place in the region ?
❹ What is the impact of human activities on the environment ?

We developed a work timeline, beginning with identifying the study site. The team then conducted a field visit to the site to study the problem, understand its causes, and develop hypotheses and potential solutions.

The research team contacted the Dhofar Environment Authority and the Directorate General of Agriculture to assess the monitoring and oversight of the area and to request their cooperation in the study. Fieldwork commenced, and the relevant program protocols were implemented.

🗁 The results were as follows:

✹ Climate change has had a significant impact on the environment in terms of increased temperatures, decreased rainfall, wind, soil salinization, and a decrease in the quantity and quality of groundwater and surface water (supporting the first hypothesis).

✹ The protocols and tests applied by the research team indicated that climate change has a clear impact on soil properties, specifically increasing soil alkalinity and salinity (supporting the first hypothesis).

✹ Negative human interventions have an impact on the environment in terms of overgrazing, waste and its disposal methods, industrial facilities and their byproducts, repetitive farming and traditional farming methods, and the use of pesticides and chemical fertilizers (supporting the second hypothesis).

🗁 Conclusion: Climate change and negative human interventions negatively affect soil and its quality.

🗁 Recommendations: Monitor groundwater quality, improve water management and irrigation, work to protect and increase vegetation cover in the region, limit urban expansion to reduce desertification, stabilize sand dunes, develop mechanisms to regulate grazing in areas prone to desertification and support local research.

Research questions

❶ What climate changes are the region experiencing?
❷ How have climate changes affected the environment?
❸ What human activities are taking place in the region?
❹ What is the impact of human activities on the environment?

Introduction

Agriculture is a profession practiced by a large segment of Omani citizens and supports several industries that affect major sectors of society. It plays a pivotal role in increasing national income, providing a portion of the food supply, and achieving food security for Omani citizens. With the worsening problem of desertification and the degradation of agricultural lands, a large portion of these lands is negatively impacted, affecting the agricultural sector and its benefits to Omani citizens through food scarcity and a lack of diversity. This, in turn, harms other sectors of society and its stability. it motivated us to study the problem and its impact on the environment, identifying the underlying causes.

The study was successful and based on sound scientific principles, from defining the problem and formulating and verifying hypotheses to implementing the necessary protocols for studying the characteristics of water, air, and soil. The results revealed potential causes of the problem, and recommendations were offered to address it, aiming for a positive impact on our local community and citizens, and to maintain ecological balance, ultimately benefiting the environment and our beloved country, Oman. Finally, we hope that the relevant authorities will take the initiative to find radical solutions to mitigate the impact of climate change on the soil and study the recommendations presented by the research team to address this problem. This is crucial for preserving vegetation cover and natural resources from various threats

Research Methods

First, the research plan

1 – Establishment of the proposed timetable for the research plan.
2-Distributing work roles among the research team and starting implementation
3-Identifying and inspecting study sites, determining what needs to be implemented at the site, and selecting the appropriate protocol to apply
4 – Organizing meetings with STEM specialists and environmental experts to support the study.
5- Identifying the devices and tools used in the study
6 – Calibration of devices
7 –Applying the study to samples by implementing appropriate protocol activities
8-Collect and organize data into tables.
9- Enter data into the program's website, www.GLOBE.gov.
10- Analyze and graphically represent the data.
11- Draw conclusions and make recommendations.

🕮 Location of implementation and protocols: At the study site – School laboratory

Second : Study Location

(Sultanate of Oman – Dhofar Governorate) Raysut, December, moderate weather, atmosphere- Hydrosphere - Biosphere- Pedosphere protocols were used

Third : Data Collection and Analysis

↘The data related to questions one, three, and four were collected through interviews with STEM

↘The data related to the second question was collected on-site through:

❶ Implementing the atmospheric protocol, which included measuring air temperature, cloud cover, and humidity, and utilizing meteorological centers to determine rainfall amounts.

❷ Implementing the Hydrosphere protocol, which included measuring transparency, water temperature, dissolved oxygen, salinity, conductivity, dissolved substances, and water pH.

❸ Implementing the soil protocol: measuring soil temperature; studying the soil properties of each layer in terms of: (structure, color, consistency, texture, rocks, roots, carbonates) - soil pH protocol - salinity: by repeating the steps used to measure pH, the sample salinity and dissolved substances were measured using a conductivity meter.

❹ Implementing the land cover protocol and site classification (MUC).

↘ The study data was entered into the program website.

↘ The data was organized into tables.

↘ Comparison tables were created for different time periods.

✹ Graphs were used to represent and compare the data.

The team had several suggestions through our study of the problem under study - reviewing several studies that we will address through our study.

Badge Search: We hope that our study will achieve:

I WORK WITH SATELLITE DATA
I AM A DATA SCIENTIST
I MAKE AN IMPACT
I AM A COLLABORATOR

Results

Discussion of results

After collecting and presenting the data, which was previously summarized in tables and graphs that express the measurements and readings taken during the application of the protocols, all of which answer the research questions:

To answer the third and fourth questions in the research through interviews with all parties concerned with the subject of the study: All experts agree that climate changes, in terms of rising temperatures and drought, are factors that the region is going through, as well as negative human activities in terms of industrial and commercial activities and urban expansion, have had a clear impact on the deterioration of agricultural lands and the increase of desertification in the region

To answer the first and second questions, protocols for the atmosphere, Hydrosphere, soil, land cover, and vegetation were implemented at the study site during different time periods. Comparing the results, it was found that:

1- As shown in Tables (8 and 13) of the Atmospheric Protocol, the average air temperature in summer was 41.5°C, consistently higher than in autumn (31°C). Summer rainfall was negligible,while in autumn it averaged 2 mm.Relative humidity also decreased in summer, averaging 51% compared to 69% in autumn. The high temperature in summer, coinciding with the dry season, exposes the soil to heat stress and reduces vegetation cover.

