



UNIVERSITÉ
LAVAL

Faculty of Agriculture
and Food Sciences

Identifying and Addressing Emerging Food Safety Issues

*Drivers of Change Impacting Food Safety and
Security*

Prof. Samuel Godefroy, Ph.D. | *Food Risk Analysis and Regulatory Policies, Université Laval, Canada*

Identified Drivers of Change

1. Growing world population to reach 9.6 Billion by 2050.



Identified Drivers of Change (2)

2. Scarce resources that support food and agrifood production – E.g. less water resources

- ❑ Climate change impacting conditions of production and introducing emerging contaminants.
- ❑ Pressure on production Systems
- ❑ Drivers of Innovation: including to encourage sustainable food production systems
 - *More resistant crops.*
 - *Reliance on recycling.*



3. Introducing sustainability in planning of resources:

- ❑ Identification of new sources of food: diversification of protein sources
 - E.g. new plant-based proteins are becoming more heavily used in food production to respond to consumer interests in such legumes.
 - E.g. new animal-based protein sources such as insects.
- ❑ Innovative food processes are being developed using disruptive technologies such as High-Pressure Processes or Pulsed Light Technology / Pulsed Electric Field Treatment.



Identified Drivers of Change - Conclusion

***ALL THESE APPLICATIONS NEED TO BE BETTER UNDERSTOOD
AND EVALUATED FOR SAFETY AND EFFICACY,
LEADING TO NEW REQUIREMENTS IN FOOD STANDARDS
DEVELOPMENT REGIONALLY AND GLOBALLY***

***RANKED FOOD RELATED ISSUES
DRIVING CHANGE
EU PERSPECTIVE***



Excess Body Weight

The #1 food-borne public health concern in Europe!

- ❑ Besides physical inactivity and harmful alcohol use, **obesity** is clearly linked to unhealthy diet (WHO 2011)
- ❑ **One third** of the European children of 11 years of age are either overweight or obese (WHO 2018) => responsible for **2–8% of the health costs**
- ❑ Increasing obesity is linked to **higher consumption of “fast-food”** high in fat, sugar and salt
- ❑ Such diets lead to a lowered Intake of vitamins and minerals and cause hidden hunger, as individual physiological needs for micronutrients are not fulfilled.

FOOD SECURITY ISSUE!



Contamination of Food by Microbial Agents

The 2nd most important food-borne public health concern in Europe!

□ In the **EU-27**, microbiological contaminations count for

- **>95%** of national food safety violations
- and 37% of **RASFF** notifications.

□ Multiple outbreaks occur annually in the EU making millions of people ill

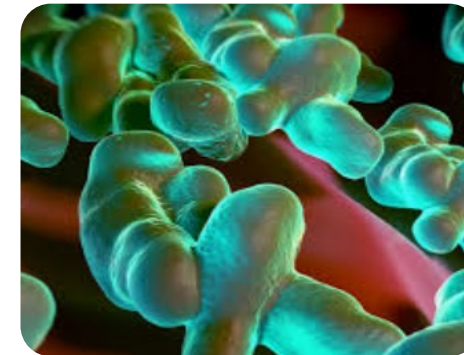
- 200 000 food-borne human poisoning outbreaks due to **Campylobacter**
- 90 000 due to **Salmonella**
- 2 000 due to **Listeria monocytogenes**

But also outbreaks reported due to

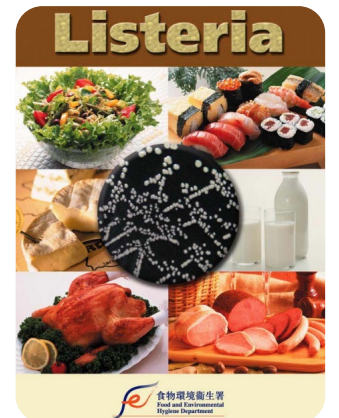
- Toxin producing **Bacillus cereus & Escherichia coli**
- **Viruses**, such as **Calicivirus** (including norovirus), **Hepatitis A and E**



