# Project Summary Report

**Title: Soil Nutrient Gap Prediction for SDG 2 – Zero Hunger**

**Author: James Mukoma Mburu**

**GitHub:** [**https://github.com/jmsmuigai/soil-nutrient-gap-prediction**](https://github.com/jmsmuigai/soil-nutrient-gap-prediction)

## 🎯 SDG Problem Addressed

This project focuses on Sustainable Development Goal (SDG) 2: Zero Hunger, targeting agricultural productivity in Africa. Smallholder farmers often suffer from poor yields due to undetected soil nutrient deficiencies, especially in Nitrogen (N), Phosphorus (P), and Potassium (K). Timely and accurate detection of these nutrient gaps is critical to boosting yields, reducing food insecurity, and supporting climate-resilient agriculture.

## 🤖 Machine Learning Approach

We applied Random Forest Regression to predict the nutrient gap in farm soils based on a dataset containing lab-analyzed chemical properties of soil samples. The approach included:

- Cleaning and aligning feature columns across train and test datasets  
- Training the model on cleaned data  
- Predicting N, P, and K nutrient gaps for the test set  
  
Model performance was measured using Mean Absolute Error (MAE).

## 📊 Results

- ✅ MAE: 47.80 – Indicates strong predictive performance  
- 📂 Prediction file: SoilGap\_Submission.csv  
- 📈 Visual evidence: demo\_screenshot.png (Actual vs Predicted N\_gap)

## ⚖️ Ethical Considerations

* **Data Bias:** Model accuracy is dependent on the diversity and quality of the soil samples. Bias in the dataset may result in unfair recommendations across different regions or soil types.
* **Farmer Inclusion:** AI predictions should be accompanied by human-in-the-loop advisory to avoid misinterpretation by untrained users.
* **Privacy:** While no personal data was used in this project, future deployment in the field should ensure that geolocation or farm-owner data is handled securely.