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Holistic assessment for food safety management

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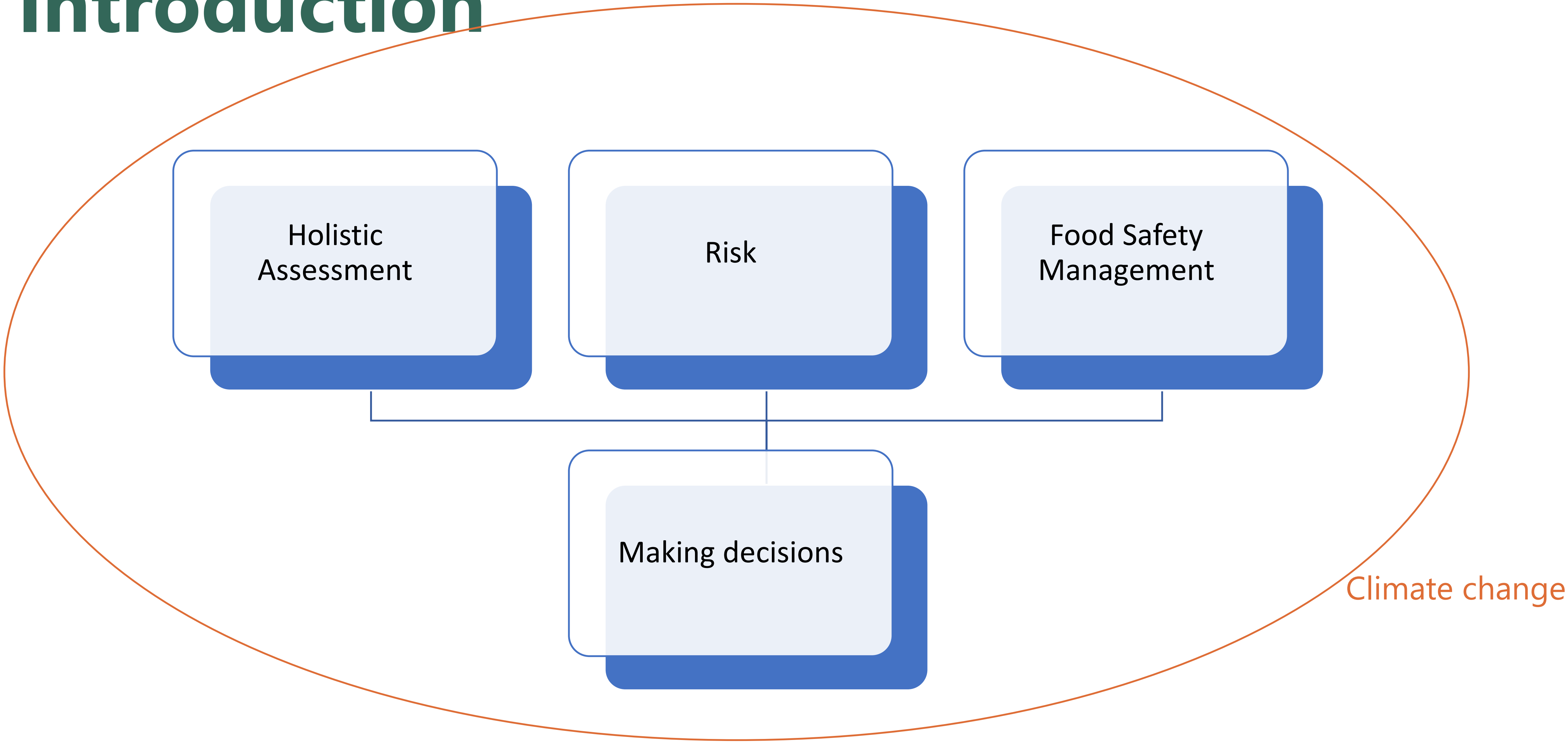
Introduction

Introduction



Holistic Assessment of food systems

- Assessing the impacts of food systems encompasses*:
  - the evaluation of the effects of its different elements and activities related to food production, processing, distribution, preparation, and consumption,
  - from an **economic, safety, health, social, and environmental** perspective