ehai.ie



efsa.europa.eu

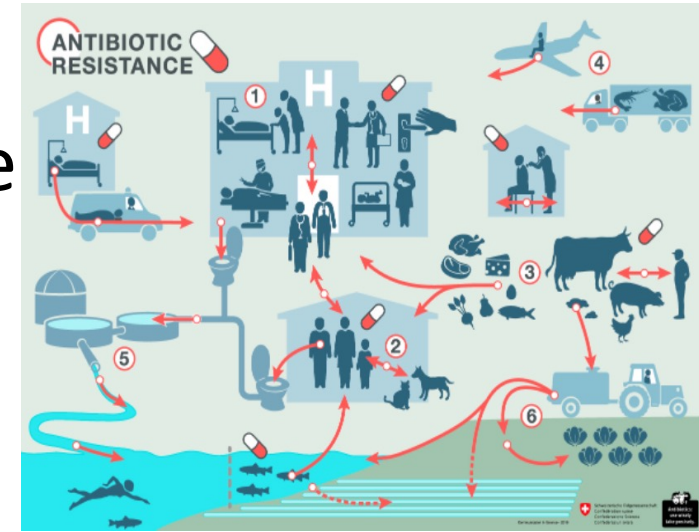


cfs.gov.hk

Microbial Risk Emergence

❑ **Unqualified use of drugs and natural occurrence of antimicrobial traits** triggered by globalized trade and climate change:

- Are drivers for the emergence of **transferable AMR genes** → **inactivating** highest priority antimicrobials (e.g. carbapenems)



bag.admin.ch

❑ Bacteria from humans and animals show **increasing resistance to antimicrobials** incl. multidrug-resistance

❑ WHO has estimated that **25,000 EU-citizens die per year** due to AMR



Towards a dietary-exposome assessment of chemicals in food: An update on the chronic health risks for the European consumer

Mari Eskola^a, Christopher T. Elliott^b, Jana Hajšlová^c, David Steiner^a, and Rudolf Krska^{a,b}

Table 1. Chemical contaminants that pose potential health risks for the average adult European consumers from the chronic dietary exposure and their critical adverse health effects.

Chemical contaminant	Critical adverse health effect	Reference
Lead	Chronic kidney disease	EFSA 2010b
Cadmium	Kidney dysfunction	EFSA 2009d
Arsenic	Lung, urinary bladder and skin cancer, skin lesions	EFSA 2009c, 2014b
Nickel	Reproductive and developmental effects	EFSA 2015c
Dioxins and dl-PCBs	Impaired sperm quality	EFSA 2018g
PBDE (BDE-99)	Neurodevelopment	EFSA 2011a
PFOS, PFOA	Increased serum cholesterol	EFSA 2018h
Acrylamide	Carcinogenic effects	EFSA 2015a
Furan and methylfurans	Liver damage, liver cancer	EFSA 2017c
Ethyl carbamate	Lung cancer	EFSA 2007a
Aflatoxins	Human liver cancer	EFSA 2007b, JECFA 2017
Pyrrolizidine alkaloids	Liver cancer	EFSA 2011i, 2017i
Mineral oil hydrocarbons	Carcinogenic effects, liver microgranulomas	EFSA 2012h

An Attempt to Address: FoodSafeR

A joined-up approach to the identification, assessment and management of **emerging Food Safety Hazards and Associated Risks** (FoodSafeR)



FoodSafeR
EVERYBODY'S BUSINESS



Rudolf KRSKA and Martin Wagner

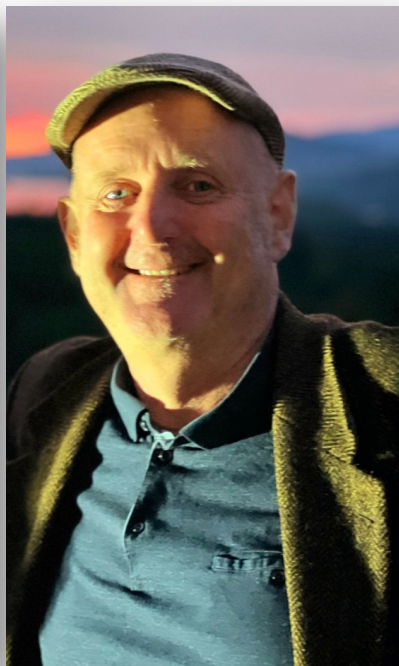
Austrian Competence Center for Feed & Food Quality, Safety and Innovation
FFoQSI

