



Emerging Food Safety Risks: New Developments

Dr. H.J.P. Marvin

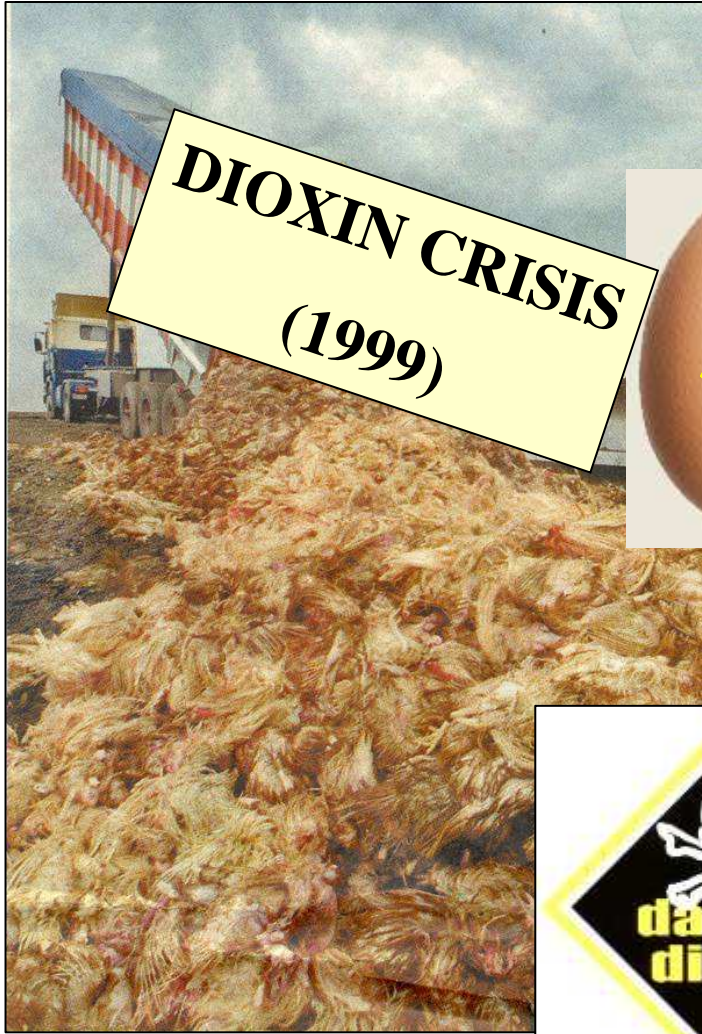
RIKILT - Institute of Food Safety

The Netherlands

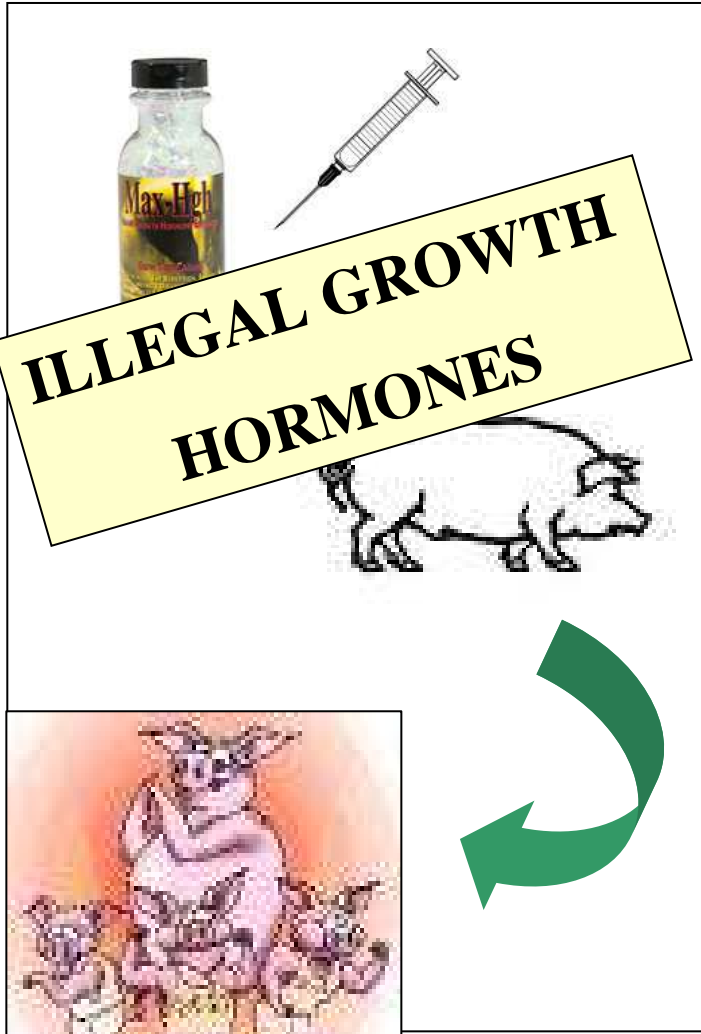
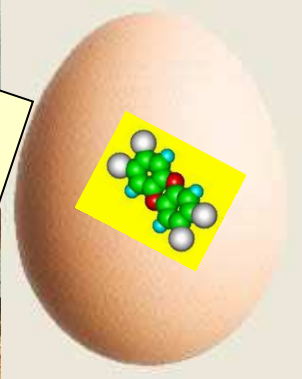


Outline of the presentation

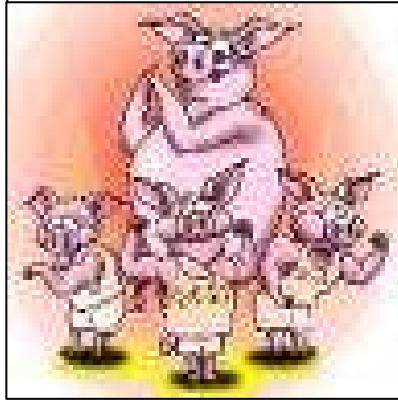
- Food safety crises in Europe
- Food Safety Authorities (EU, The Netherlands)
- Emerging risk definitions
- Emerging risk identification: a holistic approach



**DIOXIN CRISIS
(1999)**



**ILLEGAL GROWTH
HORMONES**



The Puztai Potato



Illustration: L...

Introduction of GMO's
in the European food chain

Frankenstein Food



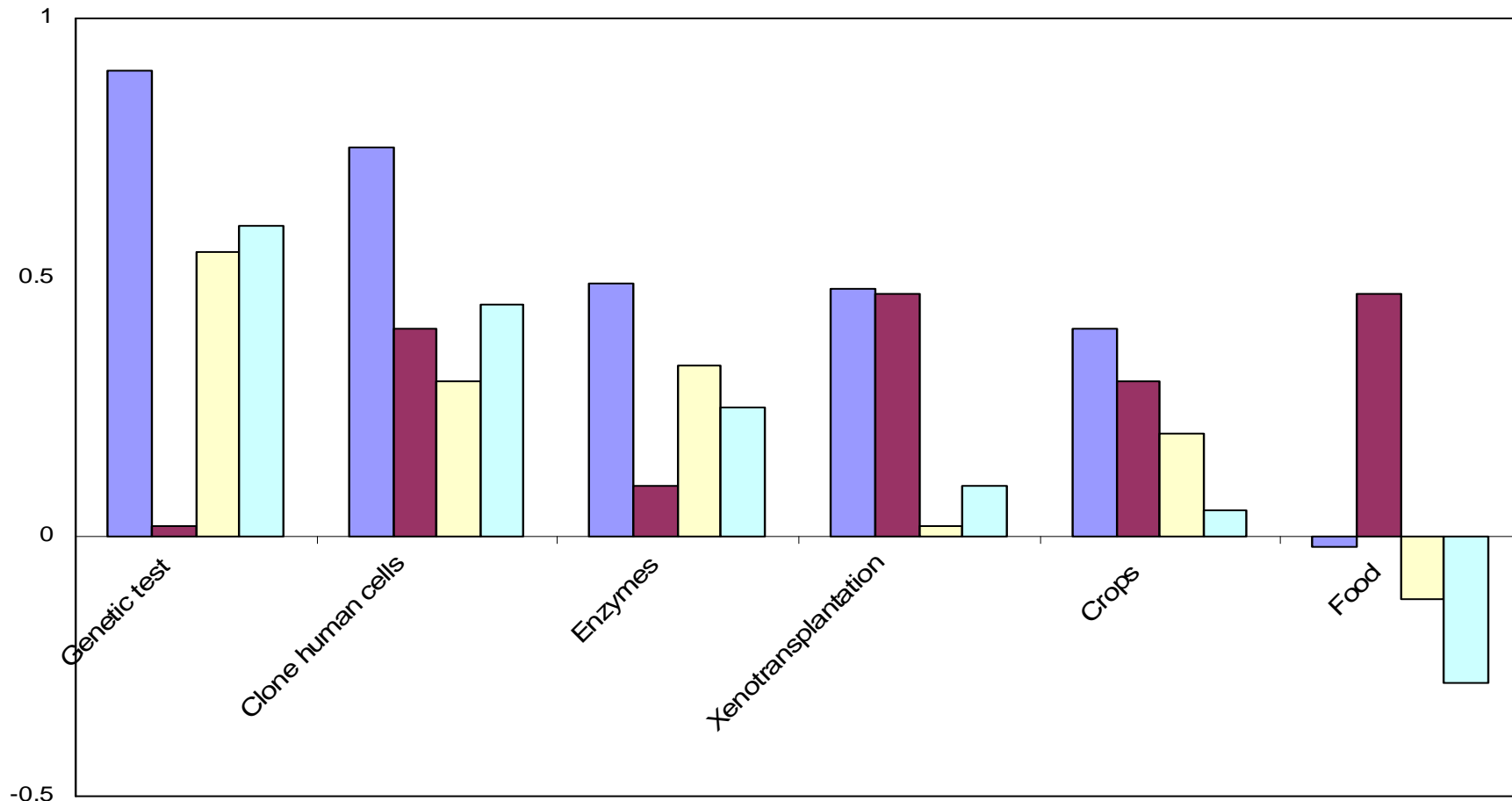
Friends of the Earth



Greenpeace



European attitudes to six applications of biotechnology in 2002



Useful Risky Morally acceptable Should be encouraged

Eurobarometer 58.0



Food Safety & Risk Assessment

- Broad public concern about the safety of the European food supply
- BSE, dioxin, *E. coli* 0157, GM food crops...
- Low public trust in how food crises were handled
- Low trust in the regulatory system in Europe

