



Sultanate of Oman

Ministry of Education

Directorate General of Education in Al Wusta Governorate

Al Ma'arif School for Basic Education (Grades 1-12)



**Using environmental data to study the change in
dissolved oxygen concentration resulting from
phytofiltration and aeration in local waters**



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Summary



Groundwater reservoirs in the Sultanate of Oman face environmental challenges, including dissolved oxygen depletion resulting from over-extraction and pollution. This affects water quality and threatens agricultural and drinking water uses. This research aims to explore the experience of oxygen depletion through sample analysis and field studies, while proposing sustainable solutions for conserving water resources given the country's heavy reliance on these aquifers



Research question



Does natural plant filtration with aeration lead to an increase in the percentage of dissolved oxygen in the water?



Site description



Study Location: Sultanate of Oman, Al Wusta Governorate, Haima Wilayat

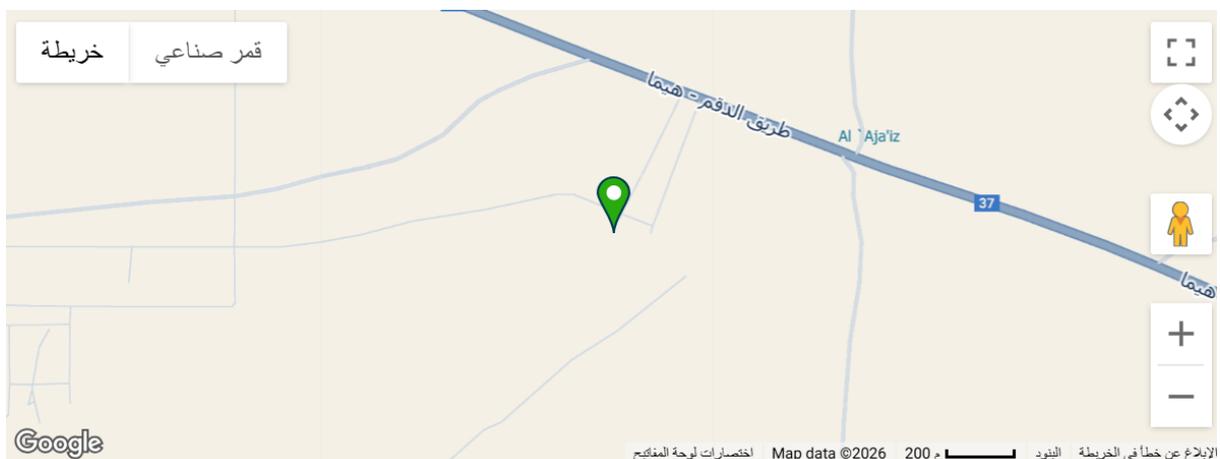
Latitude: 19.54764

Longitude: 57.19204

Elevation: 156.7

Weather temperature ranged between 23°C

The study was conducted from November to December. The hydrosphere .protocol was used





Data collection plan



By monitoring environmental data recorded on the GLOBE platform, a clear decrease in dissolved oxygen concentration was observed in some local water sources. This necessitates studying this phenomenon and analyzing its potential environmental causes. Environmental data is an important scientific tool that helps in understanding environmental changes and making decisions based on sound scientific principles

This study aims to use the environmental data available on the GLOBE platform to analyze the current dissolved oxygen concentration in local waters and link the results to proposing sustainable environmental solutions, such as phytofiltration and aeration, as natural methods that can contribute to improving water quality and increasing dissolved oxygen levels

First: Study Type

This study adopts a descriptive-analytical approach, using real environmental data recorded on the GLOBE platform without conducting field experiments. Its purpose is to analyze the current dissolved oxygen concentration in local waters and propose appropriate scientific solutions