FoodSafeR

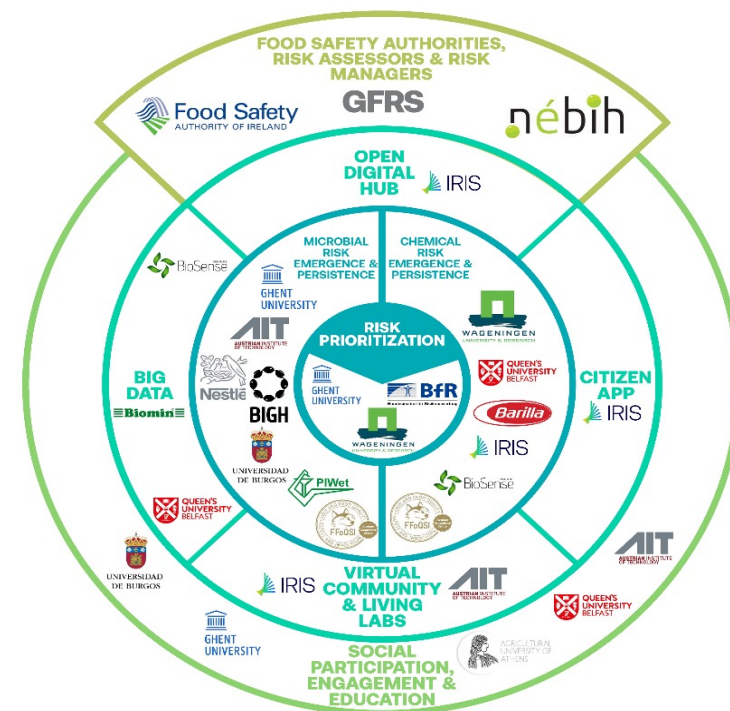


HE-CL6-2021-F2F_01-16

A JOINED-UP APPROACH TO THE IDENTIFICATION, ASSESSMENT AND MANAGEMENT OF EMERGING **FOOD SAFETY HAZARDS AND ASSOCIATED **RISKS (FOODSAFER)****



Coordinating institution: **FFoQSI**
 Coordinators: **Martin Wagner & Rudolf Krška**
 Funding volume: **5.6 Mio Euro**





A JOINED-UP APPROACH TO THE IDENTIFICATION, ASSESSMENT AND MANAGEMENT OF EMERGING **FOOD SAFETY** HAZARDS AND ASSOCIATED **RISKS** (FOODSAFER)



Driving Forces Shaping Future Food Systems



A JOINED-UP APPROACH TO THE IDENTIFICATION, ASSESSMENT AND MANAGEMENT OF EMERGING **FOOD SAFETY** HAZARDS AND ASSOCIATED **RISKS** (FOODSAFER)



DRIVING FORCES SHAPING FUTURE FOOD SYSTEMS

SEVERAL EXTERNAL FACTORS ARE DRIVING STRUCTURAL CHANGES IN THE FOOD SYSTEM, PRESENTING OPPORTUNITIES & CHALLENGES FOR FOOD SAFETY, AS WELL AS OTHER INTER-RELATED ASPECTS, SUCH AS SUSTAINABILITY, AFFORDABILITY, NUTRITION & INCLUSIVENESS.



FoodSafeR future-oriented Food Safety Hazard Management based on multi-criteria risk assessment for safer food:
 Co-benefits: consumer health and wellbeing, climate (mitigation and adaptation), environmental sustainability & circularity, dietary shift, sustainable healthy nutrition, food poverty reduction & empowerment of communities, and thriving businesses.

FoodSafeR Advisory Board

22 Members of the FoodSafeR Advisory Board representing EU and global multi-actors:



Liaising with EU projects:



PHOTON
FOOD

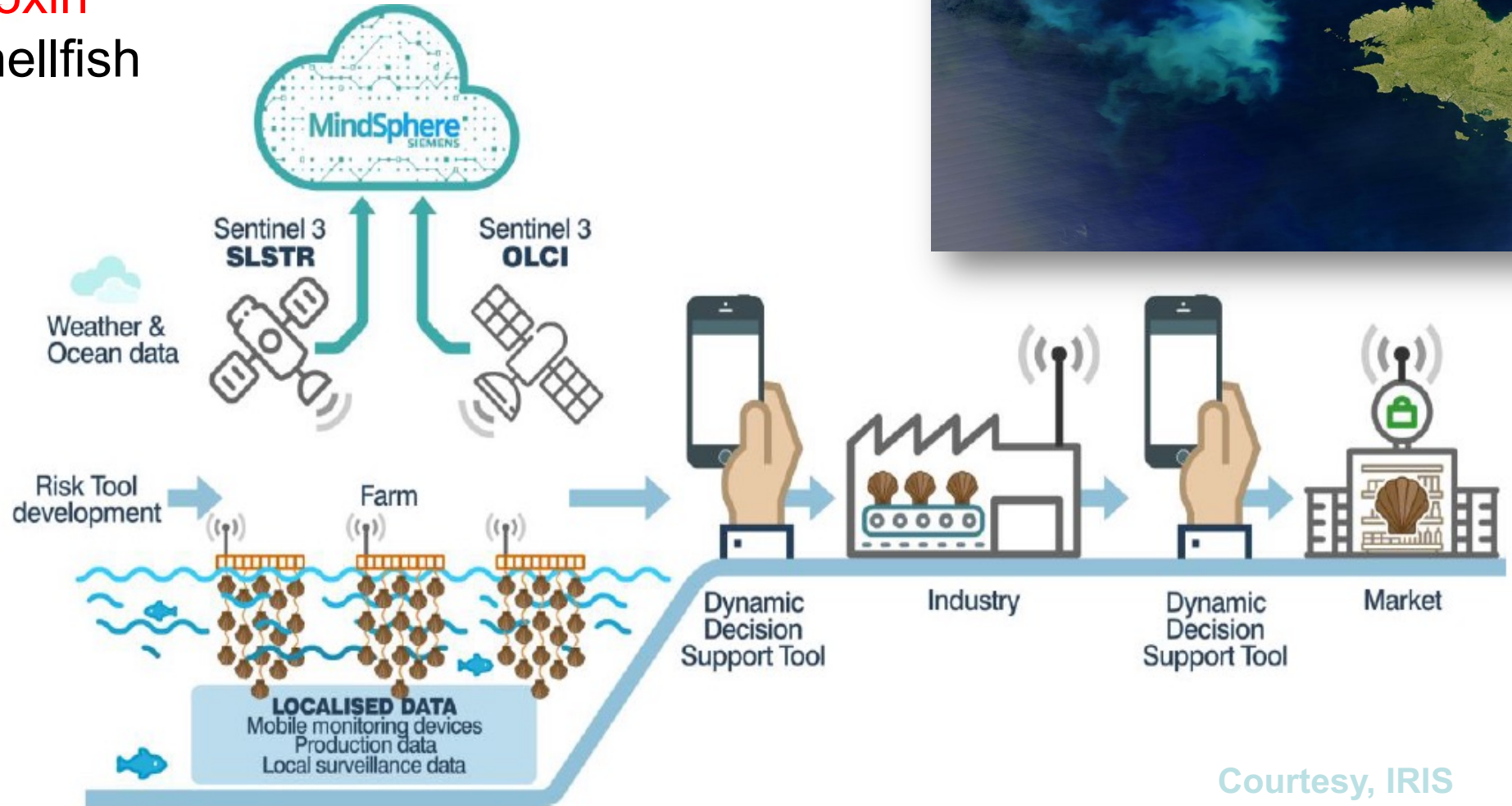
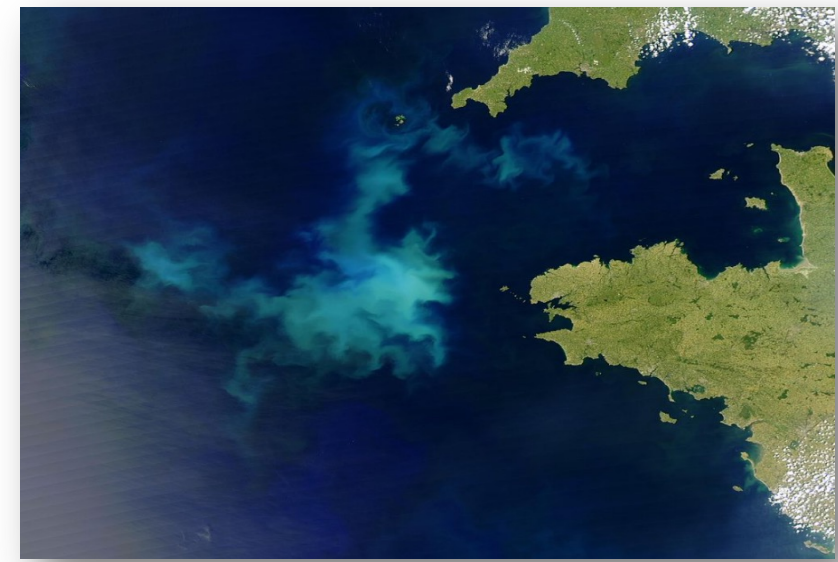