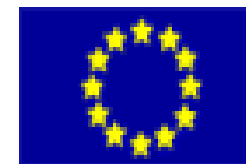


The European Commission reacted

- EU White Paper on Food Safety (COM (1999), 719 final)



- General Food Law (Regulation 178/2002)



- Establishment of the European Food Safety Authority (EFSA) in 2002,
<http://www.efsa.eu.int>



EFSA | European Food Safety Authority - Microsoft Internet Explorer

Bestand Bewerken Beeld Favorieten Extra Help

Vorige Zoeken Favorieten

Adres http://www.efsa.eu.int/about_efsa/catindex_en.html Ga naar Links

de | en | fr | it



European Food Safety Authority

About EFSA | Science | Management Board | Advisory Forum | Press Room | Opportunities | Stakeholders |

About EFSA

- EFSA Structure
- Legislation
- EFSA Funding
- Communicating Risk
- Cooperation
- Enlargement
- Contact Us

About EFSA ■■■

» You are here : EFSAWeb | About EFSA

[Back to the home page <<](#)

Moving towards full strength

Last updated: 14 April 2005

Following a series of food scares in the 1990s (eg BSE, dioxins...) which undermined consumer confidence in the safety of the food chain, the European Union concluded that it needed to establish a new scientific body charged with providing independent and objective advice on food safety issues associated with the food chain. Its primary objective as set out in the White Paper on Food Safety would be to: "...contribute to a high level of consumer health protection in the area of food safety, through which consumer confidence can be restored and maintained." The result was the European Food Safety Authority (EFSA).



Palazzo Ducale in Parma, Italy

Search this site

Latest News

27 September 2005
Call for expressions of interest for the position of member of the Management Board of the European Food safety Authority - Partial renewal of the Management Board of the European Food Safety Authority

Subscribe now to receive the Highlights and EFSA News mailings

[Modify your subscription](#)

Gereed Internet

start

EFSA | European ... Microsoft PowerPoin... Bureaublad Mijn documenten 14:45



Tasks of EFSA

- Risk assessment



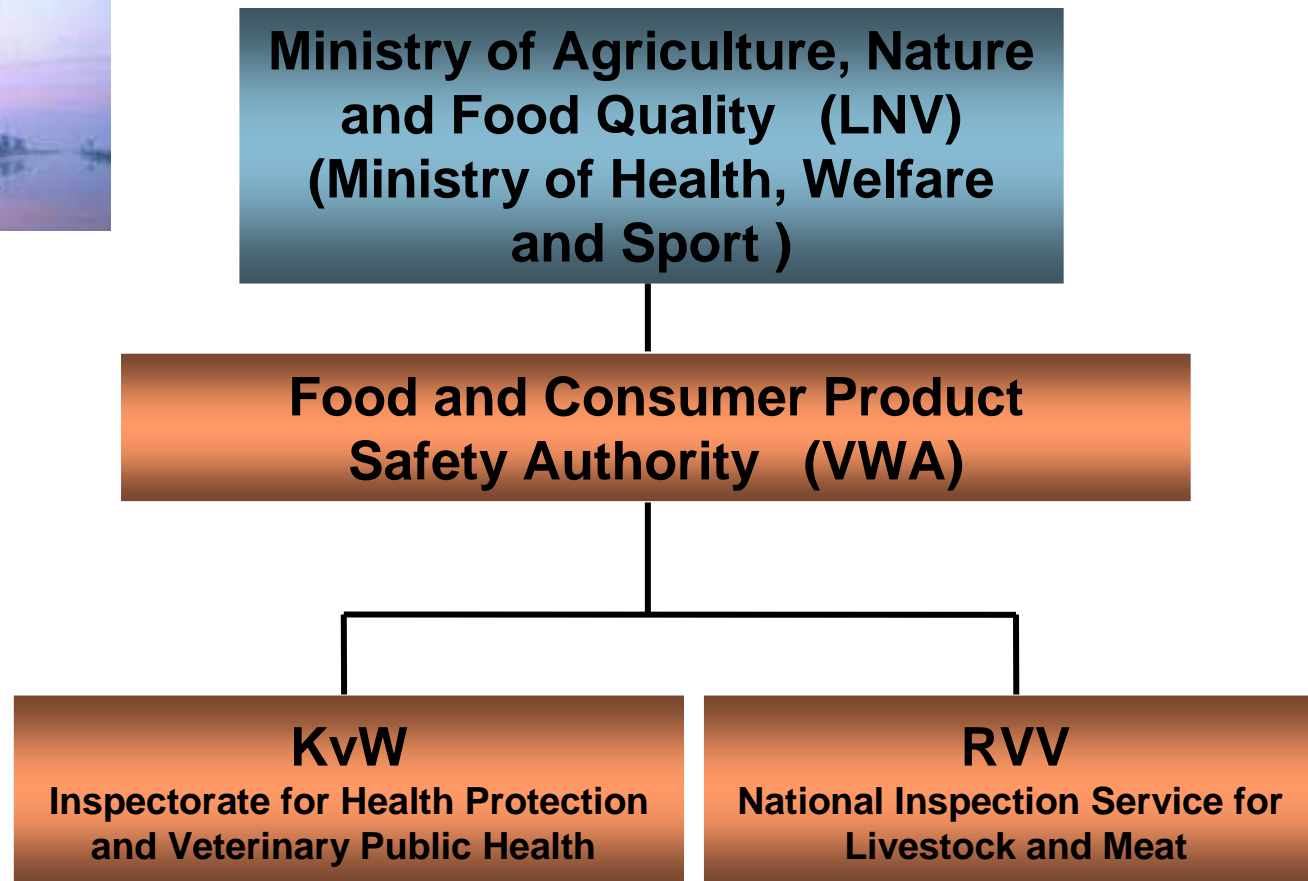
- Risk communication



- *NOT* Risk management!



In many EU members states Food Safety Authorities were established; also in The Netherlands



Food Authorities reaction

“To decrease the number of food safety crises it is important to detect the problem in an very early stage, preferably before it develops”

Available tools:

- Monitoring systems
- Rapid Alerts:
 - EU: RASFF
 - WHO: INFOSAN



Overview of early warning systems

■ Overview of early warning systems (reactive)


- European Rapid Alert System on Food and Feed (RASFF)
- European Centre for Disease Prevention and Control (ECDC)
- Center for Disease control (CDC, USA)
- WHO early warning activities
 - Global Public Health Intelligence Network (GPHIN)
- ...



Source: SAFE FOODS; to be published



Overview of early warning systems

- **Predictive early warning: emerging risk systems**
 - Early warning systems for mycotoxin in maize and / or wheat
 - Trend analysis using information of early warning systems (e.g. RASFF)
 - Holistic approach 

Source: SAFE FOODS; to be published



Emerging Risk Projects

Some projects aim to develop new tools for the early detection of emerging risks (with involvement of RIKILT)

- EU 6th FP: PERIAPT
- EU 6th FP: SAFE FOODS; Workpackage 2
- EFSA: EMRISK
- Dutch project: Emerging Risks in the Dutch Food Chain

Holistic approach: look at influences inside *and* outside the food chain



Some definitions (from EFSA 2007)

Emerging Risk:

An emerging risk to human, animal and/or plant health is understood as a risk resulting from a newly identified hazard to which a significant exposure may occur or from an unexpected new or increased significant exposure and. Or susceptibility to a known hazard

Assessment of Emerging Risk:

Early detection of facts related to that risk derived either from research and/or monitoring programs or episodic observation.

