Tanzania Water Well Classification

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Business Understanding

Background

Goals

Success Criteria

- Tanzania faces challenges providing clean water
- Costly & complex:
  - ***70k*** water wells
  - ***67 million*** citizens
- NGO seeks efficient well-repair solutions

Business Understanding

Background | **Goals** | Success Criteria

- Assist NGO in identifying wells needing repair
- Prioritize minimizing false negatives for safety
- Ensure reliable access to clean water

Business Understanding

Background

Goals

Success Criteria

Negative:

Repair not needed

+

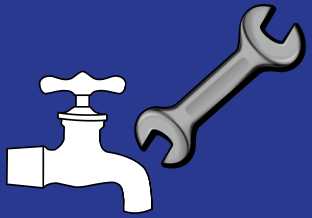
Correctly identified

Positive:

Needs Repair

+

Correctly identified



Business Understanding

Background

Goals

Success Criteria

Negative:

Repair not needed

+

Correctly identified

False Positive:

Repair not needed

+

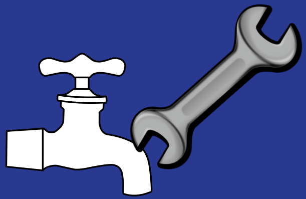
Wrongly flagged

Positive:

Needs Repair

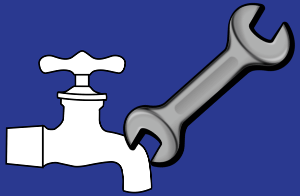
+

Correctly identified



Business Understanding

Background › Goals › **Success Criteria**

Negative: Repair not needed + Correctly identified 	**False Positive:** Repair not needed + Wrongly flagged
False Negative: Needs Repair + Missed 	**Positive**: Needs Repair + Correctly identified 

Business Understanding

Background | Goals | **Success Criteria**

Key Metric: **Recall**

- ○ Minimizes false negatives

False Negative:

Needs Repair

+

Missed

Data Understanding

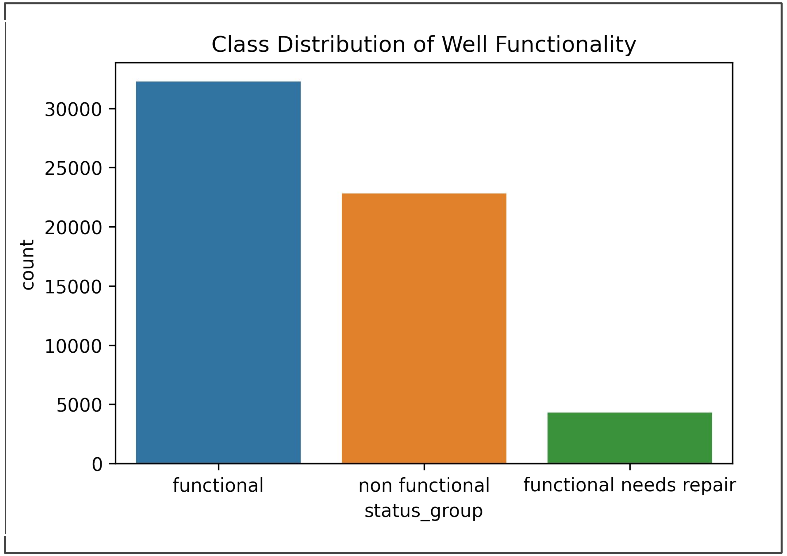
Data: ***41*** features, almost ***60k*** wells

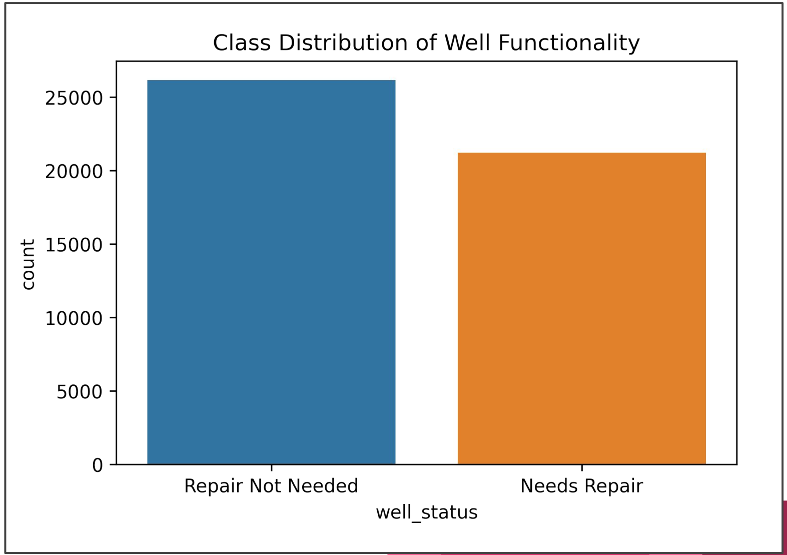
Features: Included location, water source, installer

Data Preparation

1. Handled Duplicates
2. Processed features reducing cardinality
3. Handled Null Values
4. Reclassified the Target Variable to Binary
5. Cleaned Dataset Overview:
    - Reduced to ***19*** features, ***47k*** rows, ***0*** nulls

Data Preparation: Reclassified Target to Binary





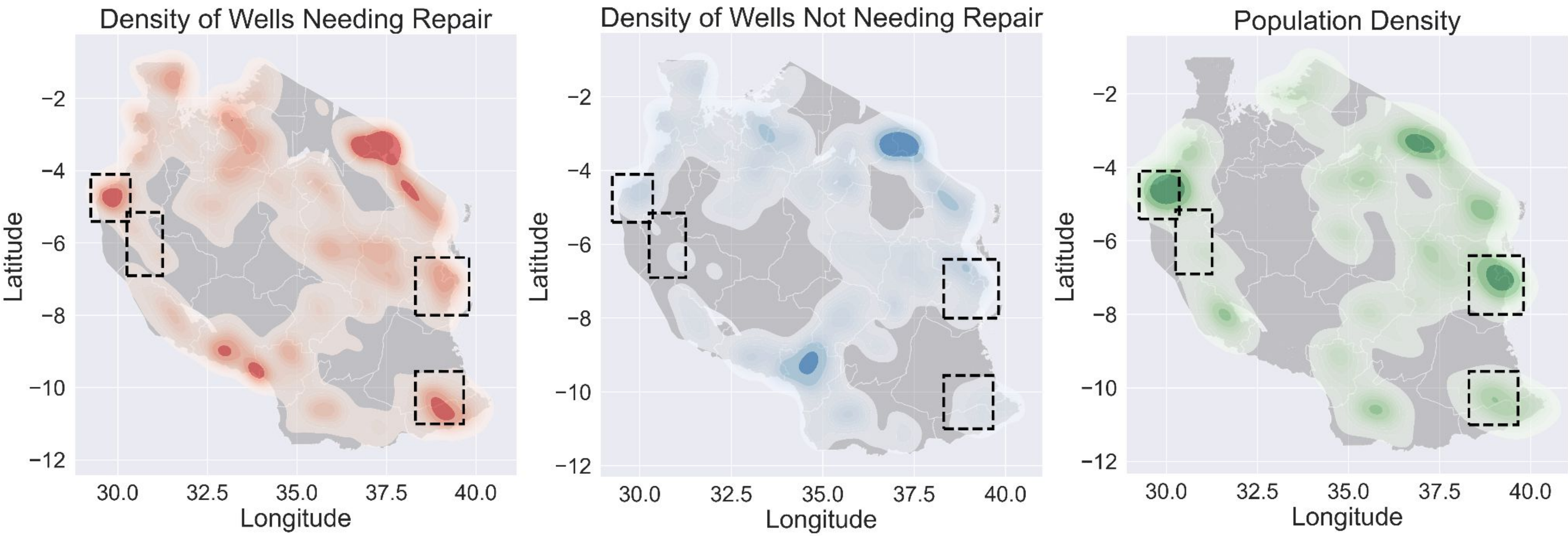
Exploratory Data Analysis

Findings

1. Government installer = higher non-functioning well rates
2. Ruvuma/Southern Coast and Lake Rukwa basins = higher non-functioning well rates
3. High-Priority Areas:
    - Areas with **high repair needs**, **low functional wells**, and **high population density**.

Exploratory Data Analysis: High-Priority Areas

Areas with **high repair needs, low functional wells**, and/or **high population density**.



Modeling and Evaluation: Key Components

- **Preprocessing**
  - Transformed categorical data into a format the model could understand (***OHE***)
  - Scaled numeric data (***MinMaxScaler***)

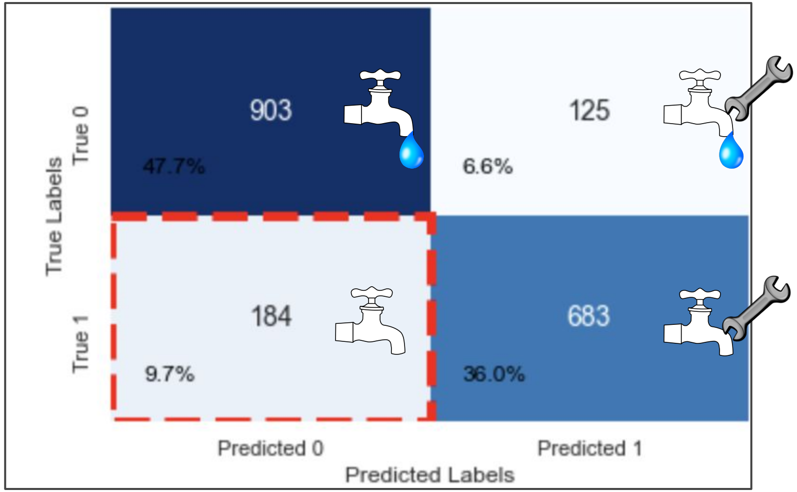
- **Model Comparison**
  - Compared complex models against ***baseline logistic regression*** model

- **Feature Selection & Hyperparameter Tuning**
  - Reduced model complexity by selecting relevant features and tuning hyperparameters to address overfitting

Modeling and Evaluation: Confusion Matrices

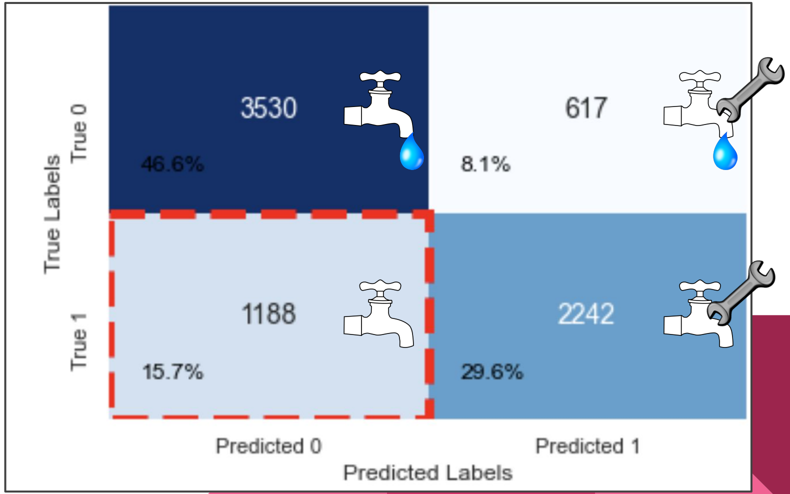
Initial Random Forest

Train recall score: ***100***%
Validation recall score: ***78.6***%



Baseline Logistic Regression

Train recall score: ***66.85***%
Test recall score: ***66***%



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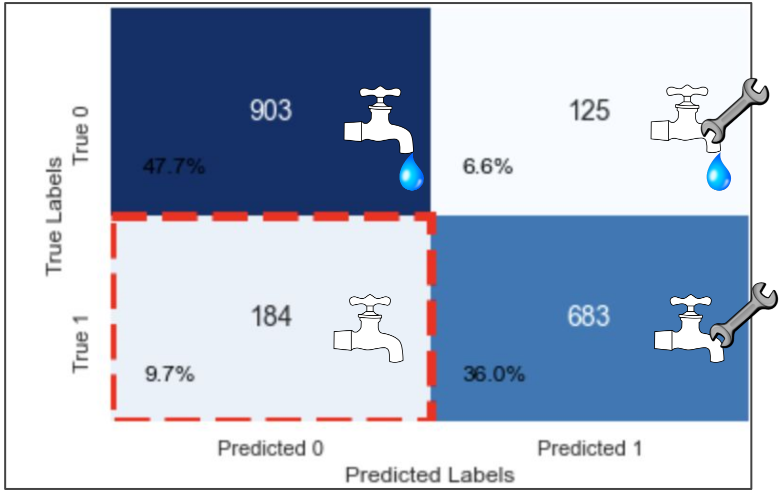
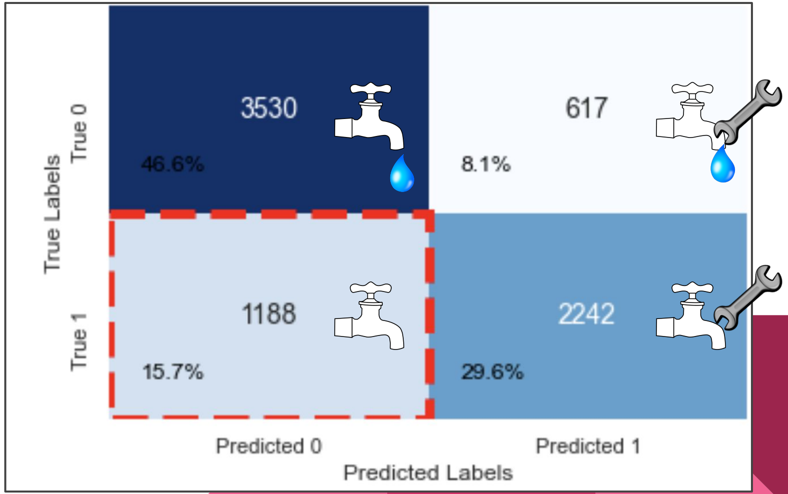


Logistic Regression Model

Train recall score: ***66.85***%
Test recall score: ***66***%



Limitations

- **Domain Knowledge**:
  - Lack of local expertise affected feature selection

- **Data Quality**:
  - Model is only as good as its data

- **Computing and Time Constraints**

Recommendations

Recommendation 1: **High-Demand Areas**

Focus repairs in following regions:

- **Northwest (Kigoma)**
- **Southeast (Dar Es Salaam, Mtwara)**

Recommendation 2: **Model Deployment**

Deploy initial random forest for urgency

Recommendation 3: **Refine Models**

Improve performance

- Informed **feature selection**
- Apply **cross-validation**
- Address **overfitting**

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Next Steps

1. Enhance Data Collection
2. Improve Beyond Baseline Score
3. Explore Advanced Algorithms

Thank you!

Github Repository:
https://github.com/ckucewicz/water_well_classification

Contact Chris Kucewicz at
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