# Risk Negotiation – Integrated risk analysis for One Health

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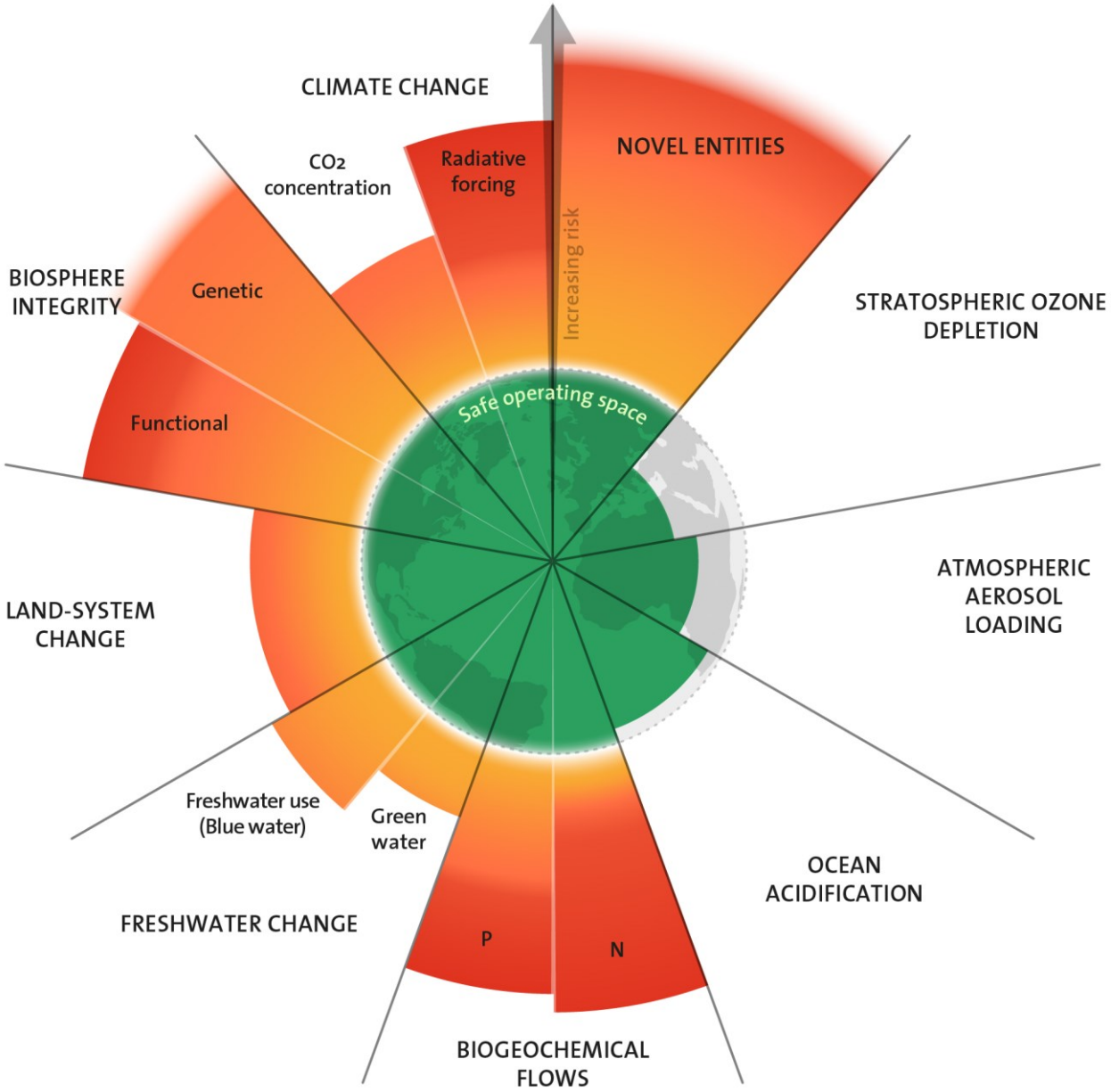
International Scientific Conference on “Global commodity chains from a risk assessment perspective”, BfR Berlin, May 29th, 2024

# Planetary Boundaries

6/9 boundaries are already crossed

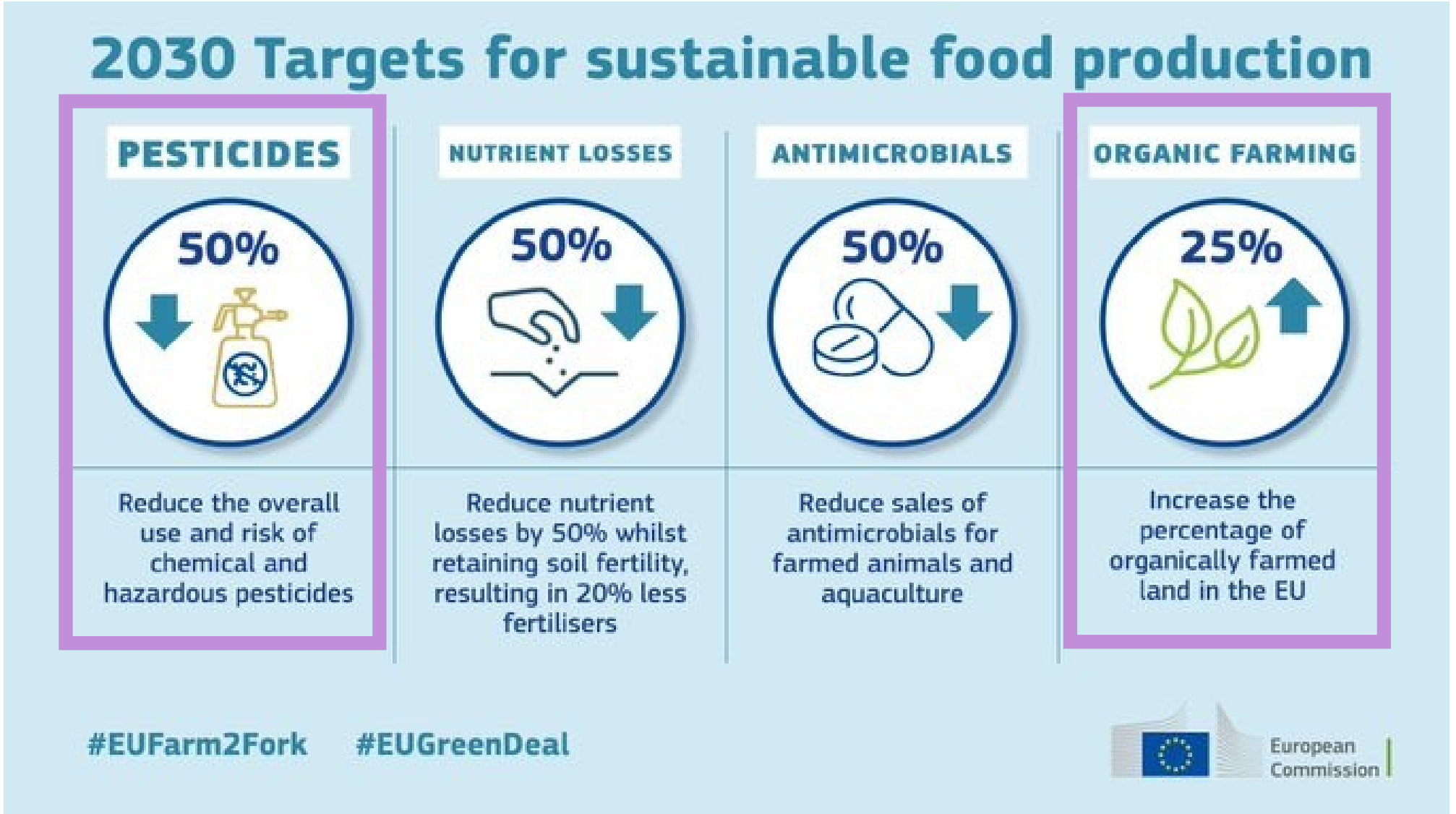
=> Transformation of agro-food systems needed