- The complexity of assessing food systems based on these several criteria results in increased complexity in regulatory decision-making*:
  - **focusing on single benefits for each of these criteria could lead to a multitude of conflicting goals**
  - for instance, one may want to control microbiological risks (safety goal) by applying more stringent thermal treatments which in return increase the energy demand (conflicting with the environment goal)

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* Országh et al., 2024, doi: 10.1016/j.gfs.2024.100802

Risk

- Risk analysis provides policy makers with the information and evidence they need for **effective and transparent decision-making**, contributing to better food safety outcomes and improvements in public health (FAO.org)

- Variability & uncertainty and their implication in decision making:
  - Variability refers to real and identifiable differences between individuals within a population addressed by the risk assessment. **The existence of variability in the population** implies that a single action or strategy may not emerge as optimal for each of the individuals, and consequently any **decision made will go too far for some and not far enough for others***
  - Uncertainty arises from our lack of perfect knowledge. **Uncertainty implies that we might make a nonoptimal choice** because we may expect one outcome but something quite different might actually occur*

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* Thompson, 2002, doi: 10.1111/0272-4332.00044

Food safety management

- Food safety
  - Food safety is a science-based discipline, process or action that prevents food from containing substances that could harm a person's health (FAO.org)

- Risk-based food safety management*
  - **Evaluation of risk management options** is the weighing of available options for managing a food safety issue in light of scientific information on risks and other factors…. **A cost-benefit analysis could be performed** at this stage

- Food safety and climate change
  - Climate change will affect agriculture, fisheries and livestock production, processing and distribution, storage at consumers'; the entire food system is impacting by climate change**
  - It is important to ensure that food supply chains and regulatory systems are better prepared to adapt to the **growing climate change impacts on food safety****

