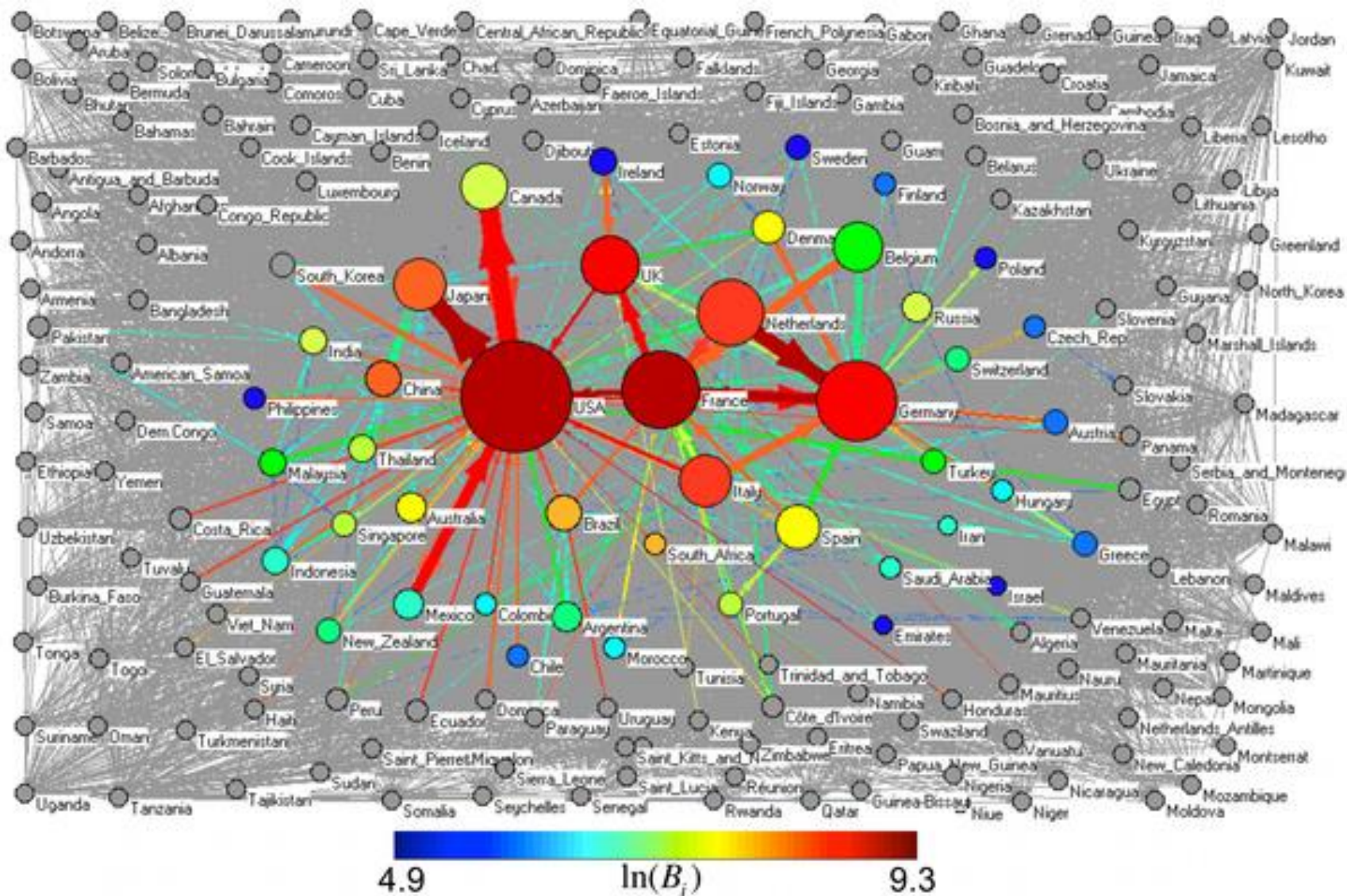


## **FoodRiskLabs – new tools for risk assessment along global food chains**

Bernd Appel and the global food  
chain team

# Are we prepared for risk assessment in global food chains?

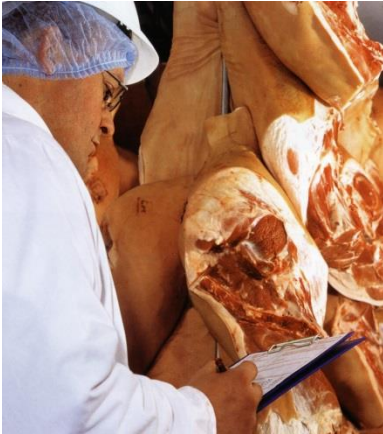


The complete International Agro-Food Trade Network in 1998.

Ercsey-Ravasz M, Toroczkai Z, Lakner Z, Baranyi J (2012) Complexity of the International Agro-Food Trade Network and Its Impact on Food Safety. PLoS ONE 7(5): e37810. doi:10.1371/journal.pone.0037810

# Food chain and possible points of contamination

bacteria - viruses – toxins (chemicals)



Feed and Animal production  
=“Primary production”

Slaughter Processing Distribution Retail Consumption



Food chain Information (FCI)

Meat Inspection, Hygiene control, ...

Hygiene

Hygiene

Hygiene

Good Agriculture Practice (GAP)

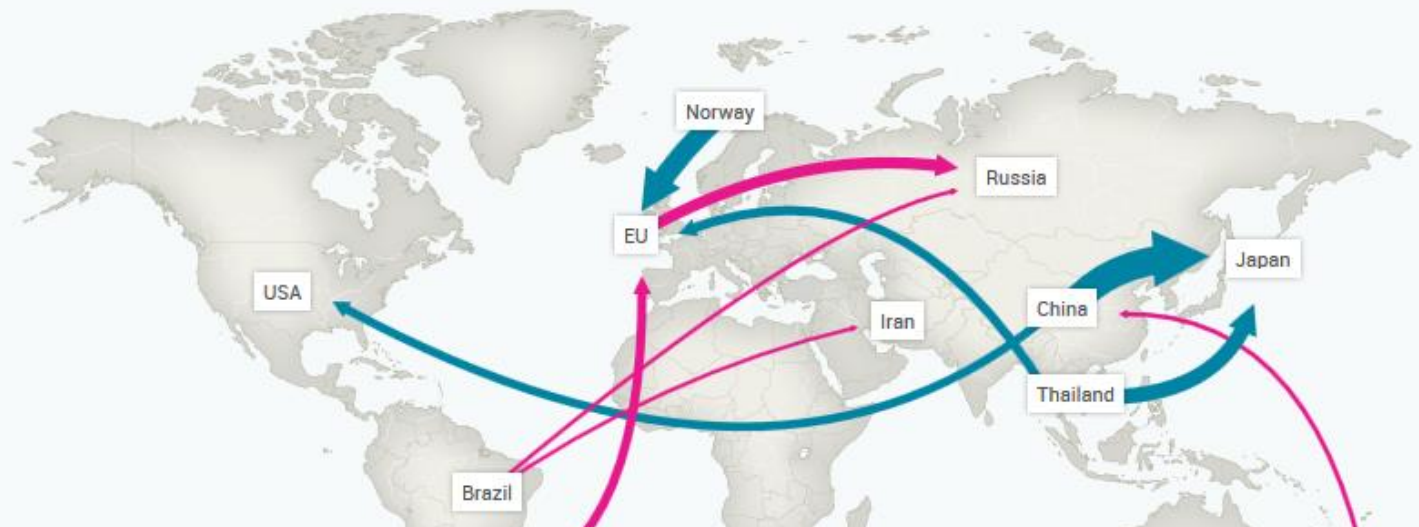
Good Hygiene Practice / Good Manufacturing Practices (GHP) (GMP)

# Global Food Chains

2000 2010



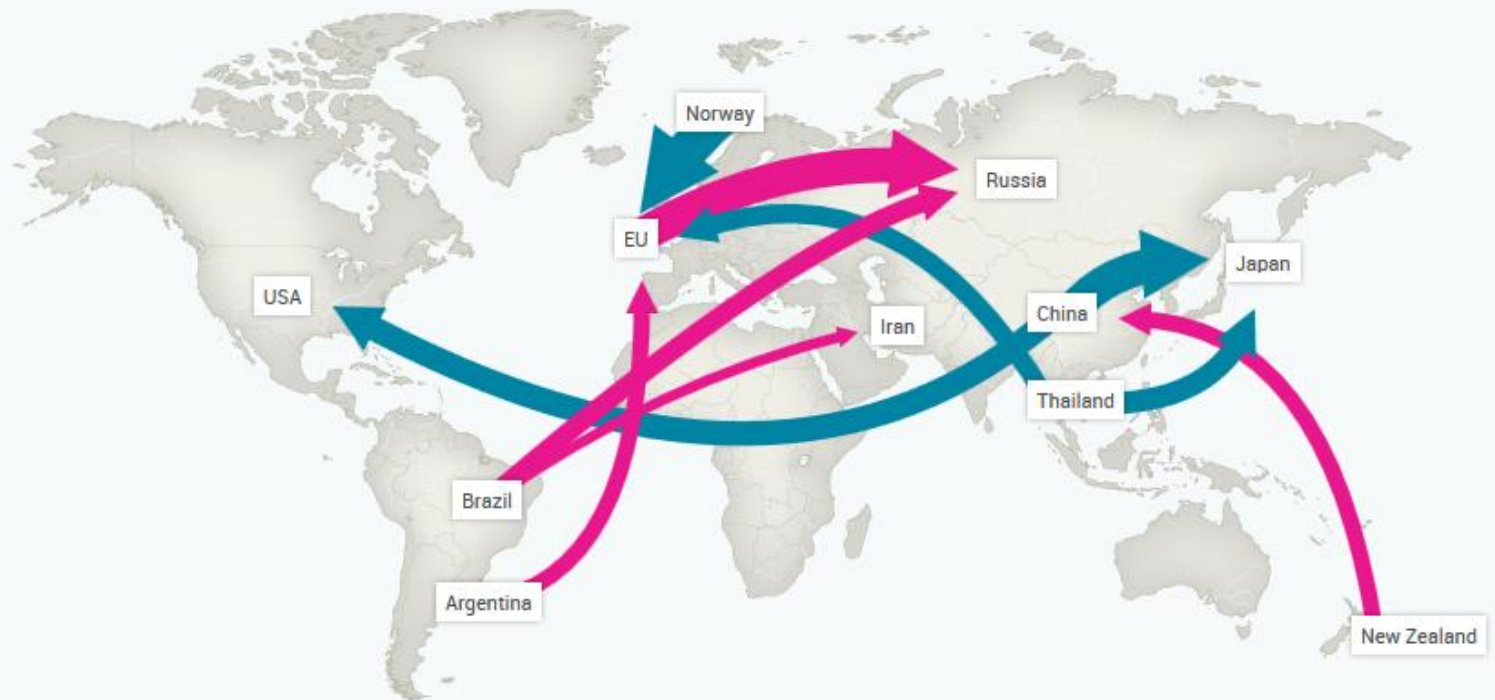
Middle Eastern, Russian, and Chinese imports of meat and fish are increasingly rapidly, and developing countries are becoming increasingly important suppliers.



