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# Holistic AI Models for Emerging Risk Prediction in Feed and Food

Safe Food, Smart Future Symposium

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June 10th, 2026

# Agenda

Emerging risks & Holistic prediction models

Prediction of hazards in feed – ProRiskFeed

Prediction of hazards in food – HOLiFOOD

# Emerging food safety risks

## WHAT IS AN 'EMERGING FOOD RISK?'

A risk resulting from a newly identified hazard to which a significant exposure may occur, or from an **unexpected new or increased significant exposure** and/or **susceptibility** to a known hazard.



**INCREASED EXPOSURE  
TO KNOWN HAZARD**



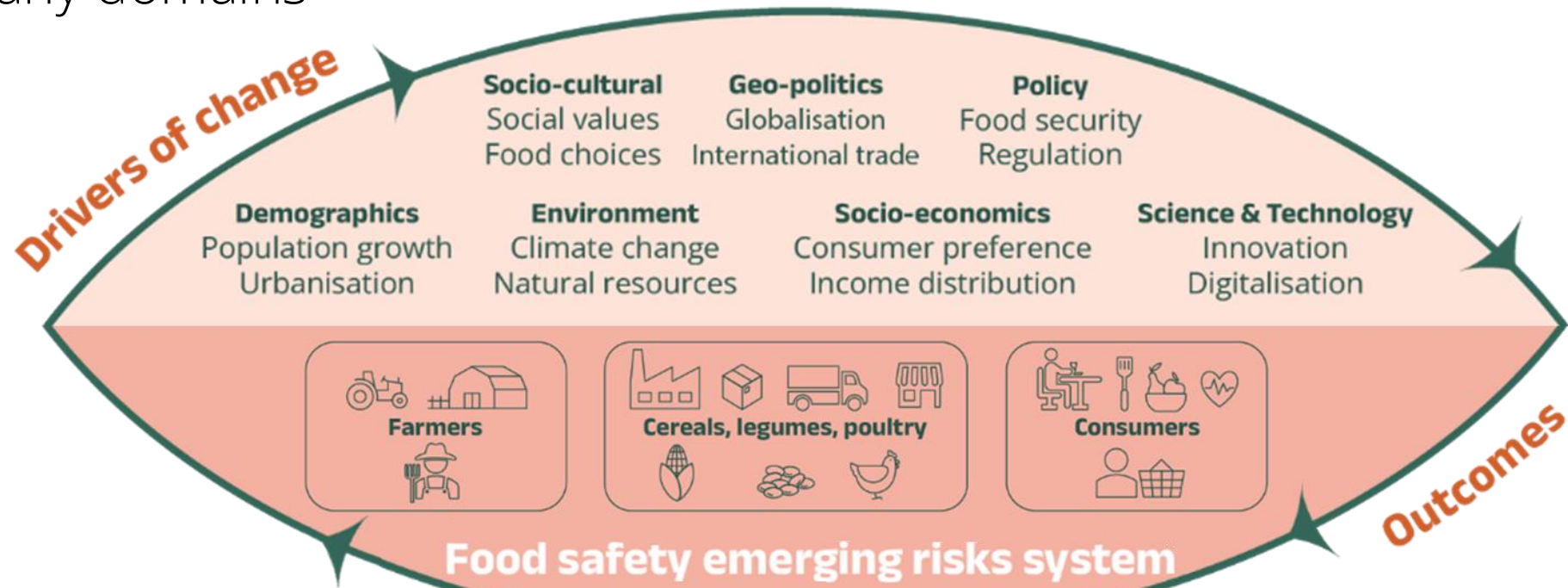
**NEW  
HAZARD**



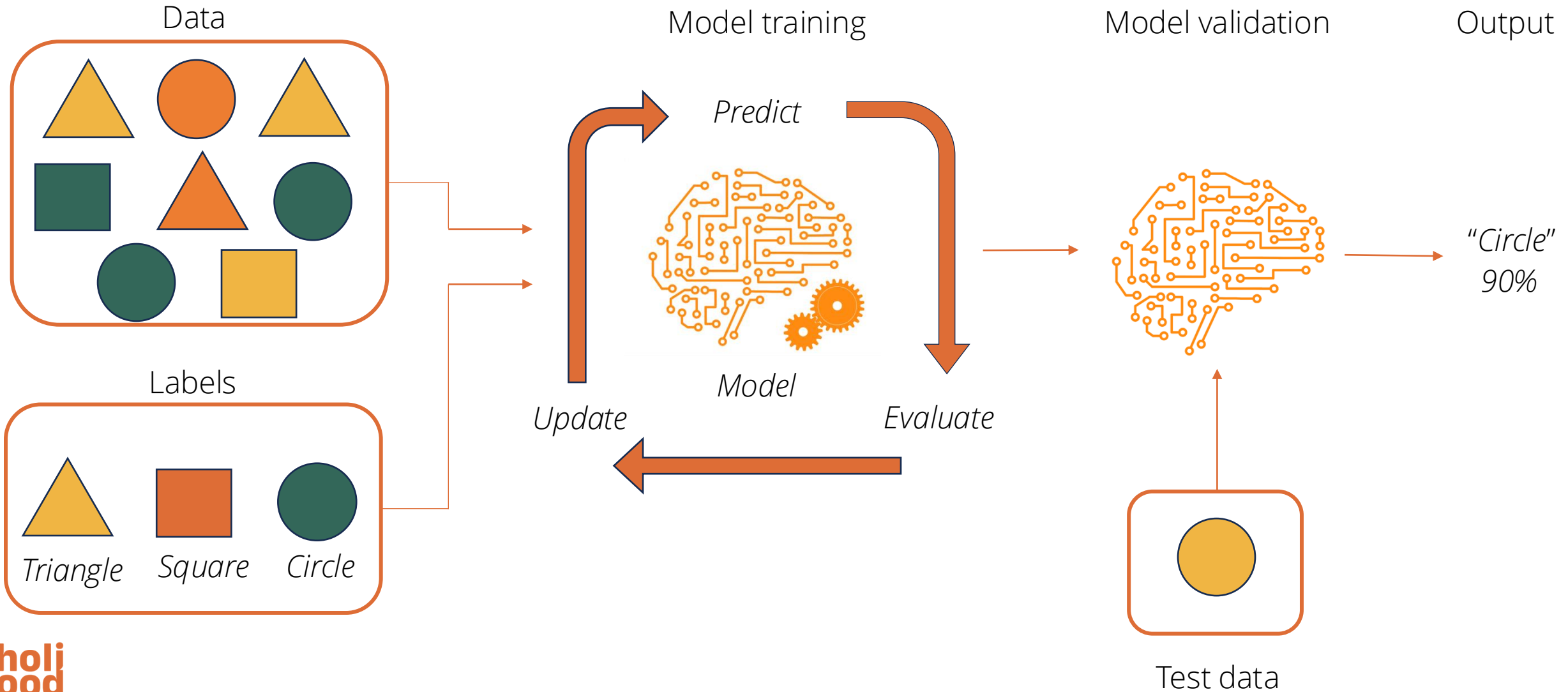
**INCREASED SUSCEPTIBILITY  
TO HAZARD**

# Holistic approach

- ▶ To identify emerging risks in food safety faster, we are developing prediction models to create a more **proactive system**
- ▶ We need a **holistic approach**, which uses drivers of change across many domains



# Machine learning



# Prediction models

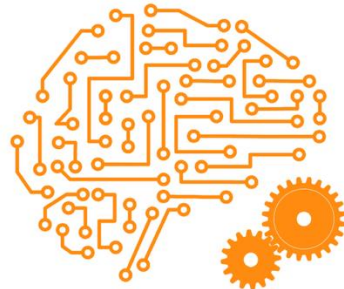
