#Team

6

QTEdu GHANA

Statistics

- **2.2 Bil** don’t have access to safe water globally
- **3 mil** rely on unsafe water sources in Ghana
- **$260 bil** is lost globally in low to middle
- **829K** deaths annually from unsafe water

The Problem

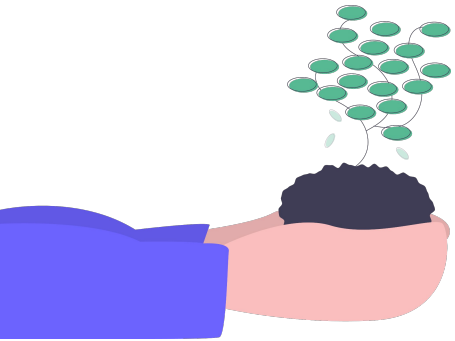
Lack of access to clean, safe, and equitable

water for millions of people globally, particularly in Ghana and Africa.

#Team
6

QleanFlow

Drinkable Water



Value Proposition

Harnessing the power of Quantum Machine Learning (QML) to model, analyze, and predict water quality across diverse geographic, hydrological, socioeconomic, and environmental variables and factors.

UN and UNESCO SDG Goals

Our Approach

Synthesized the data

data engineering

Built SVM

Built the QSVC vs QNN

Metrics to Benchmark

Quantum advantage

Why QML?

We use QML to solve this problem because:

01. Limitations of Traditional ML

02. Complexity of Water Quality Data

03. Enhanced Expressive Capacity of QML

Why QSVC and QNN?

These are primarily used as quantum kernel-based classifiers to detect patterns and predict water safety levels.

Support Vector Machine (SVM)

The objective of a Support Vector Machine (SVM) is to find an optimal hyperplane that best separates the different classes of data. This is achieved by maximizing the margin between the classes and minimizing the norm of the separating hyperplane.

The optimization task is defined by the following formula:

$$\max_{\alpha} \sum_{i=1}^{m} \alpha_i - \frac{1}{2} \sum_{i=1}^{m} \sum_{j=1}^{m} \alpha_i \alpha_j y_i y_j K(\mathbf{x}_i, \mathbf{x}_j)$$

With the constraint:

$$\sum_{i=1}^{m} \alpha_i y_i = 0 \quad \text{for} \quad 0 \leq \alpha_i \leq C$$

- **alpha_i are the Lagrange multipliers.**
- **K is the kernel function.**

The prediction is given by:

$$\hat{y} = \operatorname{sgn}\left[\sum_{i=1}^{m} \alpha_i y_i K(\mathbf{x}_i, \mathbf{x}_j) + b\right]$$

For this model, a radial basis function (RBF) with a penalization of 1 was used because it handles non-linear data well, has fewer parameters than the polynomial kernel, and is universal due to its Gaussian nature.

Model Accuracy: 0.77

Quantum Support Vector Classifier (QSVC)

The QSVC aims to find a hyperplane that maximizes the margin between different classes of data points in a high-dimensional feature space. The "quantum" part of the QSVC is primarily used to map the data into this complex space.

- **The optimization is similar to that of the classical SVM, but the kernel calculation is different:**

$$K(\mathbf{x}_i, \mathbf{x}_j) = |\langle \phi(\mathbf{x}_i) | \phi(\mathbf{x}_j) \rangle|^2$$

where phi is the map that transforms classical data into quantum states:

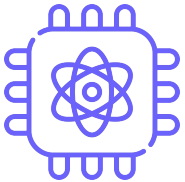
$$\phi : \mathbf{X} \to |\phi(\mathbf{X})\rangle = \mathcal{U}_\phi(\mathbf{X})|0\rangle^{\otimes m}$$

- **Accuracy : 0.8333**
- **F1 Score : 0.8214**
- **Precision : 0.8214**
- **Recall : 0.8214**
- **AUROC : 0.8694**
- **AUPRC : 0.8921**

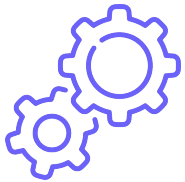
AUROC (Area Under the Receiver Operating Characteristic Curve): 0.8694
Measures the model's ability to distinguish between classes. A value of 0.8694 is considered very good.

AUPRC (Area Under the Precision-Recall Curve): 0.8921
Particularly useful for imbalanced datasets, a high value like 0.8921 indicates excellent performance in identifying positive cases.