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* FAO/WHO, 2002

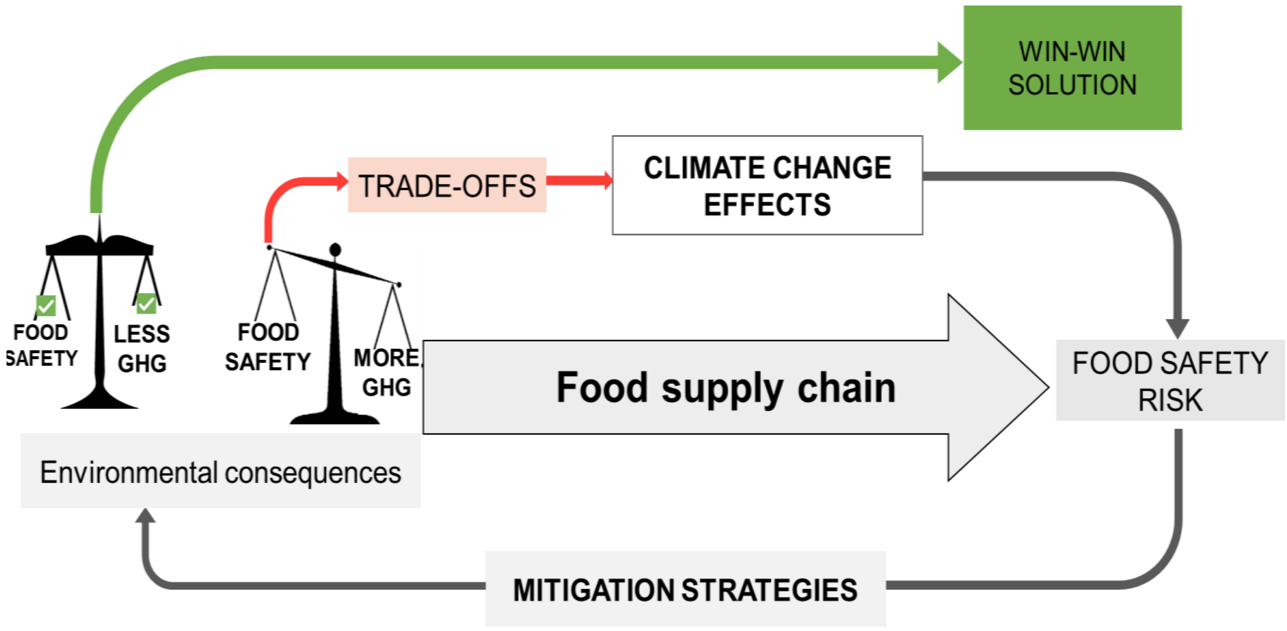
** FAO 2022

Climate change / the challenge

Climate change: illustration of the challenge

- Rising temperatures and their impact on chilled food storage (FAO, 2020):
  - An increase in ambient temperatures has an effect on all aspects of the cold chain, from the initial chilling or freezing of food, to transportation, storage and retailing.
  - Changes to the cold chain system will therefore be necessary as ambient temperatures rise.
  - However, this often implies an increase in the energy consumption of food refrigeration systems, and an increase in CO_2 emissions → which contributes to climate change.

Climate change / the challenge



http://www.protect-itn.eu/

From Feliciano et al., 2022, doi: 10.1016/j.tifs.2022.02.027

- **Consider environment and food safety when making decision!**
- In EU ITN PROTECT project
  - 2 dimensions
  - 1 supply-chain
- **In EU Holifood project**
  - **5 dimensions**
  - **3 supply-chains**

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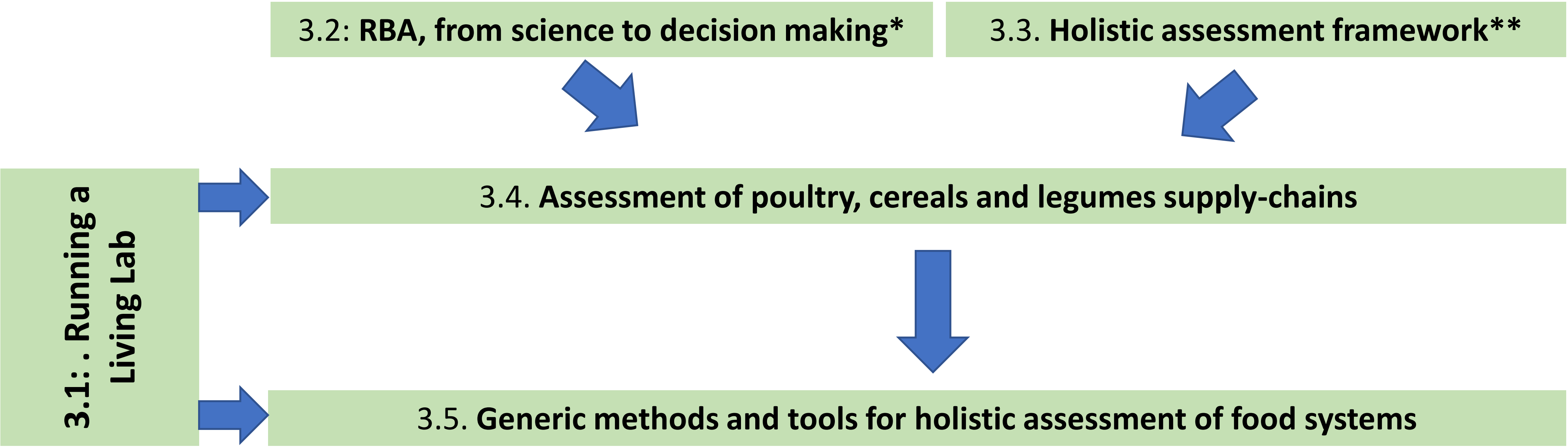
Holifood – WP3

Overall presentation

WP3: Holistic risk assessment for regulation

- Develop holistic risk assessment methods and tools to support regulation in a changing global environment.
  - Food safety risk were embedded in a comprehensive cost-benefit analysis of the food system including positive and negative health, environment and economic dimensions.
  - The approach was validated against poultry, cereals and legumes supply-chains to finally deliver proven, generic, holistic risk assessment methods and tools.