2000 2010

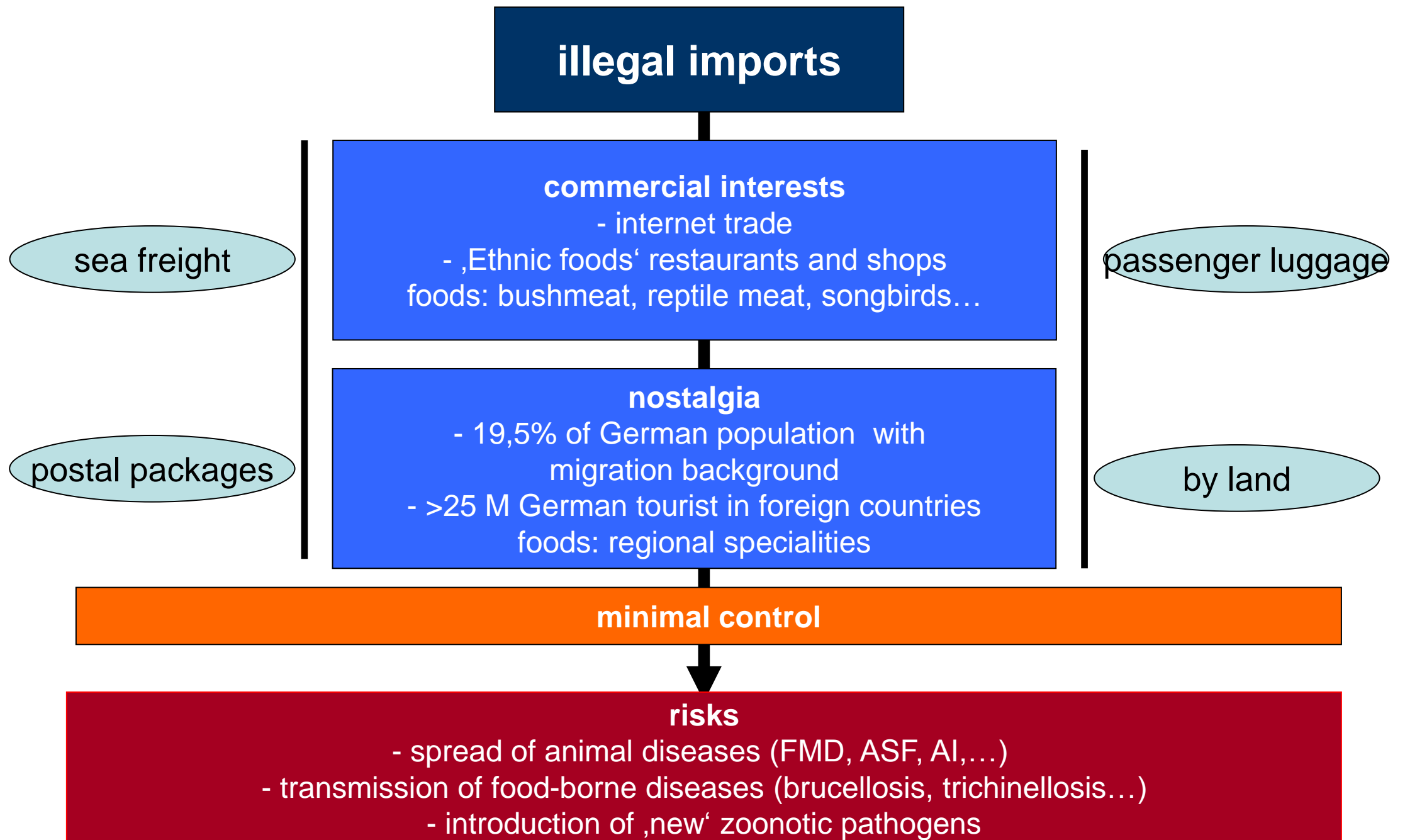


Middle Eastern, Russian, and Chinese imports of meat and fish are increasingly rapidly, and developing countries are becoming increasingly important suppliers.

