Is the beef value chain a key driver in Foot and Mouth Disease Outbreaks?

A Data Platform for Foot and Mouth Disease Outbreak

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Introduction

- **Foot and Mouth Disease (FMD)** is a major threat to animal health, particularly in countries with significant cattle production like South Africa.
- The disease has **socio-economic** impacts, affecting both local communities and national exports.
- While FMD outbreaks are influenced by many factors, **cattle movement in the beef value chain** may play a central role.
- Our aim is to investigate this hypothesis through data visualization and machine learning.

Problem Statement

- **Malnutrition** and dietary transformation is on the rise.
- **Foot and Mouth Disease (FMD)** affects both commercial and local farmers.
- Data is **siloed** and **unstandardized**.

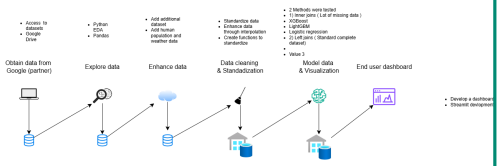
Goals

- Establish a **Single Source of Truth** for comprehensive, standardized zoonotic disease data impacting beef production through a centralized data platform.
- Develop a predictive model to identify the most vulnerable groups to Foot-and-Mouth Disease (FMD), aiming to minimize the spread of FMD and maximize beef production.
- Identify trends between zoonotic diseases and beef production using a data platform that enables data-driven exploration of historical patterns.

Data sources

- Historical FMD outbreak data from DAFF and provincial records.
- Livestock population data from national censuses.
- Weather data (temperature, precipitation, humidity) from global meteorological sources.
- Custom-aggregated municipality shapefiles for mapping.

Approach



Predictive Model

- We used XGBoost and logistic regression to predict the likelihood of outbreaks per province per year.
- Outbreak predictions were binarized using a tuned threshold (≥ 0.5).
- Predictions were overlaid on a geographic interface for visual validation.

Conclusion

- By creating a data platform, data can be easily visualized.
- Data visualization enables user friendly trend identification.
- The more data is standardized, the easier pattern detection will become.
- By overlaying a predictive model, the faster potential outbreaks can be identified and treated.

Future Steps

- Adding more and higher quality data to the predictive model.
- Deploy dashboard to agricultural stakeholders and policymakers.

Extra figures

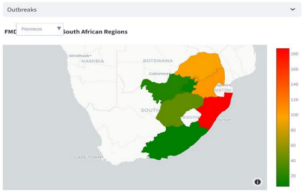
Data Platform

Our dashboard supports filtering by:

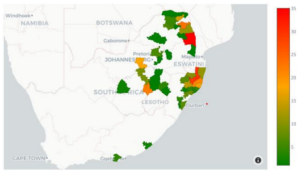
- **Province or Municipality**
- **Cases, Outbreaks, Dead, Killed**
- **Actual vs Predicted outbreaks**
- **Time Period (1993–2024)**

This allows users to visually inspect outbreak trends and model performance interactively.

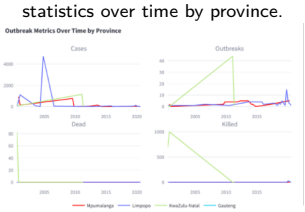
The next graph shows the provinces which were most affected by FMD outbreak over all time periods.



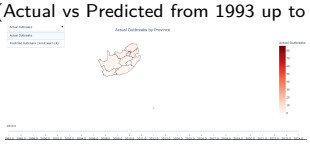
This dashboard view displays the municipalities with the most FMD outbreaks.



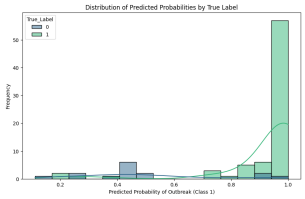
Here one can view cases, outbreak, dead and killed statistics over time by province.



As seen in the graph below, we developed a dashboard where you can choose to view outbreak data (Actual vs Predicted from 1993 up to 2025)



Furthermore, we had a highly skewed dataset. The distribution of outbreaks are as follow.



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