Monitoring data



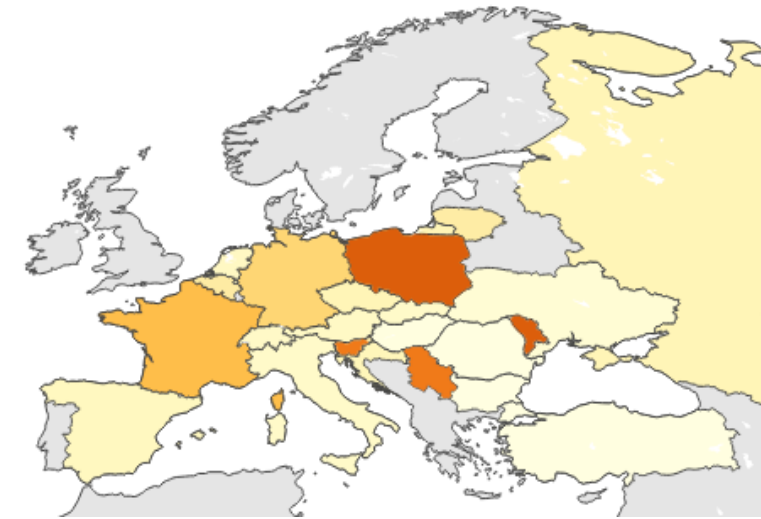
Drivers of change



Prediction model



Food safety contamination



# Monitoring data



- To make good models we need good data → EFSA (CHEFS) and feed company monitoring data
- Contains monitoring data from **EU countries/World** across many different products and contaminants with **millions** of measurements
- Information includes product, contaminant, analytical result, origin country, sampling country, sampling date etc.



# Driver data

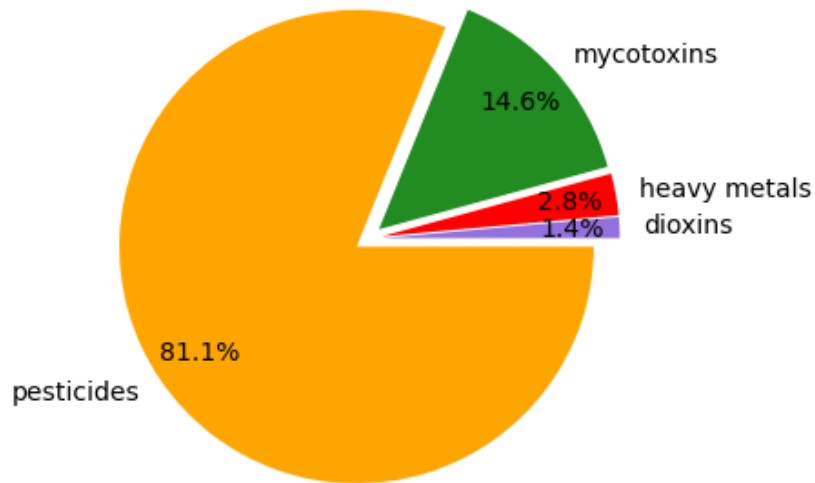
- ▶ Drivers were selected in collaboration with food safety experts
- ▶ The models used +/- **100** different drivers
- ▶ Driver categories can be divided between:
  - ▶ **Climate** (temperature, precipitation, humidity, disasters),
  - ▶ **Economics** (trade, prices, GDP, consumption, energy costs),
  - ▶ **Social** (human development, press freedom, innovation, digitalisation),
  - ▶ **Policy** (corruption, legal system, food safety/security),
  - ▶ **Agricultural** (production, emissions, manure, pesticide/antibiotic usage)



