

Modeling Evaporation Dynamics and Water Quality in Metal Tanks and Their Impact on Bio-Sustainability: An Applied Study from the "Al-Naqaa School Observatory" (September – December 2025)

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Abstract

This investigative research, conducted by the GLOBE team at the Al-Naqaa School Observatory, aims to model and estimate weekly evaporation rates and analyze water quality dynamics within an open metallic tank in Sohar, Oman. The research problem focuses on the imperceptible loss of water both quantitatively and qualitatively—manifesting as increased salinity and decreased oxygen—driven by the thermal conductivity of metallic tanks and the deposition of atmospheric aerosols. The methodology employed an experimental-descriptive approach during the seasonal transition (September – December 2025). The GLOBE team acted as "Data Scientists" and "Problem Solvers," utilizing rigorous protocols including the Class A Evaporation Pan and a 7-in-1 monitoring device to track air quality (and), alongside measuring Electrical Conductivity, and water transparency. The results revealed that evaporation peaked in September and October due to the high thermal conductivity of the tank, leading to a significant rise in salinity. This created environmental stress that weakened the vitality of tomato crops compared to the resilience of onions and eggplants. However, as weather conditions stabilized in December, the team documented a recovery in water clarity and biological indicators. In conclusion, the study provides predictive models and practical recommendations for thermal insulation of tanks, confirming that the GLOBE team serves as a vital influence in promoting water sustainability and protecting local biodiversity in the Sultanate of Oman

Research Question

- How do climatic changes and air purity from September to December affect the efficiency of metallic tanks?
- How do the chemical properties (Electrical Conductivity, Transparency, and pH) of water change as a result of this "Drought Journey"?
- To what extent are agricultural crops (Tomato, Eggplant, and Onion) affected by the chemical correlation between water and suspended soil particles?

Introduction & Significance of the Research

Evaporation is a strategic challenge facing water sustainability in arid regions like Sohar, where thermal fluctuations lead to significant water loss and quality degradation. The significance of this research lies in its practical application at the Al-Naqaa School Observatory, where the GLOBE team seeks to document the "Drought Journey" within metallic tanks—chosen specifically for their high thermal conductivity which accelerates the evaporation process. The scientific importance of this study is highlighted by linking climatic variables to water quality. As noted by Al-Nimrawi (2020), the disruption of air purity results from increased emissions and suspended particles that settle into the surrounding environment. This aligns with the team's field observations, showing that atmospheric dust directly affects water transparency and chemical properties in open reservoirs. Consequently, this study contributes to providing practical solutions for farmers to protect their crops and local biodiversity from the effects of increased salinity caused by excessive evaporation.

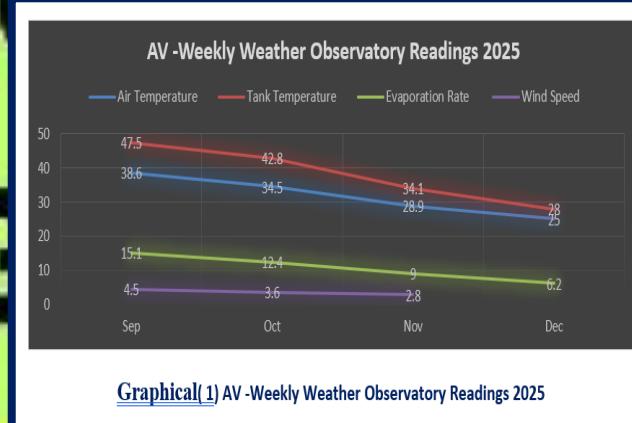
| Month | Avg. Air Temp (°C) | Avg. Tank Temp (°C) | Avg. Soil Temp (°C) | Avg. Wind Speed (m/s) | Avg. Evaporation Rate (mm) |
|-----------|--------------------|---------------------|---------------------|-----------------------|----------------------------|
| September | 38.6 | 47.5 | 41.5 | 4.8 | 15.1 |
| October | 34.5 | 42.8 | 37.9 | 3.6 | 12.4 |
| November | 28.9 | 34.1 | 31.4 | 2.8 | 9.0 |
| December | 25.0 | 28.5 | 27.0 | 2.0 | 6.2 |

Discussion

These results fully support the research hypotheses, proving that metallic tanks act as thermal accelerators that alter water chemistry, confirming the need for Sohar farmers to adopt insulation and dust protection strategies

Conclusion & Future Steps

The study concludes that protecting water from heat and dust is essential for food security; thus, we recommend developing "Smart Thermally Insulated Tanks" with solar-powered cooling systems. Future steps include issuing a guide for Sohar farmers identifying the best crops per month based on Al-Naqaa Observatory and GLOBE team



Graphical (1) AV -Weekly Weather Observatory Readings 2025

Results

- 1-A direct correlation exists between the metallic tank temperature (in Sept) and high evaporation rates, peaking at mm
- 2-Excessive evaporation concentrated salts and increased Electrical Conductivity (), leading to a drop in Dissolved Oxygen () to mg/L
- 3-The 7-in-1 detector showed that suspended dust () in Sept reduced water transparency to cm and increased alkalinity
- 4-Tomato recorded the lowest growth (cm) as a bio-indicator of salt stress, while Eggplant emerged as the "Champion Crop" (cm).

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Research Methodology

The research adopted an experimental-descriptive approach, collecting daily data via GLOBE Atmosphere and Water protocols using a Class A Pan, a 7-in-1 air quality detector, and chemical/biological monitoring tools

