Improving safety in the food production chain through risk-based monitoring of feed

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Why risk-based monitoring ?

- **Official controls** of feed and feed materials by **Member States** should be carried out regularly, on a **risk basis** and with **appropriate frequency** (Regulation (EC) 882/2004, the "Official Control Regulation", Article 3)
- Article 3 a: taking account of identified risks associated with **animals, feed or food**, feed or food businesses, the use of feed or food or any process, material, substance, activity or operation that may influence **feed or food safety**, **animal health** or **animal welfare**

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How to estimate the risks ?

- How to estimate the risks of feed and feed materials ?
  - Gut feelings
  - Feed crises / incidents
  - RASFF (European Rapid Alert System)
  - Expert opinion
- Dutch approach:
  - Expert opinion ..... and
  - Model for risk-based monitoring
  - Trend analysis

Model for risk-based monitoring (1)

- Which factors should be included in the model ?

  a) Which contaminants ?

  - Our *start*: dioxins, aflatoxin B1, DON

  b) Volume of a feed ingredient (NL feed consumption):

  - Wheat (by-products): 3.302.000 ton
  - Copra: 20.000 ton

  ➡ More samples for wheat

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Model for risk-based monitoring (2)

- Which factors should be included in the model (2)?

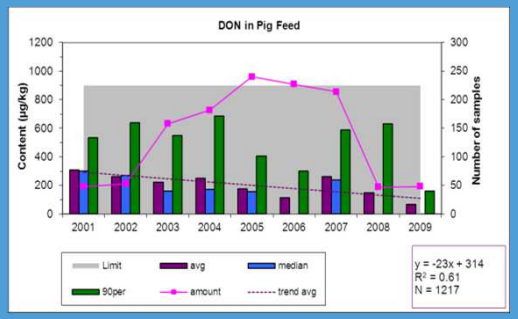
c) Risk for exposure of humans through consumption of meat, eggs, milk, viz. **transfer from feed to food**: e.g. dioxins are transferred to milk and eggs but DON is hardly transferred to food

d) Toxicity for animals (*by species*): e.g. pigs are more sensitive for DON than other species

Model for risk-based monitoring (3)

- Which factors should be included in the model (3)?
  - e) Risks for contamination, specified for each contaminant, for each country or *region* of origin and for each feed ingredient

    - Trend analysis data



    - Information on processing (e.g. drying), climate, etc.
    - RASFF data

RASFF
Rapid Alert System for Food and Feed

Model for risk-based monitoring (4)

- All factors are included in the following formula:

$$R_{human} = (^{10}\log a) * b * c * d_{human} * e$$

$$R_{animal} = (^{10}\log a) * b * c * d_{animal} * e$$

- The risk scores R_{human} and R_{animal} are calculated for feeds for individual animal species and summed up in order to give a **total risk score** for a **selected contaminant** in a **selected feed ingredient**

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Model for risk-based monitoring (5)

$$R_{human} = (^{10}\log a) * b * c * d_{human} * e$$

a. volume of a feed ingredient included in Dutch feeds (in 1000 tons); log-transformation because otherwise the volume has too much weight in the risk score
b. share of the feed ingredient in a feed for a selected animal species (0-1)
c. share of the country of origin of the feed ingredient (0-1)
d. exposure of humans through consumption of animal products (0-1)
e. risk factor for each country of origin (0-1)

Model for risk-based monitoring (6)

Example of calculation of the risk of dioxins in maize from Brazil consumed by laying hens

	a, use, kton	b, to layers	c, from Brazil	d, toxicity / exposure	E, risk in Brazil	Risk score, $x10^3$
Animal	2458	0.25	0.31	0.1	0.1	2.67
Human	2458	0.25	0.31	1	0.1	26.7