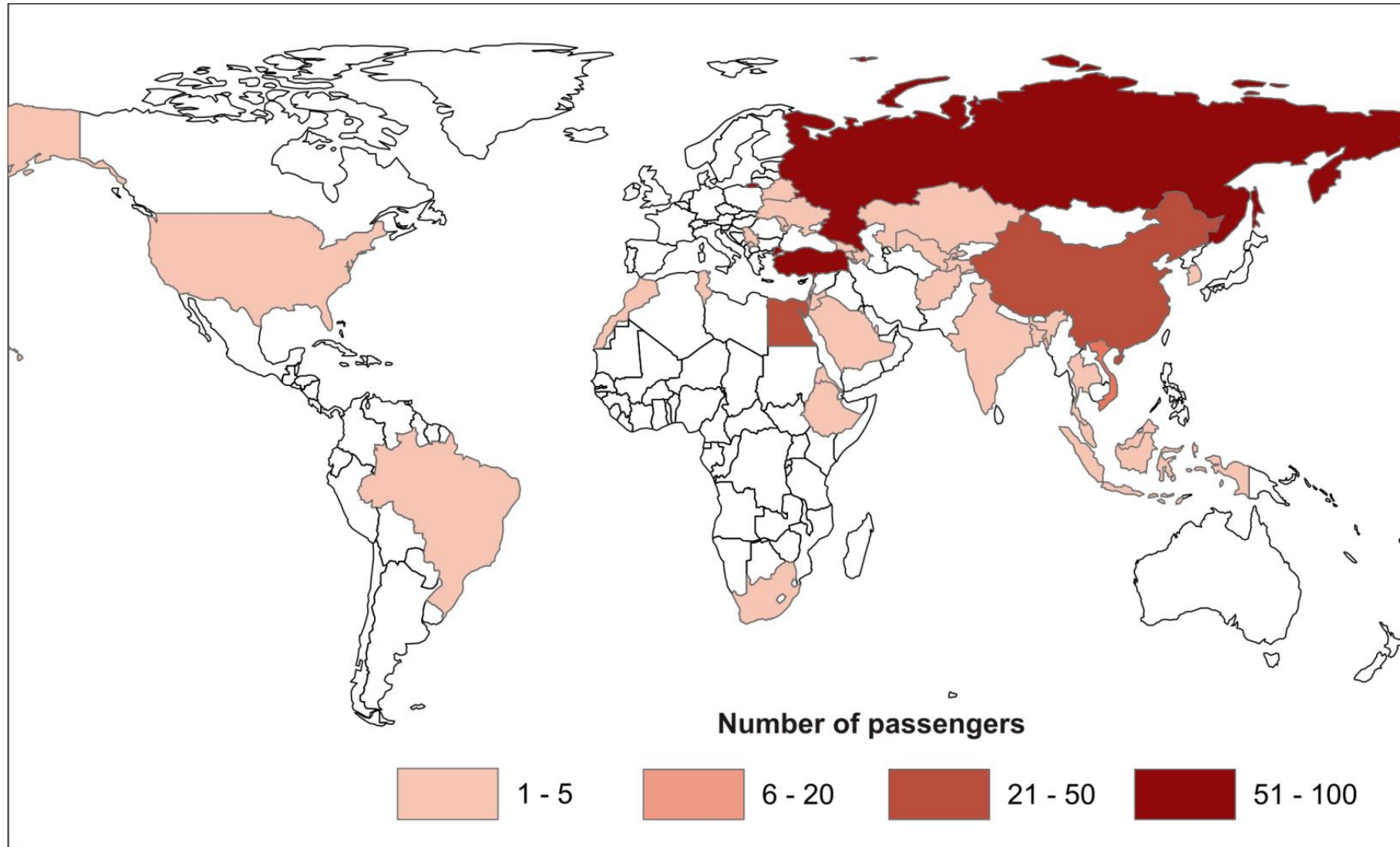


Meat  
Fish

# Consequences of globalisation and diversification of consumer behaviour



# Origin of passengers



# Confiscated food items



sausage and bacon from Russia



lamb carcass from Tunisia



poultry carcass from Egypt



meat products from Vietnam

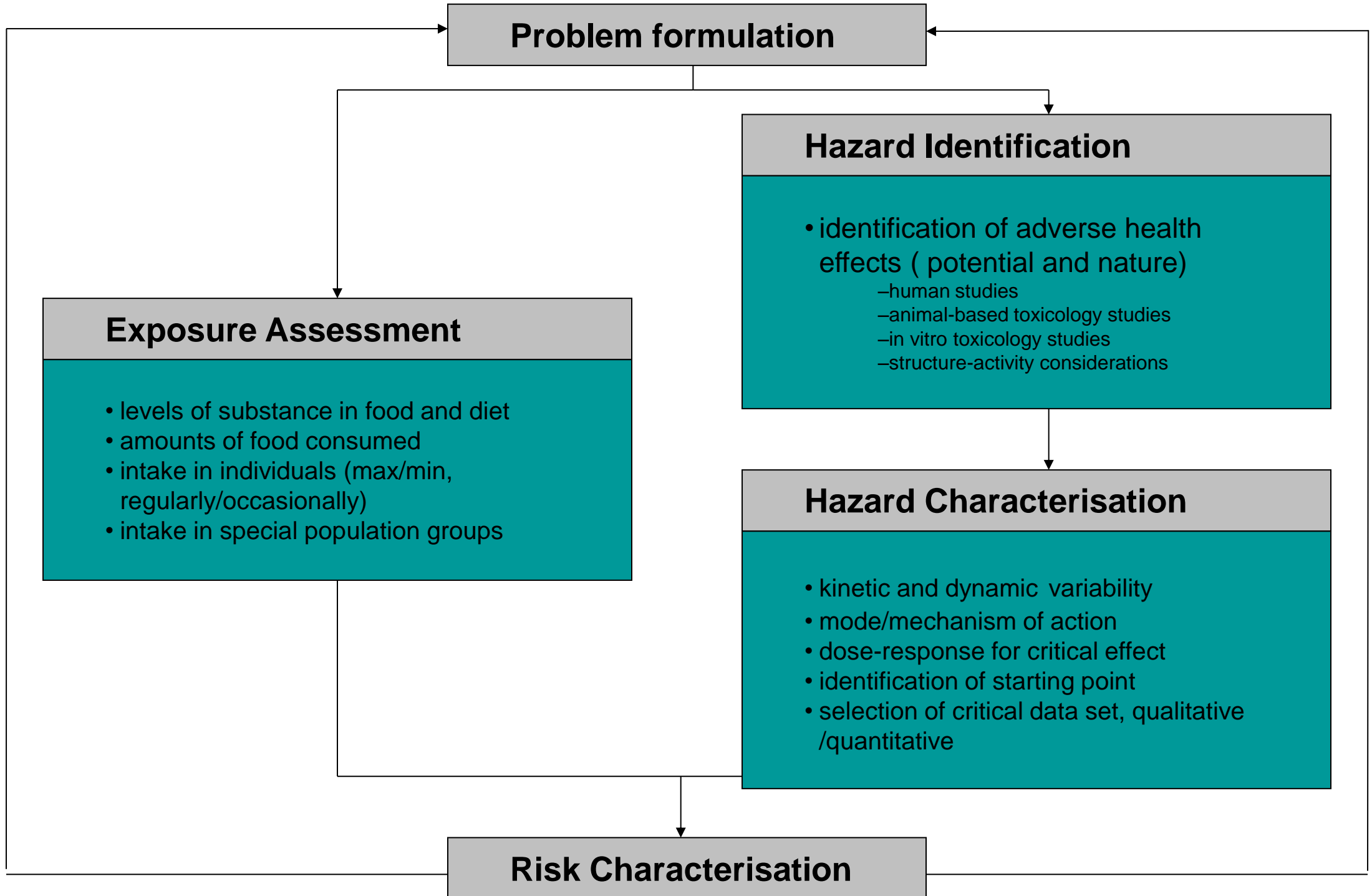


meat products and century eggs from China



biltong from South-Africa

# Risk Assessment in global trade: easy to do?

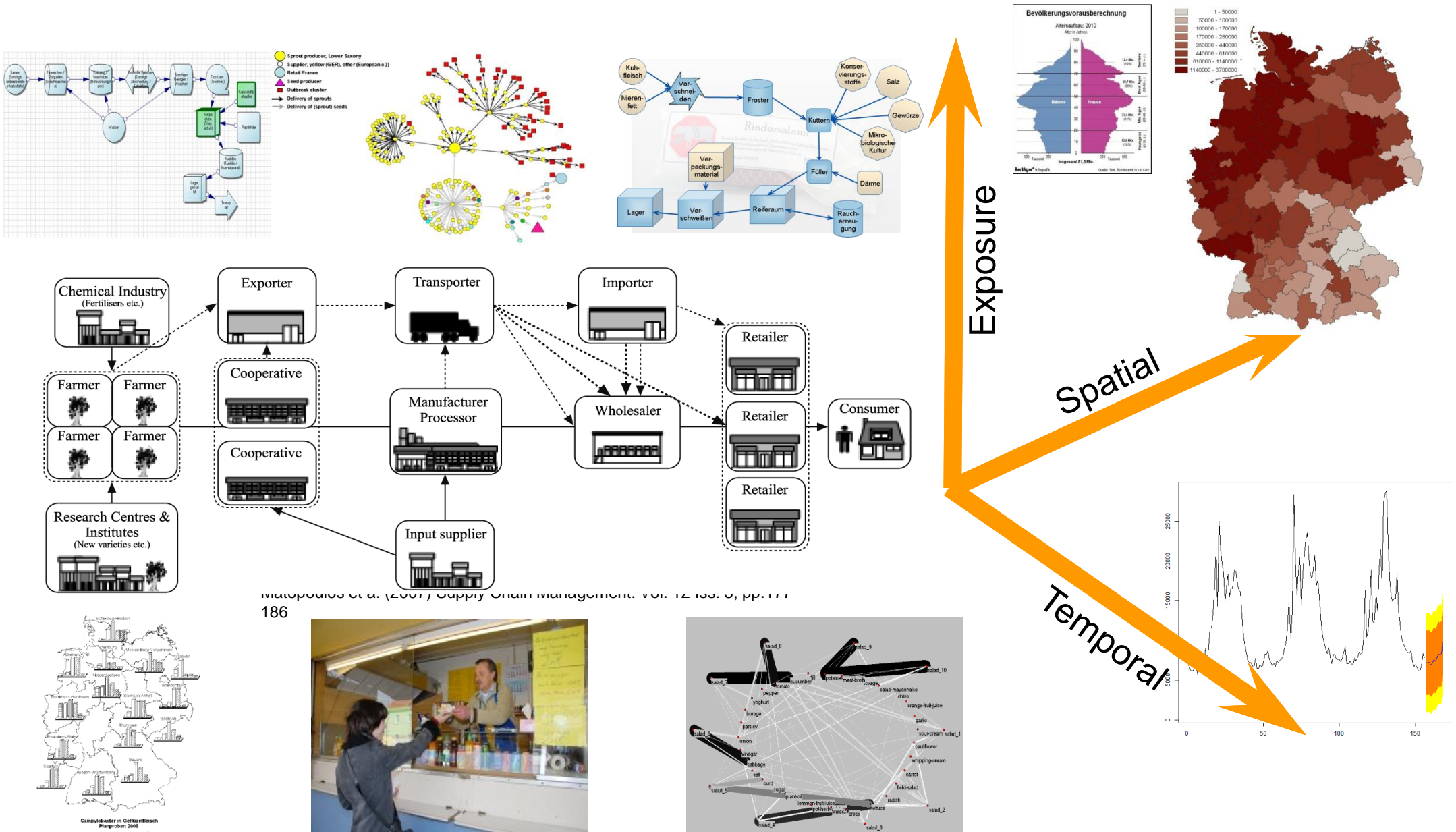




# **Methods and tools for understanding food risks in a global world:**

## **FoodRiskLabs – tools developed at BfR**

# Implications of global food supply chains – Increased complexity of risk / exposure assessments



Matopoulos et al. (2007) Supply Chain Management, vol. 12, iss. 3, pp. 177-186

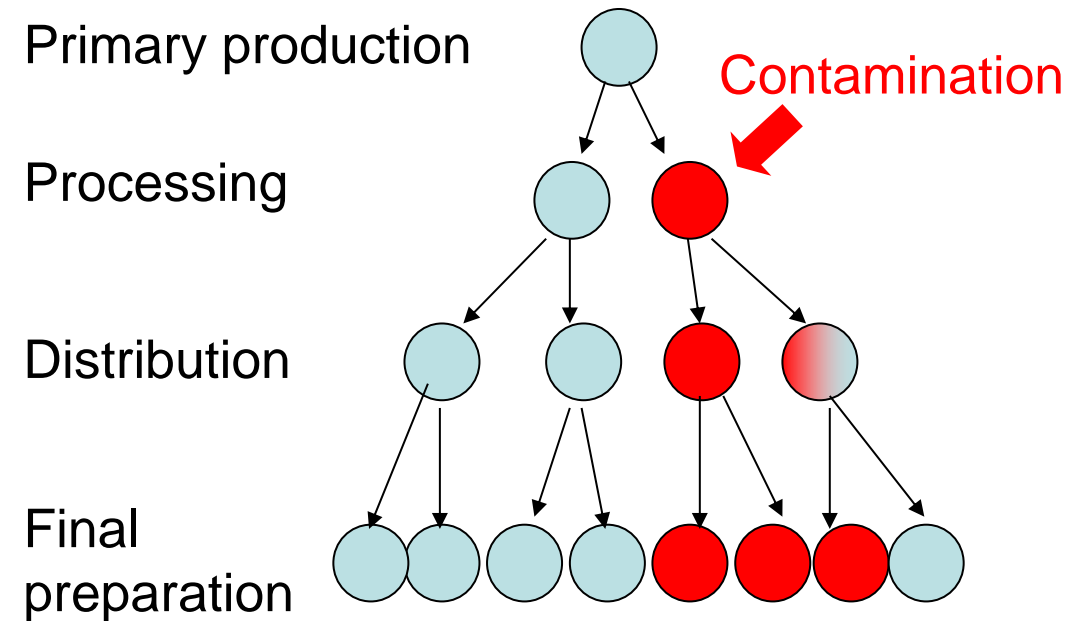
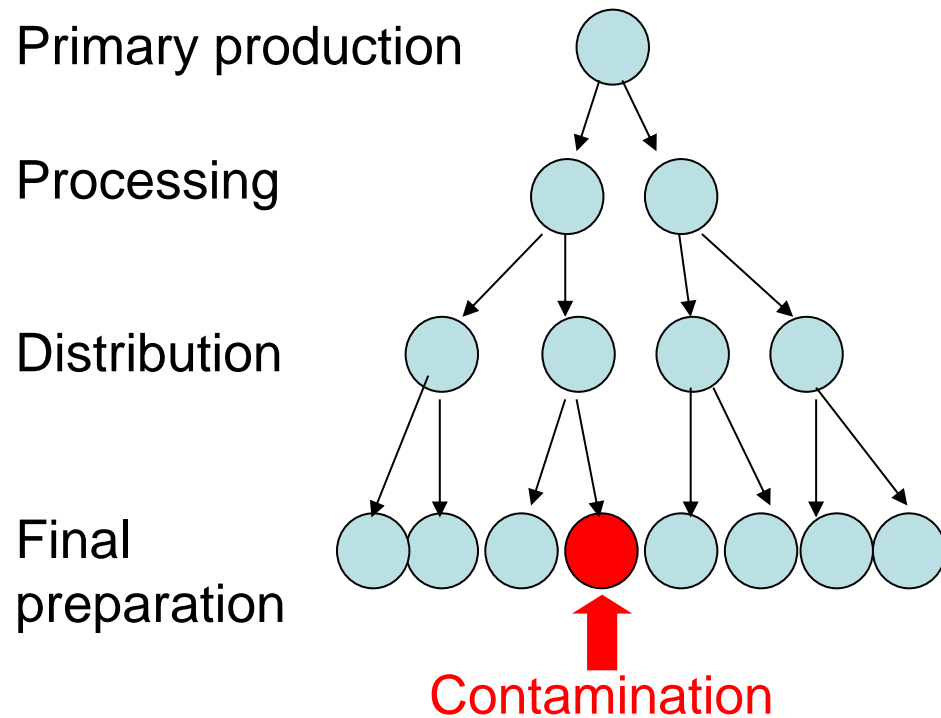
# **How do we cope with food-borne outbreaks in the context of global food chains?**

# Outbreaks resulting from contaminations along the food chain

## Local foodborne outbreak

vs.