Some definitions (from EFSA 2007)

Emerging Risk Identification:

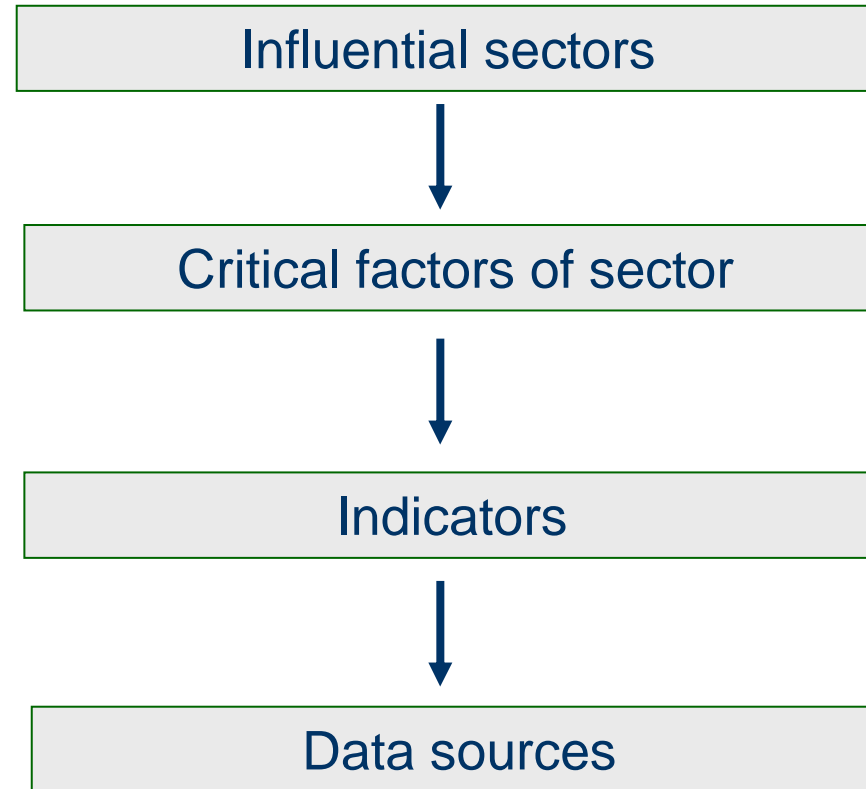
Evidence supporting the identification of an emerging risk should preferably be in the form of an “indicator” and of a trend over time or space.

“Indicator”

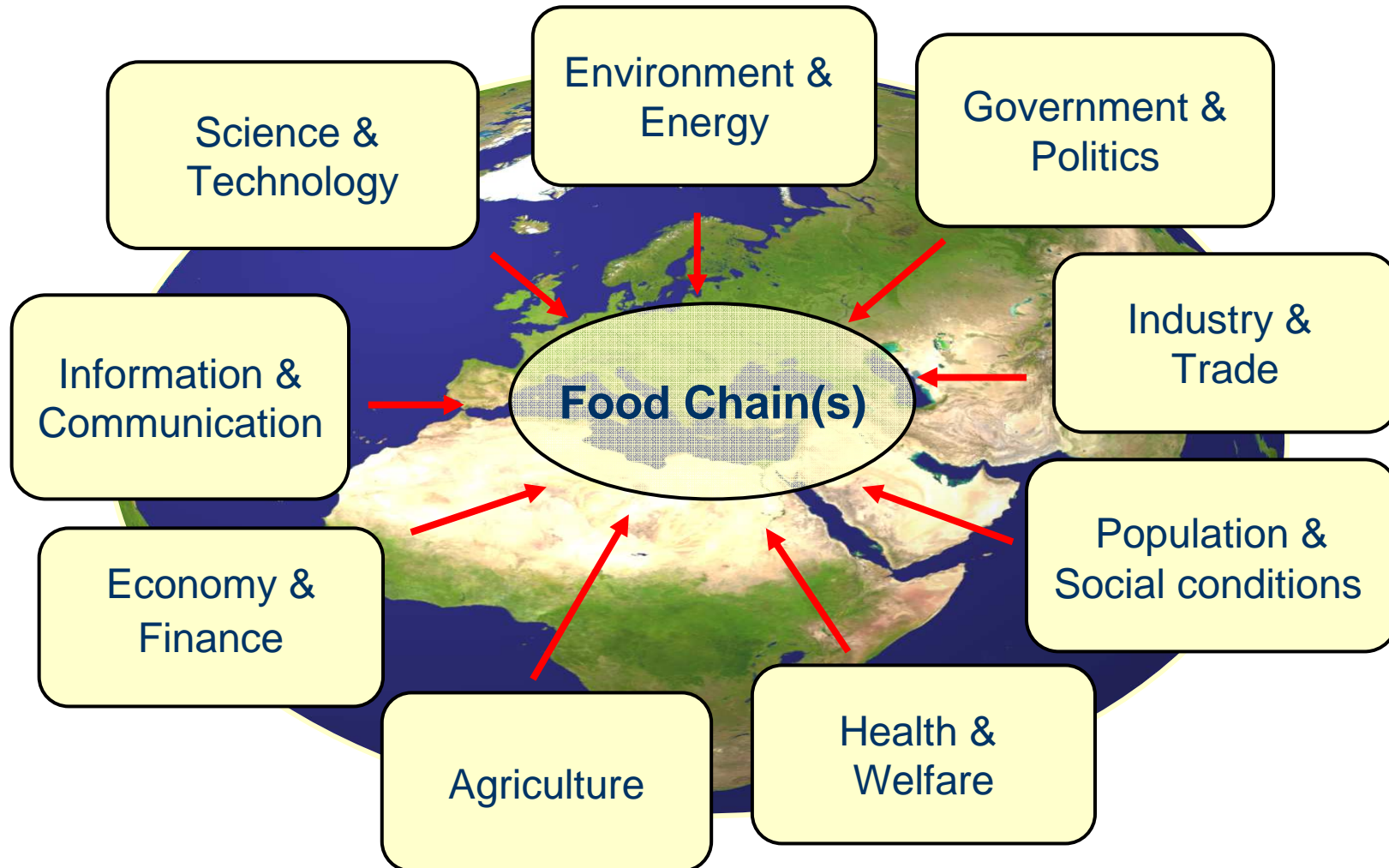
“Indicator” is a measurement and/or observation that should be reliable, sensitive, quantifiable and should provide the information of the nature of the hazard (agent/ process involved) and the source of risk.

“Indicators” may point to a specific emerging risk in different ways, either directly or indirectly related to the food chain.

Holistic approach followed



Examples of Influential Sectors



Source: Wim Ooms VWA, 2006

Key information

To determine the indicators (first influential sector) for emerging food safety risks, case studies have been performed on recent food safety incidents.

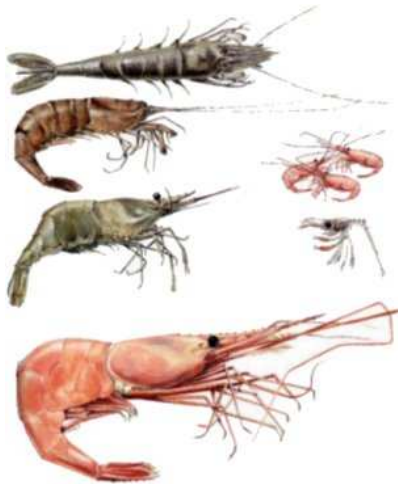
Examples (from different projects):

- Use of botanicals/ herbs in Food and Feed
 - Renal disease after Chinese slimming pills in Belgium
 - Intoxication by consumption of star anise tea
- BSE
- Antibiotics in cultured shrimp
- Acrylamide
- Perfluorinated contaminants in fish
- PCB's/ dioxines and organochlor pesticides in fish
- Dioxine in pork meat
- VTEC Escherichia coli
- ...