.....will support the FoodSafeR project in a voluntary capacity providing advice, insight, knowledge and recommendations.

.....eminent outreach is given through an international Advisory Board spanning global dimensions, which will also serve as hubs for the FoodSafeR to anticipate and mitigate future food crises.

The future of food safety monitoring

Innovative Platforms for
norovirus and **biotoxin**
management in shellfish



Courtesy, IRIS

Relevant Case Studies








Relevant case studies as identified by FoodSafeR in cooperation with stakeholders along food chains

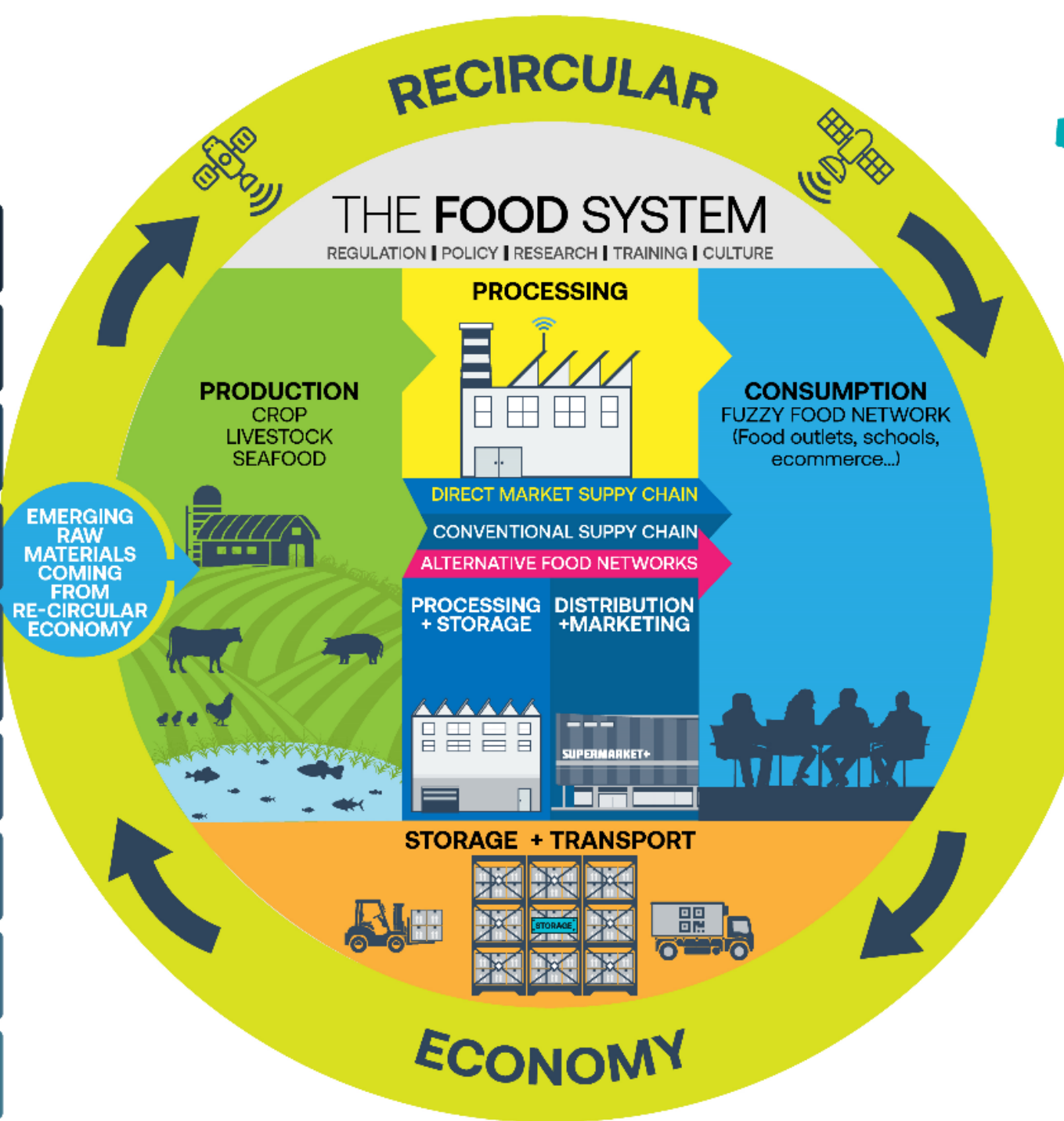
- Advancing **smartphone-based (bio)analytical sensing and diagnostic tools**, through the **integration of biorecognition** elements that enable the on-site testing of **pyrrolizidine alkaloids (PAs)** in herbal **teas** and **tropane alkaloids** (atropine and scopolamine) in **buckwheat and processed cereals**