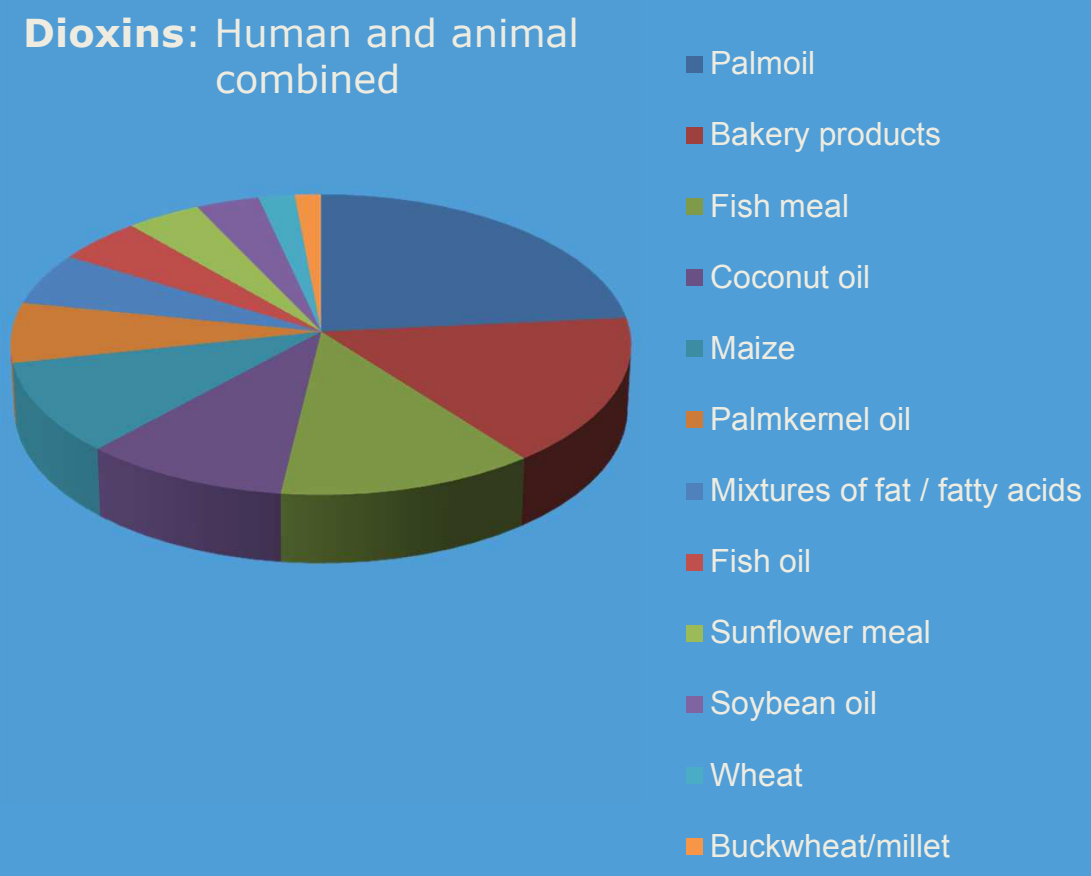
Model for risk-based monitoring (7)

Example of use of maize and distribution (%) of risk of dioxin and DON for different target animal categories and human food

category	Usage, %	Dioxin		DON	
		Human	Animal	Human	Animal
growing pigs	17	3.7	0.4	0	55.6
sows	6	1.5	0.2	0	18.1
broilers	38	8.3	8.3	0	12.4
laying hens	26	56.0	6.2	0	8.5
dairy cattle	6	11.5	0.1	0	1.9
other	7	3.3	0.3	0	3.5
	100	84.4	15.6	0	100

Model for risk-based monitoring (8)

Advice for official control for dioxins



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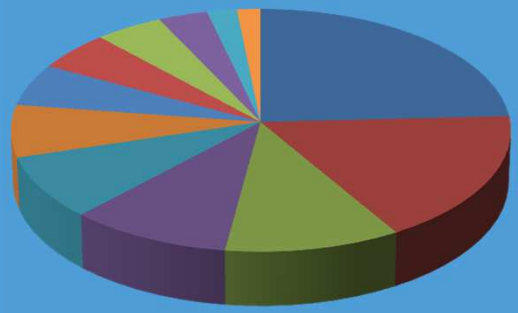
Model for risk-based monitoring (9)

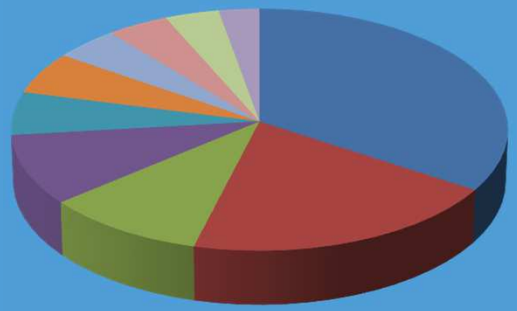
Advice for official control for dioxins

Dioxins: Human



- Palm oil
- Bakery products
- Coconut oil
- Maize
- Fish meal
- Palmkernel oil
- Fatty acids mixtures
- Fish oil
- Sunflower oil
- Soybean oil
- Wheat
- Buckwheat/millet

Dioxins: Animal



- Fish meal
- Palm oil
- Maize
- Bakery products
- Coconut oil
- Fatty acids mixtures
- Soybean oil
- Peas
- Palmkernel oil
- Fish oil

