CONCEPT NOTE

Impacts of Droughts and Heatwaves on River Water Quality Worldwide: Addressing SDG 6 (Clean Water and Sanitation) and SDG 13 (Climate Action)

Concept of the Project

Water is essential for life, ecosystems, and human development. However, climate change, particularly the increasing frequency and severity of droughts and heatwaves, poses significant challenges to maintaining the quality of river water globally. Understanding the impacts of these climatic events on water quality is crucial for sustainable water management and for achieving the United Nations Sustainable Development Goals (SDGs).

Problem Statement

Climate change is increasing the frequency of droughts and heatwaves, negatively impacting river water quality worldwide. These extreme weather events alter water temperature, pH levels, and contaminant concentrations, threatening ecosystems, human health, and economic activities. This project aims to examine the effects of droughts and heatwaves on key water quality parameters, identify spatial and temporal patterns of these impacts, and provide data-driven recommendations for policies. The ultimate goal is to support SDG 6 (Clean Water and Sanitation) and SDG 13 (Climate Action) by promoting sustainable water resource management in the face of climate change.

Objective of the Project

The primary objective of this project is to analyze the impacts of droughts and heatwaves on river water quality to propose data-driven solutions that can help mitigate these impacts. The specific objectives are:

- To collect and analyze water quality data from reliable sources.
- To identify the primary effects of droughts and heatwaves on river water quality.
- To understand the temporal and spatial trends of these impacts.
- To develop predictive models for future water quality based on current data.
- To propose actionable solutions and policy recommendations to mitigate the adverse effects of climate change on water quality.
- To assess the potential impact of these solutions on achieving SDG 6 (Clean Water and Sanitation) and SDG 13 (Climate Action).

Data Sources Used

A total of 8 water quality monitoring databases were processed into a single database. These included:

1. Two global databases: GEMStat (United Nations Environment Programme, 2018) and GLORICH (Hartmann et al., 2014)

2. One European database: Water base (European Environment Agency, 2022) OpenAQ: An open platform that aggregates air quality data from government and research-grade sources worldwide.

3. Five national datasets:

- Canada (Government of Canada, 2021)
- United States (Water Quality Portal, 2021)
- South Africa (Department of Water and Sanitation, 2022)
- Australia (Government of Australia, 2022)
- New Zealand (National Institute of Water and Atmospheric Research, 2022)

Features

The key features of the dataset will include:

- Location: Geographic coordinates of the monitoring stations.
- Water Quality Parameters: Levels of various water quality parameters such as temperature, pH, dissolved oxygen, nitrate, phosphate, and contaminants.
- Time: Temporal data including date and time of the recordings.
- Weather Conditions: Temperature, humidity, wind speed, and other relevant meteorological data.
- Source Identification: Information on potential sources of contaminants (e.g., agricultural runoff, industrial discharge).

Tool for Analysis

The following tools and technologies will be used for data analysis:

1. Python: For data cleaning, analysis, and visualization, using libraries such as Pandas, NumPy, Matplotlib, and Seaborn.
2. Jupyter Notebooks: For documenting the analysis process and visualizations.
3. Scikit-learn: For developing predictive models and machine learning algorithms.
4. QGIS: For spatial analysis and creating geographic visualizations of water quality data.
5. Tableau: For creating interactive dashboards and visualizations to present the findings.

Hypothesis

The hypothesis of the project is that the increasing frequency and severity of droughts and heatwaves will lead to significant changes in river water quality, including increased contaminant concentrations and altered pH levels, threatening ecosystems and human health. Identifying these impacts and proposing mitigation strategies will support the achievement of SDG 6 and SDG 13.

Methodology
The project will be conducted in the following phases:

Data Collection:
- Gather water quality data from the aforementioned sources.
- Compile weather and other relevant data to support the analysis.

Data Cleaning and Preprocessing:
- Handle missing values, outliers, and inconsistencies in the data.
- Standardize data formats and integrate datasets from different sources.

Exploratory Data Analysis (EDA):

- Perform descriptive statistical analysis to understand the distribution and variability of water quality parameters.
- Visualize temporal trends (daily, monthly, seasonal) and spatial distributions using charts and maps.

Source Identification:
- Use correlation analysis and regression models to identify potential sources of contaminants.
- Analyze the impact of different factors (e.g., drought severity, heatwave duration) on water quality.

Predictive Modeling:
- Develop machine learning models (e.g., linear regression, random forest) to predict future water quality based on historical data.
- Validate and test the models using appropriate metrics.

Solution Development:
- Based on the analysis, propose solutions such as improved water management practices, drought-resistant agricultural techniques, and pollution control measures.
- Assess the feasibility and potential impact of these solutions.

Reporting and Presentation:
- Compile the findings into a comprehensive report.
- Create visualizations and interactive dashboards to present the results.
- Develop policy briefs and recommendations for stakeholders.

Probable Outcome
The expected outcomes of the project are:

- Comprehensive Analysis: A detailed analysis of water quality data identifying key impacts of droughts and heatwaves.

- Predictive Models: Reliable models for predicting future water quality and assessing the impact of potential interventions.
- Actionable Solutions: Data-driven solutions and policy recommendations to mitigate the adverse effects of climate change on water quality.
- Impact Assessment: Evaluation of the potential impact of proposed solutions on achieving SDG 6 and SDG 13.
- Awareness and Engagement: Increased awareness among policymakers and the public about the impacts of droughts and heatwaves on water quality and the benefits of proposed interventions.

By addressing the impacts of droughts and heatwaves on river water quality through data analysis and evidence-based solutions, this project will contribute to ensuring clean water and sustainable management of water resources, aligning with the objectives of SDG 6 and SDG 13.