Azote for Stockholm Resilience Centre,
based on analysis in Richardson et al 2023

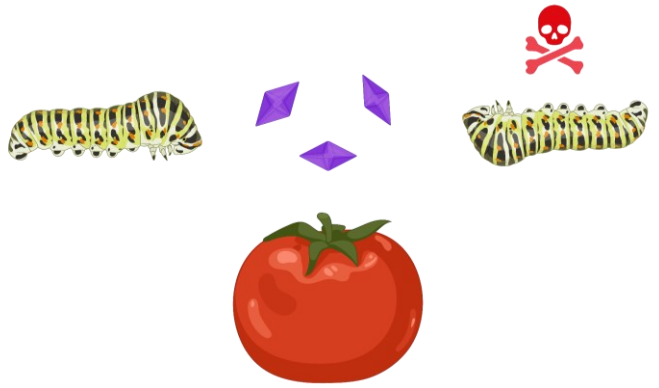
# United Nations SDGs & Agenda 2030

# EU Green Deal

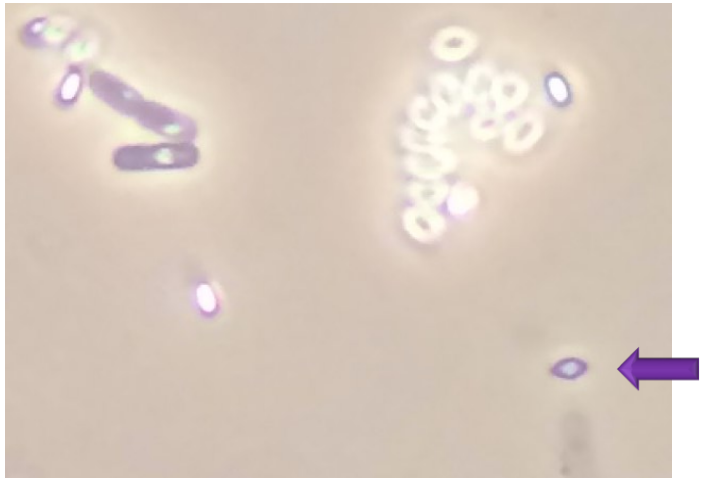


# Increased use of *Bacillus thuringiensis* biopesticides

- Most common biopesticide worldwide
  => forms insecticidal parasporal crystals



- EFSA scientific opinion[1]:
  Levels of *B. cereus* considered as a risk for consumers are also valid for *B. thuringiensis*




[1] EFSA BIOHAZ Panel. 2016. Risks for public health related to the presence fo *Bacillus cereus* and other *Bacillus* spp. Including *Bacillus thuringiensis* in foodstuffs. *EFSA J.*

# *Bacillus cereus* group

Members differ substantially in their ability to cause disease.