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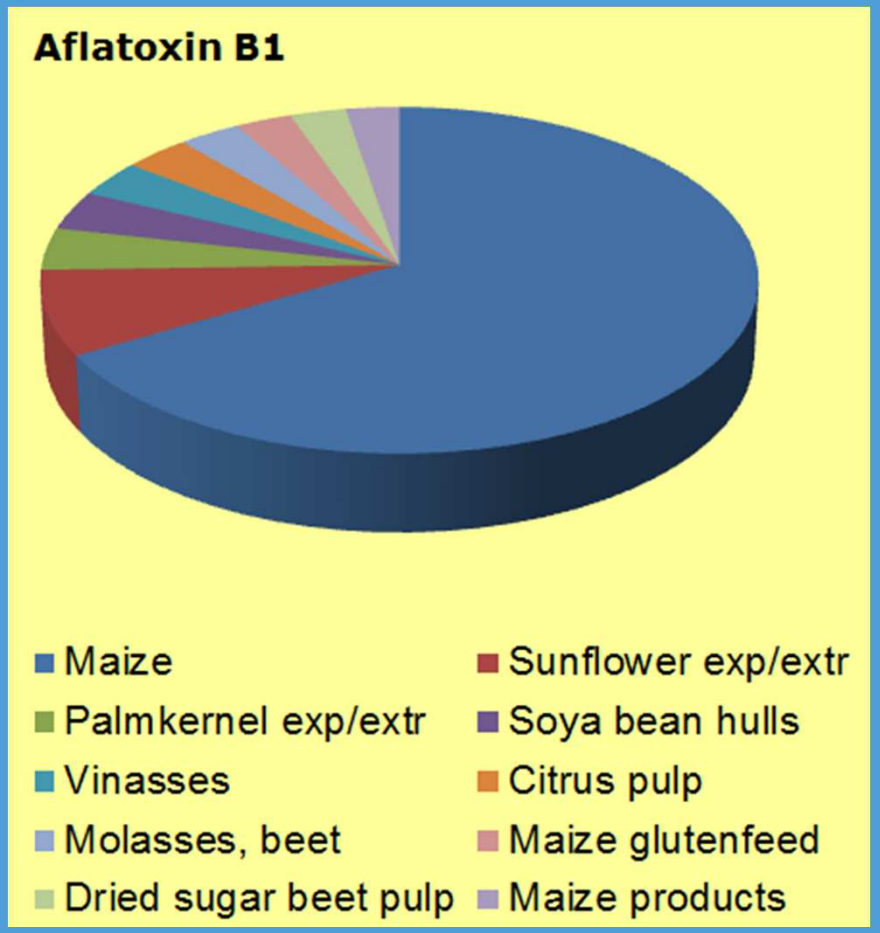
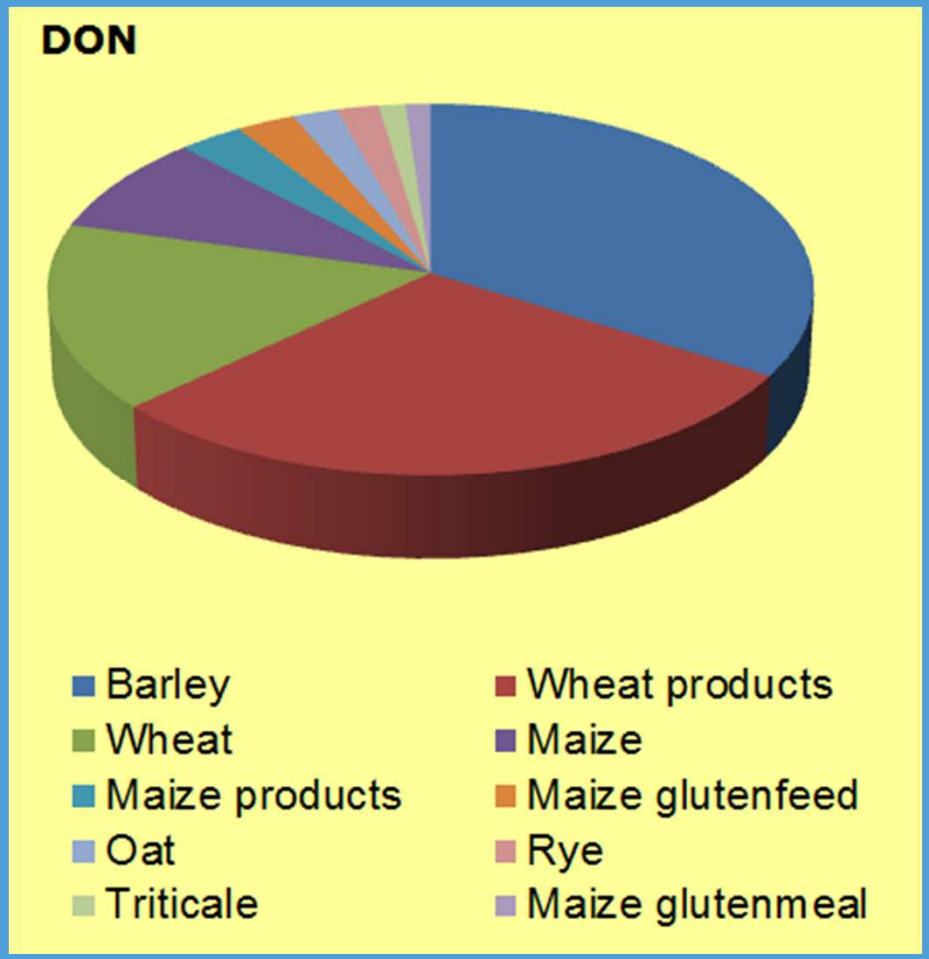
Model for risk-based monitoring (10)

Advice for official control for aflatoxin B1



Model for risk-based monitoring (11)

Advice for official control for DON



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Model for risk-based monitoring (12)

Cooperation with the Dutch Feed Manufacturers (TRUSTFEED)

- Input and feedback about
  - Composition of animal diets
  - Imported feed materials (volume and origin)
  - Risks associated with specific countries
- Regular meetings twice a year

Trend analysis (1)

- Objectives:

1. Detection of trends in the levels (or occurrence) of contaminants in feed and feed ingredients
2. Get insight into the levels of contaminants in relation to maximum levels in legislation (in most cases Directive (EC) 2002/32)