# ProRiskFeed

- ▶ 1.8 million analytical results from 202,325 feed samples (2010-2023)

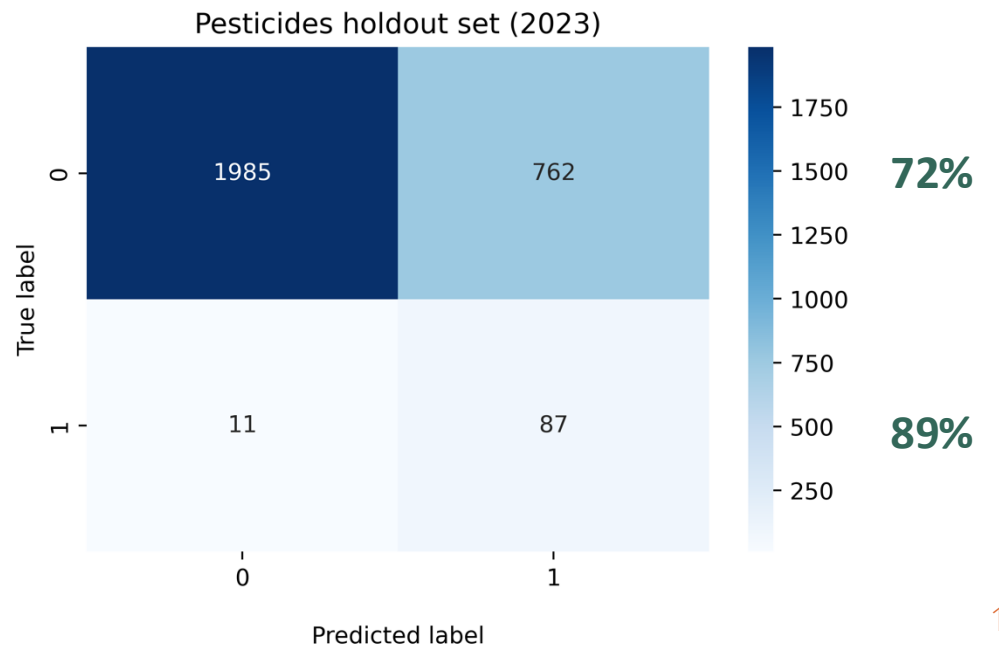
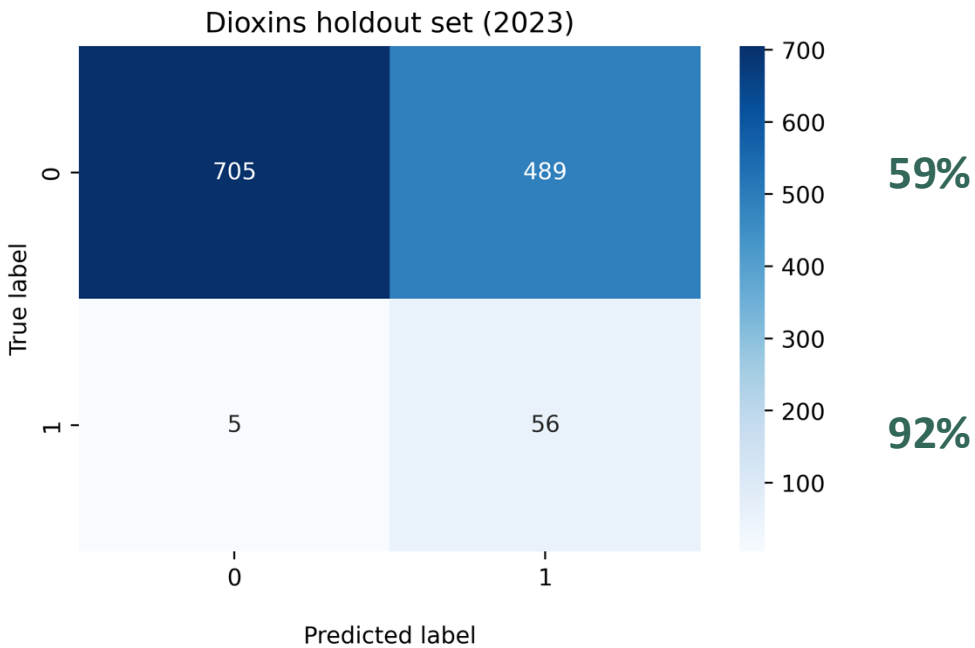
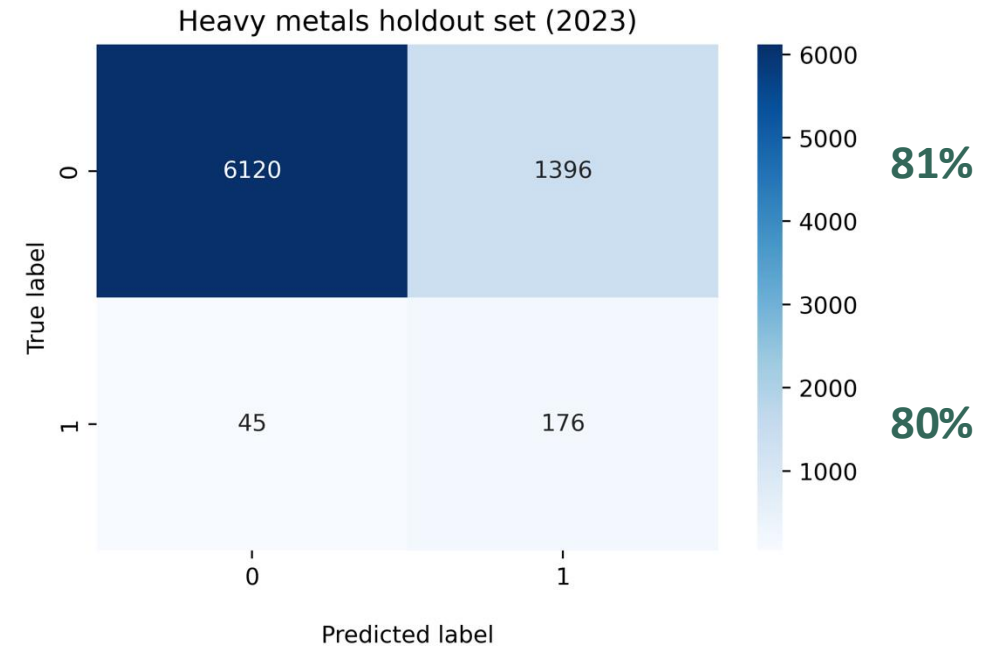
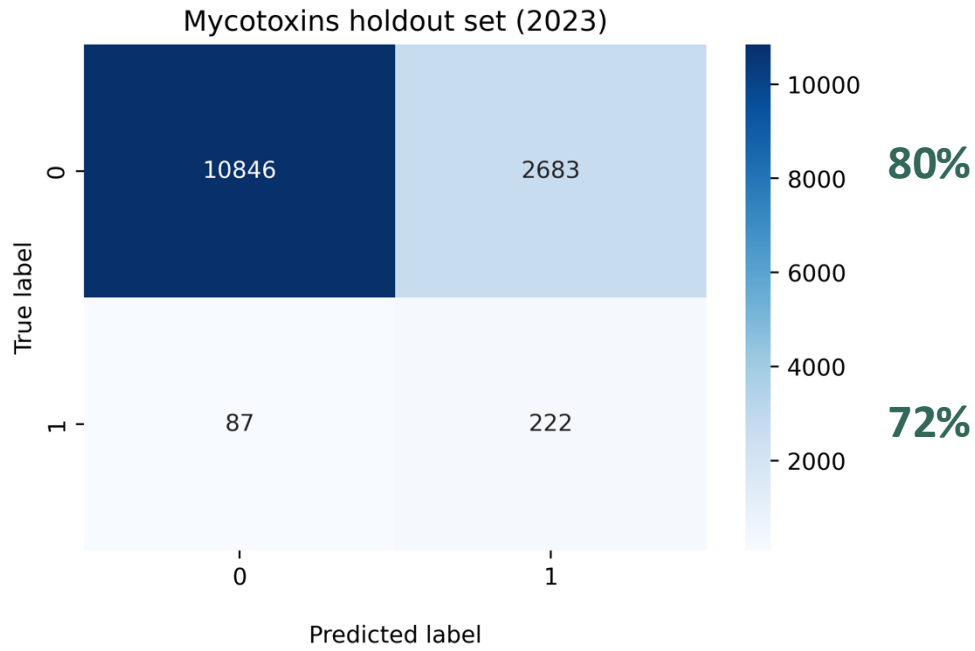
Contaminant groups