Second: Data Sources

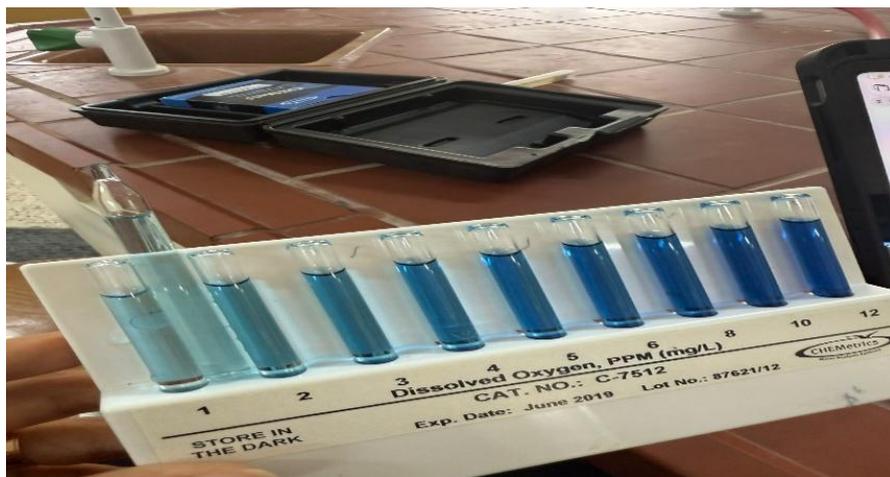
:Data recorded on the GLOBE platform related to .1

Dissolved Oxygen Concentration •

Water Temperature •

Measurement Location and Date •

We observed a decrease in the percentage of dissolved oxygen in the water, where the percentage of dissolved oxygen appeared (mg/L 1)



المحيط المائي

3

درجة حرارة الماء



يكتب:
مقياس الرطوبة الحبلي

عينة #1

درجة حرارة الماء:
25 °C

الرقم الهيدروجيني



يكتب:
مقياس الرقم الهيدروجيني

عينة #1

الرقم الهيدروجيني:

الرقم الهيدروجيني

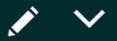


يكتب:
مقياس الرقم الهيدروجيني

عينة #1

الرقم الهيدروجيني:
6

الأكسجين المذاب



الطريقة المستخدمة
عدة

عينة #1

الأكسجين المذاب:
1 mg/L



Basic and supporting information



Dissolved Oxygen (DO) Definition and Importance in Water Quality .1

Dissolved oxygen (DO) is the amount of oxygen gas dissolved in water. It is essential for all aquatic organisms, from fish to small creatures, as they rely on it for cellular respiration. This indicator is one of the most important water quality parameters, as it allows for the assessment of water's ability to support aquatic life. A decrease in dissolved oxygen concentration leads to environmental stress that can threaten the survival of species and .reduce biodiversity in the aquatic system

Factors Affecting Dissolved Oxygen Concentration .2

The concentration of dissolved oxygen in water is determined by several :environmental factors, including

A. Temperature

The higher the water temperature, the less dissolved oxygen it can hold, .and vice versa; colder water holds a greater amount of dissolved oxygen

B. Water Movement and Aeration

Flowing water with good aeration tends to contain higher levels of dissolved oxygen compared to stagnant water, which suffers from limited gas exchange with the air

C. Biological Activity and Decomposition

Microorganisms consume oxygen during the decomposition of organic matter, which can lower its levels, especially in polluted waters that absorb large quantities of dissolved oxygen

D. Human Factors

Pollution processes resulting from agricultural runoff, sewage, and industrial waste increase organic matter in water, leading to increased oxygen consumption by bacteria and a decrease in dissolved oxygen

The Environmental Role of Dissolved Oxygen .3

Dissolved oxygen not only supports fish life but also plays a role in the ecological balance within water bodies. It allows for aerobic decomposition processes that maintain water quality and efficiently purify the natural environment of organic waste compared to anaerobic decomposition, which produces harmful compounds

Low Dissolved Oxygen and Its Effects .4

When dissolved oxygen drops below critical levels (e.g., less than 5 mg/L), aquatic organisms enter a state of environmental stress and may die in severe cases. This condition, known as hypoxia, occurs, rendering the aquatic environment unsuitable for supporting many species

:This decrease could lead to

- .Mass die-off of fish and other sensitive organisms

- .A decline in biodiversity

- .Changes in the food web within the aquatic system

Phytofiltration and Aeration as Proposed Solutions .5

In natural and artificial environments, phytofiltration (such as using photosynthetic aquatic plants) and aeration (increasing air exchange with :water) can contribute to raising dissolved oxygen levels

- Aquatic plants produce oxygen during photosynthesis, increasing
• .dissolved oxygen in the water during daylight hours

- Aeration helps to effectively introduce air into the water through surface
• .movement or air pumping, thus improving dissolved oxygen levels

The Relationship Between Temperature and Dissolved Oxygen Change .6 in the Context of Climate Change

Recent studies have shown that climate change and rising temperatures affect dissolved oxygen levels in water bodies. A decrease in dissolved oxygen concentration in the upper water layers is expected in the future due to global warming, expanding the area of hypoxic zones and impacting .marine environments such as the Gulf of Oman



Expected results and objectives



Dissolved oxygen is one of the most important environmental indicators reflecting water quality and its suitability for supporting aquatic life. A decrease in its concentration leads to ecological imbalance, negatively impacting aquatic organisms and threatening the sustainability of aquatic ecosystems.