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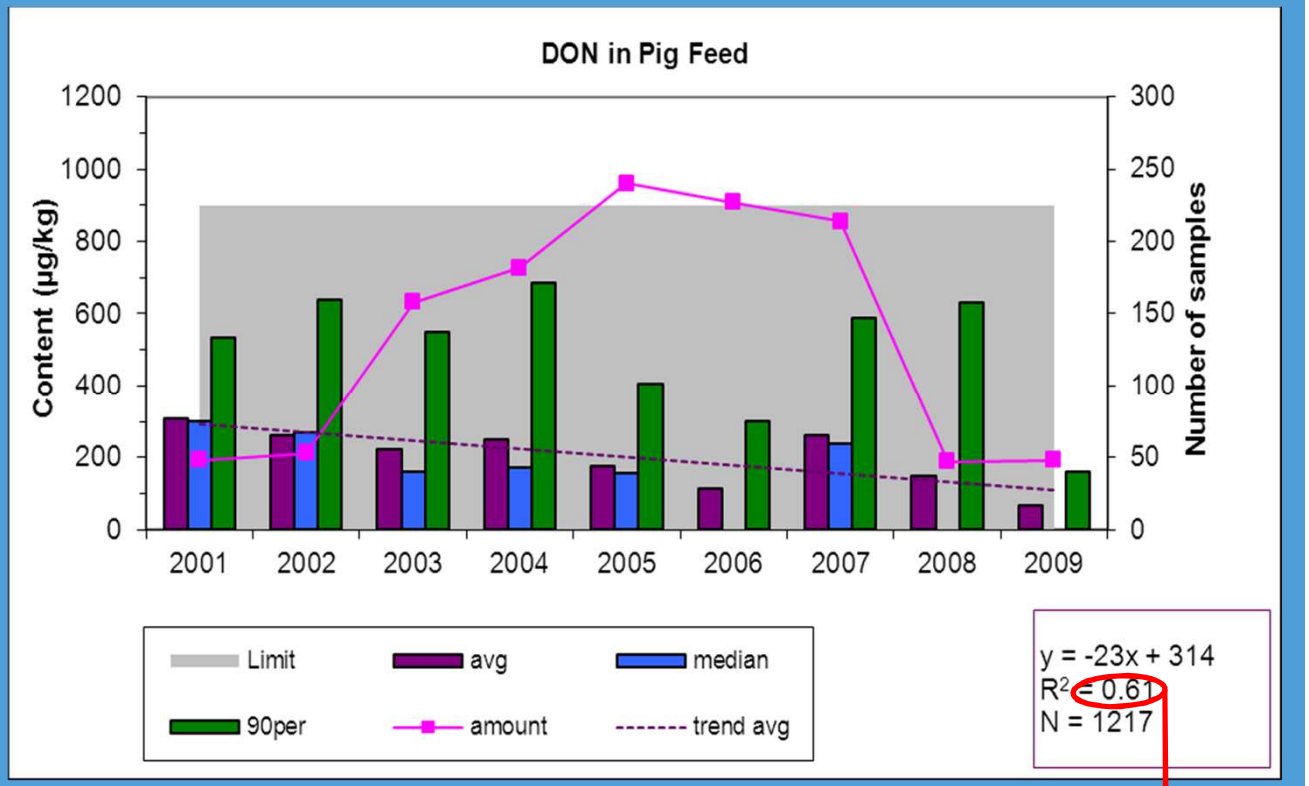
Trend analysis (2)

- **Quality** of the analytical data is crucial:
  - Quality of the **methods of analysis**: validation / accreditation, suitability of the method, trueness, LOQ, LOD, etc.
  - **Random** sampling
  - **Country of origin** must be (correctly) specified
- Data are available from:
  - National Plan
  - Feed sector: Product Board Animal Feed and TRUST FEED

Trend analysis (3): trend diagrams

Descriptive analysis

- average
- median (N>5)
- 90th percentile (N>10)
- linear regression (--- trend line)
- number of samples (■)
- official maximum limit or guidance value



