The role of Artificial Intelligence and Digitalization in Sustainable Food Systems

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SCAR FOOD SYSTEMS SWG online workshop "Assessing digitalisation in Food Systems", 25 November 2022

Outline

1. Introduction
2. Systems approach & AI
3. Digitalization in sustainable food systems
4. Examples of new Horizon Europe initiatives
5. Conclusions

Introduction

- Current food systems are unsustainable and contribute significantly to climate change, in addition generating large amounts of waste
- The EC European Green Deal sets out the path for a fundamental transformation of European society, and the efficacy of its economic functioning
- An integral part of the Green Deal is to implement the United Nation’s 2030 Agenda and the Sustainable Development Goals

Introduction

“ To realize the requested transition a systems approach is needed in which all aspects related to production and consumption of sufficient and healthy food are considered including economic, environmental and societal aspects”

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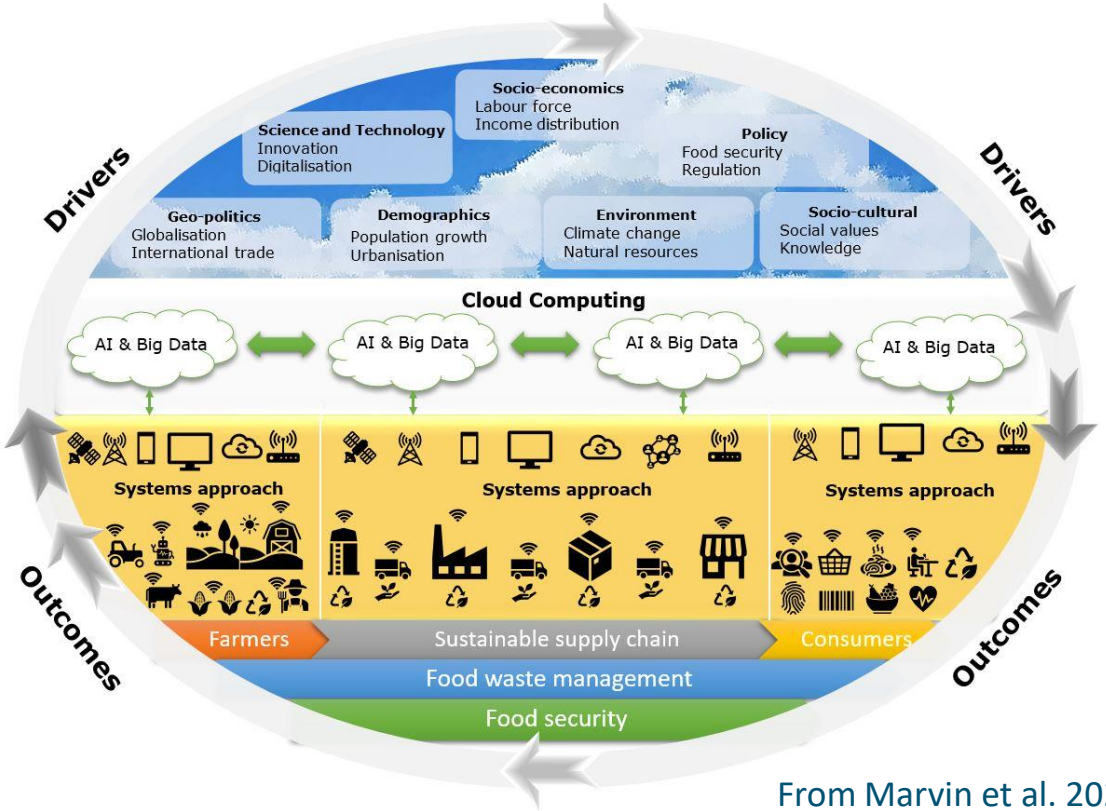
Food production and Food Safety driven by a web of interacting drivers



From Marvin et al. 2022

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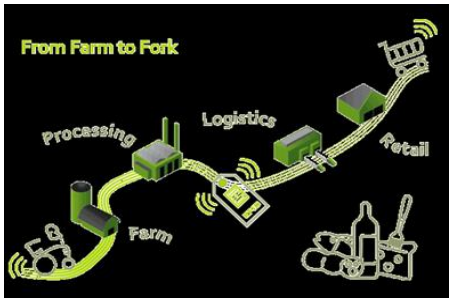
Systems approach needed!