## Diffuse foodborne outbreak



### Focal

Source of contamination  
 Contamination dose  
 Detection  
 Investigation

local food handling  
 high  
 self-reporting, lab follow-up  
 local, tracing back

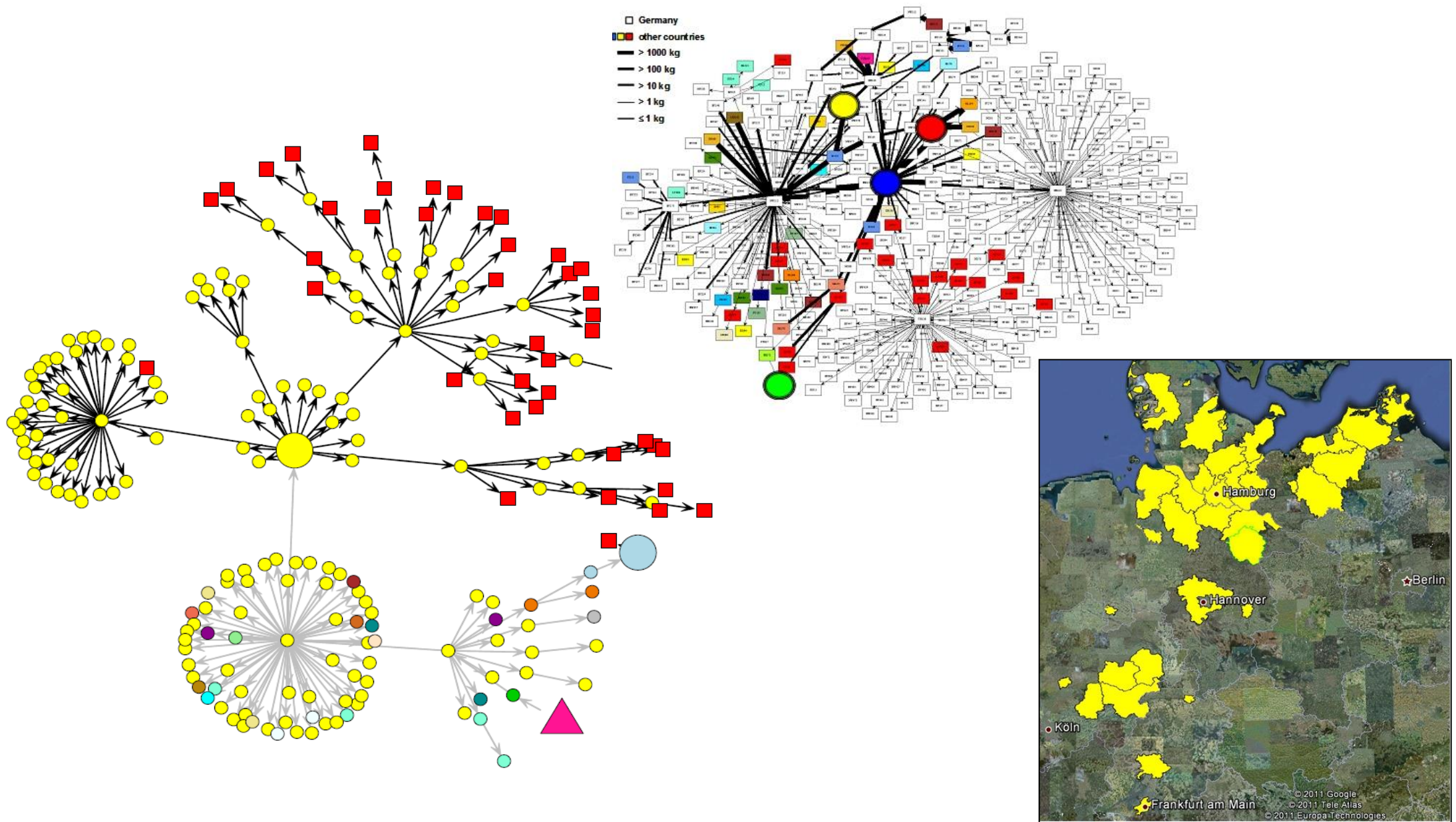
### Multifocal or diffuse

at production or processing  
 low  
 lab-based subtype surveillance  
 Complex multistate investigation

# Tracing

## Food chain lab

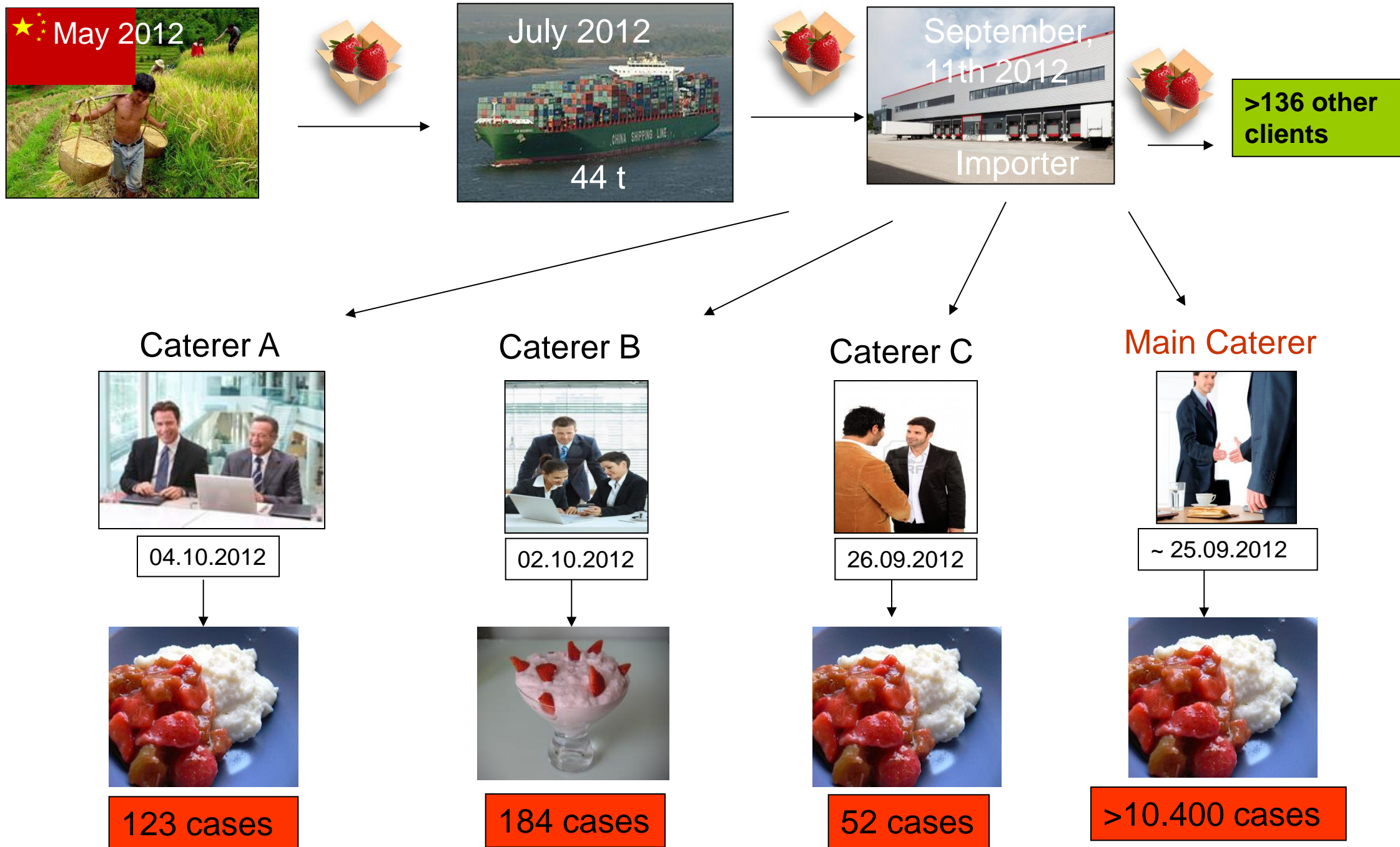
# Methodology on technical data- and network analysis - Visualizations



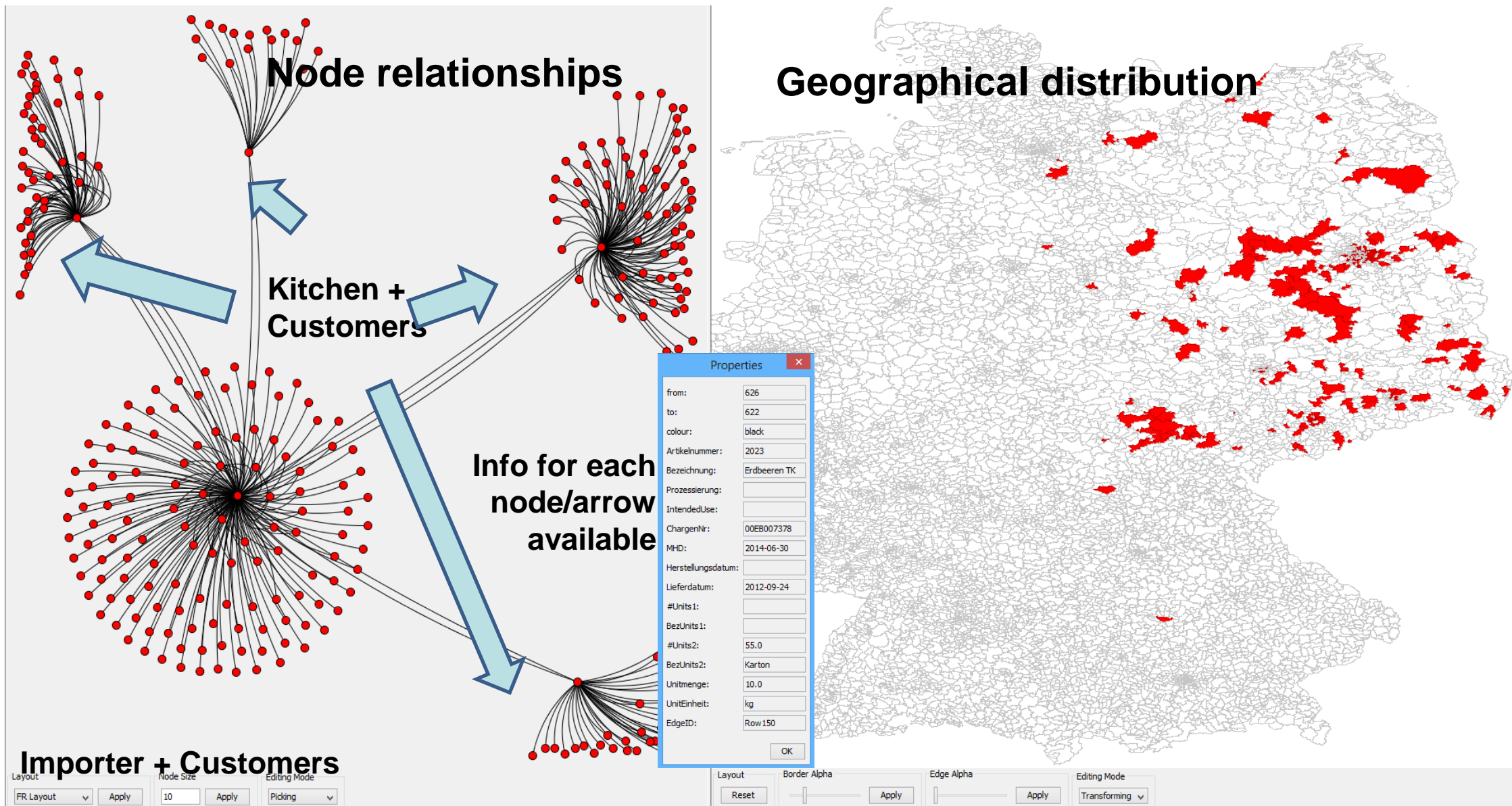
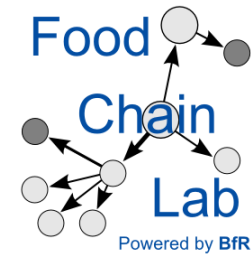
**Weiser et al., 2013:** “Trace-Back and Trace-Forward Tools Developed Ad Hoc and Used During the STEC O104:H4 Outbreak 2011 in Germany and Generic Concepts for Future Outbreak Situations“, **Foodborne Pathog Dis.** 2013.