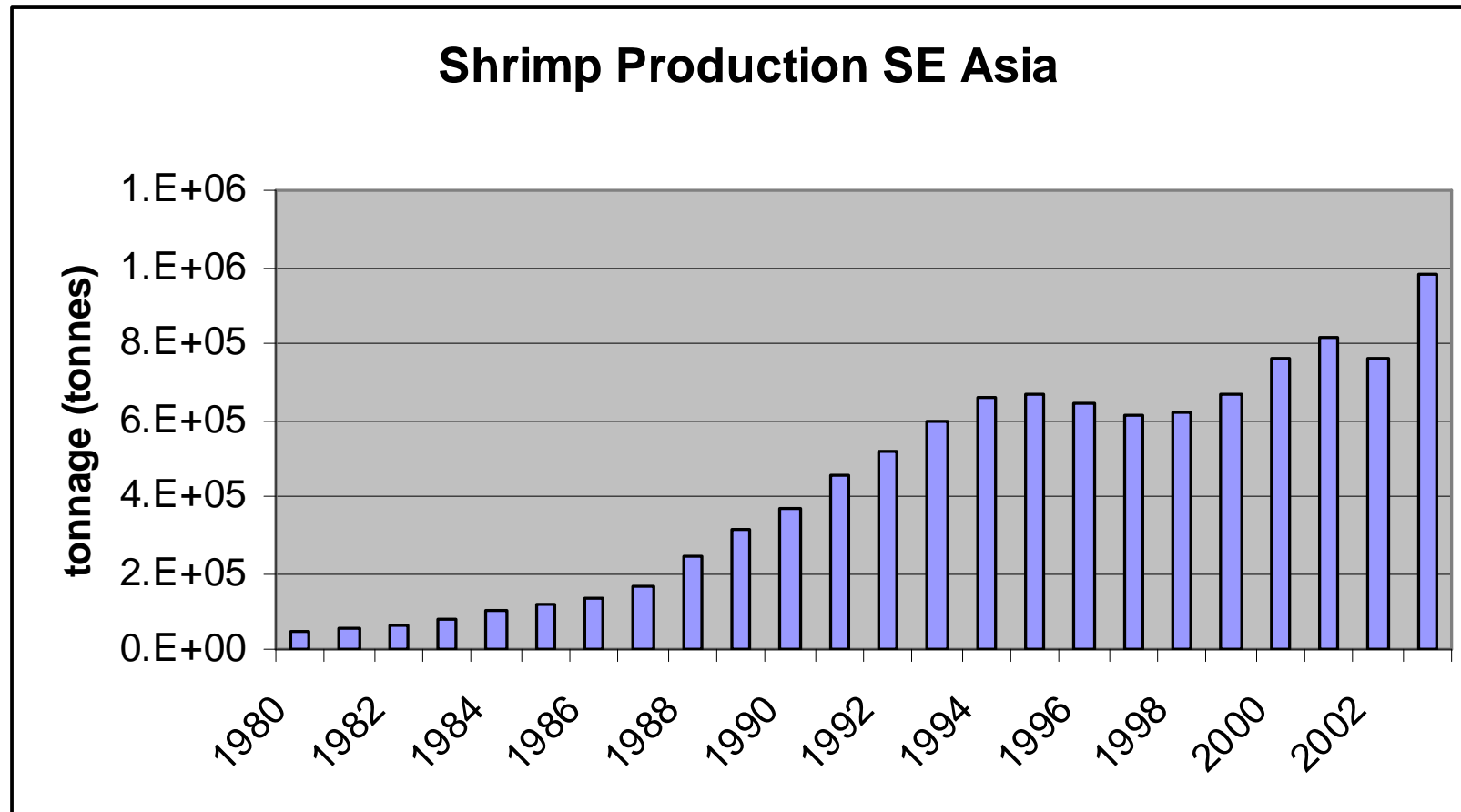
A case study

- Antibiotics in cultured shrimp (an example)



Source: "Inventory of possible emerging hazards to food safety and an analysis of critical factors"
G.A Kleter, M. Poelman, M.J. Groot and H.J.P. Marvin (2006)

Increased demand in Europe for fishery products; increased production in SE Asia

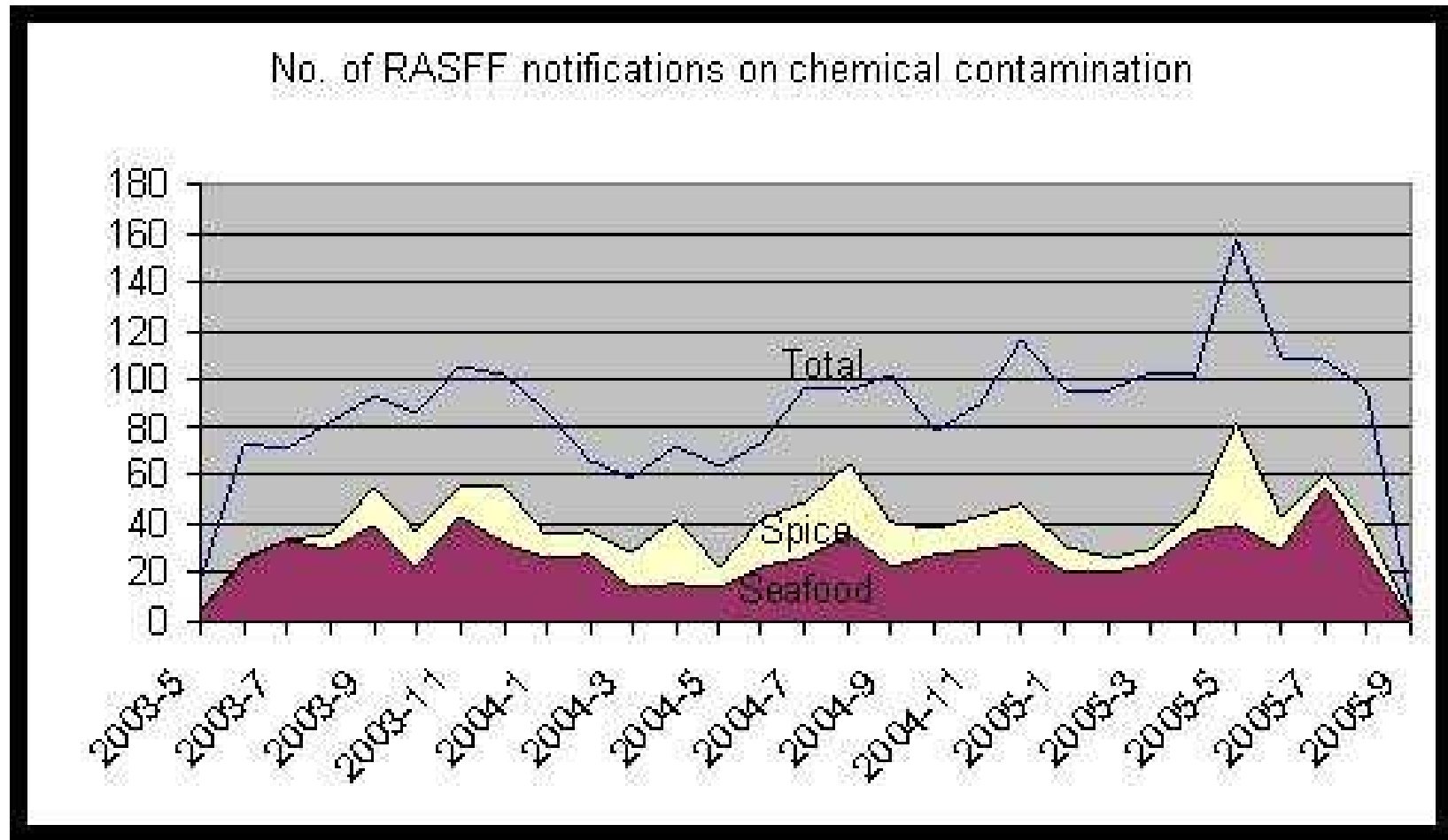


Problems occurring

Increased production associated with intensification of aquaculture

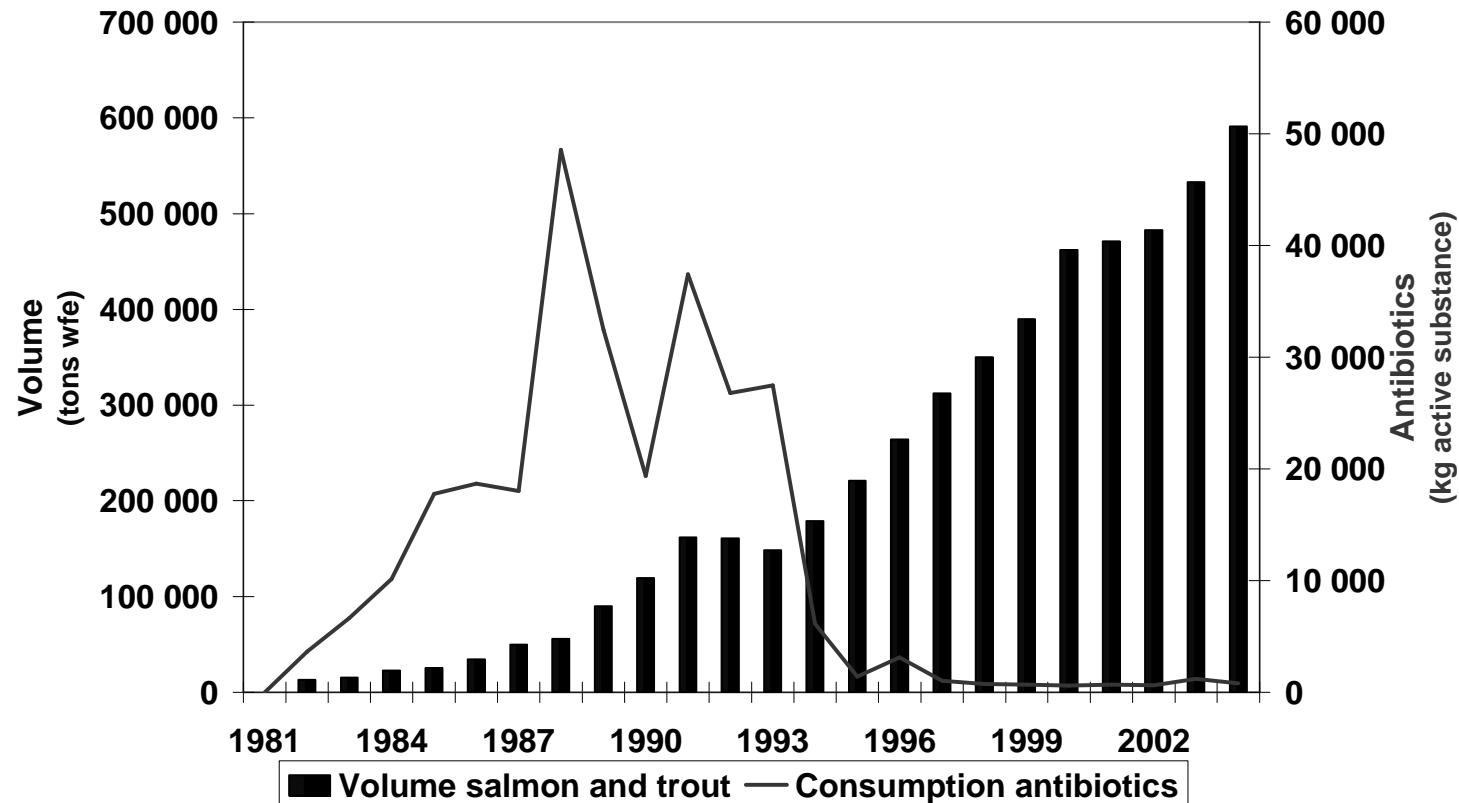
- Increase disease pressure
- Increase use of antibiotics (CAP and nitrofurans)
- No MRL existed for these compounds
- EU; zero tolerance
- Increased control