significant: > 0.3

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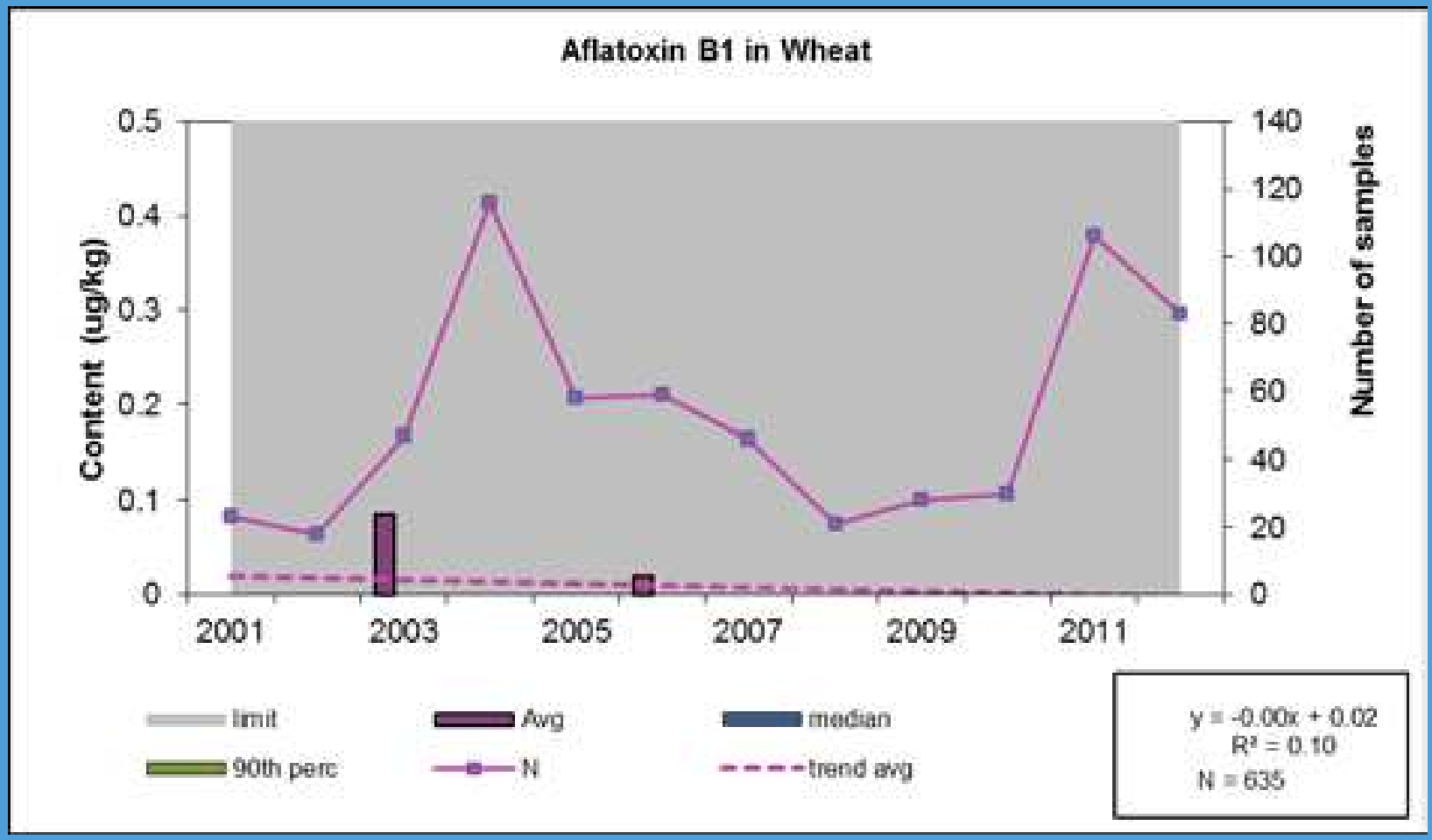
Trend analysis (4)

- Trend analysis has been performed for:
  - Mycotoxins: aflatoxin, DON, ochratoxin A, zearalenone, fumonisins B1 and B2, T-2 and HT-2-toxins
  - Dioxins and dioxin-like PCB's
  - Organochlorine pesticides and NDL-PCB's
  - Heavy metals: mercury, cadmium and lead
  - Copper and zinc
  - Meat-and-bone meal
- Reports available at RIKILT website: www.wageningenUR.nl/en/rikilt

Trend analysis – Mycotoxins (1)



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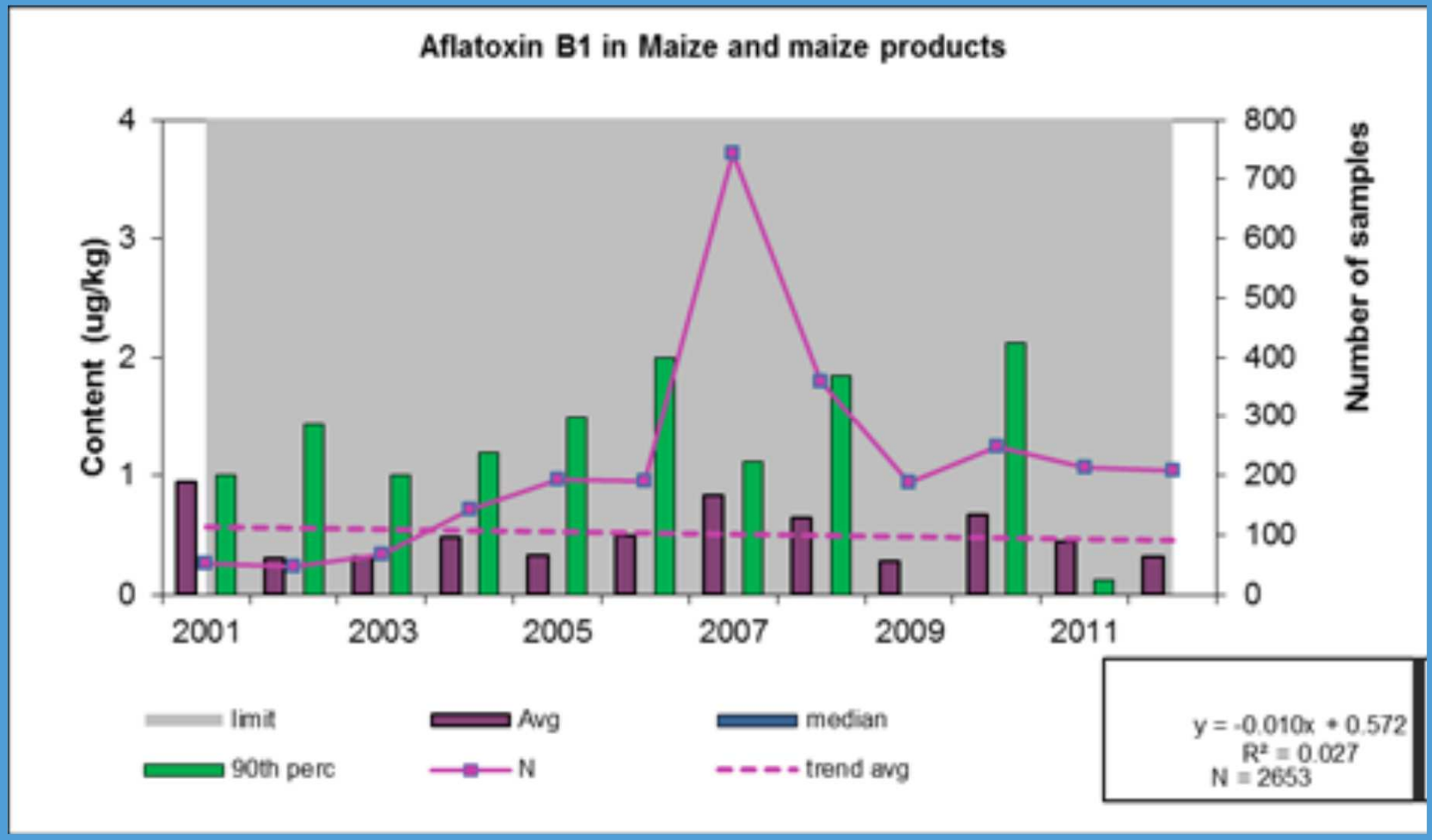
Trend analysis – Mycotoxins (2)