Commercialization



Quantum Computing Resources
~ $10 000



Data and Infrastructure
Free. Leveraged by governments and water bodies

RnD: Can be done as student projects at AIMS and supervised by senior researchers

Operations Market related salaries for Quantum Data Scientists ~ $100k per Senior Data Scientist per annum

Impact Statement

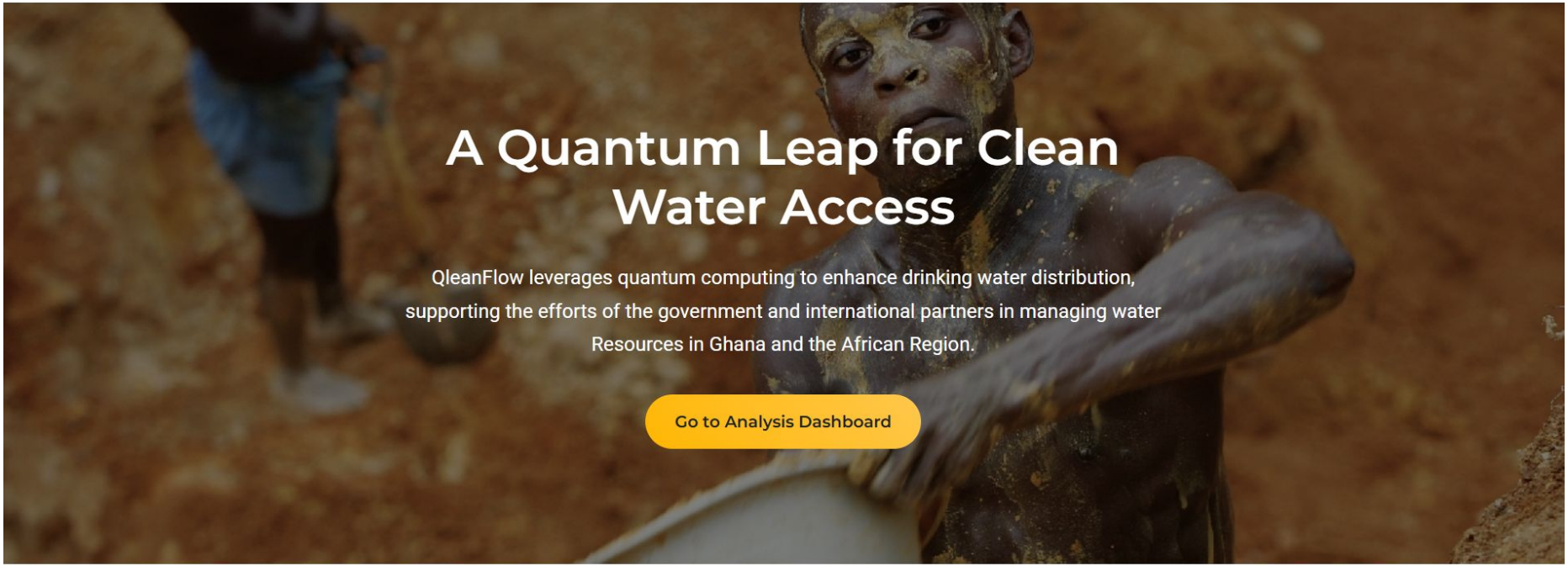
If even a **20-30%** reduction in the economic burden were achieved through highly effective prediction and intervention, this would translate to annual savings in the range of

$52-78B

165.8k-248.7k People Saved

QleanFlow

The Challenges Our Solution The Models Dashboard Launch Analysis



A Quantum Leap for Clean Water Access

QleanFlow leverages quantum computing to enhance drinking water distribution, supporting the efforts of the government and international partners in managing water Resources in Ghana and the African Region.