Monthly notifications of chemical contamination in RASFF



Source: Consumer health hazards in international food trade; Thom Achterbosch 2005

Another case: Use of antibiotics in Norway set off against the volume of farmed salmon and trout



Source: van der Roest et al. 2007



Example of holistic analysis

- Increased production → increased disease pressure → antibiotic use → risk. **Indicator:** increased production. **Source:** FAO, EUROSTAT
- Increased small scale production → lack of knowledge → misuse → risk. **Indicator:** increased small scale production; **Source:** FAO
- More resistant strains → other antibiotics → new risk. **Indicator:** more resistant strains; **Source:** science programs
- Lack of international harmonised legislation → zero tolerance → risk.

Emerging risk systems: Holistic approach

Conclusions of the case studies

In every case study influential sectors were identified

- Most frequent influential sectors were:
 - Science and technology
 - Human behavior
 - Nature and environment
 - Legislation & economy
- Many indicators were identified, generic and case-specific
- Emerging risk systems based on holistic principle seem promising but need much more research



Emerging risk systems: Holistic approach

Towards a holistic Emerging Risk System

Dutch research project

“Emerging risks in the Dutch food chain”*

4-years project (2004-2008)

Coordinator: Hans Marvin (RIKILT)

*(supervised by VWA and LNV)



Performed studies

- **Pro-active approaches to the identification of emerging risks in the food chain: retrospective case studies** (Dioxin in pork meat, BSE crisis in Great Britain, The HPA1 epidemic in the Netherlands in 2003, Residues of PCBs, dioxins and organochlorine pesticides in cultured fish, Perfluorinated contaminants in fish)
- **Inventory of possible emerging hazards to food safety and analysis of critical factors** (antibiotics in shrimps; pesticides of natural origin)
- **Consumer health hazards in international food trade**
- **The perception of emerging risks among stakeholders in the food production chain**

WORKSHOP “Emerging Risks and Early Warning Systems”:
<http://www.afsq.nl/emergingrisks>

- ⇒ **Focus on the fish production chain**
- **Option for pro-active identifying emerging risk in the fish production chain**
- **Development of a prototype**



information documents internet, ...



signals

expert knowledge

Development of a prototype: the approach

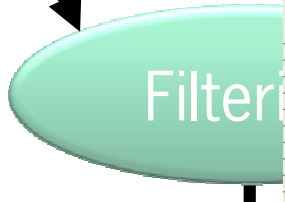


Identified Emerging Risks



Source: Hulzebos et al. 2007

information
documents
internet, ...



signals

PERMIT NO.	DATE ISSUED	Expiry Date	IMPORTER CODE	IMPORTER	COMPANY NAME	NAME OF FISH	DESCRIPTION	VOLUME
C-0319-2003	20-aug-03	20-sep-03	C-22	Mr. Lawrence Kiok	Permex Producer & Exporter Corp.	Skipjack	Frozen	477 MT
C-0320-2003	20-aug-03	20-sep-03	C-04	Mr. Gregory G. Tung, Jr.	A. Tung Chingco Trading Inc.	Mackerel	Frozen	16104 kg
C-0321-2003	20-aug-03	20-sep-03	C-02	Mr. Benjamin Sy	Chattrade Enterprises	Mackerel	Frozen	52,755 MT
C-0323-2003	20-aug-03	20-sep-03	C-02	Mr. Benjamin Sy	Chattrade Enterprises	Mackerel	Frozen	53.22 MT
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 10/30	3000 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 20/40	2208 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 30/50	12000 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 50/70	15096 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 70/90	1004 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 100/200	2292 kgs
P-0442-2003	21-aug-03	21-sep-03	P-28	Mr. Benedicto Alves	East Asia Fish Co. Inc.	Yellow Fin Tuna	Fresh/Chilled	5 Tons
P-0442-2003	21-aug-03	21-sep-03	P-28	Mr. Benedicto Alves	East Asia Fish Co. Inc.	Big Eye Tuna	Fresh/Chilled	4 Tons
P-0443-2003	21-aug-03	21-sep-03	P-44	Ms. Evelyn Chiu	Philippine Kingford Inc.	Yellow Fin Tuna	Fresh/Chilled	4 Tons
P-0443-2003	21-aug-03	21-sep-03	P-44	Ms. Evelyn Chiu	Philippine Kingford Inc.	Big Eye Tuna	Fresh/Chilled	2 tons
P-0443-2003	21-aug-03	21-sep-03	P-44	Ms. Evelyn Chiu	Philippine Kingford Inc.	Swordfish	Fresh/Chilled	1.5 tons
P-0443-2003	21-aug-03	21-sep-03	P-44	Ms. Evelyn Chiu	Philippine Kingford Inc.	Marlin	Fresh/Chilled	1 tons

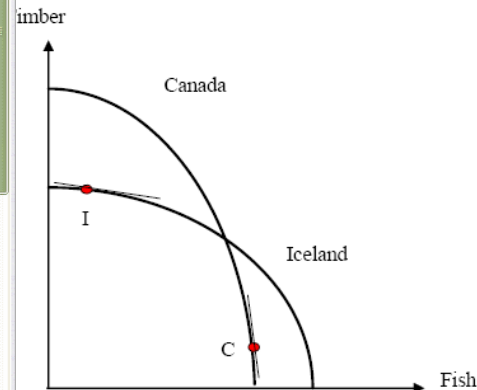
4. (10 minutes/10 points) Consider an economy with two goods, timber and fish, and two countries, Canada and Iceland. Draw a graph that reflects the following information.

- Both countries have increasing marginal costs of production for timber and fish.
- Iceland has an absolute advantage in fish.

Canada has an absolute advantage in timber.

Under autarky, Canada would devote almost all of its resources to fishing and Iceland would devote almost all of its resources to timber production.

Draw a graph to explain what good, if any, each country has a comparative advantage in producing. Which country, if any, will export timber and which, if any will export fish.



The graph shows that Iceland has a lower opportunity cost of producing fish than Canada. Thus, Iceland has a comparative advantage in producing fish and should export fish to Canada. Canada will then have the comparative advantage in harvesting timber and should export timber to Iceland.

Source: Hulzebos et al. 2007

information
documents
internet, ...



signals

PERMIT NO.	DATE ISSUED	Expiry Date	IMPORTER CODE	IMPORTER	COMPANY NAME	NAME OF FISH	DESCRIPTION	VOLUME
C-0319-2003	20-aug-03	20-sep-03	C-22	Mr. Lawrence Kiok	Permex Producer & Exporter Corp.	Skipjack	Frozen	477 MT
C-0320-2003	20-aug-03	20-sep-03	C-04	Mr. Gregory G. Tung, Jr.	A. Tung Chingco Trading Inc.	Mackerel	Frozen	16104 kg
C-0321-2003	20-aug-03	20-sep-03	C-02	Mr. Benjamin Sy	Chattrade Enterprises	Mackerel	Frozen	52,755 MT
C-0323-2003	20-aug-03	20-sep-03	C-02	Mr. Benjamin Sy	Chattrade Enterprises	Mackerel	Frozen	53.22 MT
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 10/30	3000 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 20/40	2208 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 30/50	12000 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 50/70	15096 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 70/90	1004 kgs
P-0441-2003	18-aug-03	18-sep-03	P-46	Mr. Mariano Qua	Ocean Light Export & Import Corp.	Sea Shrimps	Size 100/200	2292 kgs
P-0442-2003	21-aug-03	21-sep-03	P-28	Mr. Benedicto Alves	East Asia Fish Co. Inc.	Yellow Fin Tuna	Fresh/Chilled	5 Tons
P-0442-2003	21-aug-03	21-sep-03	P-28	Mr. Benedicto Alves	East Asia Fish Co. Inc.	Big Eye Tuna	Fresh/Chilled	4 Tons
P-0443-2003	21-aug-03	21-sep-03	P-44	Ms. Evelyn Chiu	Philippine Kingford Inc.	Yellow Fin Tuna	Fresh/Chilled	4 Tons
P-0443-2003	21-aug-03	21-sep-03	P-44	Ms. Evelyn Chiu	Philippine Kingford Inc.	Big Eye Tuna	Fresh/Chilled	2 tons
P-0443-2003	21-aug-03	21-sep-03	P-44	Ms. Evelyn Chiu	Philippine Kingford Inc.	Swordfish	Fresh/Chilled	1.5 tons
P-0443-2003	21-aug-03	21-sep-03	P-44	Ms. Evelyn Chiu	Philippine Kingford Inc.	Marlin	Fresh/Chilled	1 tons

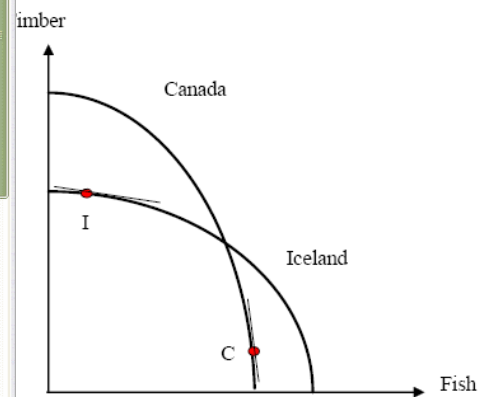
4. (10 minutes/10 points) Consider an economy with two goods, timber and fish, and two countries, Canada and Iceland. Draw a graph that reflects the following information.