*B. thuringiensis*

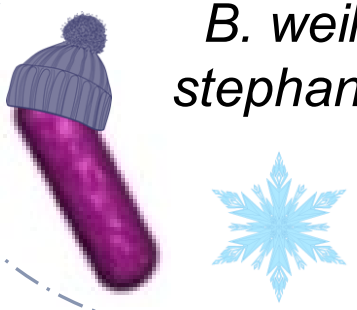
*B. anthracis*


*B. cytotoxicus*

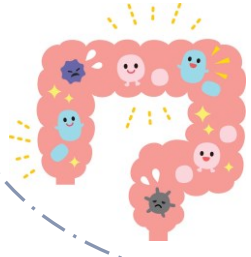
*B. cereus sensu stricto*

*B. (pseudo-) mycoides*

*B. weihen-stephanensis*



*B. toyonensis*



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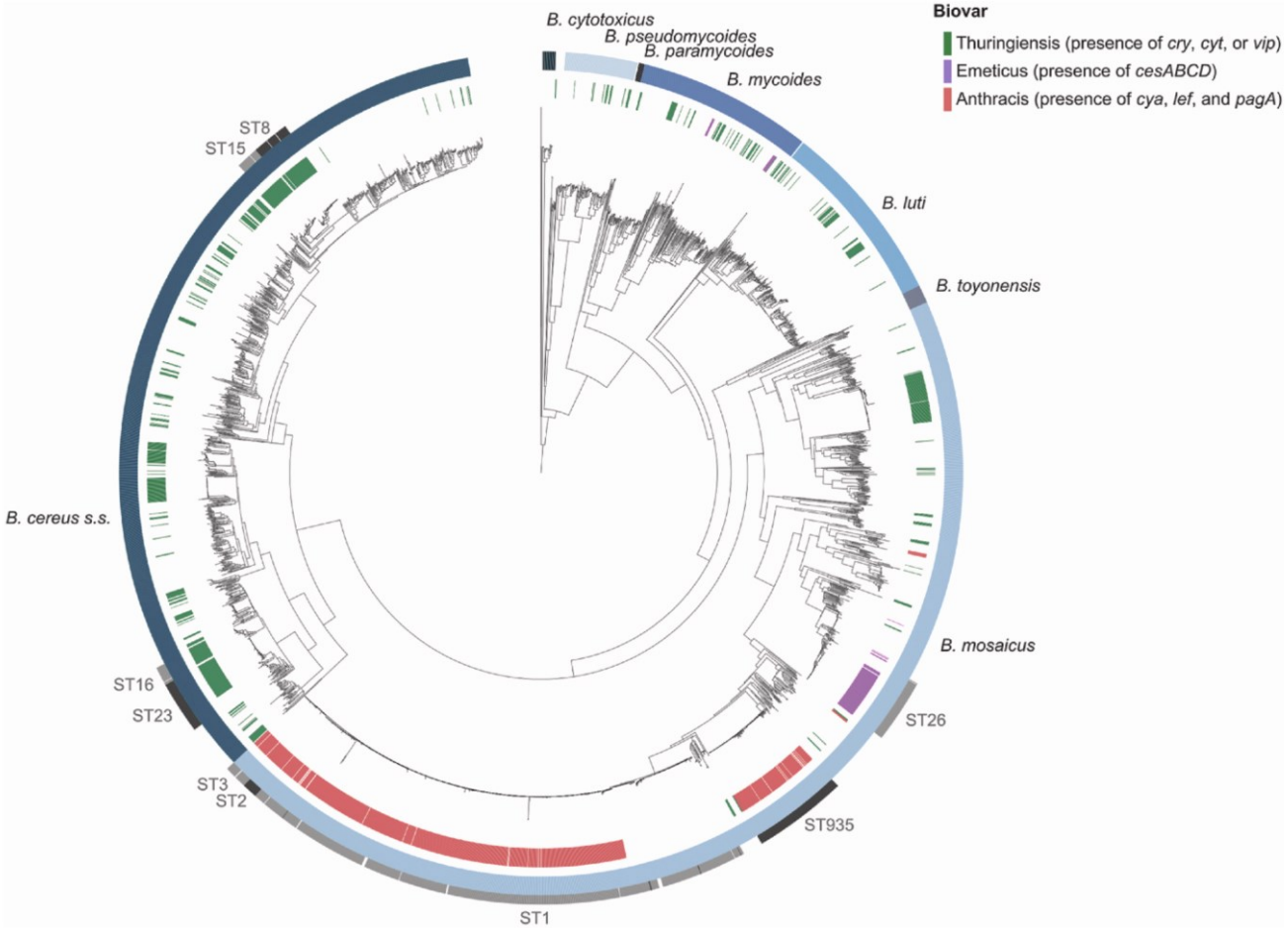
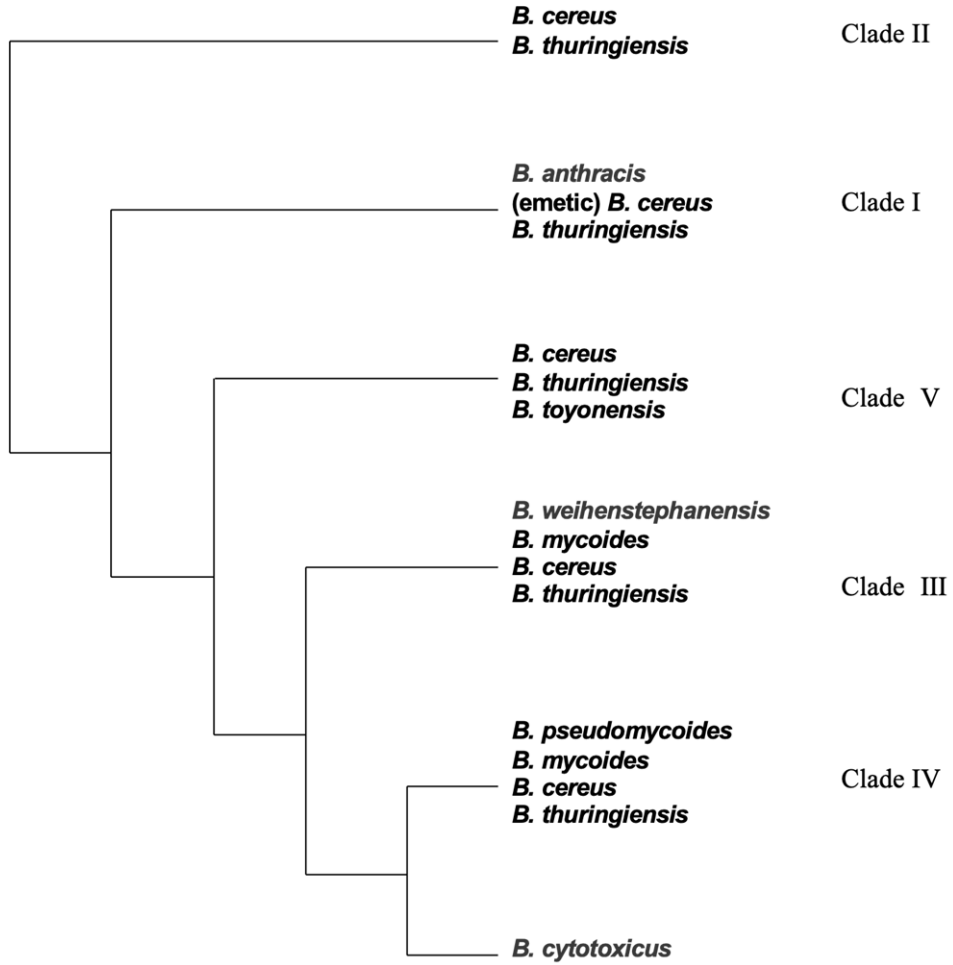
# Population structure of *B. cereus s. l.*