Analysis of environmental data recorded on the GLOBE platform revealed a clear decrease in dissolved oxygen concentration in some local water sources. This necessitates further investigation into this phenomenon and an understanding of its potential environmental causes. The significance of this research lies in its use of available environmental data to analyze the environmental situation without conducting field experiments, relying instead on a descriptive-analytical approach to interpret the results.

This research aims to study changes in dissolved oxygen concentration in local waters using GLOBE data and to link the findings to proposed sustainable environmental solutions such as phytofiltration and aeration. This will contribute to raising environmental awareness and improving the quality of water resources.

Proposed solution	Related goal	Expected results
Plant filtration	Proposing sustainable environmental solutions to improve water quality	Gradual improvement in water quality and a potential increase in dissolved oxygen concentration
natural water aeration	Increased gas exchange between air and water	A relative increase in dissolved oxygen and a reduction in the risk of hypoxia

Increase vegetation cover around water sources	Lowering water temperature and improving environmental conditions	Improving the water's ability to retain dissolved oxygen
Reducing sources of organic pollution	Reducing oxygen consumption resulting from decomposition	Stabilizing dissolved oxygen levels and long-term improvement of the ecosystem
Continuous environmental monitoring via GLOBE	Supporting environmental decisions with scientific data	Monitoring environmental changes and early detection of water quality deterioration

Based on the analysis of environmental data recorded on the GLOBE platform, the research revealed a decrease in dissolved oxygen concentration in some local water sources. This indicates the presence of environmental challenges that could affect water quality and the health of the aquatic ecosystem. The environmental data helped diagnose the problem and understand its contributing factors, such as water stagnation, rising temperatures, and organic pollution

Accordingly, the research proposed a set of sustainable environmental solutions, most notably phytofiltration, natural aeration, and increased vegetation cover, as means that could contribute to improving dissolved oxygen concentration when implemented in the future. The research also emphasizes the importance of continuous environmental monitoring using scientific platforms like GLOBE to support data-driven environmental decisions and contribute to protecting water resources and achieving environmental sustainability



References



**Garita, Acapulco et al. (2022). Biomathematical Model for Water Quality Assessment: •
Macroinvertebrate Population Dynamics and Dissolved Oxygen. Water, 14(18), 2022. This study
highlights the importance of dissolved oxygen monitoring for understanding water quality and
.its impact on ecosystems**

**Dissolved oxygen measurements in aquatic environments: the effects of changing •
temperature and pressure on three sensor technologies – PubMed. This article explains the
impact of temperature and pressure on dissolved oxygen measurements, which affects the
.accuracy of environmental data**

**The article "Nitrate and Algal Bloom Effects on DO" from JoVE explains how low dissolved •
oxygen can create dead zones in water bodies when organic decomposition and algal growth
.increase**

**Lee & Clapper (2022). Investigation of the Effectiveness of Aquatic Plants in Filtering •
Contaminated Water. An experimental study discusses the use of aquatic plants (such as Typha
and Pontederia crassipes) in water filtration and water quality improvement by removing organic
.pollutants and nutrients during filtration**

**Duan, Z. (2018). Effects of Aquatic Plants in Constructed Wetlands to Water Quality (Research •
on the role of aquatic plants in oxygenating the area around their roots and their role in
.improving water quality)**

**S Mondal (2024) – Experimental investigation of dissolved oxygen improving... demonstrates •
how mechanical movement and aeration contribute to increasing the efficiency of aerobic
.oxygen transport to water**

**Han, T. (2024). Effects of Aeration Intensity on Water Quality, Nutrient... highlights the •
importance of aeration in supporting aerobic decomposition and improving environmental
.conditions by increasing dissolved oxygen**

Data from GLOBE program, water protocol -



Description of badges



The "I am a Problem Solver" badge was chosen because it accurately reflects the nature of this research, which is based on identifying and analyzing a real environmental problem using scientific data, and then proposing practical .and applicable solutions

The research focuses on the problem of low dissolved oxygen concentration in local waters, a problem that directly affects the health of aquatic ecosystems. Using environmental data, the effects of plant filtration and aeration were studied as sustainable, natural solutions to .improve water quality and increase dissolved oxygen concentration