- a. Both countries have increasing marginal costs of production for timber and fish.
- b. Iceland has an absolute advantage in fish.

Canada has an absolute advantage in timber.

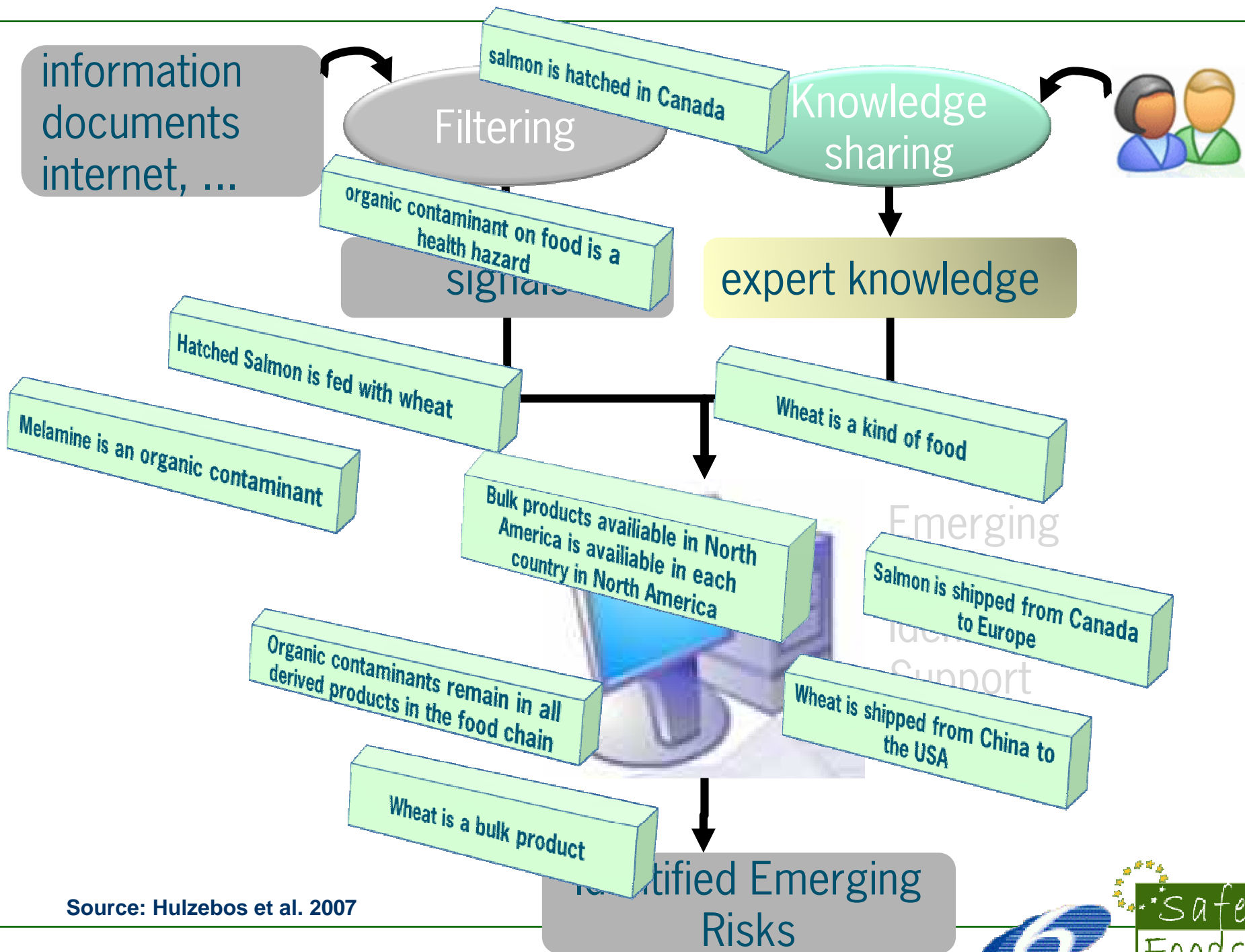
Under autarky, Canada would devote almost all of its resources to fishing and Iceland would devote almost all of its resources to timber production.

Draw a graph to explain what good, if any, each country has a comparative advantage in producing. Which country, if any, will export timber and which, if any will export fish.



The graph shows that Iceland has a lower opportunity cost of producing fish than Canada. Thus, Iceland has a comparative advantage in producing fish and should export fish to Canada. Canada will then have the comparative advantage in harvesting timber and should export timber to Iceland.

Source: Hulzebos et al. 2007



Source: Hulzebos et al. 2007



information documents internet, ...

Filtering

salmon is hatched in Canada

Knowledge sharing



organic contaminant on food is a health hazard

expert knowledge

Hatched Salmon is fed with wheat

Wheat is a kind of food

Melamine is an organic contaminant

Bulk products available in North America is available in each country in North America

Salmon is shipped from Canada to Europe

Organic contaminants remain in all derived products in the food chain

Wheat is shipped from China to the USA

Wheat is a bulk product

Identified Emerging Risks



Source: Hulzebos et al. 2007



Current & historical signals

Near/far future



Signals X

Risks Y



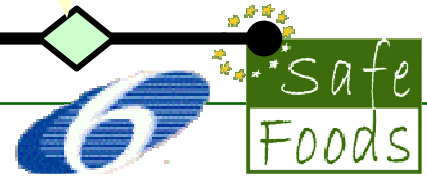
Signals X

ERDS system:
Emerging Risks!

Anticipation on
Emerging Risks



Now



2007-March-30

2007-May-09

The USA ceases imports of wheat gluten from a Chinese company

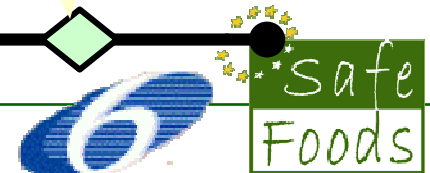
Melamine discovered in hatchery fish food in Canada

The FDA ceases imports of wheat gluten from a Chinese company

ERDS system:
Melamine is an emerging risk in hatchery fish food!

Anticipated on emerging risk in Canada

2007-March-30



Possible design of the Emerging Risk Detection System; first page

Emerging Risk Detection Support (ERDS)

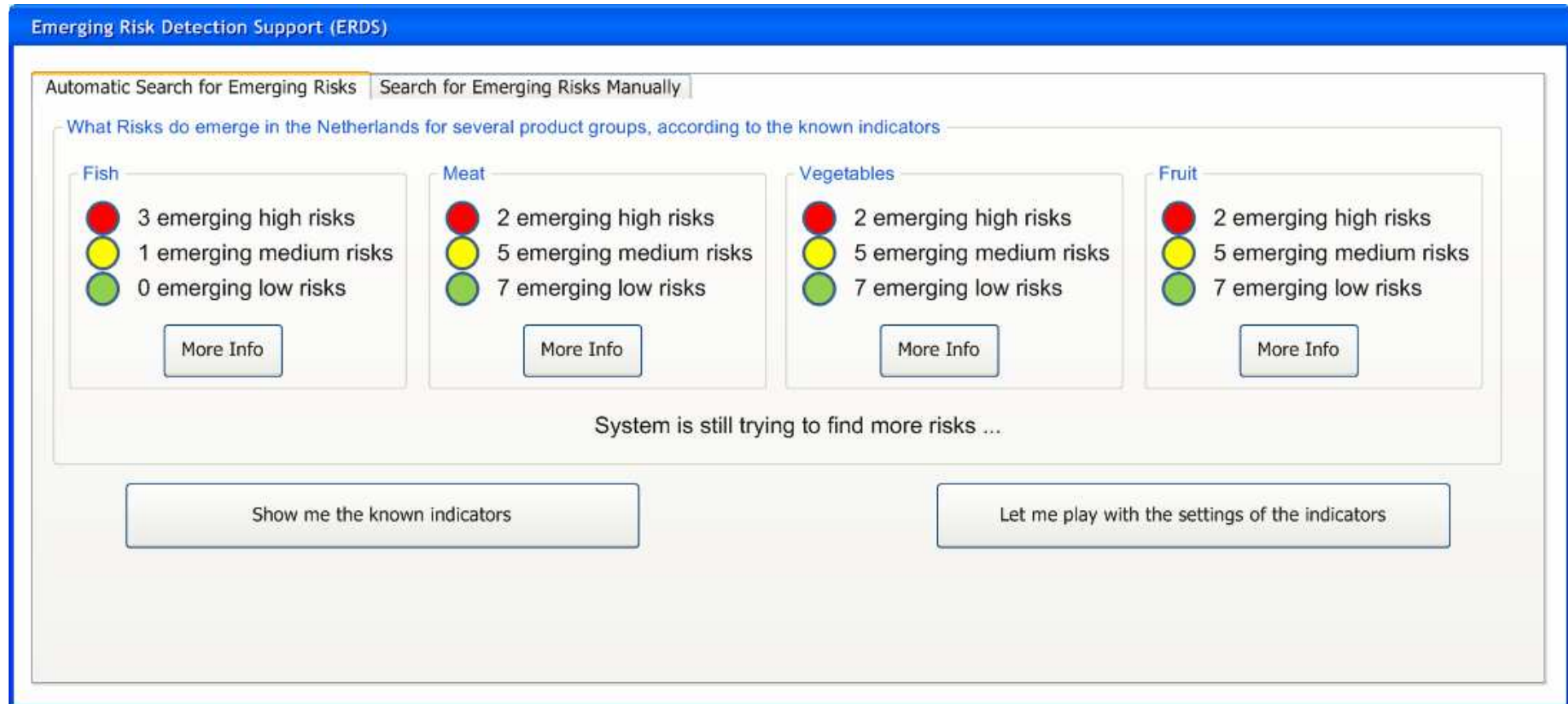
Automatic Search for Emerging Risks | Search for Emerging Risks Manually