Contaminant group	Contaminant	Threshold	% above threshold
Mycotoxins	Aflatoxin B1, Deoxynivalenol, Fumonisin B1 + B2, Ochratoxin A, T2 + HT2 toxin, Zearalenone	½ legal limit	2.8%
Heavy metals	Arsenic, Cadmium, Lead, Mercury	½ legal limit	2.2%
Dioxins	17 dioxin congeners (PCBs were not included)	½ legal limit	4.2%
Pesticides	78 pesticide residues were aggregated	MRL	6.1%

# Results

CatBoost  
model  
performed  
the best



# HOLiFOOD

Daan Korporaal



**LEGUMES**



**CEREALS**

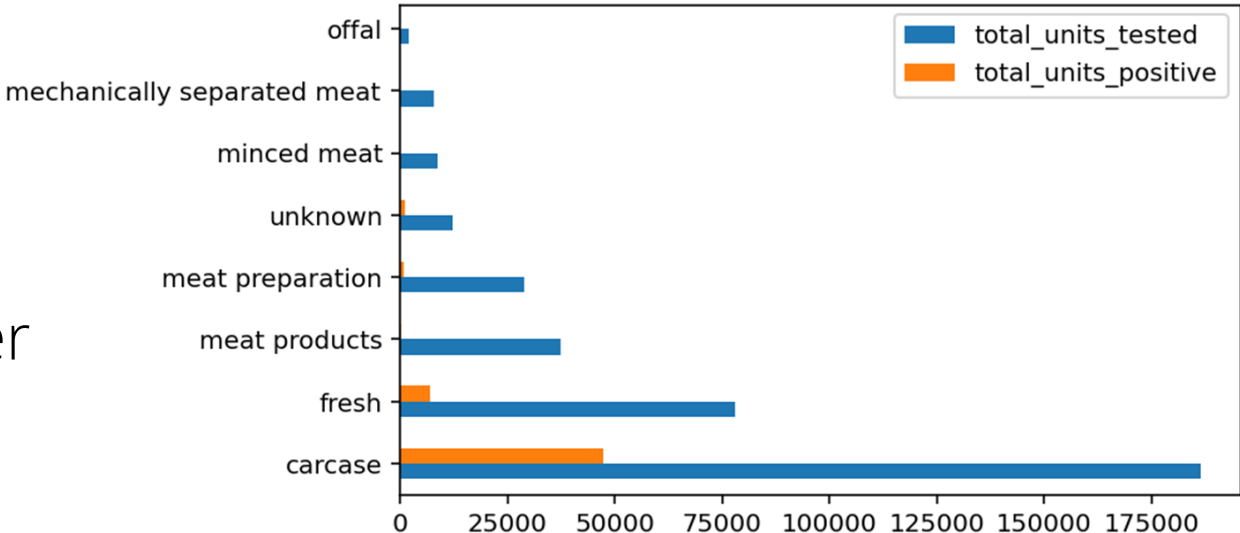


**POULTRY**



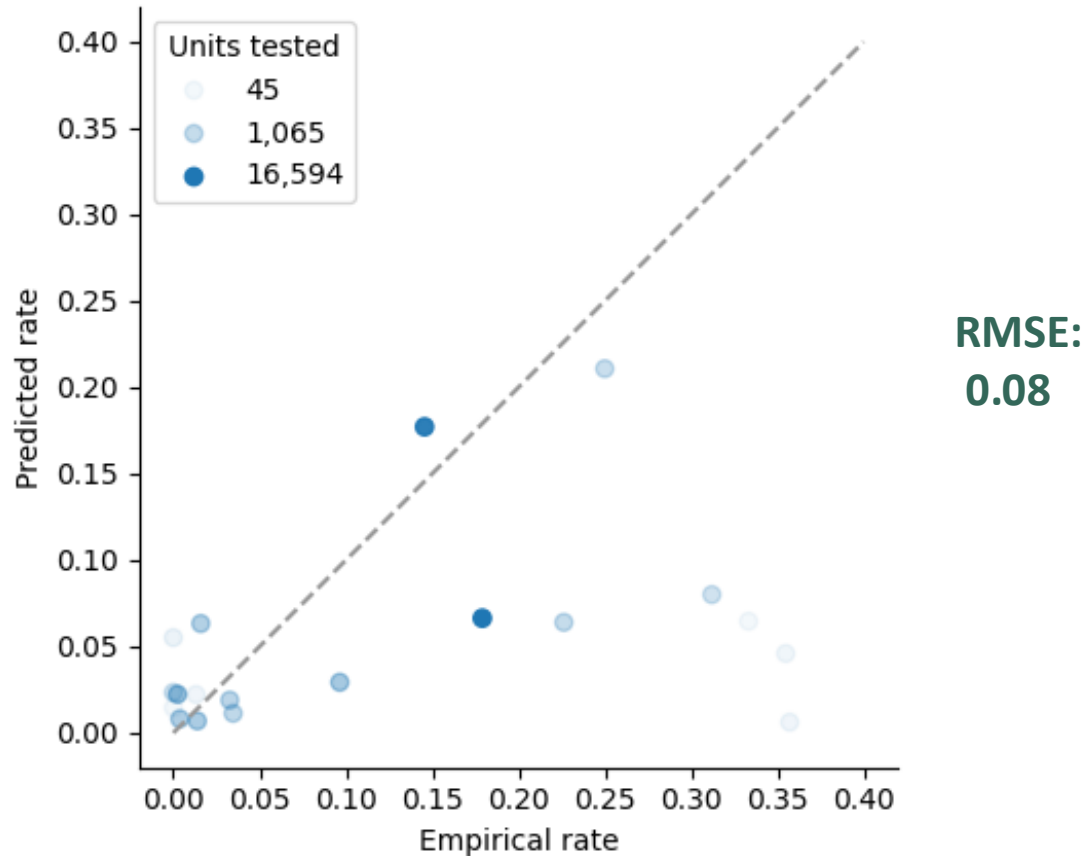
# HOLiFOOD – Poultry model

- ▶ Most poultry data in the EFSA data is meat from broilers (*gallus gallus*)
- ▶ Microbiological hazards are one of the main food safety concerns in poultry
  - ▶ Salmonella and Campylobacter are most prevalent
- ▶ For 2018-2024:
  - ▶ 254019 units for Salmonella (4.2% positive)
  - ▶ 123089 units for Campylobacter (11.3% positive)