WP3 organisation



* De Matteu Monteiro et al., 2024, doi: 10.3389/fnut.2024.1458531

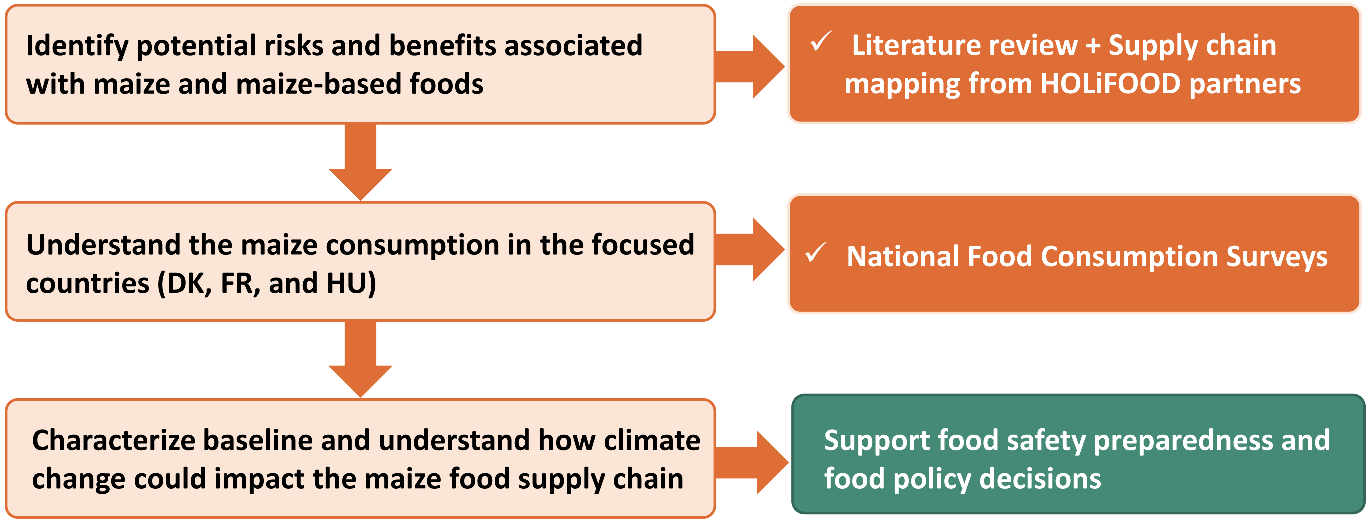
** Országh et al., 2024, doi: 10.1016/j.gfs.2024.100802

Maize supply-chain

Climate change effect – decision making

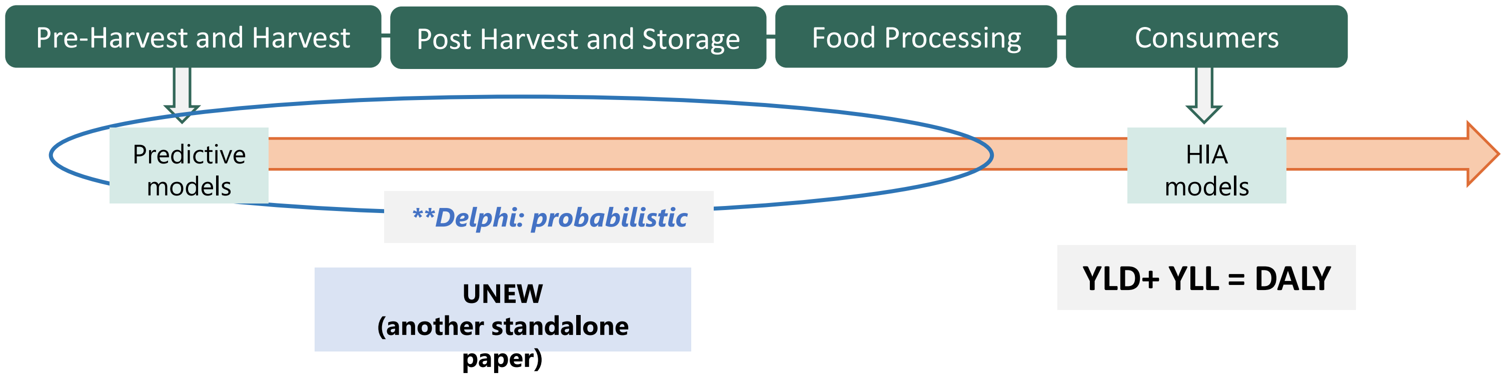
Maize

- Conduct a health impact assessment of maize incorporating a food supply chain perspective



Aflatoxin and climate change

- Build **farm-to-fork health impact assessment** (HIA) model based on existing knowledge and evidence.