What Risks do emerge in the Netherlands for several product groups, according to the known indicators

Product Group	High Risks	Medium Risks	Low Risks
Fish	3	1	0
Meat	2	5	7
Vegetables	2	5	7
Fruit	2	5	7

System is still trying to find more risks ...

Show me the known indicators | Let me play with the settings of the indicators



Source: Hulzebos et al. 2007

	Signal							ER criterium	
Melamine	X								
Wheat	X								
USA	X								
Health hazard									X
Fish									X
Europe									X

Source: Hulzebos et al. 2007



	Signal	S1								ER criterium
Melamine	X	X								
Wheat	X	X								
USA	X	X								
Health hazard		X								X
Fish										X
Europe										X

•Wheat is a kind of food
 •Melamine is an organic contaminant
 •Organic contaminant in food is a health hazard

Source: Hulzebos et al. 2007



	Signal	S1	S2							ER criterion
Melamine	X	X	X							
Wheat	X	X	X							
USA	X	X								
Canada			X							
Health hazard		X	X							X
Fish										X
Europe										X

•Wheat is a bulk product
 •Bulk products available in north America is available in each country of north America

Source: Hulzebos et al. 2007



	Signal	S1	S2	S3							ER criterion	
Melamine	X	X	X	X								
Wheat	X	X	X	X								
USA	X	X										
Canada			X	X								
Fish Farmer				X								
Health hazard		X	X	X								X
Fish												X
Europe												X

•Fish Farmers breeding salmon are located in Canada
 •Salmon is fed with fish feed
 •Wheat is a fish feed

Source: Hulzebos et al. 2007



	Signal	S1	S2	S3	S4					ER criterion
Melamine	✕	✕	✕	✕	✕					
Wheat	✕	✕	✕	✕						
USA	✕	✕								
Canada			✕	✕	✕					
Fish Farmer				✕	✕					
Health hazard		✕	✕	✕						✕
Fish					✕					✕
Europe										✕

•Fish farmers breeding salmon are located in Canada
 •Salmon is a kind of fish
 •Organic contaminants remain in all derived products in the food chain.

Source: Hulzebos et al. 2007



	Signal	S1	S2	S3	S4	S5	ER criterion
Melamine	✕	✕	✕	✕	✕	✕	
Wheat	✕	✕	✕	✕			
USA	✕	✕					
Canada			✕	✕	✕	✕	
Fish Farmer				✕	✕	✕	
Health hazard						✕	✕
Fish					✕	✕	✕
Europe							✕

•Fish is a kind of food
 •Organic contaminant in food is a health hazard

Source: Hulzebos et al. 2007

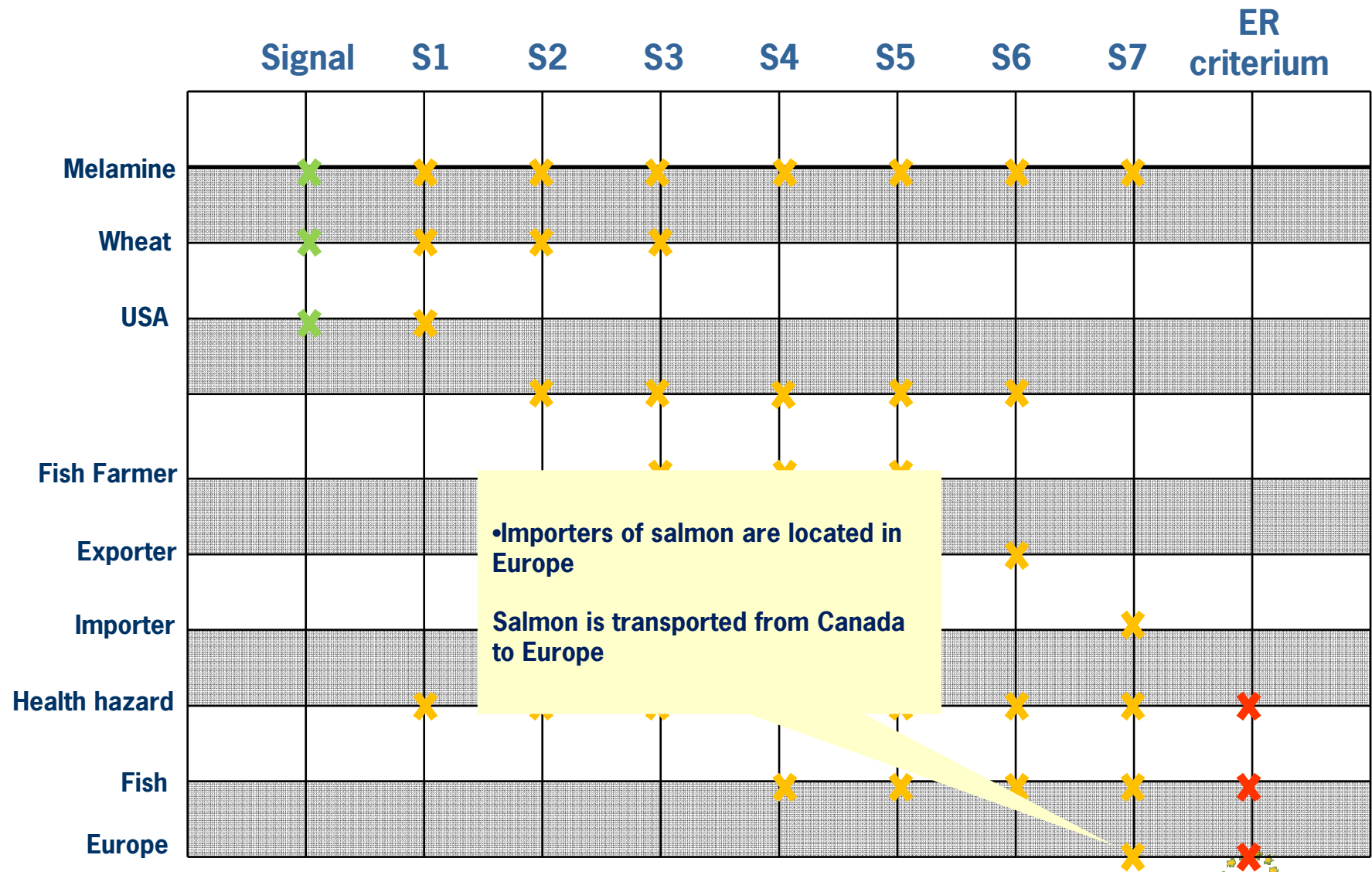


	Signal	S1	S2	S3	S4	S5	S6	ER criterion
Melamine	✕	✕	✕	✕	✕	✕	✕	
Wheat	✕	✕	✕	✕				
USA	✕	✕						
Canada			✕	✕	✕	✕	✕	
Fish Farmer				✕	✕	✕		
Exporter							✕	
Health hazard						✕	✕	✕
Fish					✕	✕	✕	✕
Europe								✕