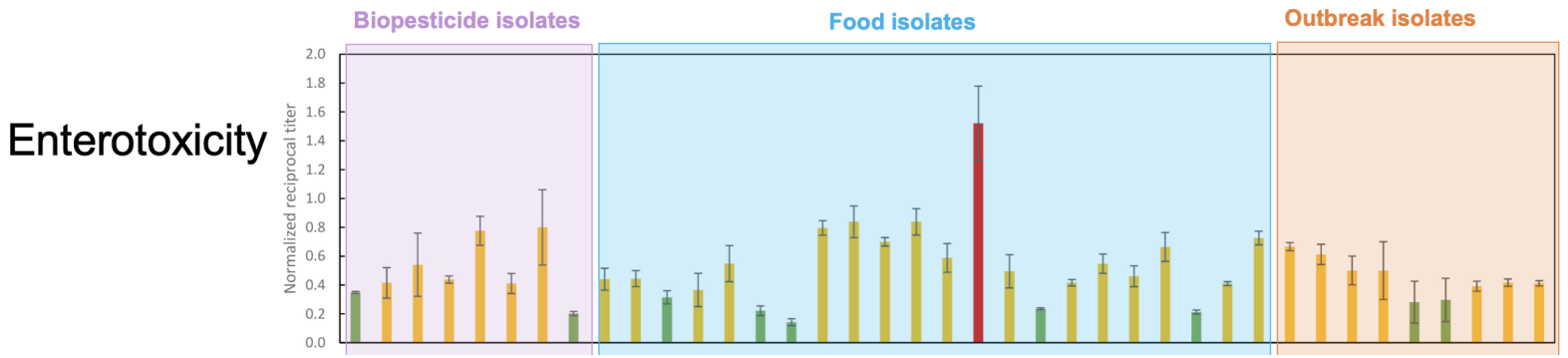





1) M. Biggel, N. Jessberger, J. Kovac, S.Johler. 2022. Food Microbiology
2) M. Ehling-Schulz, T.M. Koehler, D. Lereclus.. 2019. Microbiology Spectrum

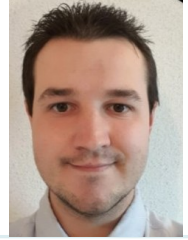
# Cause for concern?

- *Bacillus thuringiensis* strains can multiply in food[1]
- Biopesticide strains express enterotoxins[2]
- Biopesticide strains were linked to cases of foodborne diarrheal disease based on phenotypic profiles (incl. FT-IR data)[2] and WGS[3]




[1] N. Heini et al. 2020. Temperature-dependent growth characteristics of *Bacillus thuringiensis* in a ratatouille food model. *J. Food Prot.*
[2] S. Johler et al. 2018. Enterotoxin production of *Bacillus thuringiensis* isolates from biopesticides, foods, and outbreaks. *Frontiers in Microbiology*
[3] M. Biggel et al. 2022. Whole genome sequencing reveals biopesticidal origin of *Bacillus thuringiensis* in foods. *Front. Microbiol.*

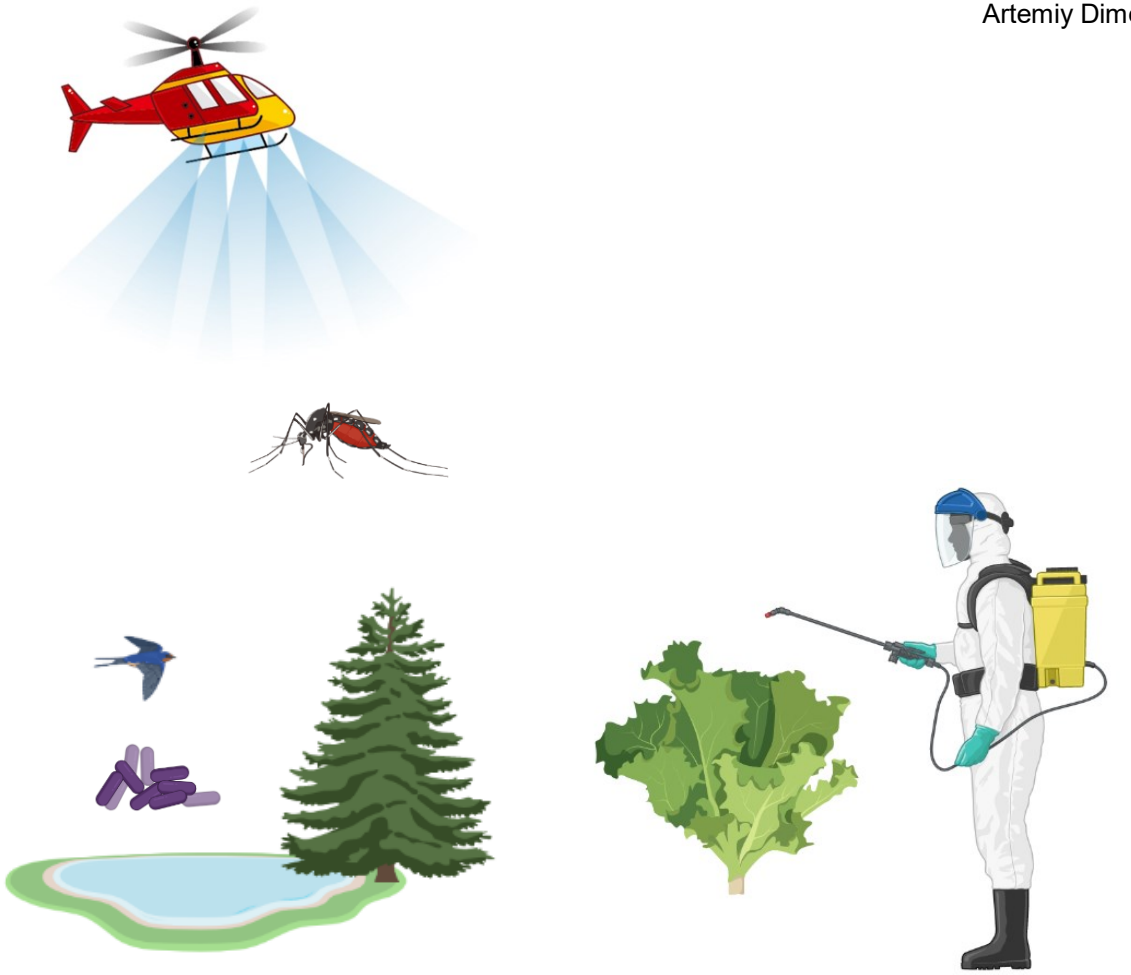
# Spillover of *Bt* from vector control to food?