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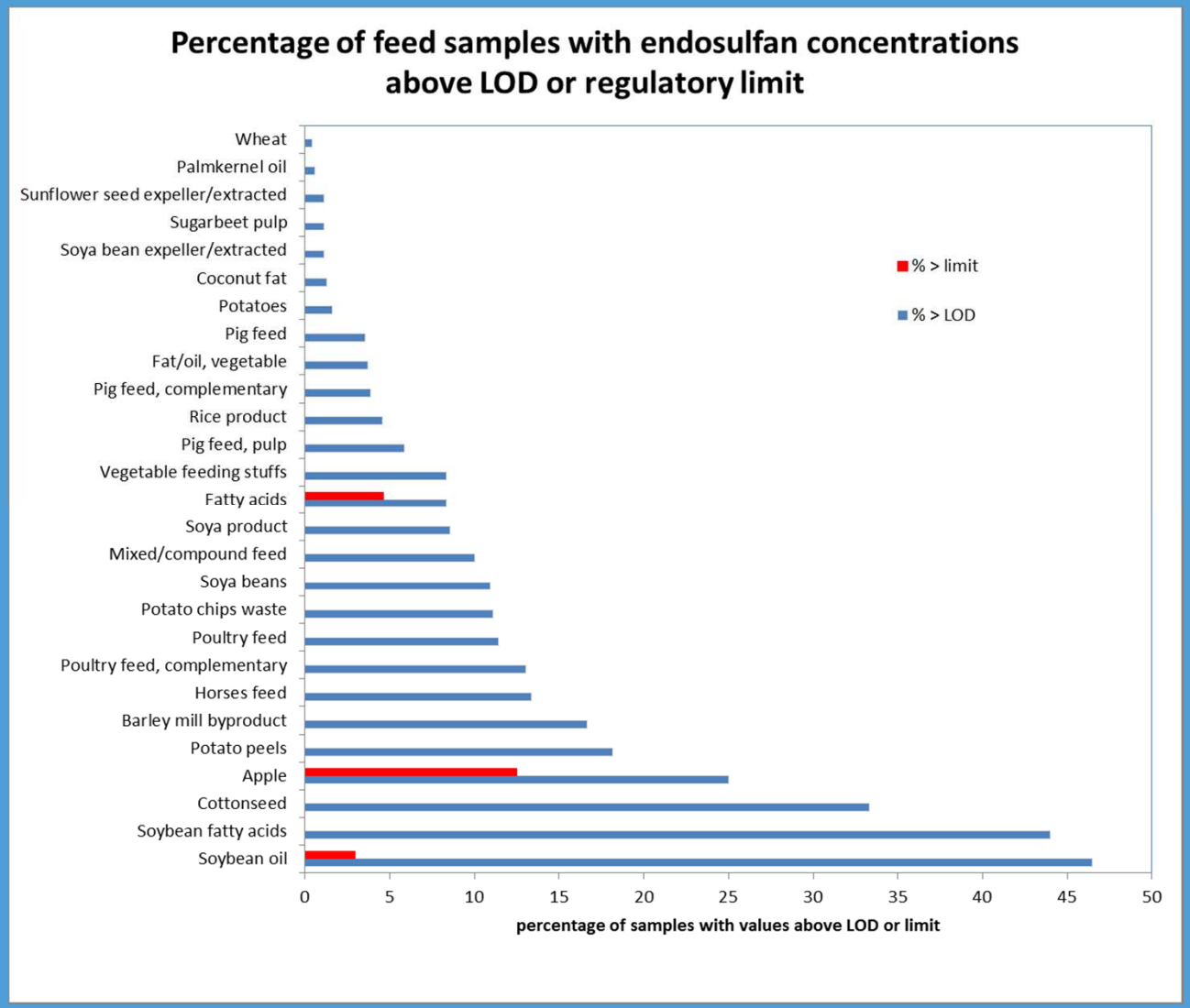
Trend analysis – Endosulfan (1)