# Example: Norovirus outbreak, 2012

Distribution of frozen strawberries from China (Batch 00EB007378, 44 t)



# Example: FoodChain-Lab on Outbreak data: Norovirus 2012



powered by BfR; SiLeBAT – Project, BMBF- research grant 13N11202

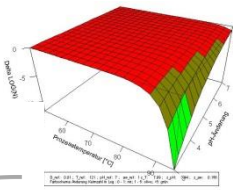
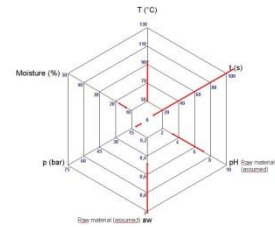
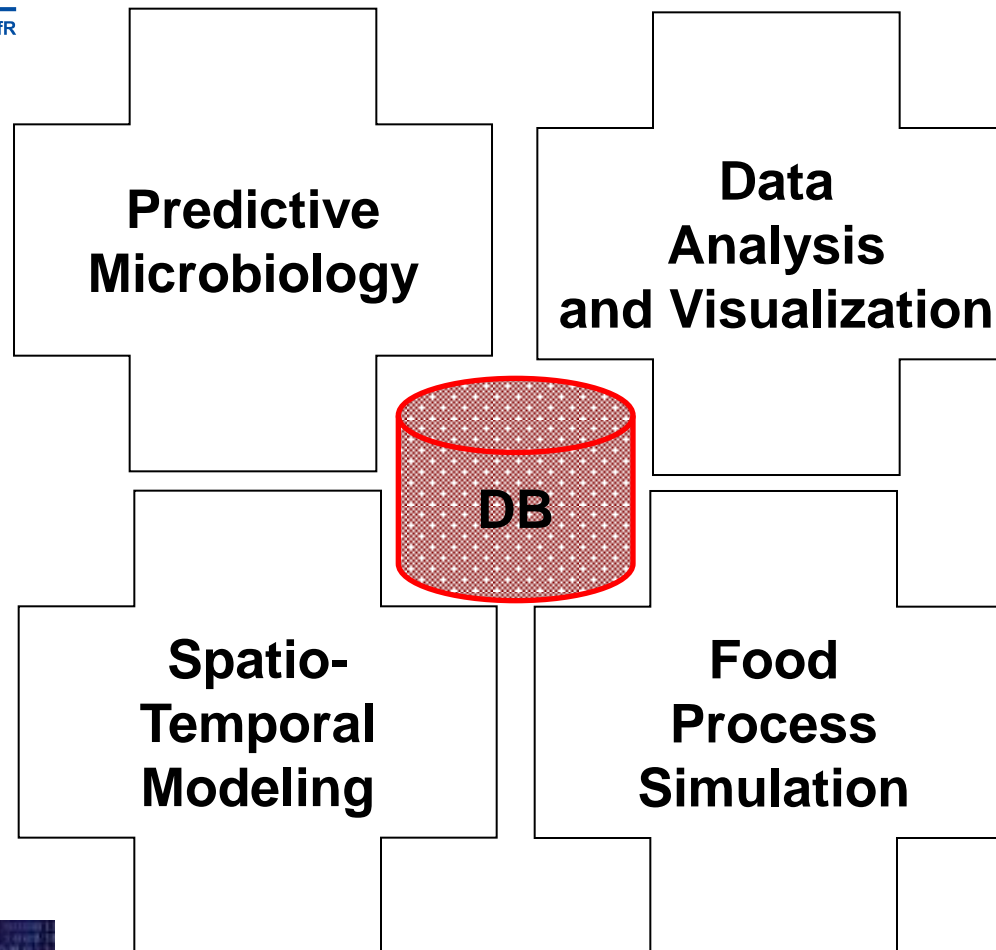
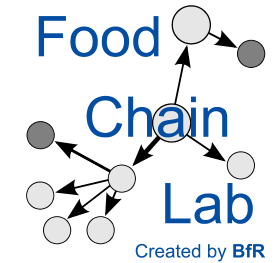
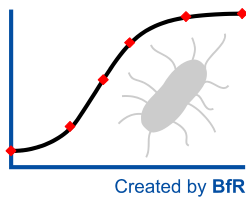


# FoodRiskLabs – Tools:

- Predictive Microbiology tool:  
PMM Lab
- Food Process Lab
- Spatio- Temporal Modeling  
and more
  - All based on Knime Software

# Open source software solutions developed / used by BfR

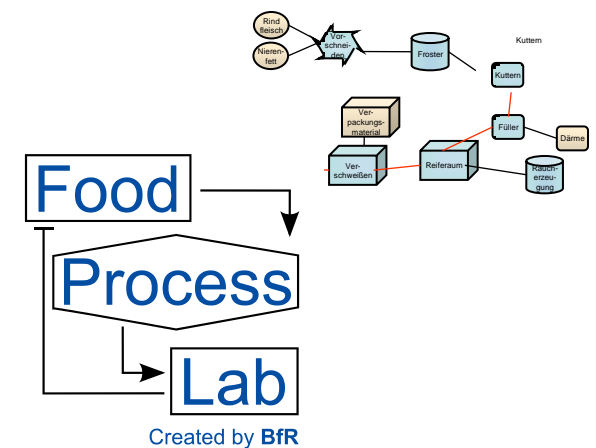
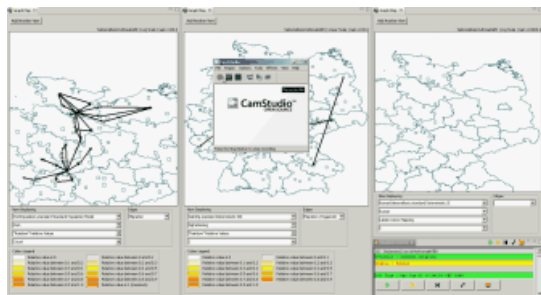
PMM-Lab



open  
FSMR

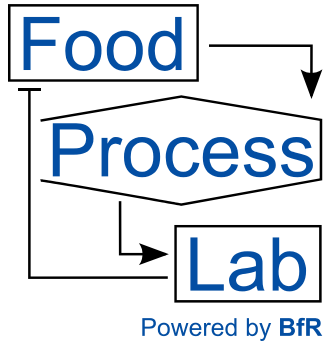
Created by BfR and UoD

[www.eclipse.org/stem/](http://www.eclipse.org/stem/)