- Develop a framework for assessing the health impacts of aflatoxin contamination attributable to maize consumption in France presently and in **future climate change scenarios**.
- Address uncertainties by incorporating *participatory forward-looking* components

De Matteu Monteiro et al. In preparation

Supporting regulation

- ✓ Quantify the potential health impacts of climate change on human health
- ✓ Uncertainty on future is unavoidable – but scenario analysis helps anticipate risks, support food safety preparedness and enable decisions that protect future population health

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Lentil supply-chain

Climate change effect – decision making

Lentil supply chain: Scenarios

- Drivers
  - Climate change → 2050 predictions
  - Diet transition → hypothetical 10% increase in consumption

Scenario	Name	Data Source
Sc.0	Baseline	*Status quo* in lentil production in France and Hungary
Sc 1	2050 production	2050 lentil production volume based on FAO lentil crop model
Sc 2	Import dependent 2050	2050 + 10% consumption (by import from Canada)
Sc 3	Local production dependent 2050	2050 + 10% consumption (by extra farming in EU)

SecAliM Food Safety & Microbiology INRAE Oniris

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Lentil supply chain: 5 dimensions, 16 indicators

	Dimension	Causative agent monitored	Endpoint/midpoint impact	Unit
1	**Microbial risk**	*L. monocytogenes*	Number of cases / year	**DALY**
		B. cereus	Number of cases / year	**DALY**
2	**Chemical risk**	Heavy metals (Cadium)	Incidence cases/yr	**DALY**
3	**Nutritional benefit**	Iron (Fe)	% contribution to total daily intake and comparison in DV	**ug/d or mg/d**
		Selenium (Se)		
		Zinc (Zn)		
		Reduction of IHD (*via lentil*)	Avoidable cases / year	**Averted DALY**
4	**Environmental impact**	Emissions and resources used	Global Warming Potential	**Kg CO_2 eq**
			Eutrophication potential	**kg PO_4-eq**
			Land use	**m^2/year**
			Acidification potential	**Kg SO_2 eq**
			Ozone layer depletion	**Kg CFC-11 eq**
5	**Economic impact**	Various factors	Price to farmers	**Euro/Kg**
			Price to consumers	**Euro/Kg**
			WTP	**Euro**
			Cost of Illness *(UVMB)*	**Euro**

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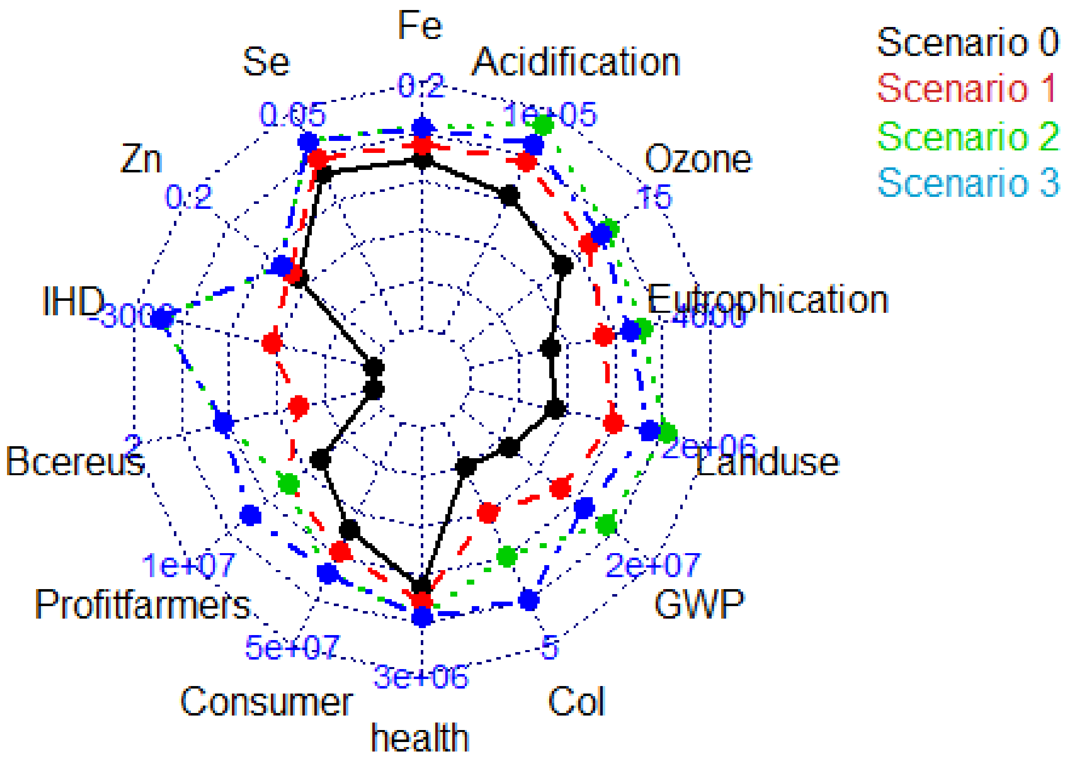
Lentil supply chain: holistic assessment



