

AI driven discovery of the linkage between climate extremes and food fraud

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Background

Extreme climate events can have significant direct and indirect effects on agricultural systems, food production, rising prices, and, in turn, food fraud. This may especially be true if the region that has been hit has a dominating market share for a fraud sensitive commodity. In this way, an extreme event in one region can introduce or increase fraudulent behavior, and as a result affect food safety somewhere else.

Objective

This project aims to find linkages between extreme climate events and the occurrence of food fraud and to investigate if it is possible to predict food fraud type from climate extremes. The positive findings can contribute to the development of early warning systems that track extreme climate events and predict the type, origin, and scale of food fraud. Thus helping to sustain food safety in a changing climate.

Methods

A Bayesian Network model (BN) and an extreme gradient boosting classifier (XGB) were developed based on food fraud records from RASFF, climate extreme variables, and other relevant socioeconomic variables.

Results

Model result using Bayesian Network (BN)

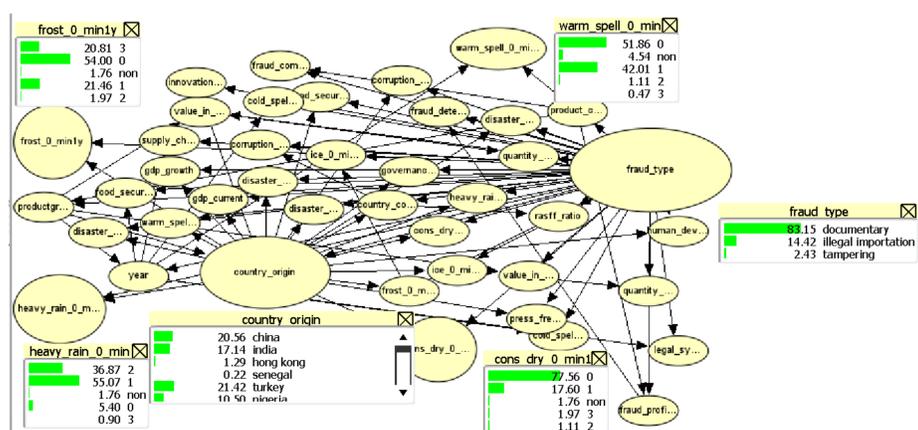


Figure 1. Bayesian network model of food fraud detection showing the interdependencies and probabilities between the various drivers/factors.

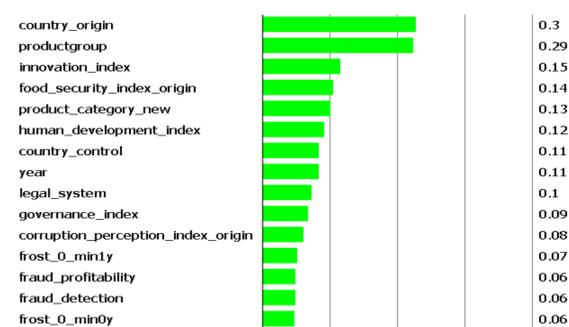


Figure 2. Value of information. Climate extremes (especially frosty days) have an influence on reported food fraud cases

Model result using Extreme Gradient Boosting (XGB)

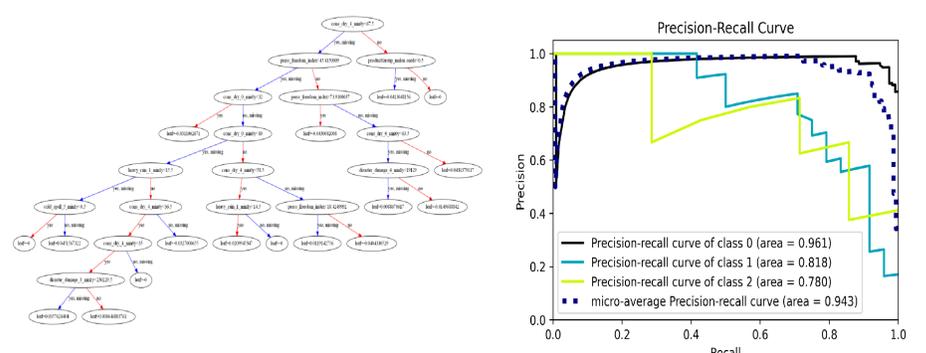


Figure 3. A single boosted tree (left) and model evaluation results (right) (class 0- tampering, class 1- illegal importation, class 2- missing documents)

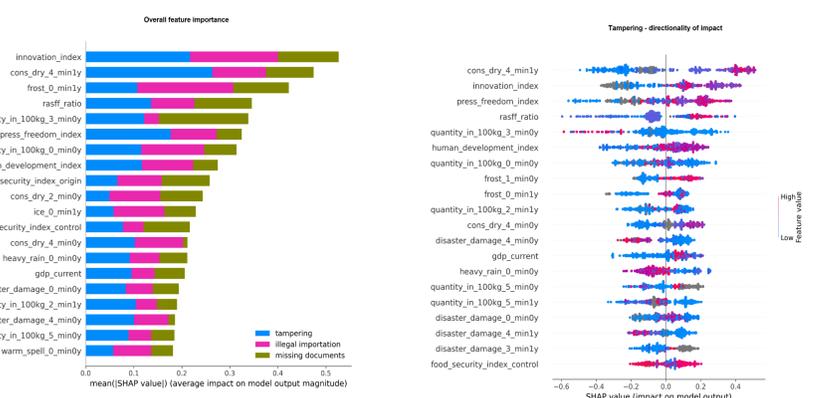


Figure 4. Overall variable importance (left) and directionality of impact on tampering (right)

Results show that climate extremes especially dry spells and frosty days have a big influence on reported food fraud cases.

Conclusions

- Climate extremes contribute to developing early warning systems that predict the type of food fraud using BN model and XGB model.
- Adding climate variables for modeling increased the predictive performance (overall brier score decreased from 0.23 to 0.21) of the BN model.
- Climate extremes especially dry spells and frosty days have a substantial influence on making predictions of food fraud categories

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