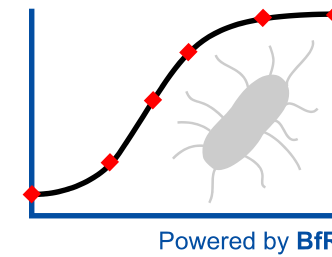


# SiLeBAT Scenario Work

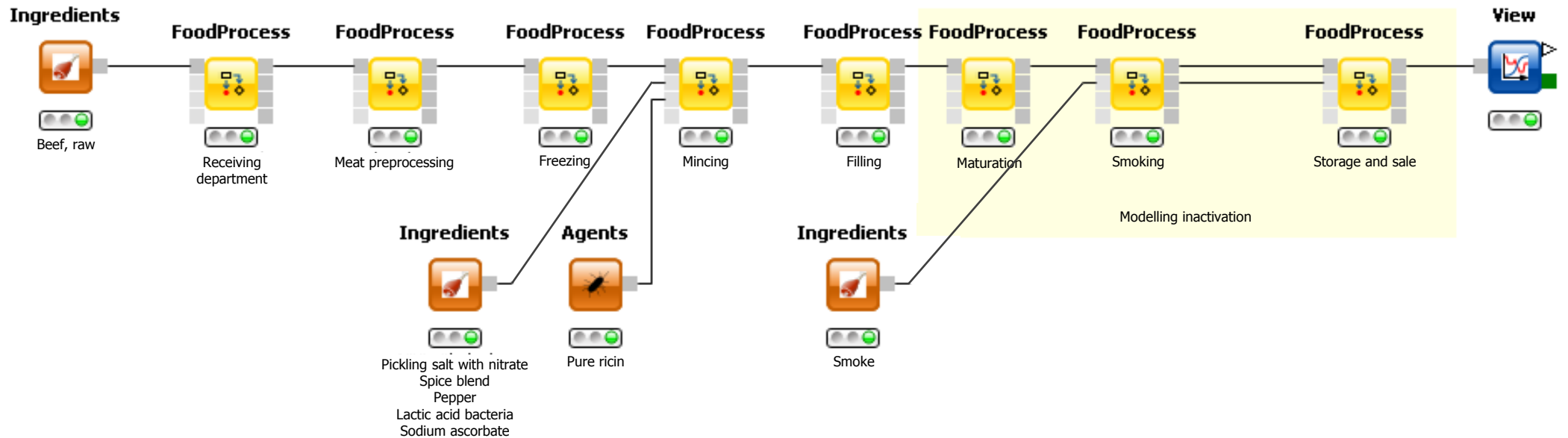
## Food Processing Chain: Salami



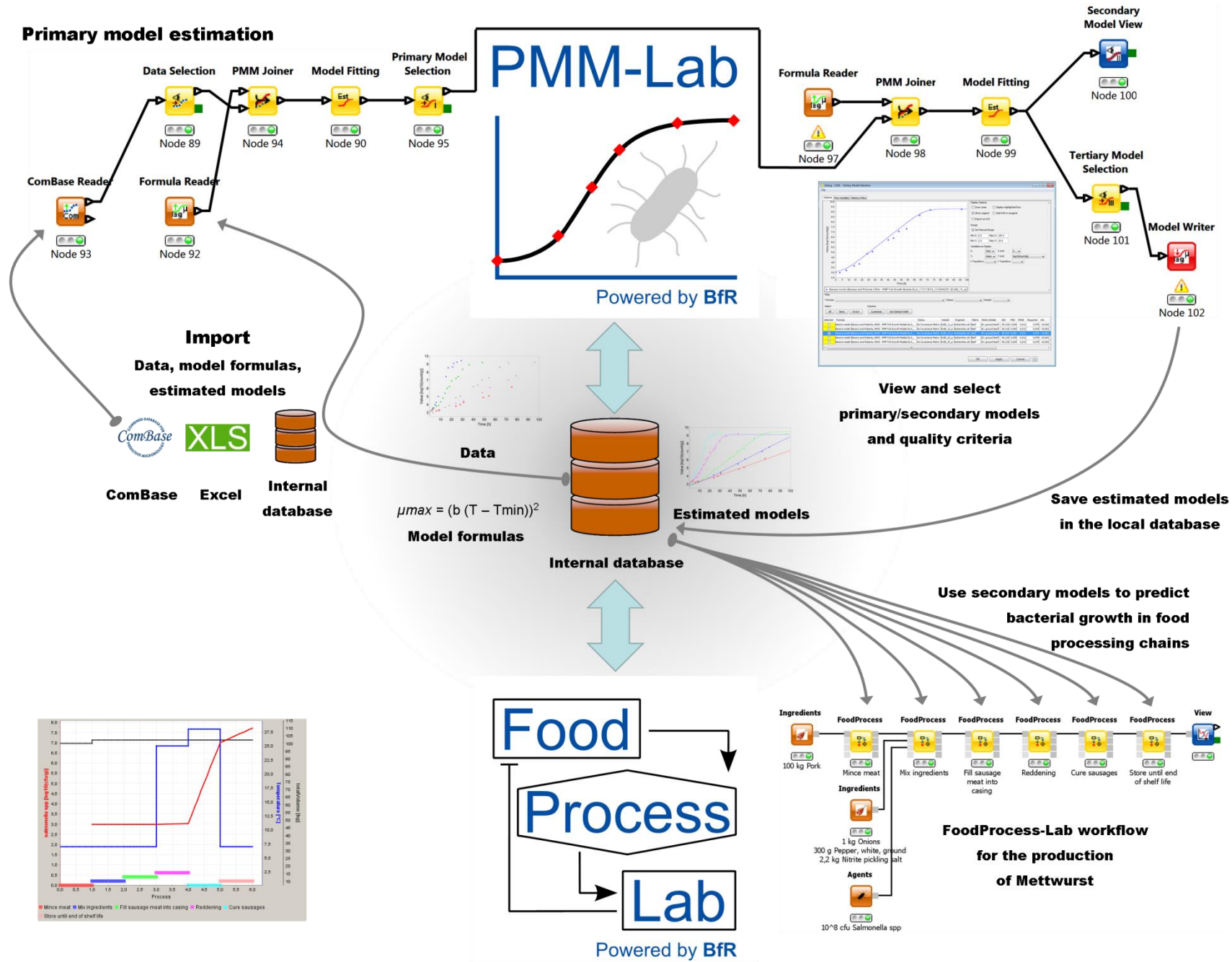
**PMM-Lab**



**Predictive microbial models**



# PMM-Lab und FoodProcess-Lab

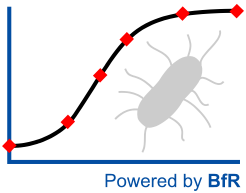


# SiLeBAT Scenario Work

## Inactivation of ricin



PMM-Lab

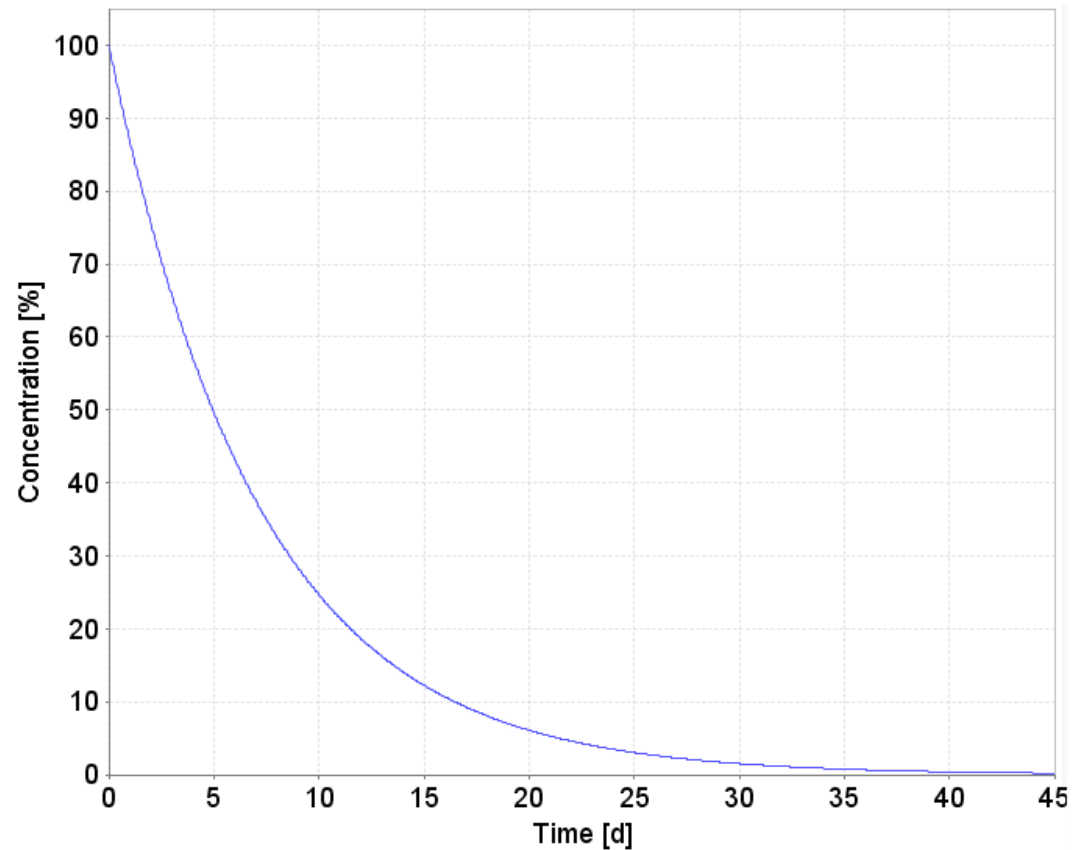


Conditions: Inactivation in PBS at 25 °C

$$\text{Concentration [\%]} = A0 * \exp (-\exp (k) * \text{Time [d]})$$

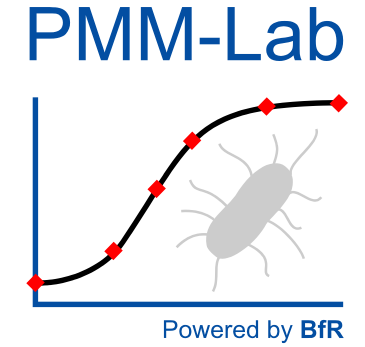
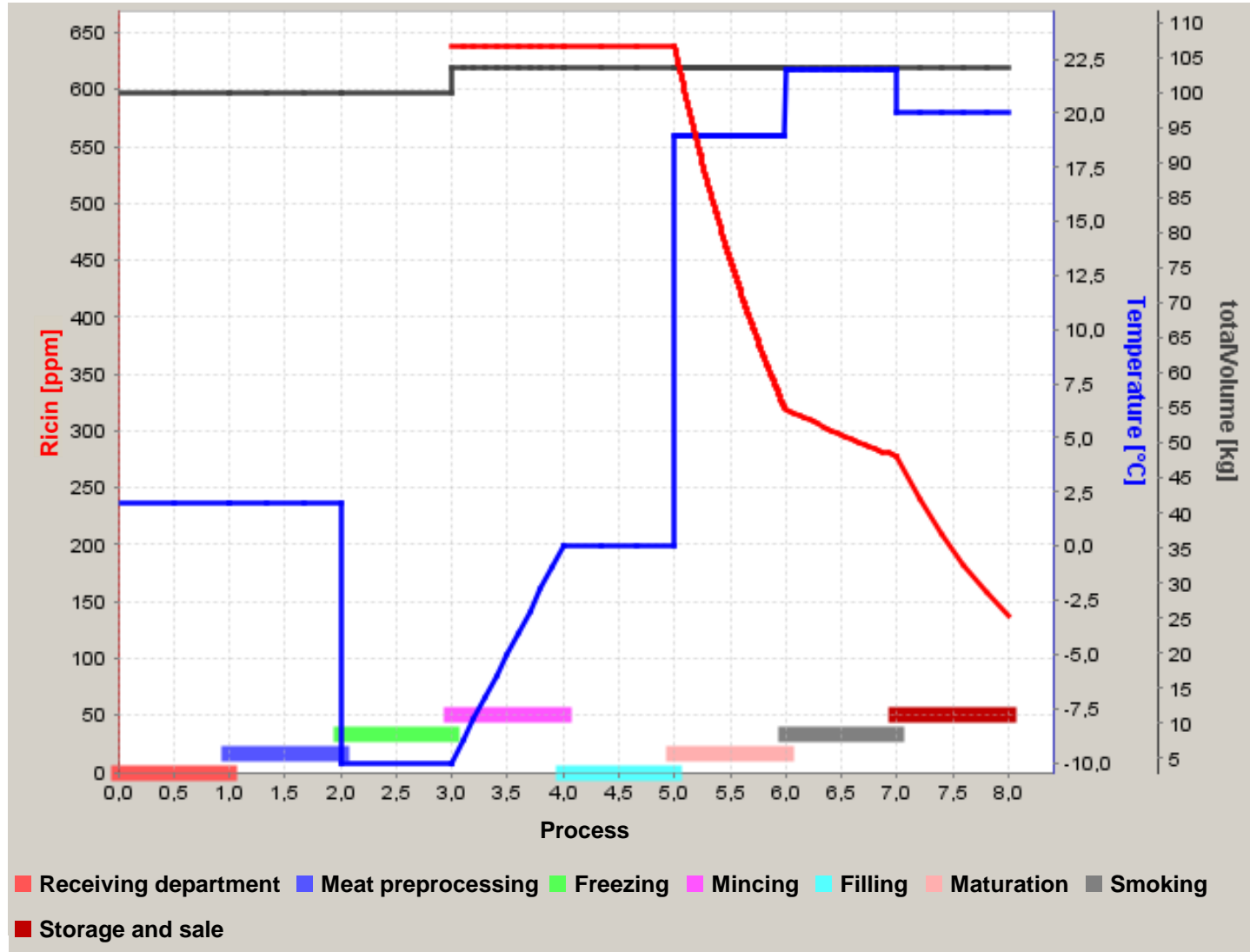
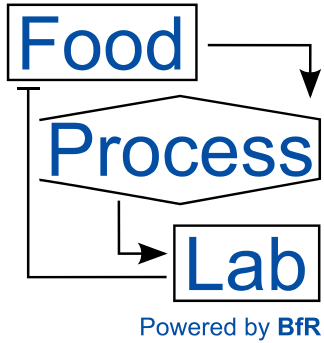
Few data about the inactivation of ricin at different conditions published.