•Exporters of salmon are located in Canada

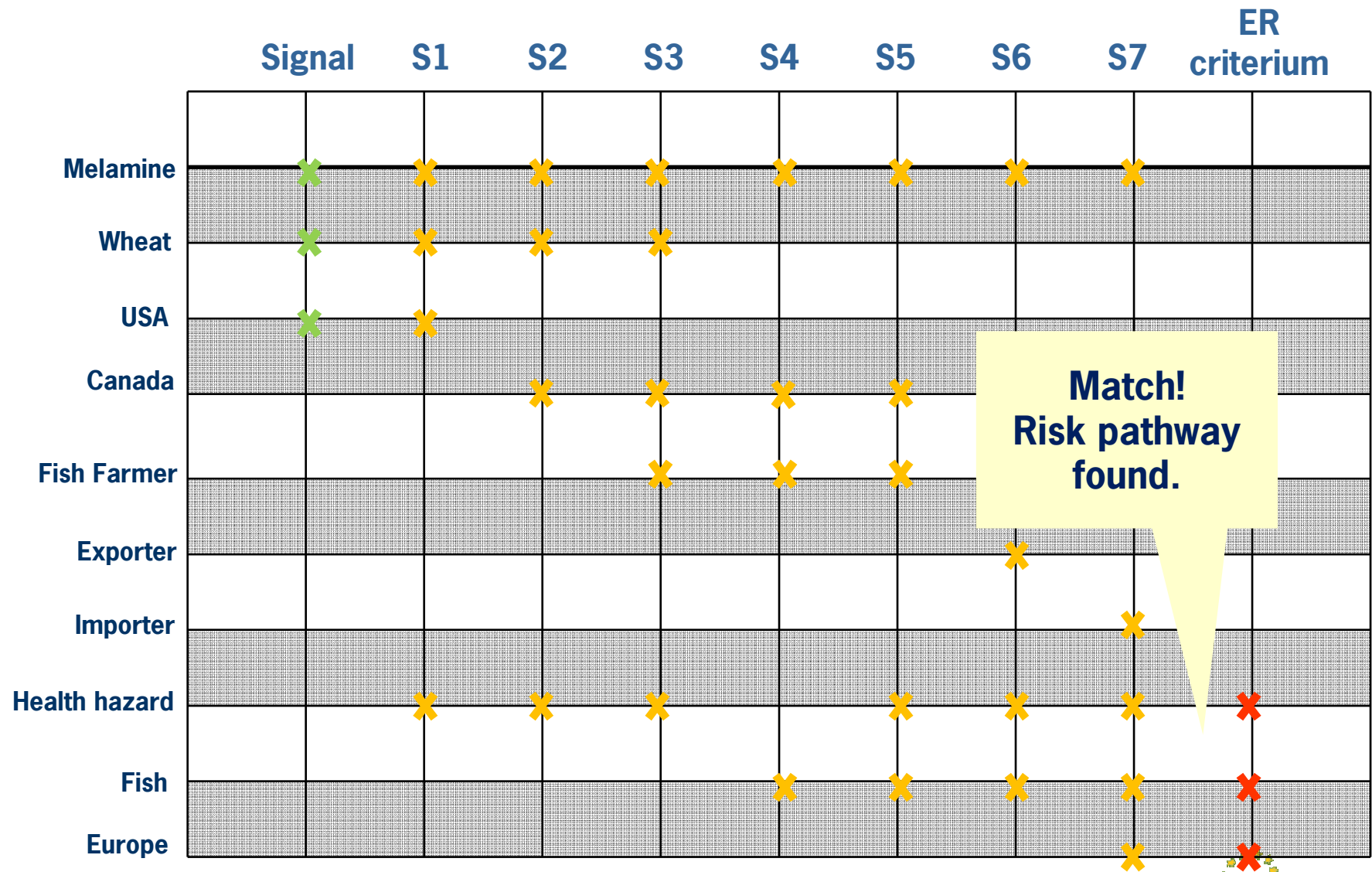
Source: Hulzebos et al. 2007





Source: Hulzebos et al. 2007





**Match!
Risk pathway
found.**

Source: Hulzebos et al. 2007



Found Risks with high health risk, europe, salmon

Risk nr.	Importance	#user questions	keywords
1	red	0	high health risk, chile, antibiotic ...
2	red	2	high health risk, chile, farming ...
3	red	4	high microbiological risk, listeria ..
4	orange	2	medium health risk, s.e. asia, catfish

Risk #3 showing situations related to high microbiological risk, europe, salmon



Legenda:

- Each rectangle represents an situation.
- A situation consists of one or more attributes that are or can be valid alltogether in a certain moment of time.
- The lines represent the cause/effect relations between two situations or the semantic equivalent relationships.
- Click a rectangle for more details

Source: Hulzebos et al. 2007

Change Search Criteria

Report

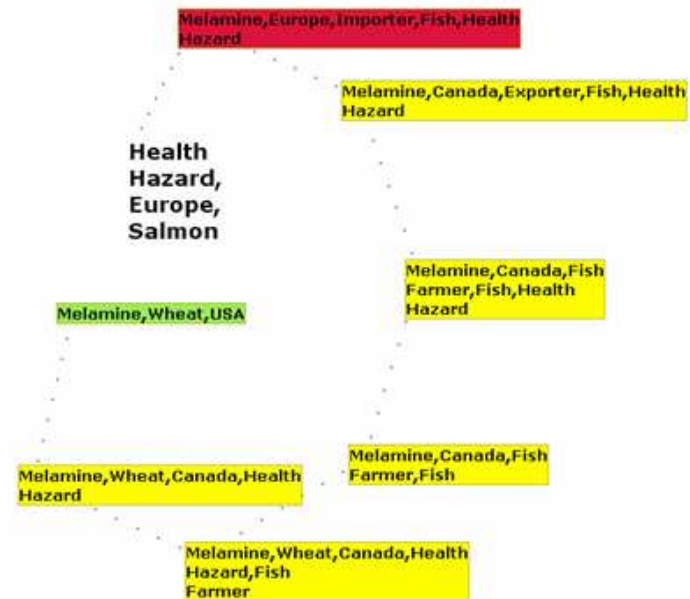
Emerging Risk Detection Support (ERDS): Search for Emerging Risks

Found Risks with high health risk, europe, salmon

Risk nr.	Importance	#user questions	keywords
1	red	0	high health risk, chile, antibiotic ...
2	red	2	high health risk, chile, farming ...
3	red	4	high microbiological risk, listeria ..
4	orange	2	medium health risk, s.e. asia, catfish

Risk #3 showing situations related to high microbiological risk, europe, salmon

global detail



Show in Graph

- Situations
 - observed
 - possible
- Attributes
 - behavior
 - product
 - actor
 - location
 - risk
 - hazard

Legenda:

- Each rectangle represents an situation.
- A situation consists of one or more attributes that are or can be valid altogether in a certain moment of time.
- The lines represent the cause/effect relations between two situations or the semantic equivalent relationships.
- Click a rectangle for more details

Source: Hulzebos et al. 2007

Change Search Criteria

Report

Emerging Risk Detection Support (ERDS): Search for Emerging Risks

Found Risks with high health risk, europe, salmon

Risk nr.	Importance	#user questions	keywords
1	red	0	high health risk, chile, antibiotic ...
2	green	2	low health risk, chile, farming, ...
3	red	4	high microbiological risk, listeria ..
4	orange	2	medium health risk, s.e. asia, catfish

Risk #3 showing situations related to high microbiological risk, europe, salmon



Risk #2

Known Indicators (click to alter)

Environment & Energy
illegal waste dumps (pacific): rapid increase [WHO]
illegal waste dumps (atlantic): stable [WHO]

Government & Politics

User Questions (click to assign value)

Industry & Trade
production trend (asia, fish): {decrease, stable, increase}

Agriculture
disease pressure (salmon, farmed, s.e. asia): Unknown {high, medium, low, unknown}

OK

Fish

Show in Graph

- Situations
 - observed
 - possible
- Attributes
 - behavior
 - product
 - actor
 - location
 - risk
 - hazard

- Legend:
- Each circle represents an situation.
 - A situation consists of one or more attributes that are or can be valid altogether in a certain moment of time.
 - The lines represent the cause/effect relations between two situations or the semantic equivalent relationships.
 - The circles with a dot are observed situations, whereas the circles without a dot are derived situations.
 - Click a circle for more details

Source: Hulzebos et al. 2007

Change Search Criteria

Report

Future perspectives: combining two systems

PERMIT NO.	DATE ISSUED	EXPIRY DATE	IMPORTER CODE	IMPORTER	COMPANY NAME	NAME OF FISH	DESCRIPTION	VOLUME
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Advice to management (industry/authorities)

4. (30 points) Consider an economy with two goods, timber and fish, and two countries, Canada and Iceland. There is a graph that reflects the following information:

- a. Both countries have increasing marginal costs of production for timber and fish.
- b. Iceland has an absolute advantage in fish.
- c. Canada has no absolute advantage in timber.
- d. Under autarky, Canada would devote almost all of its resources to fishing and Iceland would devote almost all of its resources to timber production.

The new graph to replace the graph if any, each country has a comparative advantage in producing which country, if any, will export timber and which, if any, will export fish.



The graph shows that Iceland has a lower opportunity cost of producing fish than Canada. Thus, Iceland has a comparative advantage in producing fish and should export fish to Canada. Canada will then have a comparative advantage in producing timber and should export timber to Iceland.



Signals

More Signals

Text Mining

ERDSS

ERI

Focus on ER Research
Ontology Improvement



Further questions to be answered

- What is the quality of the data sources?
- How to avoid overkill of output?
- Is there a quantitative relationship between indicator(s) (data source) and the emerging risk?
- Can we make a generic method / procedure to identify emerging risks in the food and feed chain based on the indicators?



Thank you for your attention