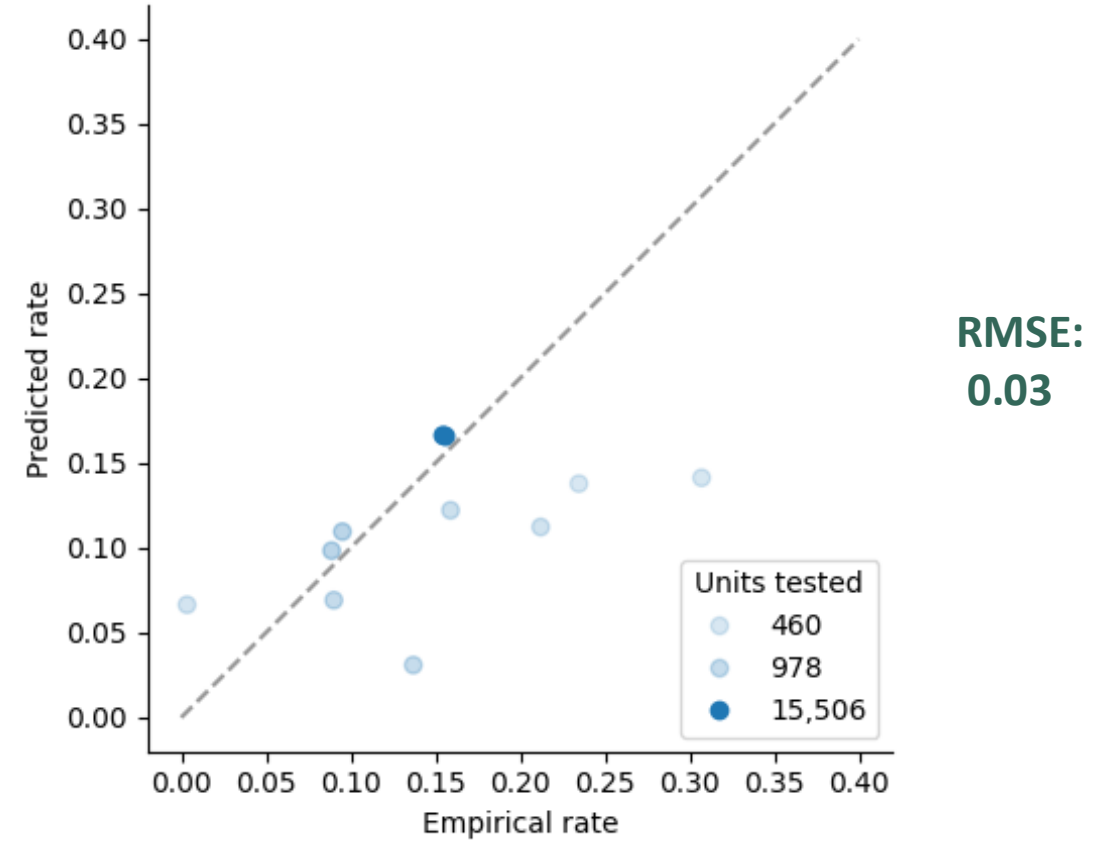


# Results

Predicted vs actual rate of salmonella contaminations per country (2023 and 2024)