Artemiy Dimov

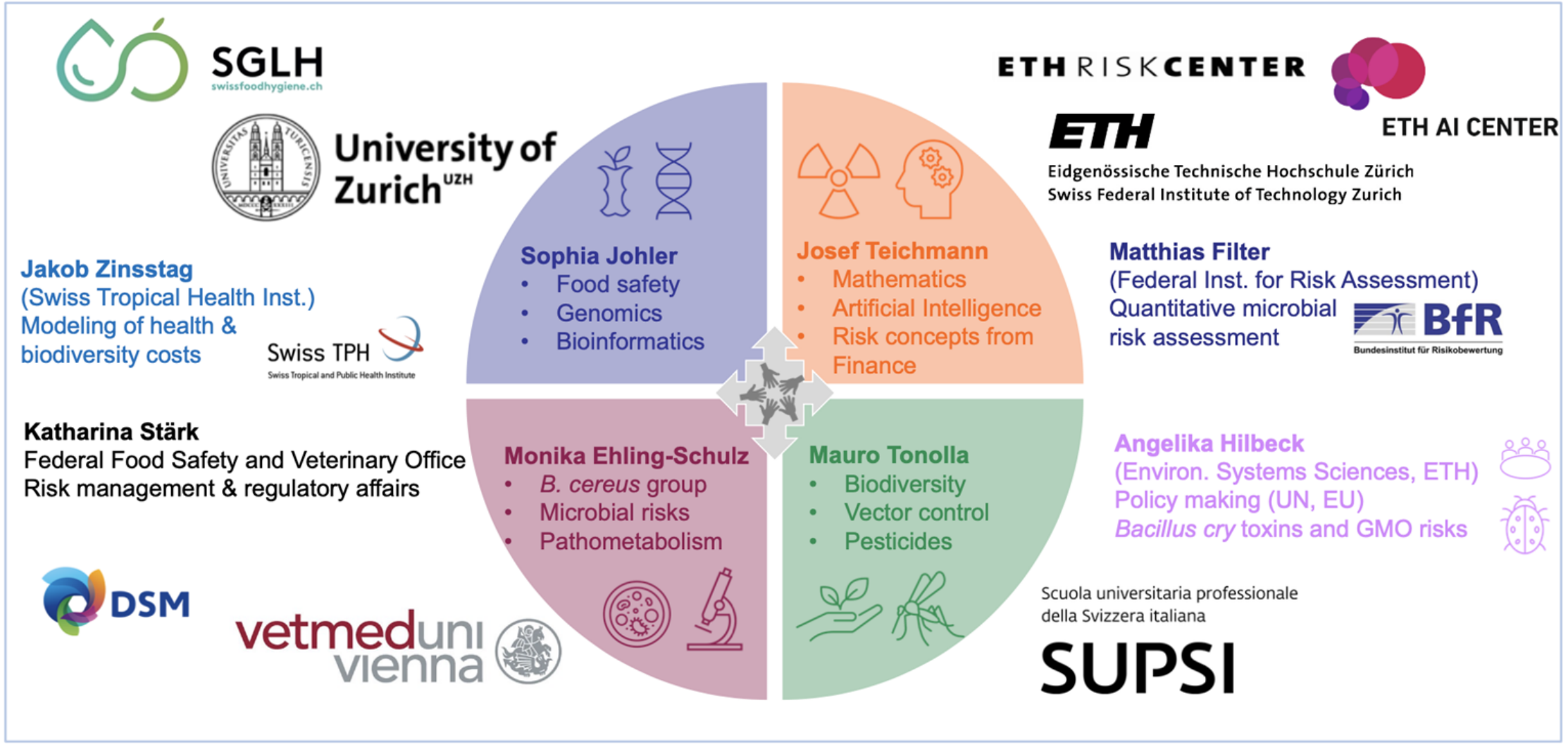
## Spillover Modeling

- Use of *Bt* in mosquito control
- Example:
  - Helicopter spraying of Natural Reserve Bolle di Magadino
  - Treatments started 20 years ago



# MicRISK Consortium

MicRISK



# Objective

Improve the currently used classical microbial risk analysis framework to meet the challenges of future food systems as part of a circular economy.

=> Using the *B. cereus* group as a model, develop an overarching risk analysis scheme enabling FBOs, policy makers and risk managers to minimize food waste while protecting human health, biodiversity, and ecosystems.

# Traditional framework for microbial risk analysis

# Drawbacks

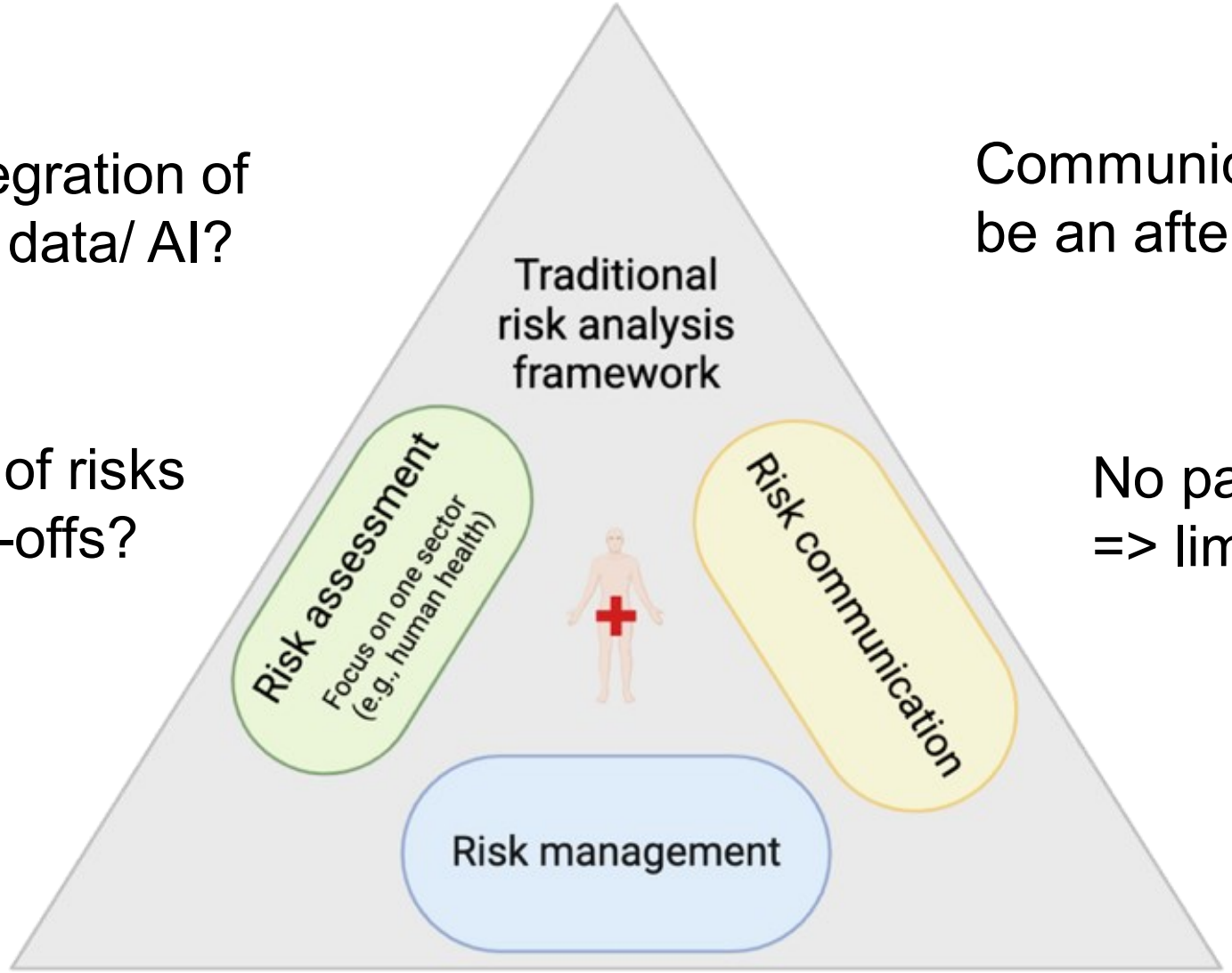
Integration of big data/ AI?