Within 5 days at 25°C 50% of the toxin are inactivated.



# SiLeBAT Scenario Work

## Food Processing Chain: Salami



Graph showing processing steps on the x-axis

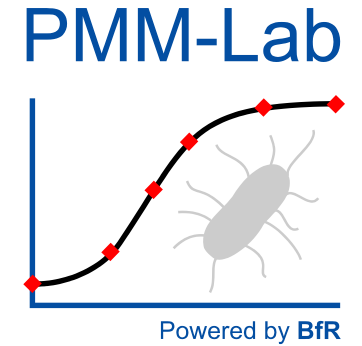
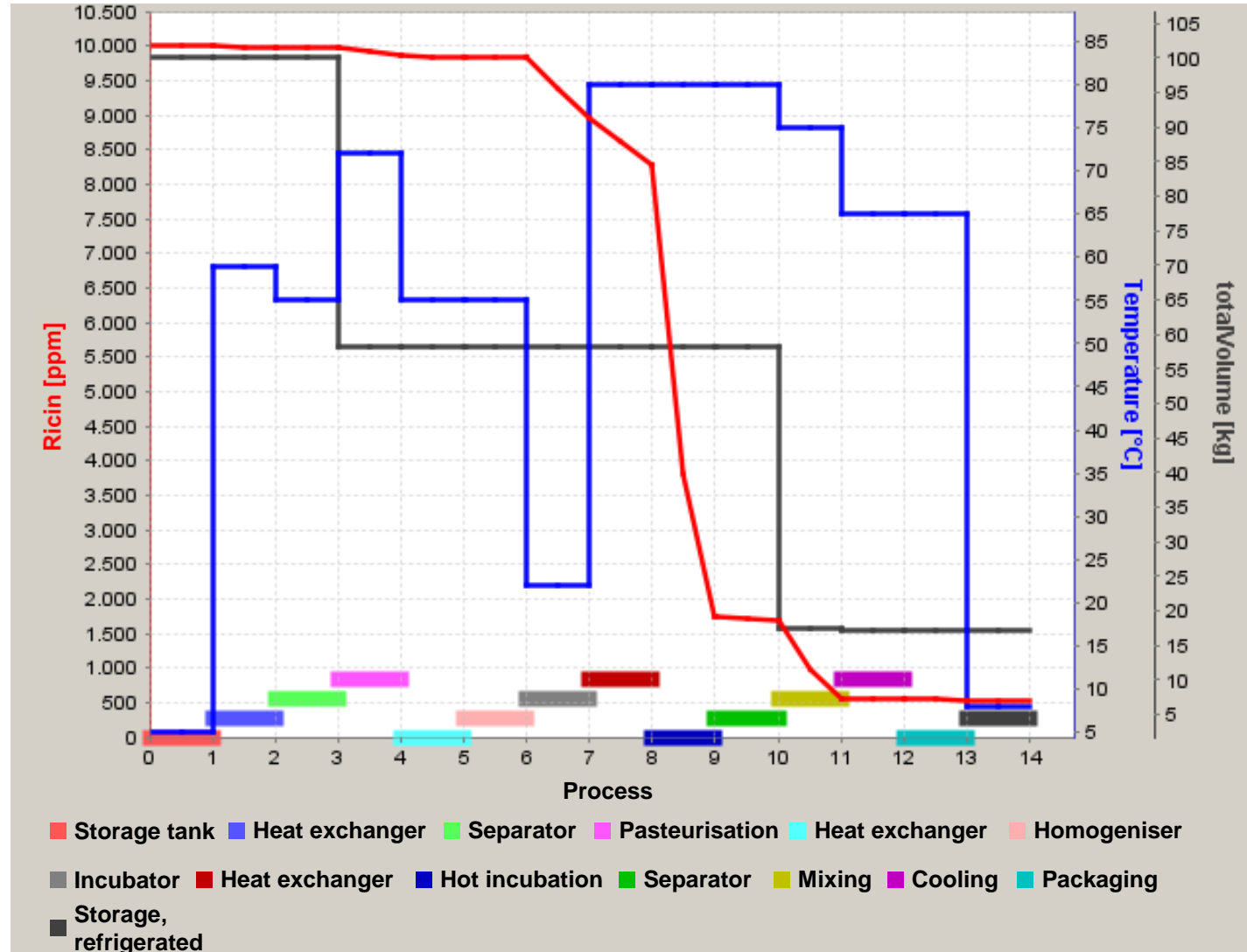
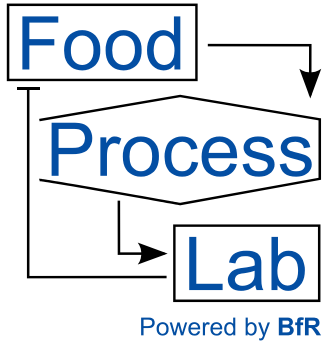
Ricin concentration [ppm]

Temperature [°C]

Production volume [kg]

# SiLeBAT Scenario Work

## Food Processing Chain: Fresh Cheese



Graph showing processing steps on the x-axis

Ricin concentration [ppm]

Temperature [°C]

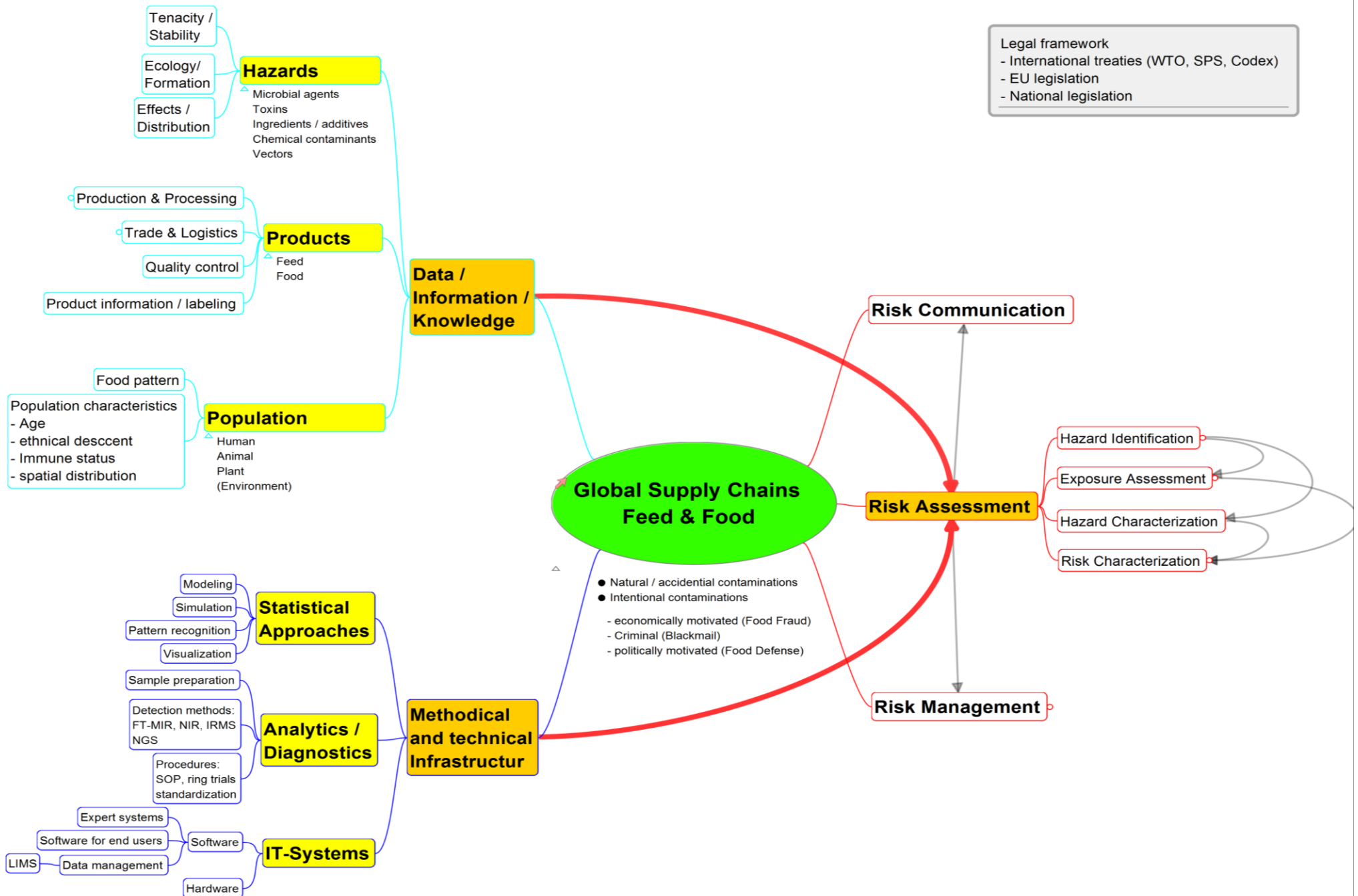
Production volume [kg]

# Global Supply Chains and Risk Assessment

What data do we need?