Data of drivers

Expert knowledge

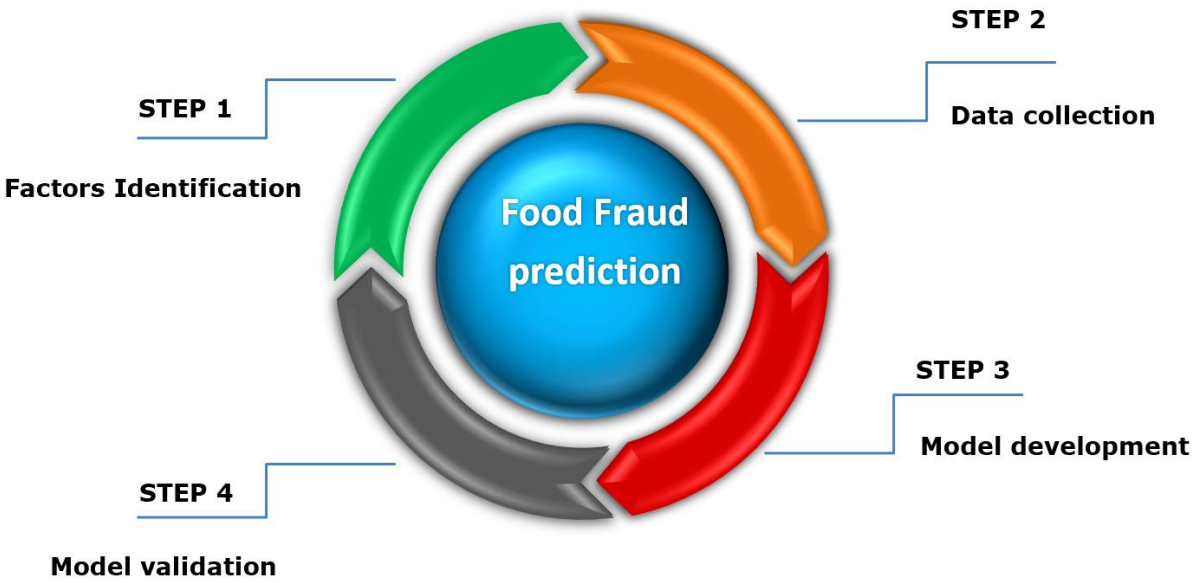


Supply chain mapping

- Integrate expert knowledge and data
- Handle huge amount of data and knowledge gaps
- Use a variety of data sources of divers nature (agricultural, economic, climate, societal, etc)
- Should allow scenario analysis, mitigation analysis

Can Big Data & AI help?

Bayesian Network (BN) approach



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Data sources used in the Food fraud BN model

Linking 36 drivers (18 data sources and 8 expert judgements)

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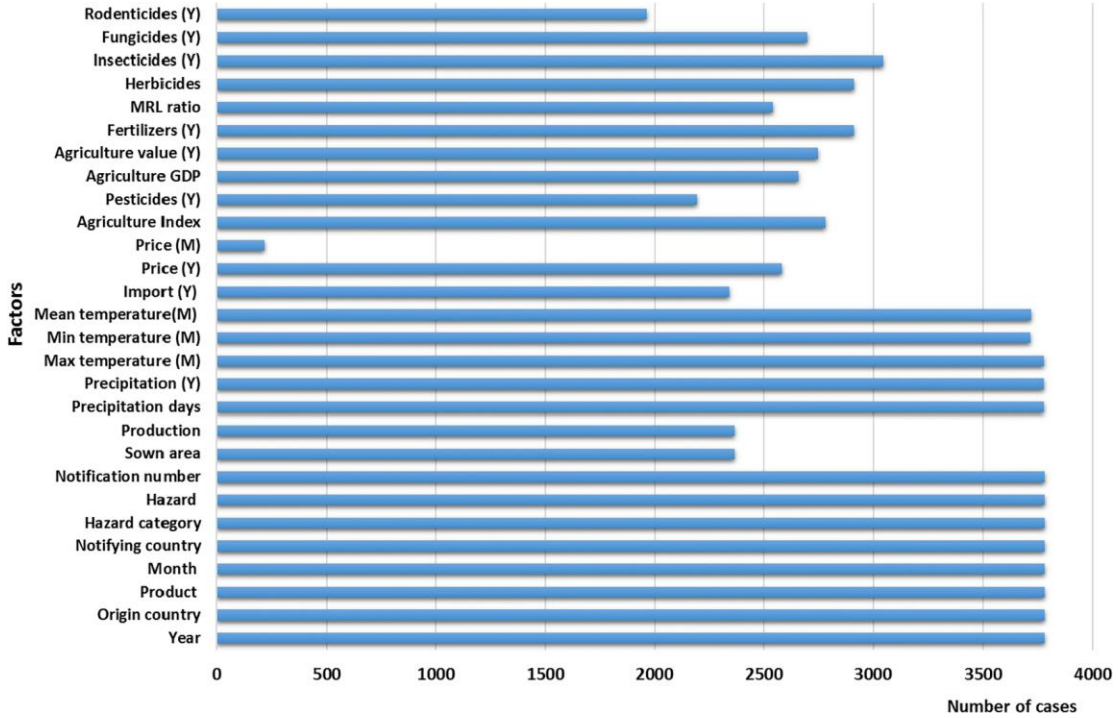
BN modelling applied in many cases

1. Food Safety (fruit & vegetables, milk, salmon, spice & herbs) and Food Fraud
2. Safety of nanoparticles
3. Yield of potato
4. Outbreak of classical swine fever and Avian Influenza in poultry
5. Short-term prediction of DSP contamination in shellfish

Generally the prediction accuracy > 90%

Example of data gaps in BN for hazard prediction in fruit and vegetables (95% accuracy)



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Challenges, digitalization and AI from farm-to-fork

The transition towards sustainable food production needs digitalization of farms and food supply chains

	Farming	Post-harvest operations	Processing & Distribution	Consumer, Retail and Out-of-Home
Challenges	• Produce more and better, with less • Climate change • Reduction of pesticide and fertilizer use • Process oriented activities • Data sharing an interoperability of data generated on farms	• Food waste and loss • Resilience to disruptions • Replace animal based foods with plant-based foods • Reduce the footprint of proteins • Valorise food products for a healthy society • Improve and automate grading, sorting, inspection, shelf-life prediction	• Food waste and loss • Resilience to disruptions • Valorise waste streams and less refining • Successful data processing and analysis in reasonable time • Scalability, availability, data integrity, data transformation, data governance, privacy and legal issues	• More sustainable and plant-based food products • Food related problems such as diabetes and obesity • High-quality data from various data sources • Consumer's privacy is properly protected

Solutions that digitalization and AI can bring from farm-to-fork

	Farming	Post-harvest operations	Processing & Distribution	Consumer, Retail and Out-of-Home
Solutions	• AI at the farm to improve farm management and farm practices • Digitalisation of farming, data sharing and collaboration • Data-driven agriculture • Precision agriculture • Agricultural automation and robotics • Internet of Things (IoT)	• AI and data driven innovations to fight food waste and loss • AI solutions for designing resilient and sustainable food supply chains • Sensors, IoT and AI predictive models • AI based quality optimisation systems for creation of plant-based foods, monitoring and optimising the properties and processing of the raw materials	• AI and data driven innovations to reduce food waste and loss • AI and digitalisation to adapt the formulation of foods to less refined ingredients • Cloud computing and IoT to accelerate the implementation of the lab to sample approach • IoT implemented in the food supply chain • Digital twins concept • Industry 4.0	• Consumer decision support systems combining available knowledge and data • AI solutions for personalized nutrition, food health and sustainability • Consumer personal priorities using multi-criteria decision • Sensors, lab-on-a-chip, and smart toilet for a non-intrusive health measurements • Digital twins in human behaviour

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HOLiFOOD project: "Holistic approach for tackling food systems risks in a changing global environment"

Call: HORIZON-CL6-2021-FARM2FORK-01-16: Identification, assessment and management of existing and emerging food safety issues

Coordinator: Wageningen Food Safety Research (WFSR)

Duration: 2022-2026

Partners: 17

Strategic objective: "to improve the integrated food safety risk analysis framework in Europe to i) meet future challenges arising from Green Deal policy driven transitions in particular in relation to climate driven changes, ii) to contribute to the United Nations' Sustainable Development Goals (SDG 2, 8, 9, 12, 15) and iii) to support the realization of a truly safe and sustainable food production"

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ECO-READY project: Achieving Ecological Resilient Dynamism for the European food system through consumer-driven policies

Call: HORIZON-CL6-2022-CLIMATE-01-04 - Fostering the resilience of food security: from observation of changes to the development of resilience strategies

Coordinator: Czech University of Life Sciences (CZU)

Duration: 2022-2026

Partners: 19

Strategic objective: "to equip the European food system with the means to obtain the necessary resilient dynamism and consolidate food security for the European citizens through improving policy-making capacity, by understanding the interconnections between climate change, biodiversity, and food security"

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Conclusions

- Systems approach is needed to make our food production sustainable and to meet the United Nation’s Sustainable Development Goals
- Digitalization of farms and food supply chains is needed for such transition
- Drivers of change that directly and/ or indirectly have an impact of food production should be considered in a system approach
- Bayesian Network has proven a useful technology to integrate data from variety of drivers yielding models with high prediction accuracies

Thank you

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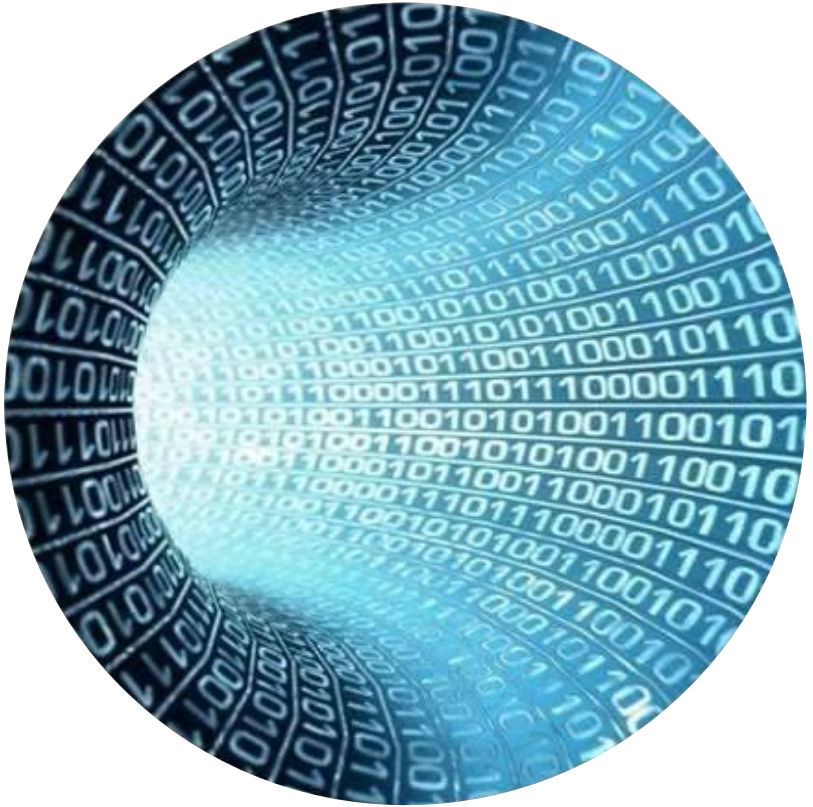

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