2 - As shown in Tables (9 and 14) of the Water Protocol:

- In summer the average water temperature is (35°C) while in autumn (25°C). Also, all measurements in summer of conductivity, salinity, dissolved substances, and alkalinity are clearly higher than in autumn, as well as a decrease in dissolved oxygen in the water, which has an effect on the soil and groundwater in the region.

3- As shown in Tables (10-11) and (15-16), the soil protocol here demonstrates the impact of thermal changes on the soil. There is a significant difference in surface soil temperature. The average temperature in summer is 52.5°C, while the average soil temperature in autumn is 31.5°C. Furthermore, all measurements in summer (conductivity, salinity, dissolved substances, and alkalinity) are significantly higher than in autumn. This is due to the high air temperature and lack of rainfall during the summer, leading to rapid evaporation and increased soil salinity and alkalinity. This also affects soil properties, particularly soil structure, as shown in Tables (12-17).

- The ground cover and vegetation protocol also indicate Non-existence of trees and a scarcity of shrubs in the area, along with a lack of cultivated plants and the presence of short, dry grasses. The ground cover is classified as 3321 according to the MUC classification.

- The study was supported by measurements from two schools, one of which has a climate like ours in terms of temperature, humidity, and ground cover and vegetation, namely Sawda Umm Al-Mu'minin School (Oman), and another school whose climate is different from ours, namely Wartburg School (Germany). The difference in measurements was clear, which led to a difference in ground cover and vegetation between them.

Conclusions

The research aimed to study the causes of desertification in the Dhofar Governorate. This was achieved by the research team identifying the study site (Raysut region), as shown on the attached map, and implementing a protocol for the atmosphere, soil, Hydrosphere, land cover, and vegetation during two different time periods (summer and autumn). The team then assessed the extent to which the region was affected to test the first hypothesis they formulated. Field interviews were conducted to test the second hypothesis. The results confirmed that desertification in Raysut is due to the impact of climate changes that the region has experienced, as follows: First, the atmospheric protocol revealed that the average air temperature in Raysut is high and humidity is low for most of the year, leading to rapid evaporation from the soil and increased salinity. This has negatively impacted soil quality, causing degradation and the gradual disappearance of vegetation cover.

Second, the Hydrosphere protocol demonstrated that the water has been affected by an increase in groundwater levels, an increase in temperature and salinity, and a decrease in dissolved oxygen. Furthermore, the high pH indicates alkalinity, which is related to the percentage of solids in the water. This has negatively impacted soil quality and the types of plants that grow in it.

Third, the soil protocol results supported those of the water protocol, showing a significant difference in average soil temperature 47.5°C and surface temperature 52.5°C compared to autumn 33.5°C and surface temperature 31.5°C. This difference leads to thermal stress in the soil, resulting in changes to its properties in Raysut.

Fourth, the land cover and vegetation protocol results clearly demonstrate the impact of climate change on the soil in the region, including rising temperatures and a semi-arid state over the decades.

✹ The change in weather between summer and autumn, and the changes that occur in the soil during this period, are clear evidence of the impact of climate change in general on soil quality and the reduction of arable land.

✹ Negative human interventions affect the environment through overgrazing, industrial facilities and their byproducts, repetitive farming practices, traditional farming methods,and the use of pesticides and chemical fertilizers.

↘ We conclude that harsh climate change is a primary cause of desertification in Dhofar Governorate, in addition to negative human interventions.✹The study could be replicated in different locations across the Sultanate in various states, and this will be the objective of our next study.

References

Amos, H.(2022).*GLOBE Data User Guide* .GLOBE gov. https://www.globe.gov/globe-data/globe-data-user-guide
Ghafarm,S.(2025,October25).*Green Dhofar under threat of desertification*.Alroya Newspaper.Retrieved on January 12, 2026. https://alroya.om/p/374520
Ali Hassan,S.(2025, August17-20).*Environmental Experts' Perspectives on Environmental Issues in the Sultanate of Oman* [Paper presentation].The Second International Cultural Conference on Human Knowledge,Amman,Jordan. https://share.google/1puUkGJuTjKej4aTg
Al-amri, A.(2023).*Desertification and drought*.Al-Obaikan Publishing
Abdullah,H.(2010).*Desertification is a degradation of the ecosystem*.Dar Dijla Publishing
Project Management.(2018).*National Strategy for Adaptation and Mitigation to Climate Change for the Sultanate of Oman (2020-2040)*. Ministry of Environment and Climate Affairs, Sultanate of Oman.
Mirzabaev, A., Wu, J.,Evans,F.,García-Oliva, I.A.G.,Hussein,M.H.,Iqbal, J.,Kimutai,T.,Knowles,F.,Meza, D., Nedjraoui, F., Tena, M., Türkeş, R.J,& Vázquez, M. (2019). *Desertification In Climate Change and Land: an IPCC special report on climate change*. Intergovernmental Panel on Climate Change(ipcc). https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Full_Report.pdf.
Reisinger,A., Cammarano,D., Fischlin,A., Hansen,G., Jung,Y., Ludden,C., Valérie,M.,Matthews,R., Mintenbeck,K., Orendain,D., Pirani,A., Poloczanska,E., & Romero,J.(2023). *Climate Change 2023 Synthesis Report*. Intergovernmental Panel on Climate Change(ipcc). https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf