IMPROVING FOOD SAFETY IN SUB-SAHARAN AFRICA

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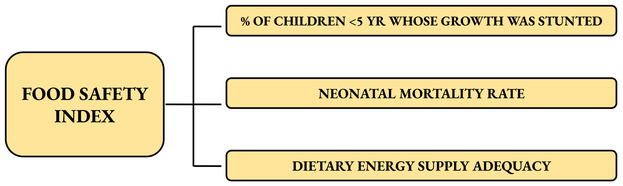
INTRODUCTION

Food safety refers to the measures and practices taken to prevent the contamination of food by harmful contaminants or substances that can cause illness or disease when consumed (World Health Organization, 2022). This involves monitoring and controlling the entire food supply chain from production to consumption to ensure that the quality of food is preserved and prevent foodborne illnesses. In Sub-Saharan Africa food safety is a concerning issue as foodborne illness is a major public health issue.

Research questions:

- What are the determinants of food safety in Sub-Saharan Africa?
- What is the future of food safety in Sub-Saharan Africa and how can we improve the situation?

To measure food safety, we created a composite index using three features that our research showed to be highly related to food safety. Our index is scaled from 1-10, where one is the best and ten is the most adverse food safety condition .



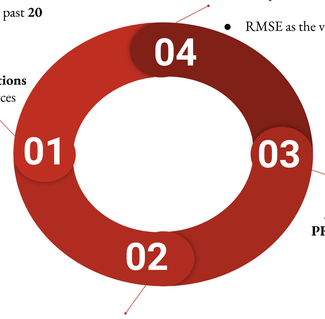
METHODOLOGY

DATA ACQUISITION

- Identify the determinants of food safety
- Gathered data on for the past **20 years**
- Sources: **World Bank, FAOSTAT, United Nations** and other reputable sources

DATA PROCESSING

- Constructed a composite index as the dependent variable to represent food safety condition in Sub-Saharan Africa
- Clustered Sub-Saharan African countries using **TimeSeriesKMeans** with the optimal cluster number of 4 (obtained by elbow method on silhouette scores).
- Cleaned missing data based on the clusters.



MODEL VALIDATION AND RECOMMENDATIONS

- Models trained on data from 2000 - 2019, and predictions were made on the 2020 data.
- RMSE as the validation metric.
- Hyperopt used to optimize the hyperparameters of the LSTM model
- Data analysis and research

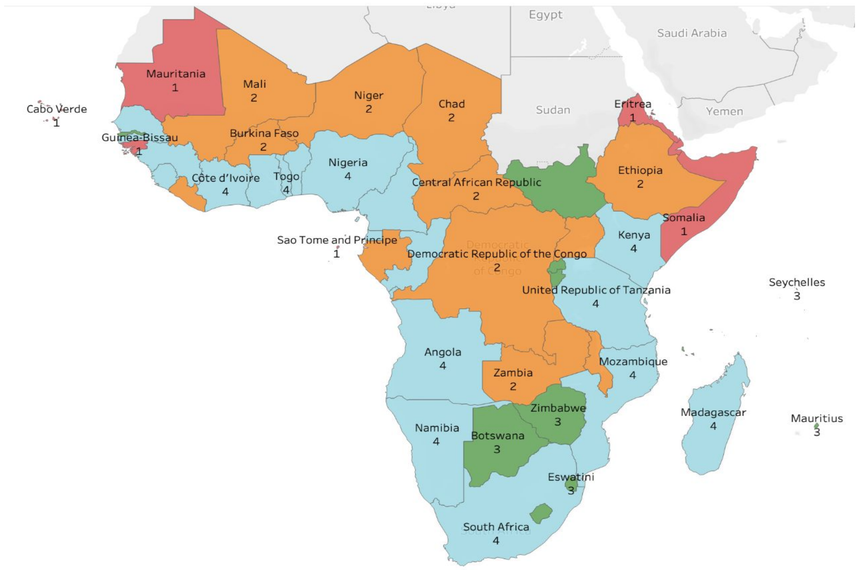
ANALYTICAL AND PREDICTION MODELS

- Variable importance: determined important variables with interpretable ML models including **Random Forest**, **Lasso** and **Ridge**.
- Prediction: generated prediction for Year 2023 with LSTM model.

Tools used: RStudio, Python, Tableau, and Microsoft Excel

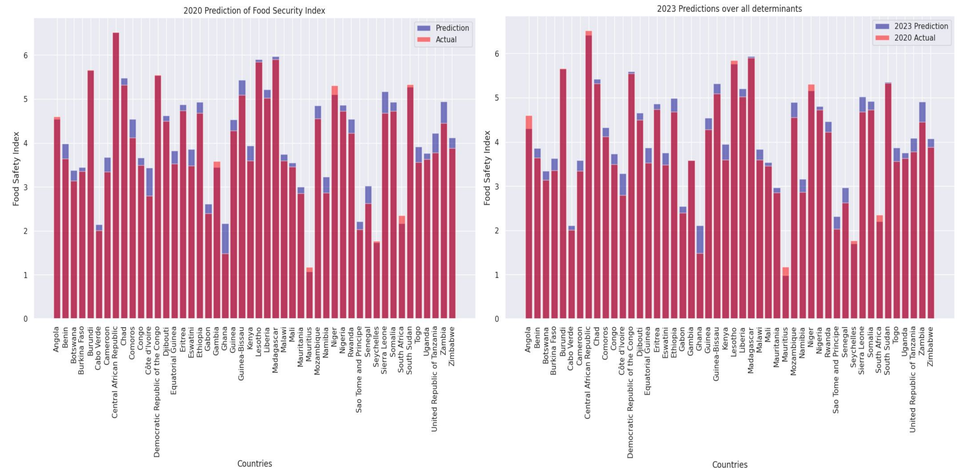
ANALYSIS

Cluster classification based on features:



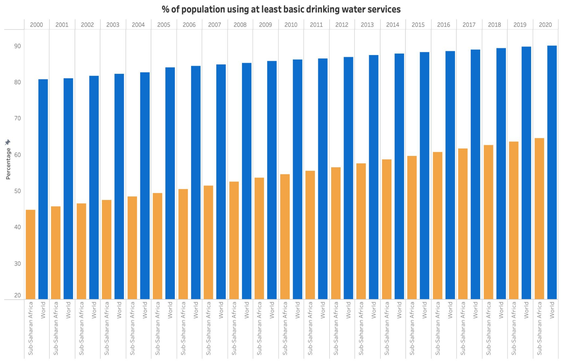
DETERMINANTS / CLUSTERS		ECOLOGICAL & BIOLOGICAL	FOOD SYSTEMS & MARKETS	PHYSICAL INFRASTRUCTURE	ECONOMIC & GOVERNANCE
CLUSTER 1	LSTM Model RMSE	0.205	0.228	0.188	0.124
	Top 3 Important Features according to Random Forest:	Year: 0.29 Agriculture Land: 0.22 Irrigable Land: 0.11	Added Manufacturing: 0.24 Caloric Loss in Retail: 0.20 FPI: 0.15	Basic drinking water: 0.72 Clean Fuel Access: 0.07 Year: 0.06	GDP per cap: 0.46 Area: 0.20 Year: 0.13
CLUSTER 2	LSTM Model RMSE	0.066	0.222	0.097	0.093
	Top 3 Important Features according to Random Forest:	Agriculture Land: 0.38 Crop Land: 0.35 Livestock: 0.11	Caloric Consumption Variation: 0.33 Rural Percentage: 0.18 Area: 0.12	Basic Drinking Water: 0.43 Basic Sanitation: 0.29 Clean Fuels Access: 0.22	GDP per cap: 0.72 Unemployment: 0.13 Area: 0.05
CLUSTER 3	LSTM Model RMSE	0.112	0.158	0.111	0.131
	Top 3 Important Features according to Random Forest:	Livestock: 0.24 Cereal Production: 0.15 Total Manure: 0.13	Caloric Loss in Retail: 0.31 FPI: 0.25 Year: 0.10	Basic Sanitation: 0.57 Year: 0.21 Area: 0.07	GDP per cap: 0.53 Unemployment: 0.19 Year: 0.09
CLUSTER 4	LSTM Model RMSE	0.126	0.188	0.068	0.096
	Top 3 Important Features according to Random Forest:	Agriculture Land: 0.71 Crop Land: 0.13 Cereal Production: 0.06	Caloric Loss in Retail 0.63 Added manufacturing 0.26 Net Export 0.05	Basic Drinking Water: 0.47 Clean Fuels Access: 0.27 Water use Efficiency: 0.14	GDP per cap: 0.40 Unemployment: 0.25 GDP :0.16

PREDICTION



POTENTIAL SOLUTIONS

TOP 5 IMPORTANT VARIABLES FOR FOOD SAFETY	
VARIABLE	IMPORTANCE
Basic Drinking Water	0.35
Clean Fuels Access	0.17
GDP per Capita	0.15
Food Production Index	0.05
Cereal Yield	0.04



Based on our analysis we can see that the current food safety crisis in Sub-Saharan regions could persist. We propose different solutions to alleviate the situation in the coming years based on our model:

- Develop a food safety program emphasizing sanitation, storage, and handling, with emphasis on public education and awareness.
- Investment on infrastructure:
  - Basic drinking water improvements can lead to increased agricultural productivity, reduce water waste, and reduce pressure on natural water resources.
  - Clean fuel access improvement lead to better cooking techniques to reduce contamination, better hygiene methods, economic development, and health benefits

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