Go to Analysis Dashboard

Analysis Parameters

Region of Ghana

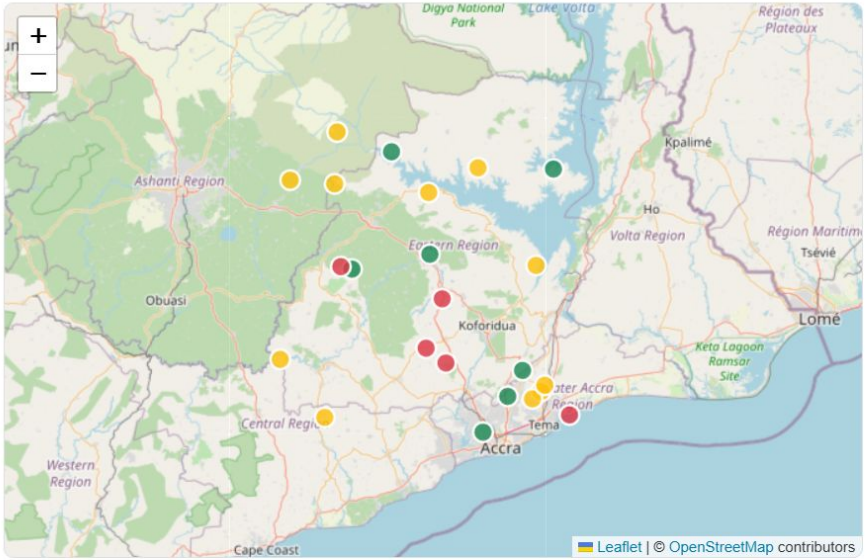
Eastern

Optimization Model

- Classical Machine Learning
- Quantum (QSVC)
- Quantum (QNN)

Run Analysis

Data Visualization



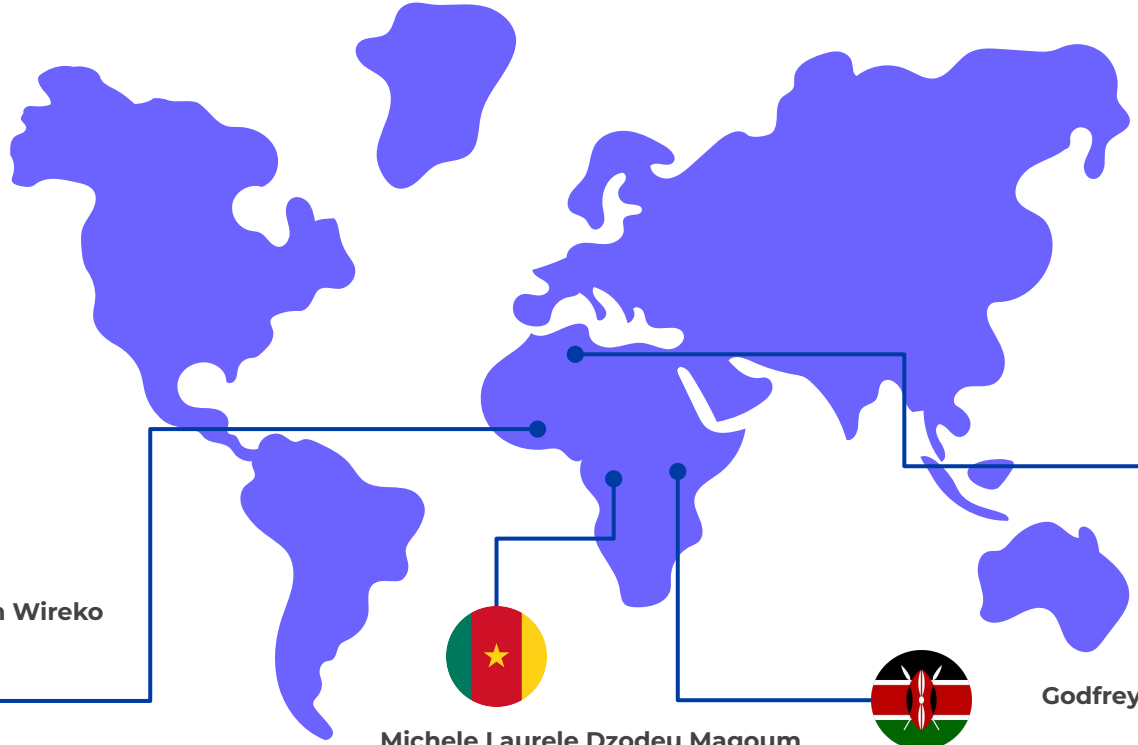
Results and Recommendations

```
ANALYSIS REPORT
========================================
Target Region  : Eastern
Model Used     : Quantum (QSVC)
----------------------------------------
PERFORMANCE:
  Accuracy     : 96.4%
  Speed        : 2.2x (vs. baseline)

RISK SUMMARY:
  High-Risk Zones   : 5
  Medium-Risk Zones : 11
  Low-Risk Zones    : 7
========================================
RECOMMENDATION:
Prioritize deployment of purification units to the 5 critical zones
identified.
Initiate route optimization for efficient distribution.
```

Thanks

#Team
6



Abdulai Yorli Iddrisu
Nana Akwasi Agyekum Wireko

Michele Laurele Dzodeu Magoum

Godfrey Kariuki Kimathi

Nadjib Mohammed
SALMI