- **Key messages**
  - Scenario 1 higher than scenario 0, i.e. some risk indicators are getting higher in the future
  - Uncertainties in estimation relatively important (due to lack of data)

- **To inform decision**
  - For env and eco, scenario 3 better than scenario 2 (GWP, Profit farmers)
  - These first findings could be further analysed by aggregating results

Feliciano et al. Submitted

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Poultry supply-chain

Climate change effect – decision making

Poultry supply chain: Scenarios

- Drivers
  - Climate change → 2050 predictions

Scenario	Name	Data Source
Sc.0	Baseline	*Status quo* in poultry production in Denmark, France and Hungary
Sc 1	Climate 1	IPCC report SSP2- 4.5 (+ 2.7 ºC)
Sc 2	Climate 2	IPCC report SSP5-8.5 (+ 4.4ºC)

Poultry supply chain: 5 dimensions, 20 indicators

	Dimension	Causative agent monitored	Endpoint/midpoint impact	Unit
1	**Microbial risk**	*Campylobacter*	Number of cases / year	**DALY**
		Salmonella	Number of cases / year	**DALY**
2	**Chemical risk**	Dioxins	Incidence cases / year	**DALY rates**
		PFAs	Incidence cases / year	**DALY rates**
3	**Nutritional benefit**	Iron (Fe)	% contribution to total daily intake and comparison in DV	**ug/d or mg/d or g/ day**
		Selenium (Se)		
		B3		
		B6		
		B12		
		Total protein		
4	**Environmental impact**	Emissions and resources used	Global Warming Potential	**Kg CO_2 eq**
			Eutrophication potential	**kg P-eq**
			Land use	**m2*a crop-Eq**
			Water use	**m3**
			Acidification potential	**Kg SO_2 eq**
			Ozone layer depletion	**Kg CFC-11 eq**
			Human health	**DALY**
5	**Economic impact**	Various factors	Cost of illness	**Euro**