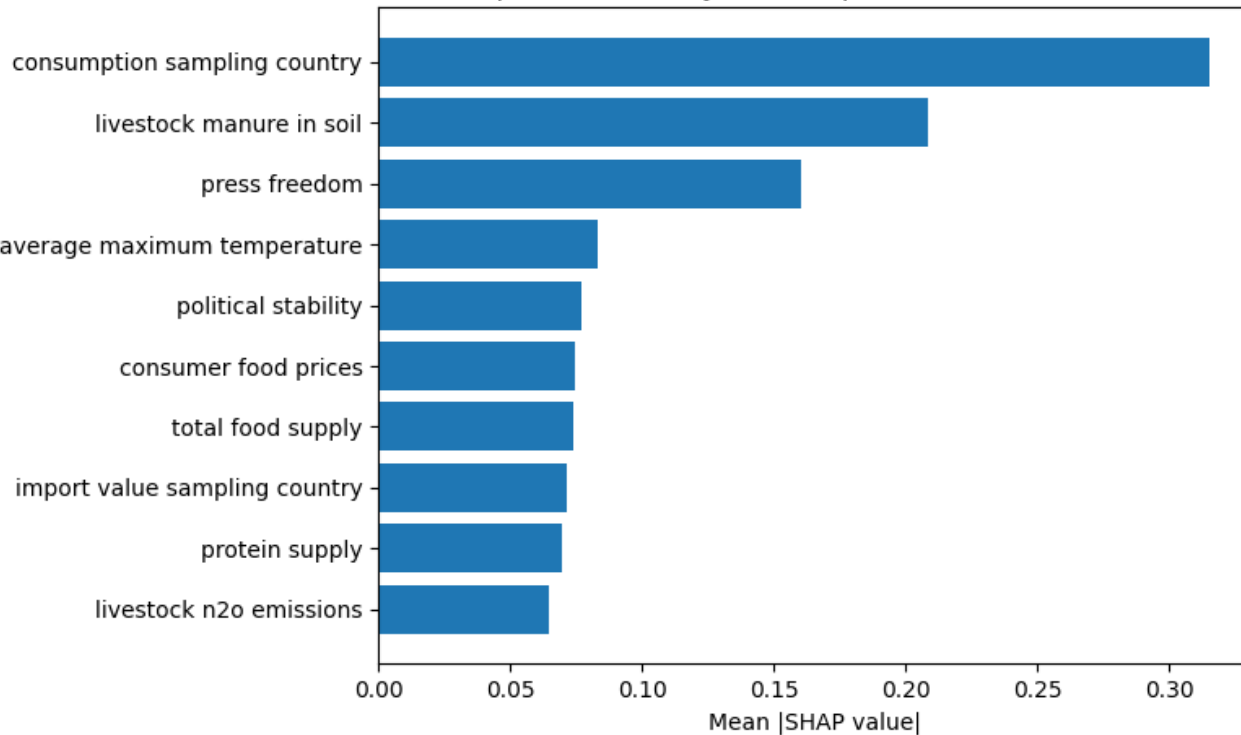


Predicted vs actual rate of campylobacter contaminations per country (2023 and 2024)

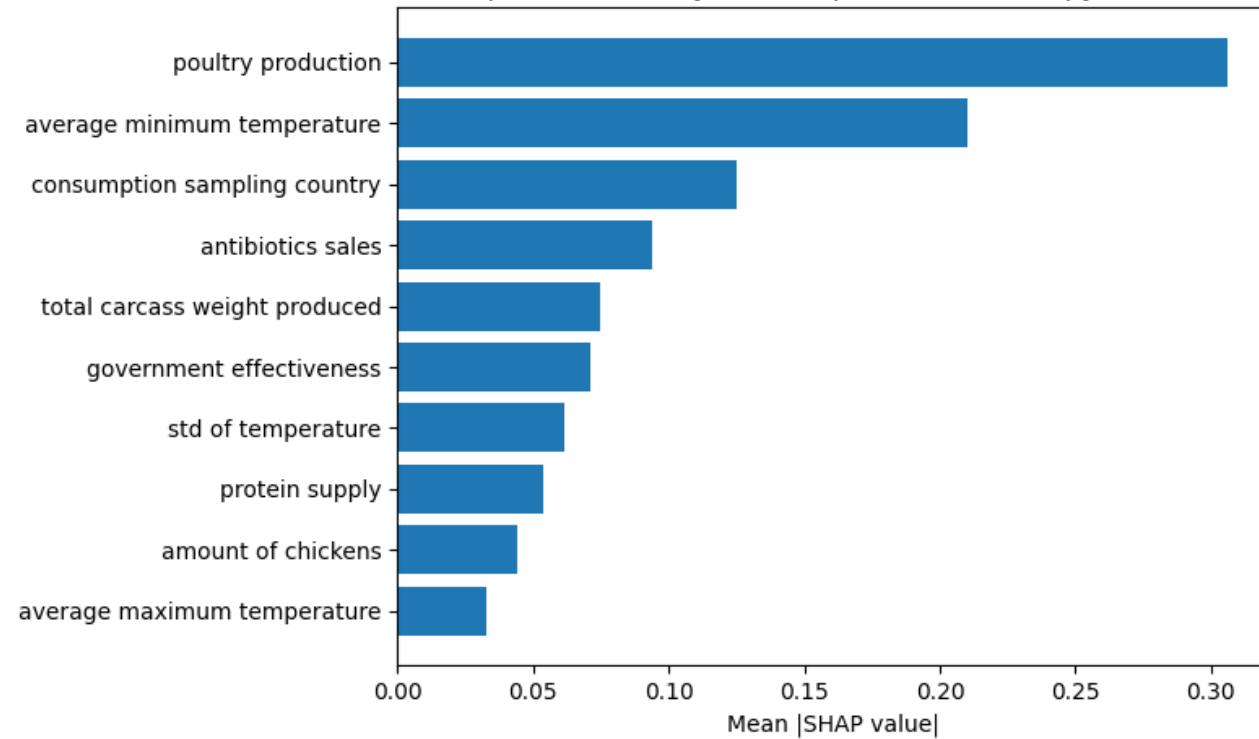


# Explainable AI

Top 10 features by SHAP importance for salmonella

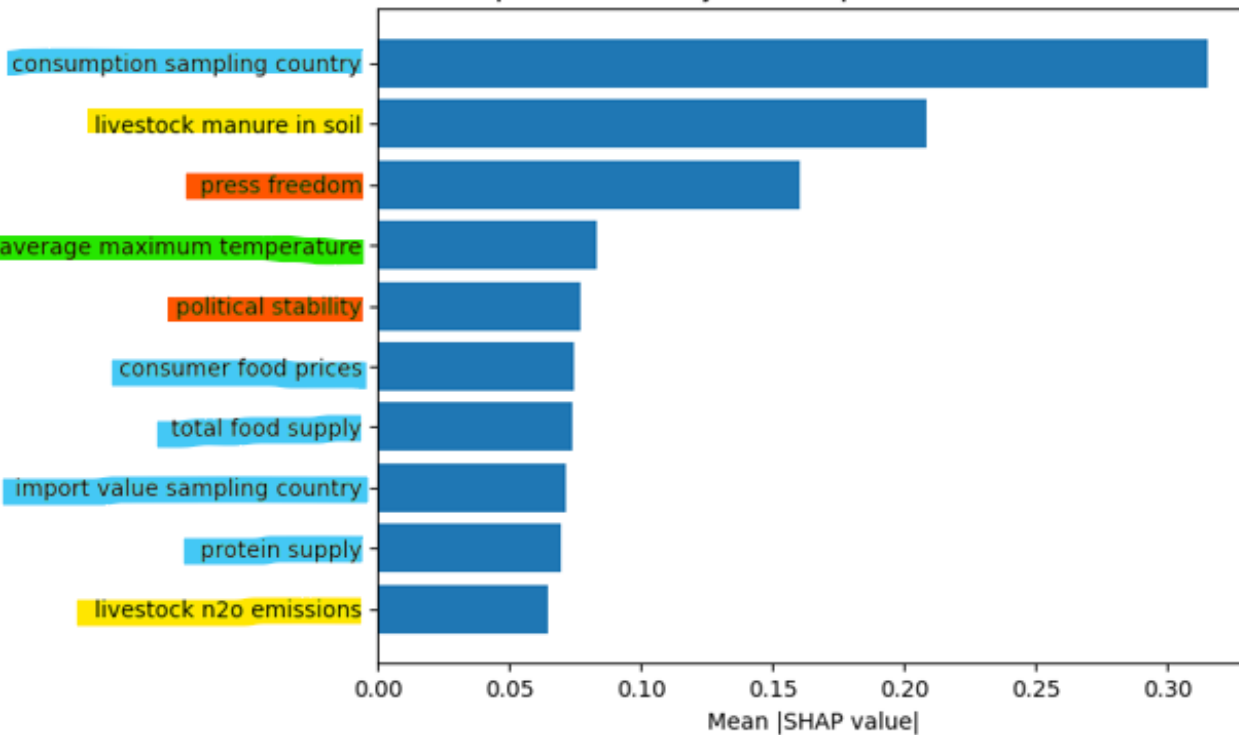


Top 10 features by SHAP importance for campylobacter

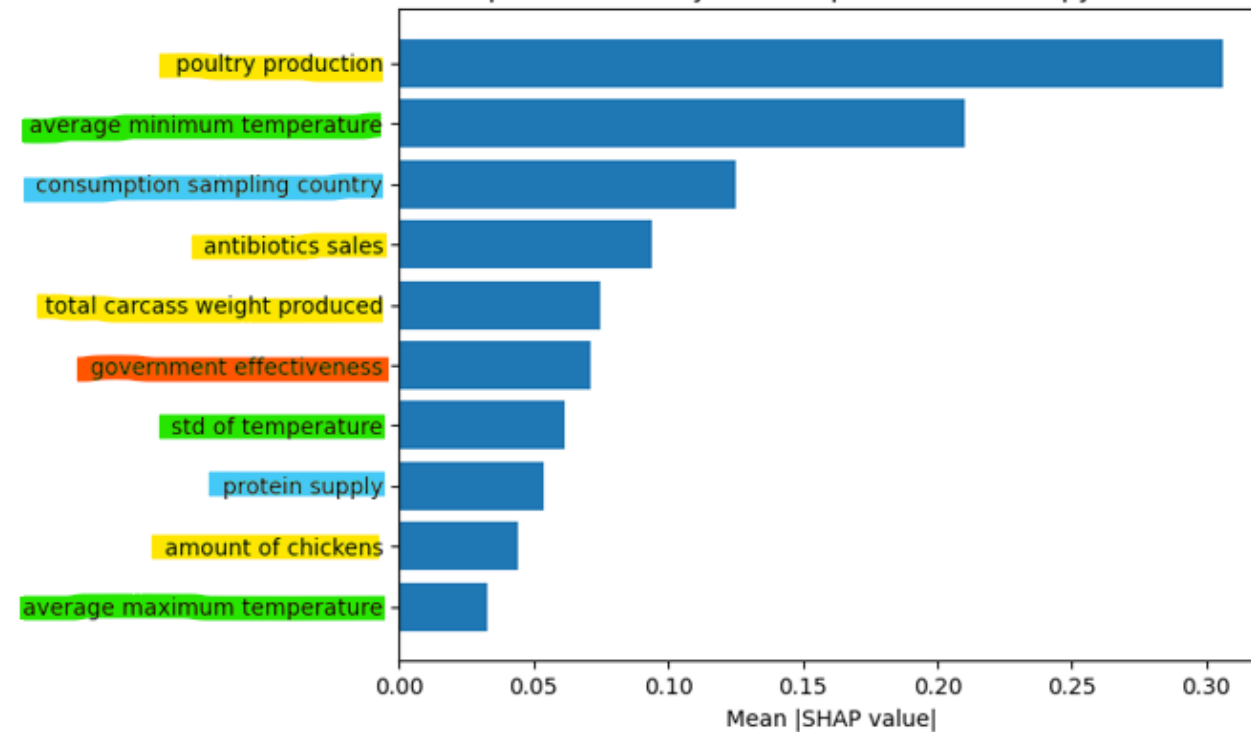






# Explainable AI

Top 10 features by SHAP importance for salmonella



Top 10 features by SHAP importance for campylobacter



 = Consumption & Economics,  = Agricultural,  = Sociopolitical,  = Climate

# Thank you!

Any questions?

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holi  
food



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