Communication can be an afterthought

Valuation of risks and trade-offs?

No participatory process => limited buy-in

Silos



# MicRISK Sounding Board

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M. Ellouze
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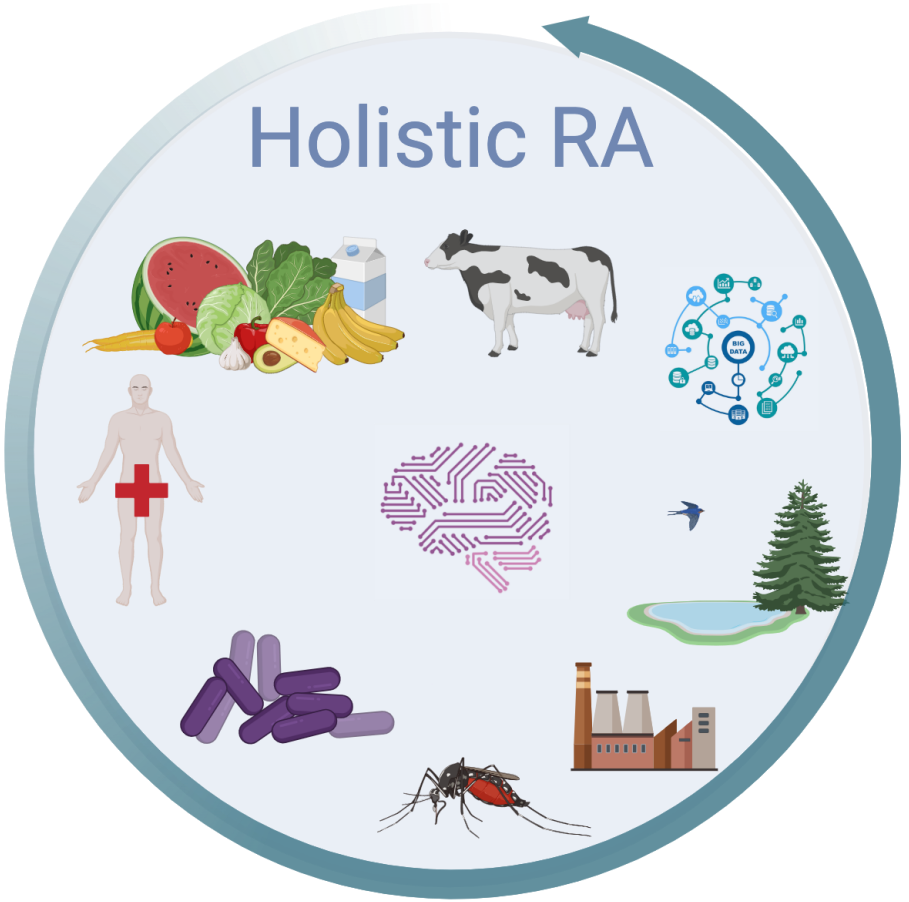
(Univ. of Thessaloniki)

K. Stärk
(Food Safety & Vet. Office)

M. Wiedmann
(Cornell Univ.)

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Angelika Hilbeck
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Matthias Filter
BfR