- Building on the prototype fully integrated immunodiagnostic **foodsmartphone** technology from the H2020 FoodSmartphone ITN project
- Next steps: a) integration of novel critical **biorecognition reagents** for the determination of plant and fungal toxins b) **image analysis linked** to the FoodSmartPhone (app), and c) integration into an Open Digital Hub
- To detect anomalies in images => collecting a large number of smartphone images of both affected and unaffected leaves of the crops and toxins (**ground truth acquisition campaign**) – deep learning










-  Knowledge of drivers and key factors for food safety risk emergence in the food system
-  Indicators for drivers of food safety risk emergence
-  Ground-breaking holistic and proactive risk-benefit and cost-benefit assessment framework
-  Map of risks of alternative supply chains & food networks vs. convention chains
-  Models of persistence phenomenon in foodborne bacteria define novel concepts for prevention of persistence in food processing environments
-  Understanding of persistence of viruses in food chains
-  Knowledge into the risk of emerging ABR traits for defining improved risk mitigation strategies
-  Advanced Big Data-based prediction tools for mycotoxin and plant toxin occurrence
-  Smartphone-based tools for the determination of plant and fungal toxins



- 

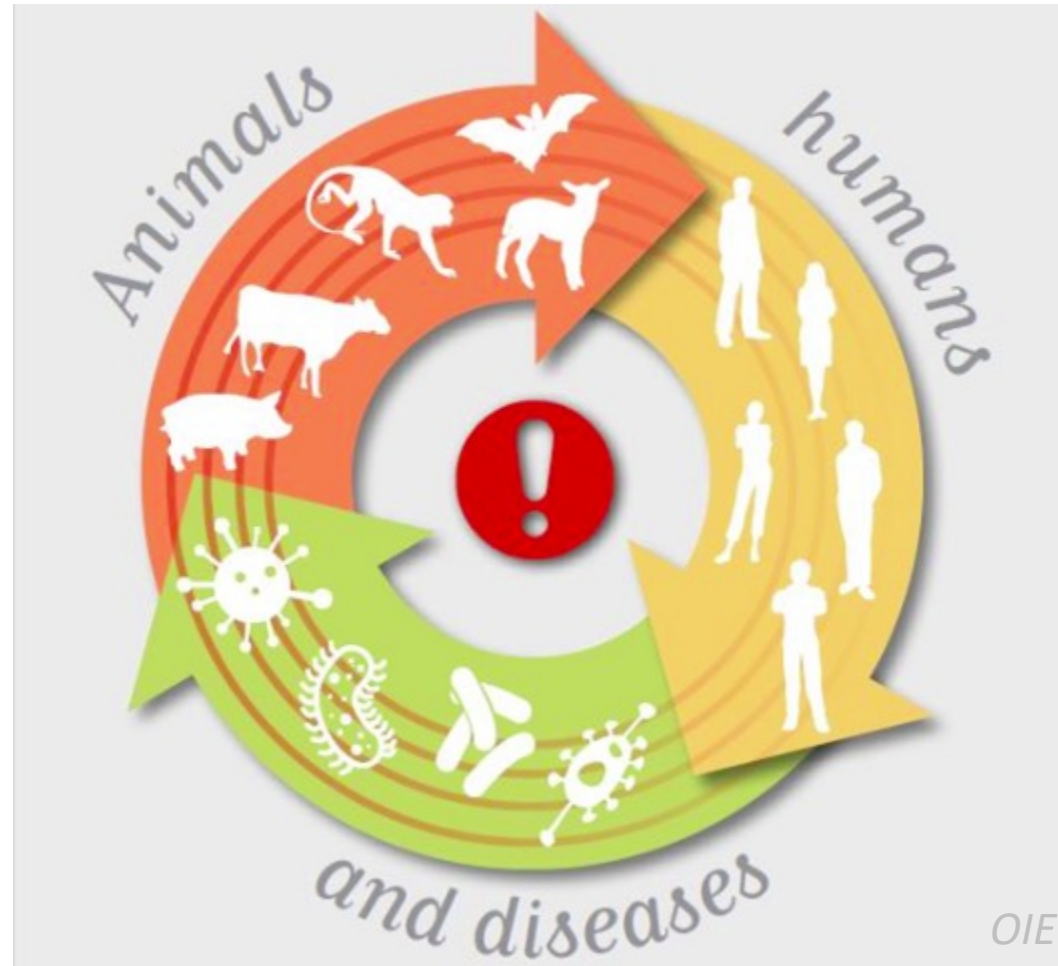
OPEN DIGITAL HUB


-  Lifelong learning material for curricula and educated consumers
 -  Training module on the aspects of early identification of emerging food safety hazards, food safety management, holistic risk-benefit and cost-benefit assessment, interactions between risk assessment and risk management
 -  Future-proof toolkit for proactive risk management systems
 -  Food risk mitigation/de-escalation strategies
 -  Future-oriented detection devices & tools for combating key emerging contaminants in view of globalisation and food fraud