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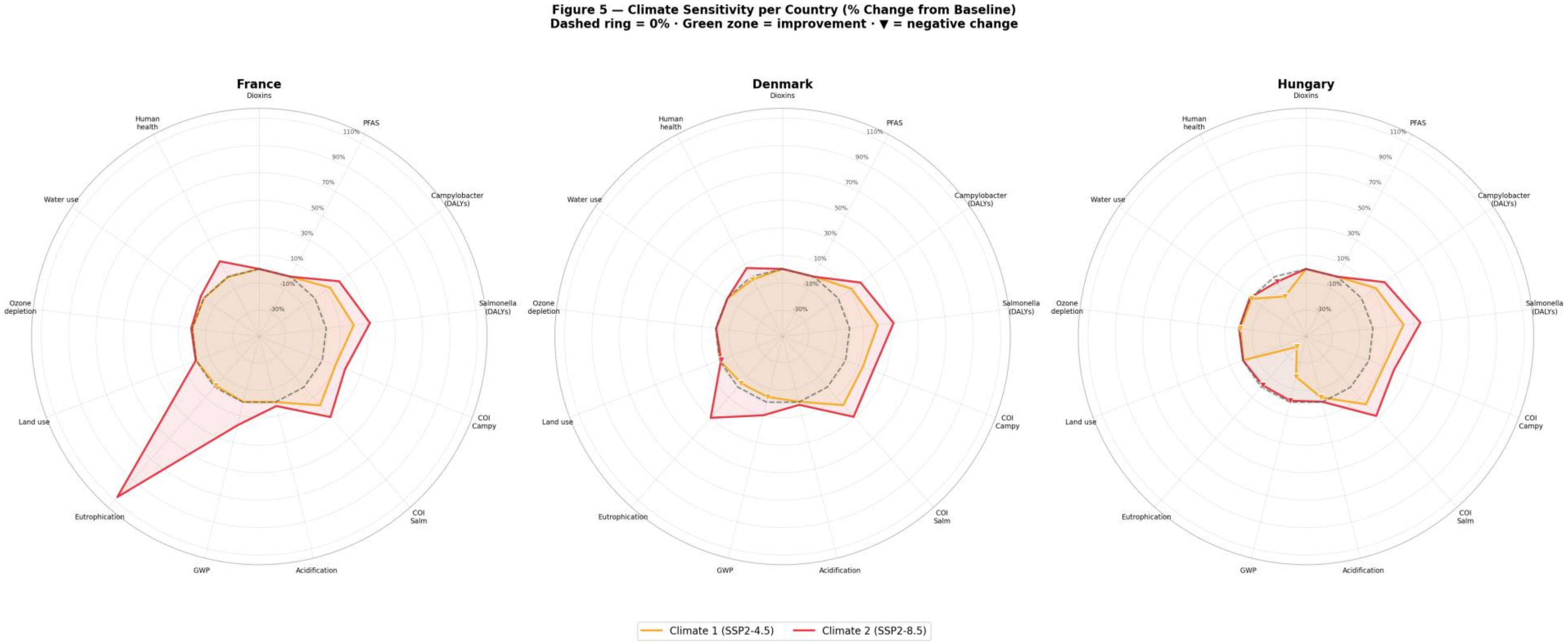
Radar plot

Climate sensitivity per country



- **Key messages**
  - Some indicators are getting higher in the future, including microbiological risks, cost-of-illness and some of the environmental impacts
  - Differences between the 3 countries
- **To inform decision**
  - For environment, scenario 1 is sometimes better than scenario 0 (e.g. Hungary: eutrophication, GWP)
  - These first findings could be further analysed by aggregating results