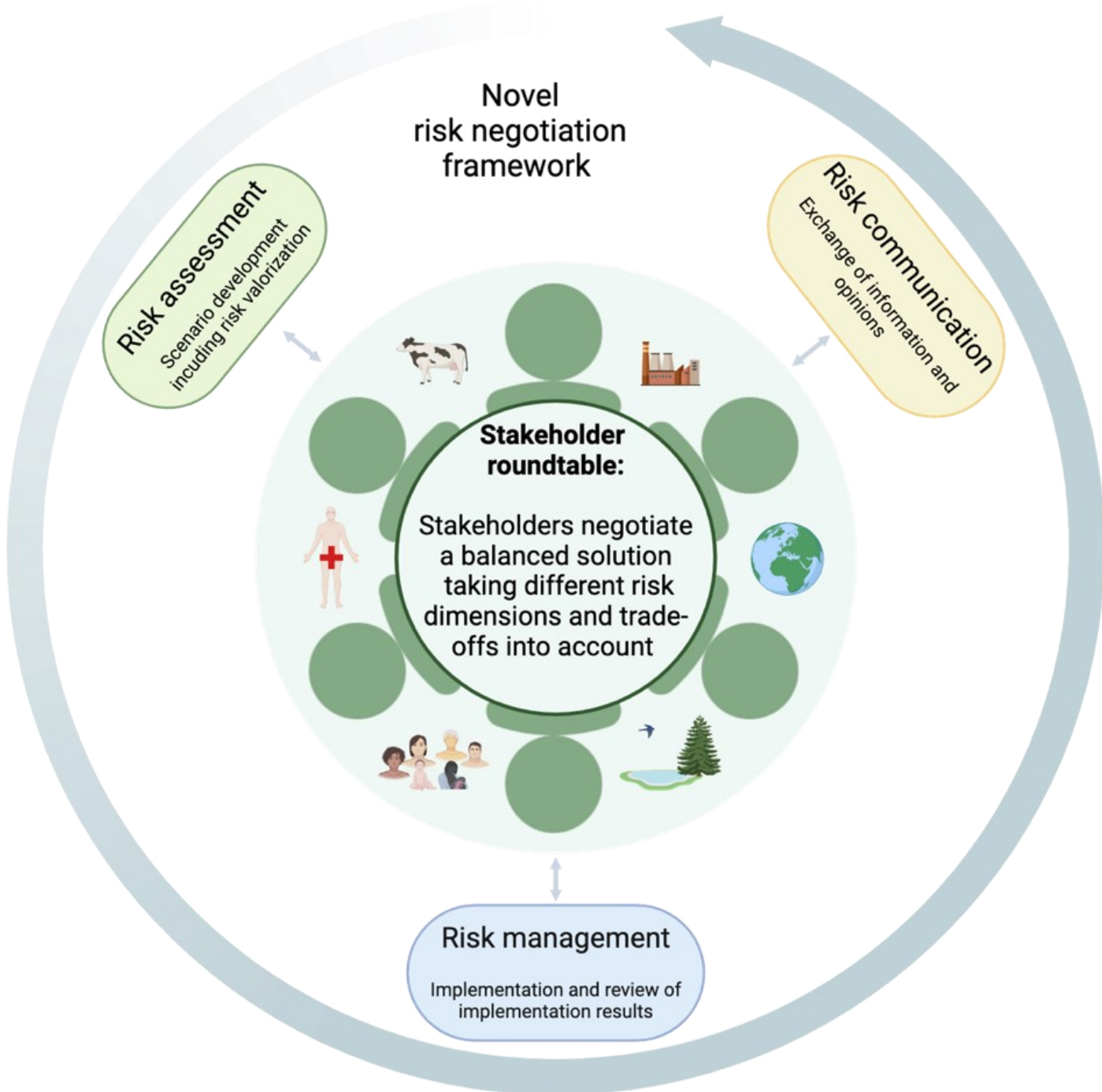
Prof. Jakob Zinsstag
Swiss Tropical Public Health Inst.

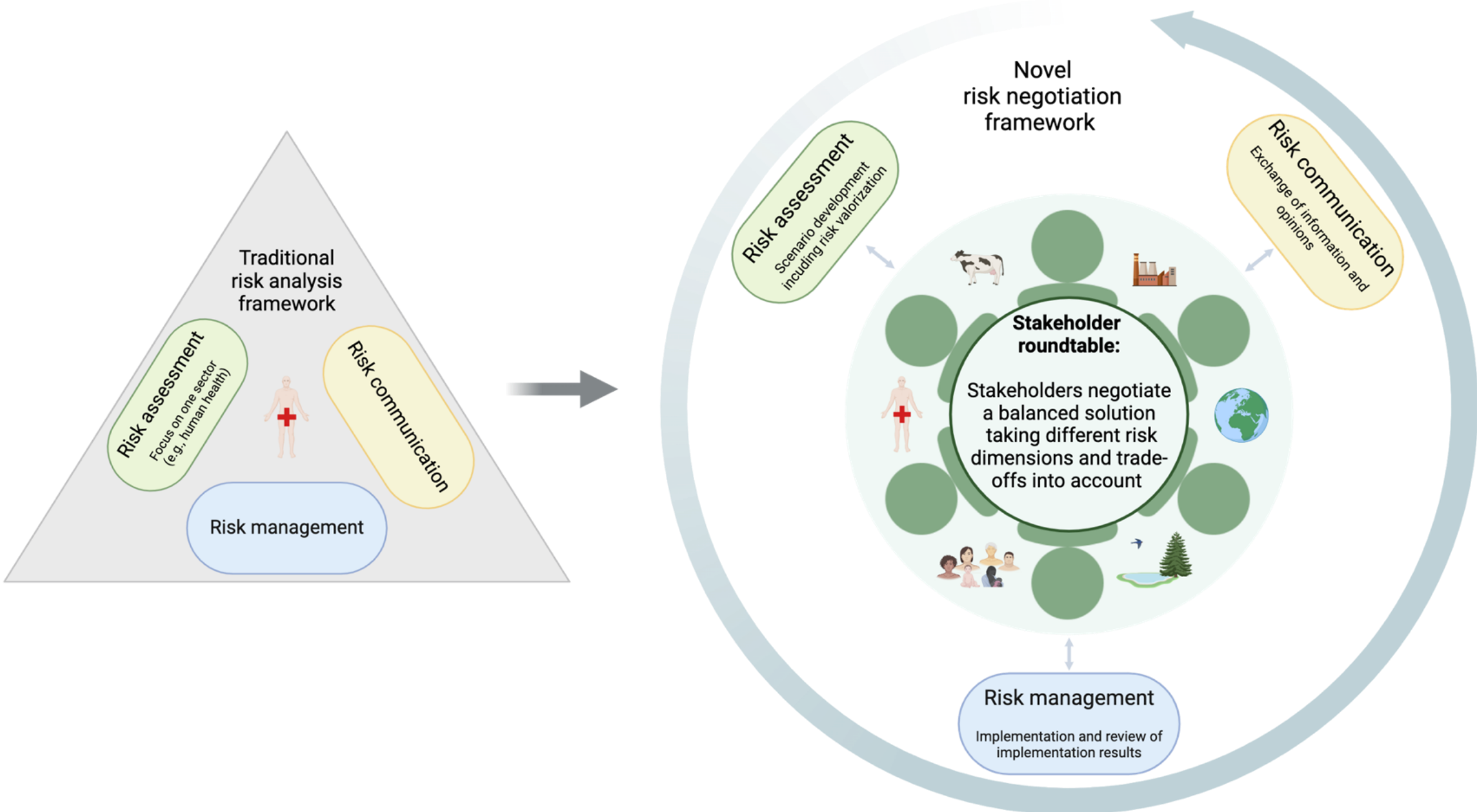
# Bigger picture

How could a novel overarching risk analysis framework look like that takes into account risks and trade-offs from multiple sectors?