 -  Novel approaches for the reduction of furans and mycotoxins through mechanical and thermal processing at industrial scale

A. International conflicts disrupting food and agrifood supply chains.



B. Pandemics, emerging human and animal health disease.



New Drivers of Change – Food Fraud

C. Food fraud proliferating as a result of rapidly changing conditions and identification of new sources for illicit gain.



Importance of **data-driven decision-making**, supporting **predictive tools**
– including possible reliance on **Artificial Intelligence**.

□ Impacts on the way food control is exercised,
with the need to better develop:

- Innovative Analytical and Risk Assessment Platforms
- Preventive approaches, e.g. supplier verification.
- Remote audits / inspections.
- Reliance on third-party-driven compliance verification.



rahmat 謝 謝 ngiyabonga
 Bаярлалаа спасибо faafetai lava 2010 danke 2010 mersi kua ora barka welalin tack teşekkür ederim mahalo
 nanni nandri kiitos dankie dank je misaotra matondo paldies grazzi tapadh leat
 bayarlalaa dhanyavad hvala maururu kōszonóm vinaka спасиби blagodaram akun dankon aciü mamnun
 enkosi bedankt bayarlalaa nandri dhanyavad hvala maururu kōszonóm dankie dank je misaotra matondo paldies grazzi tapadh leat
 sobodi dekuji dankie dank je misaotra matondo paldies grazzi tapadh leat
 dziękuje dankie dank je misaotra matondo paldies grazzi tapadh leat
 obligado mési sagolun chnorakaloutioun gratias ago grācijas sulpáy go raibh maith agat
 didi madloba sagolun chnorakaloutioun gratias ago grācijas sulpáy go raibh maith agat
 najis tuke sukriya kop khun krap taiku go raibh maith agat
 kam sah hamnida sukriya kop khun krap taiku go raibh maith agat
 rahmat terima kasih tanemirt rahmet grazie arigatō takk dakujem trugarez
 তোমাকে ধন্যবাদ rahmat terima kasih tanemirt rahmet grazie arigatō takk dakujem trugarez
 감사합니다 xiexie eucharistw diolch dhanyavadagalu shukriya merce мерси
 شَكَرًا لَكَ