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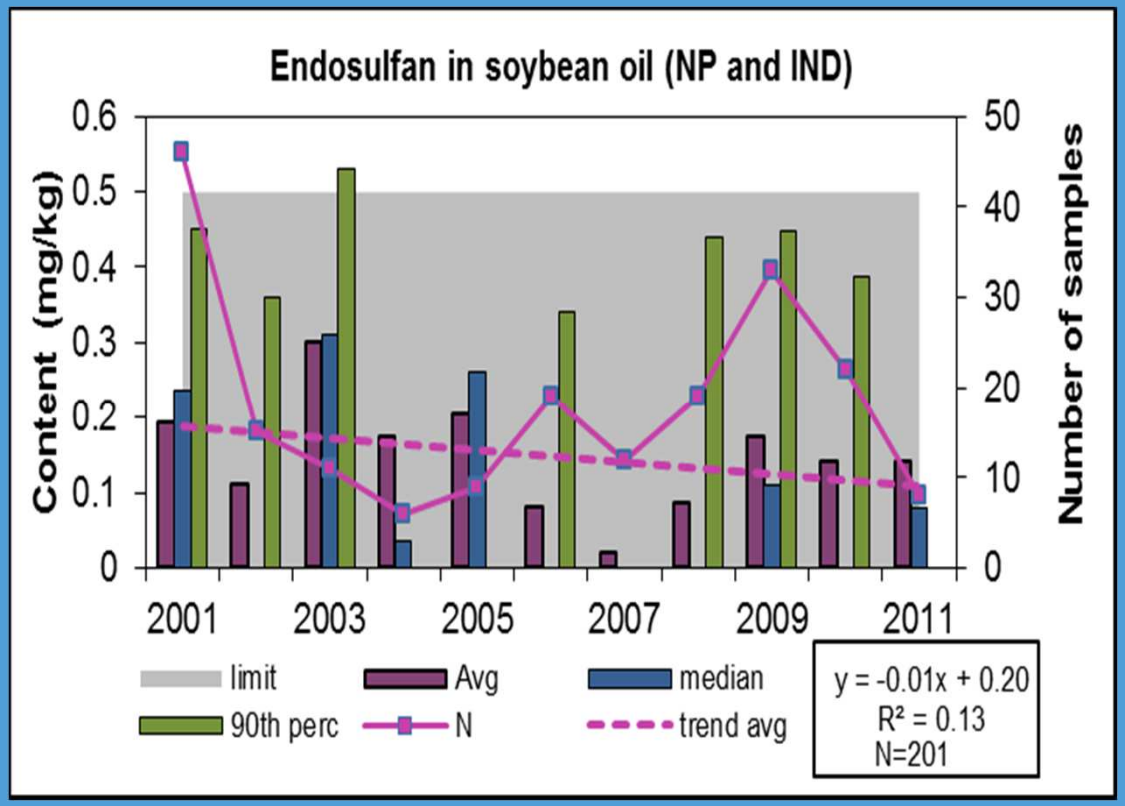
Trend analysis – Endosulfan (2)



- Refined oil (ML = 0.5 mg/kg) or crude oil (ML = 1 mg/kg) ?
- Country of origin in most cases unknown

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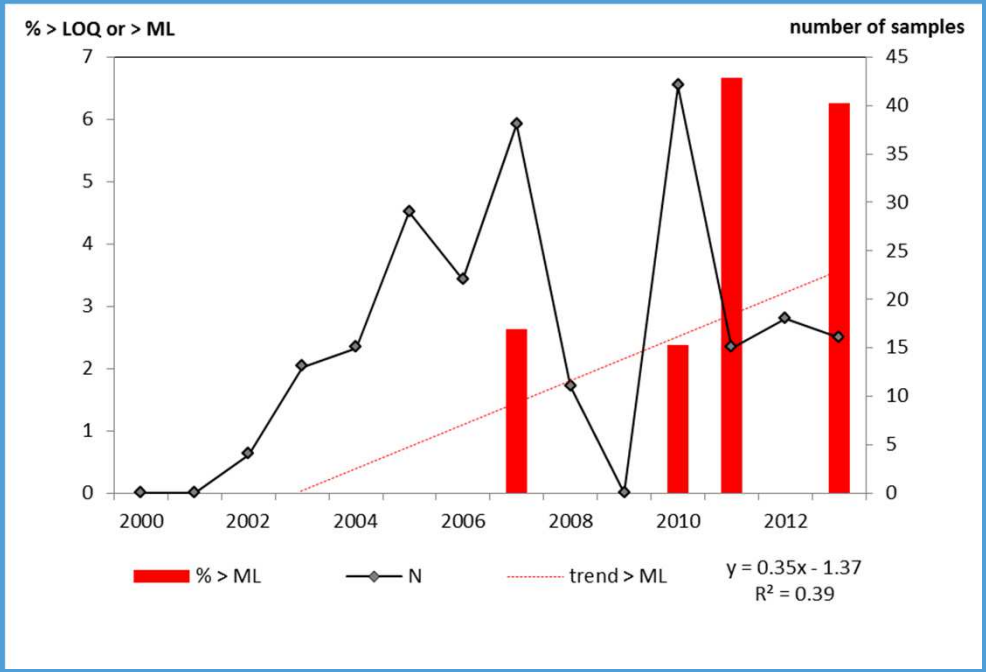
Trend analysis – Cadmium (1)