Characteristics of a novel risk analysis framework:

- Participatory and interdisciplinary
- Valuation of risks
- Big data & AI enabled


Novel
risk negotiation
framework
Risk assessment
Scenario development incuding risk valorization
Risk communication
Exchange of information and opinions
Stakeholder roundtable:
Stakeholders negotiate a balanced solution taking different risk dimensions and trade-offs into account
Risk management
Implementation and review of implementation results


Traditional
risk analysis
framework
Risk assessment
Focus on one sector
(e.g., human health)
Risk communication
Risk management
Novel
risk negotiation
framework
Risk assessment
Scenario development
incuding risk valorization
Risk communication
Exchange of information and
opinions
Stakeholder
roundtable:
Stakeholders negotiate
a balanced solution
taking different risk
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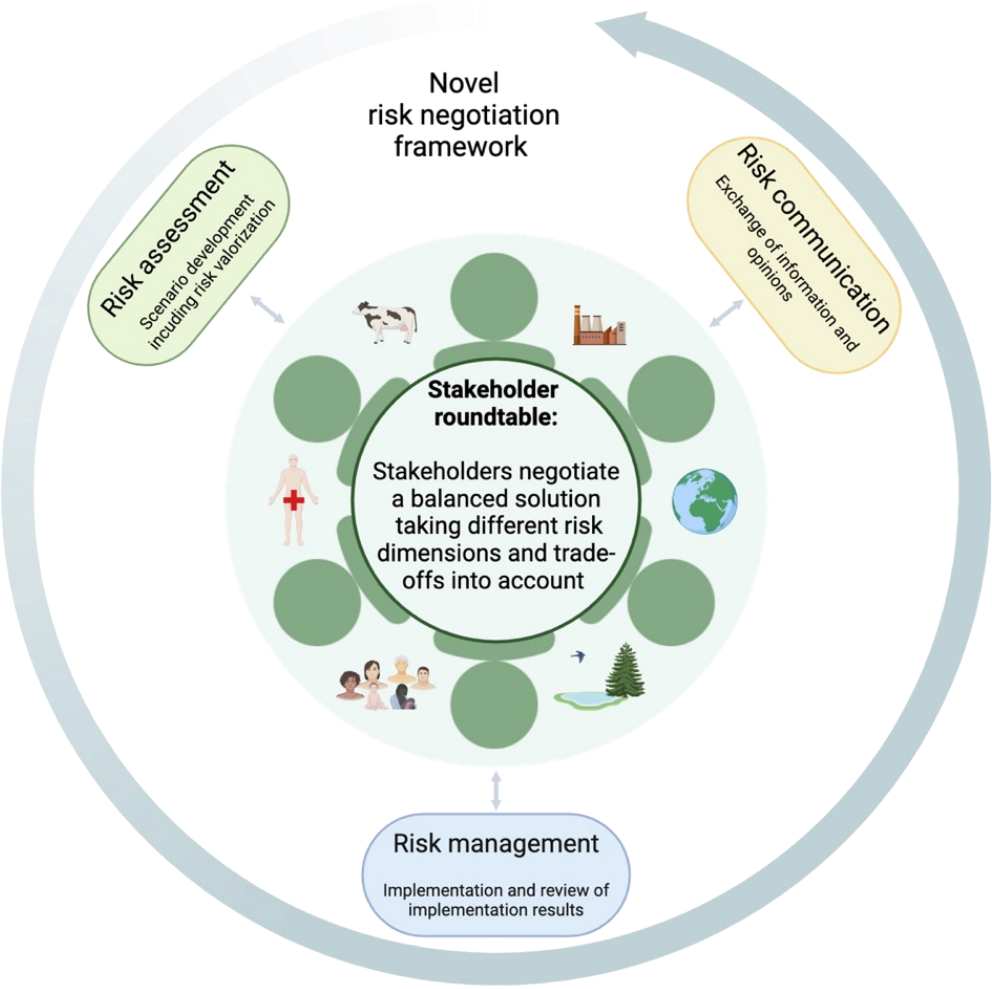
Risk management
Implementation and review of
implementation results

# Risk Negotiation

Steps

1) Establishment of stakeholder roundtable
2) Problem formulation
3) Risk assessment and valuation
4) Risk negotiation
5) Communication and implementation
6) Outcome evaluation and risk re-negotiation



# Risk Negotiation

**Steps**

1) Establishment of stakeholder roundtable
   => Could be done following OECD guidelines
2) Problem formulation
   => could be aided by LLMs
   => containing LLMs in protected environments (e.g. using open source LLMs from Huggingface) can aid in overcoming privacy concerns
3) Risk assessment and valuation
   => Risk assessors undertake a multi-dimensional, evidence-based risk assessment and consider different action options and trade-off analyses.

# Risk Negotiation

**Steps**

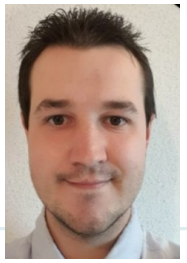
4) Risk negotiation
=> Agent-based risk negotiation
=> AI can
    i) serve as artificial stakeholder or mediator
    ii) suggest decisions to the roundtable stakeholders by identifying equilibria of maximized benefits and minimized risks
    iii) simulate the consequences of decisions (for individual stakeholders or the entire roundtable) and devise actionable solutions by using a human-in-the-loop approach

5) Communication and implementation

6) Outcome evaluation and risk re-negotiation

# Acknowledgments


Alex Fetsch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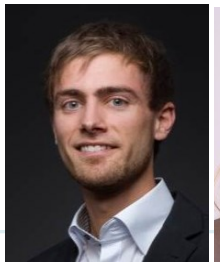
Danai Etter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**MicRISK Team**

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Katharina Stärk (BLV)

Josef Teichmann & Angelika Hilbeck (ETH)

Mauro Tonolla (SUPSI/ University of Geneva)

Martin Wiedmann (Cornell University)

Jakob Zinsstag (Swiss Tropical Public Health Institute)

**Institute for Food Safety and Hygiene (UZH)**

Roger Stephan & ILS Team

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Universität Zürich

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