# Global Supply Chains and Risk Assessment

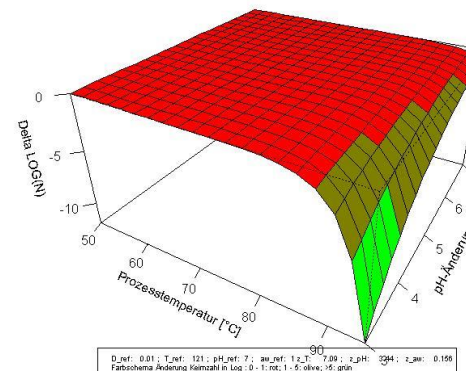
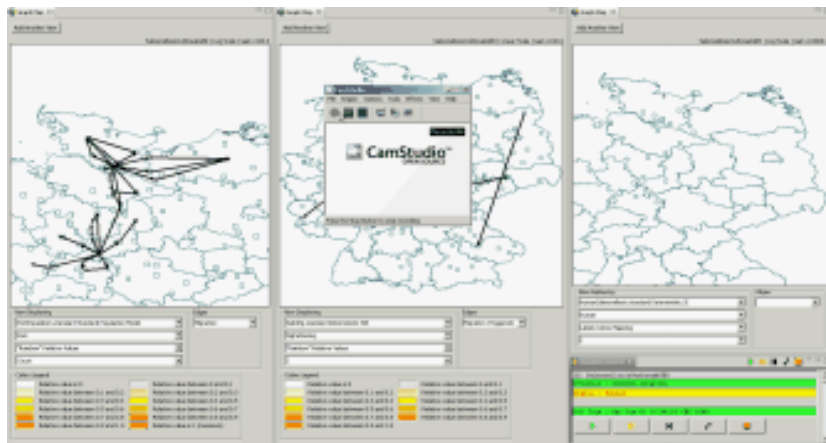


**Legal framework**

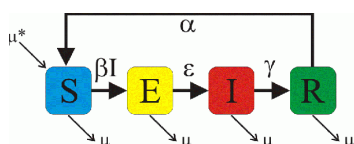
- International treaties (WTO, SPS, Codex)
- EU legislation
- National legislation

# Vision

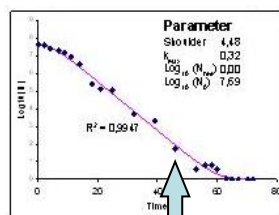
”Food safety community resources  
(data, models, tools)  
supporting state-of-the-art risk assessments along the food chain”



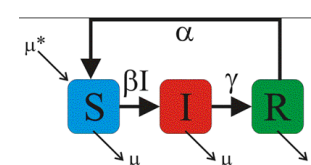
animal disease models



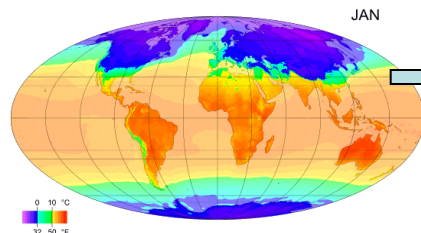
Food processing and distribution



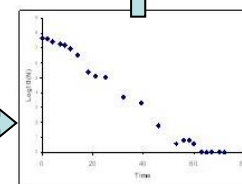
human disease models



Environmental factors

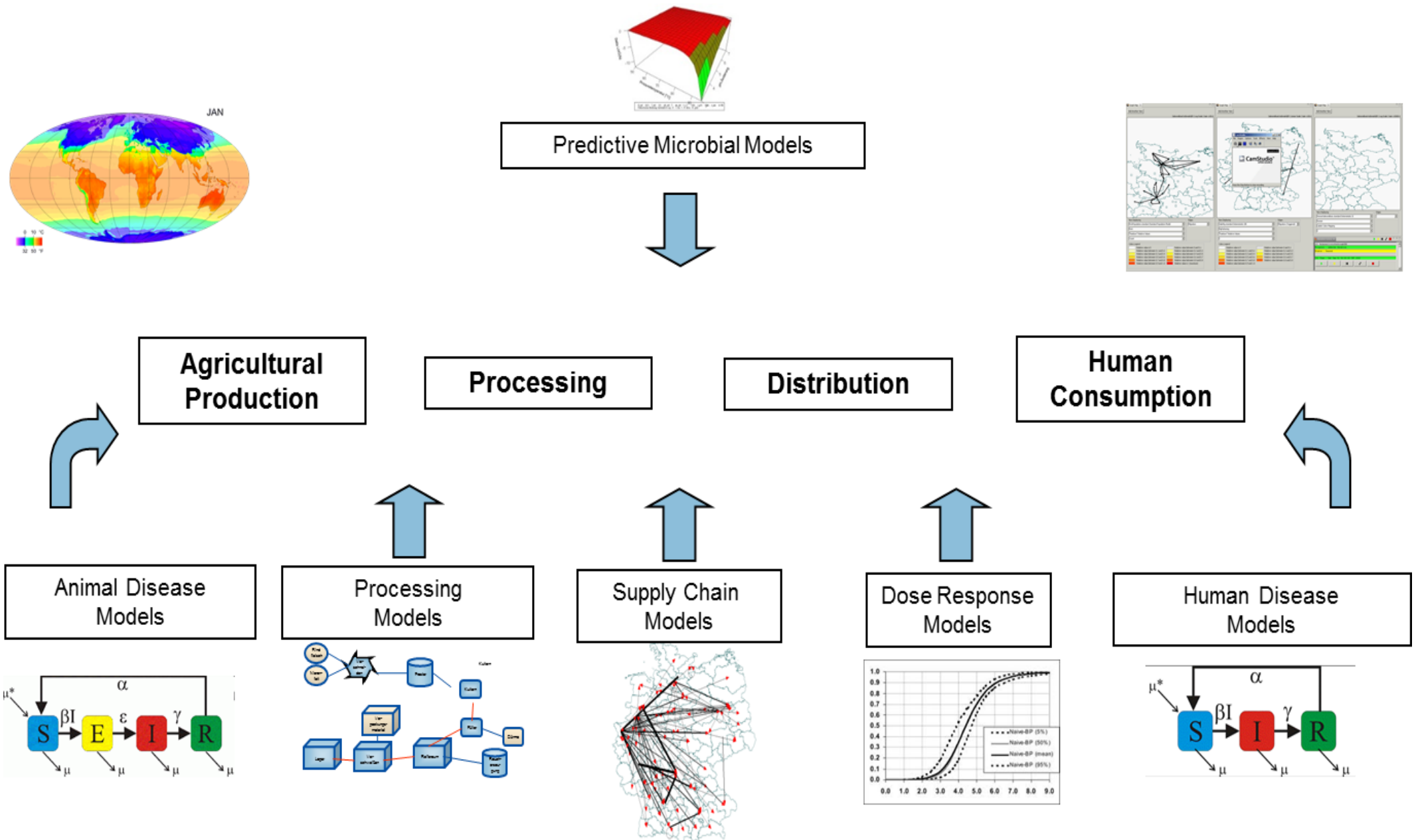


Processing parameters



# Solution:

## Application of mathematical modelling and IT tools to support Risk assessments



# Open Food Safety Model Repository (openFSMR)

Powered by BfR and

**MENU**

- OPEN FS MR
- OPEN FS MR-DETAIL SEARCH VIEW
- IMPROVE DATA
- DOWNLOAD FILE FOR NEW ENTRIES
- FILE UPLOAD
- CONTACT FORM

4. open FS MR

2.

1.

5.

3.

PMF-Organism	PMF-Environment	Model-Type	Model-DependentVariables	Software
Bacillus cereus	Culture media	Growth	Concentration, Rate, Doubling time	Combase
Bacillus cereus	Culture media	Growth	Concentration, Rate, Doubling time	Combase
Bacillus cereus	Culture media	Inactivation	Concentration, Rate	Combase
Bacillus cereus	broth culture	Growth	Concentration, Lag time, Rate, Maximum population density	USDA PMP
Bacillus cereus	broth culture	Growth	Concentration, Lag time, Rate, Maximum population density	USDA PMP
Bacillus cereus	Brain Heart Infusion broth	Growth boundary model	Logit(P)	GroPIN
Bacillus cereus	Various	Growth boundary model	Rate	GroPIN
Bacillus cereus	Broth Medium	Growth, Growth boundary model		MRV
Bacillus cereus	Beef	Growth, Growth boundary model		MRV
Bacillus cereus	Poultry	Growth, Growth boundary model		MRV
Bacillus cereus	Sausage	Growth, Growth boundary model		MRV

Feature	Value
DOLU	08/31/2015
Model-Name	CombasePredictor_Growth_BacillusCereus
PMF-Organism	Bacillus cereus
PMF-Environment	Culture media
Model-Creator	ComBase Consortium; ifr.combase@ifr.ac.uk
Model-CurationStatus	long term use
Model-Type	Growth
Model-Foodprocess	Storage
Model-DependentVariables	Concentration, Rate, Doubling time
Model-IndependentVariables	Init_level, time, temp, pH, aw, physiological_state
Software	Combase
Software-Link	<a href="https://browser.combase.cc/ComBase_Predictor.aspx?mo">https://browser.combase.cc/ComBase_Predictor.aspx?mo</a>

- Core functionalities
1. Filter models according to predefined filter (e.g. Organism, Software etc.)
  2. Full-text search
  3. Download of result list
  4. Extended filter options via menu option: OPENFSMR-DETAIL
  5. Details on each model visible in the right pane

## Take-Home Messages

- ✓ **The vision of “food safety community resources” is achievable**
- ✓ **Mathematical modelling and IT tools support risk assessments and outbreak investigations**
- ✓ **Everyone can contribute (not only software developers)**
- ✓ **All tools freely available at:**

**<http://foodrisklabs.bfr.bund.de>**

**FoodRiskLabs**  
FR

FoodChain-Lab

Predictive Microbial Modeling Lab (PMM-Lab)


FoodProcess-Lab

Open Food Safety Model Repository

Events

Contact

Search ...

Information on BfR  
  
Bundesinstitut für Risikobewertung

Masthead

Data Protection Declaration

# FoodRisk-Labs



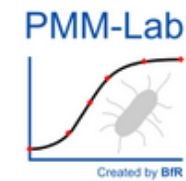
FoodRisk-Labs is a portal

to the following tools

developed by the Federal Institute for Risk Assessment (BfR):



Tracing food back and forward along food supply chains



Modelling bacterial growth or bacterial and toxin inactivation



Representation of food process chains and modelling bacterial tenacity



Repository for predictive microbial models



**Thank you for your attention**

Bernd Appel on behalf of the food chain team

Federal Institute for Risk Assessment

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