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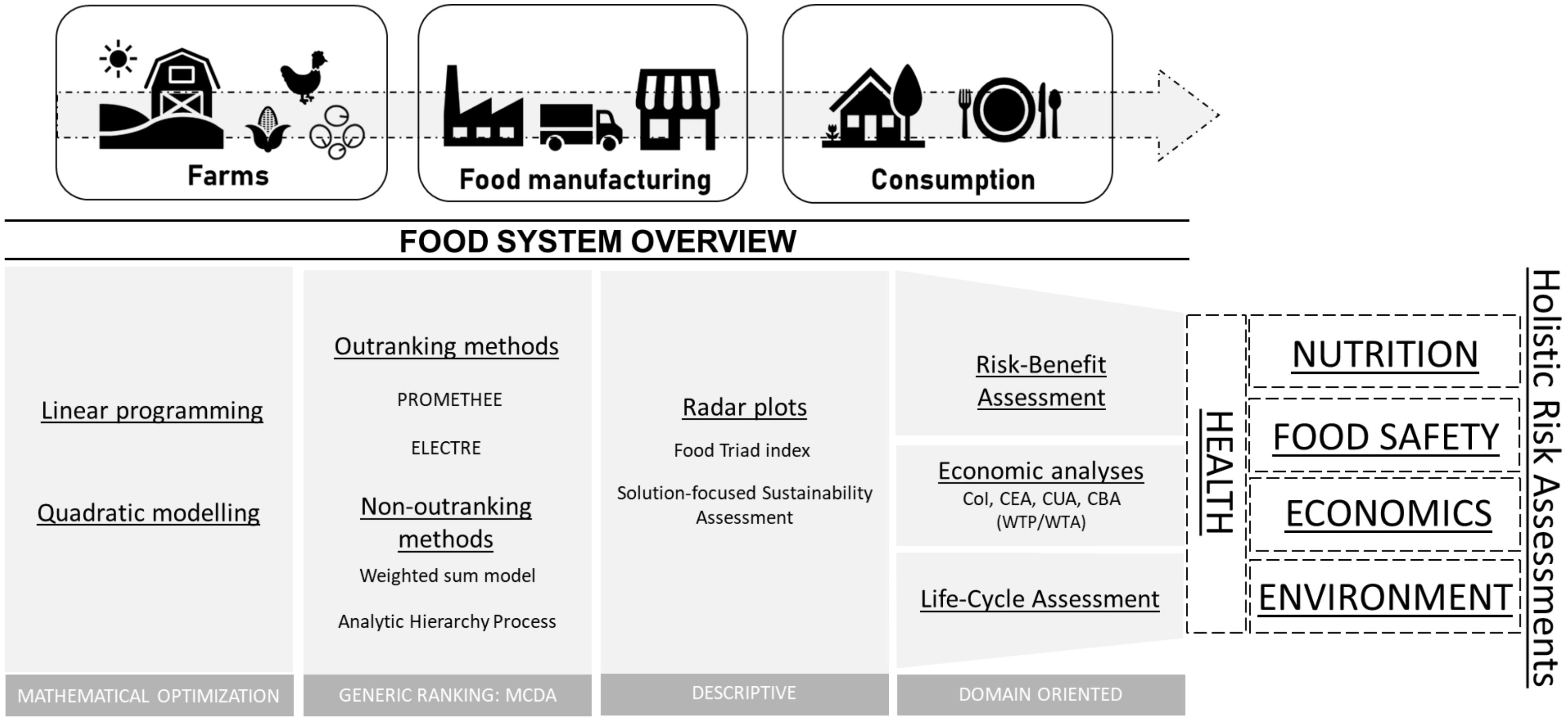
Conclusion

A comprehensive holistic assessment toolkit

Initial work: focus on methods



* Országh et al., 2024, doi: 10.1016/j.gfs.2024.100802

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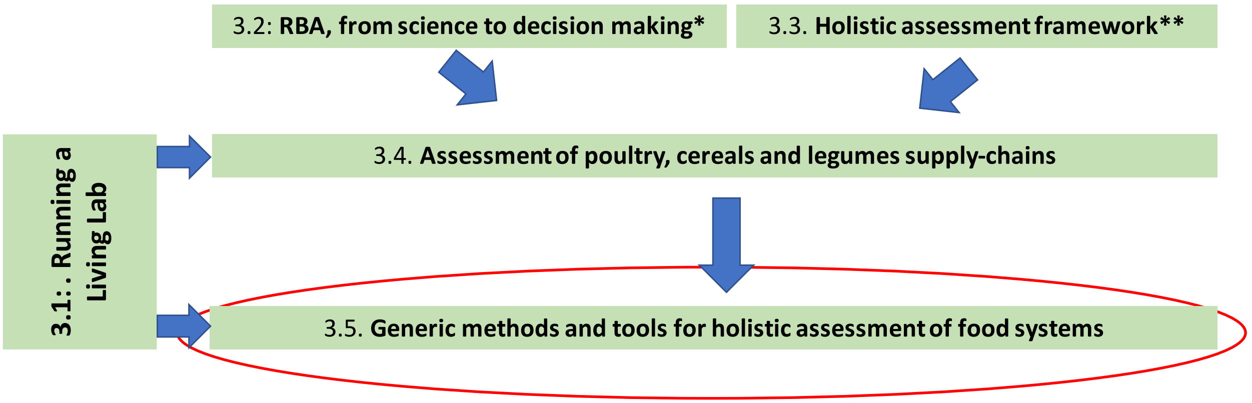
Final outputs: A comprehensive toolkit

- General framework, based on
  - holistic assessment methods
  - lessons learnt from the 3 case-studies
  - Extra inputs from the WP3 group (UNEW, WU, DTU, INRAE, UVMB)



Thank you!

Questions?

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