Percentage of samples exceeding the ML for cadmium in fish meal; N = 223; ML = 2 mg/kg



Nr. of samples exceeding the ML is only 4: fishmeal from Spain (2011), Germany (2010) Ecuador (2013) and from unknown origin (2007)

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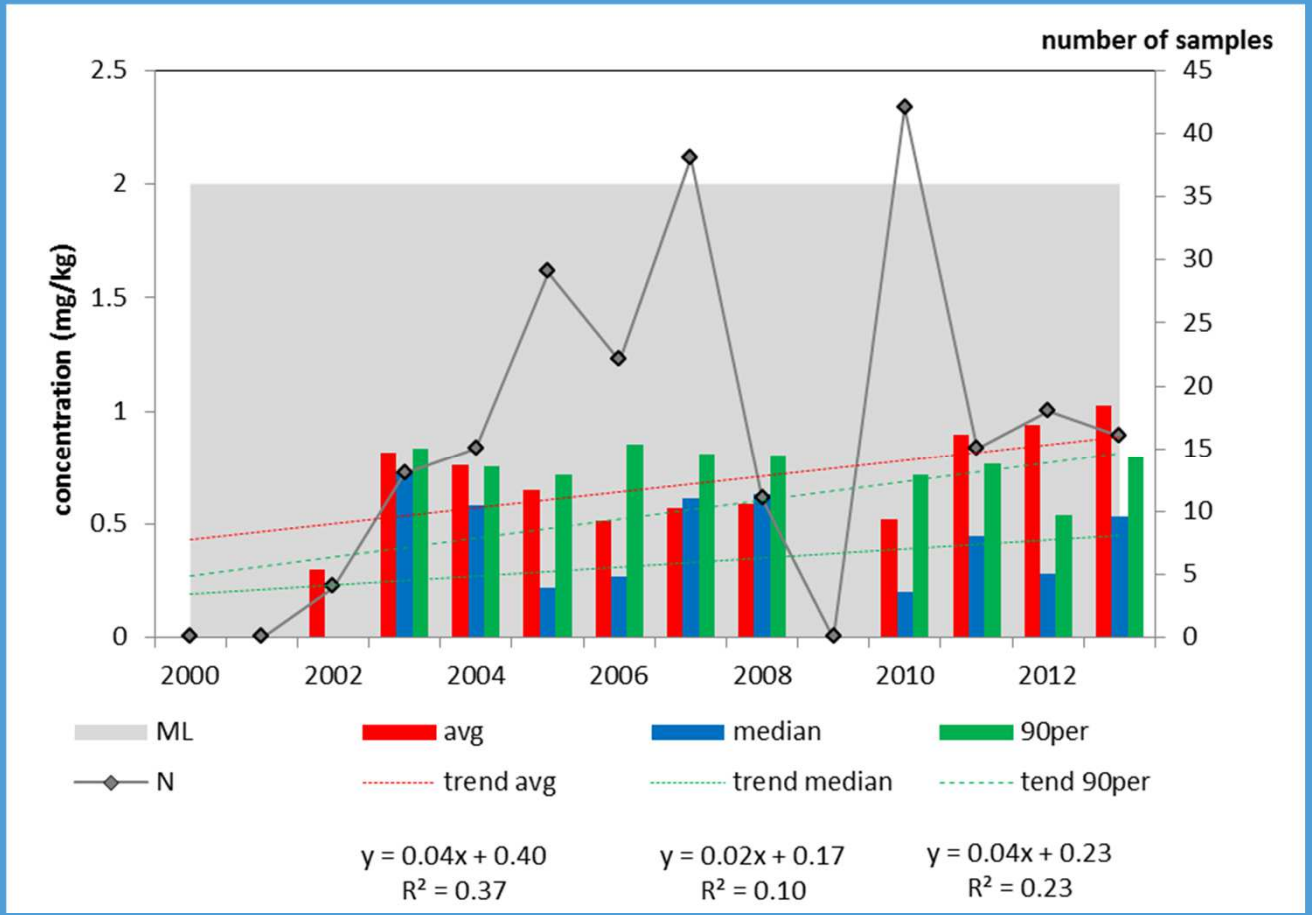
Trend analysis – Cadmium (2)

Average, mean and 90 percentile concentration of cadmium in fish meal; N = 223; ML = 2 mg/kg



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Conclusions

- The model contributes to an objective and quantified risk-based sampling strategy
- The model can be used for official control and for feed sector control
- Based on the results of the model and the trend analyses, the Dutch National Control Plan for Feed has been optimized for several contaminants
- Quality input → Quality output

Future work

- Model:
  - Application to other contaminants: heavy metals
- Trend analysis:
  - Improvement of statistical tools
  - From RIKILT-reports to a web-based system: this will allow for regular updates of the trend analysis: contribution to detection of emerging risks; this has already been started for aflatoxin B1

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Thank you for your attention

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