

Pribel historiek



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& Walter Steurbaut

1. Introduction & history Indicators Belgium

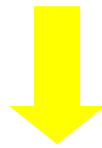
- ❖ Introduction
- ❖ WP1: Why indicators
- ❖ WP2: Principle indicators
- ❖ WP3: Overview indicators Belgium
- ❖ WP4: Pribel indicator concept

2. Case Study – Pribel 1991-1996

Introduction

PRPB: 2010 – 2001: 25% impact reduction for agricultural applications of pesticides

'90s: many efforts have been done



already high reductions realised
(impressions of people concerned,
Seq calculations in Flanders)



scientific evidence with PRIBEL!

1. Why Indicators?

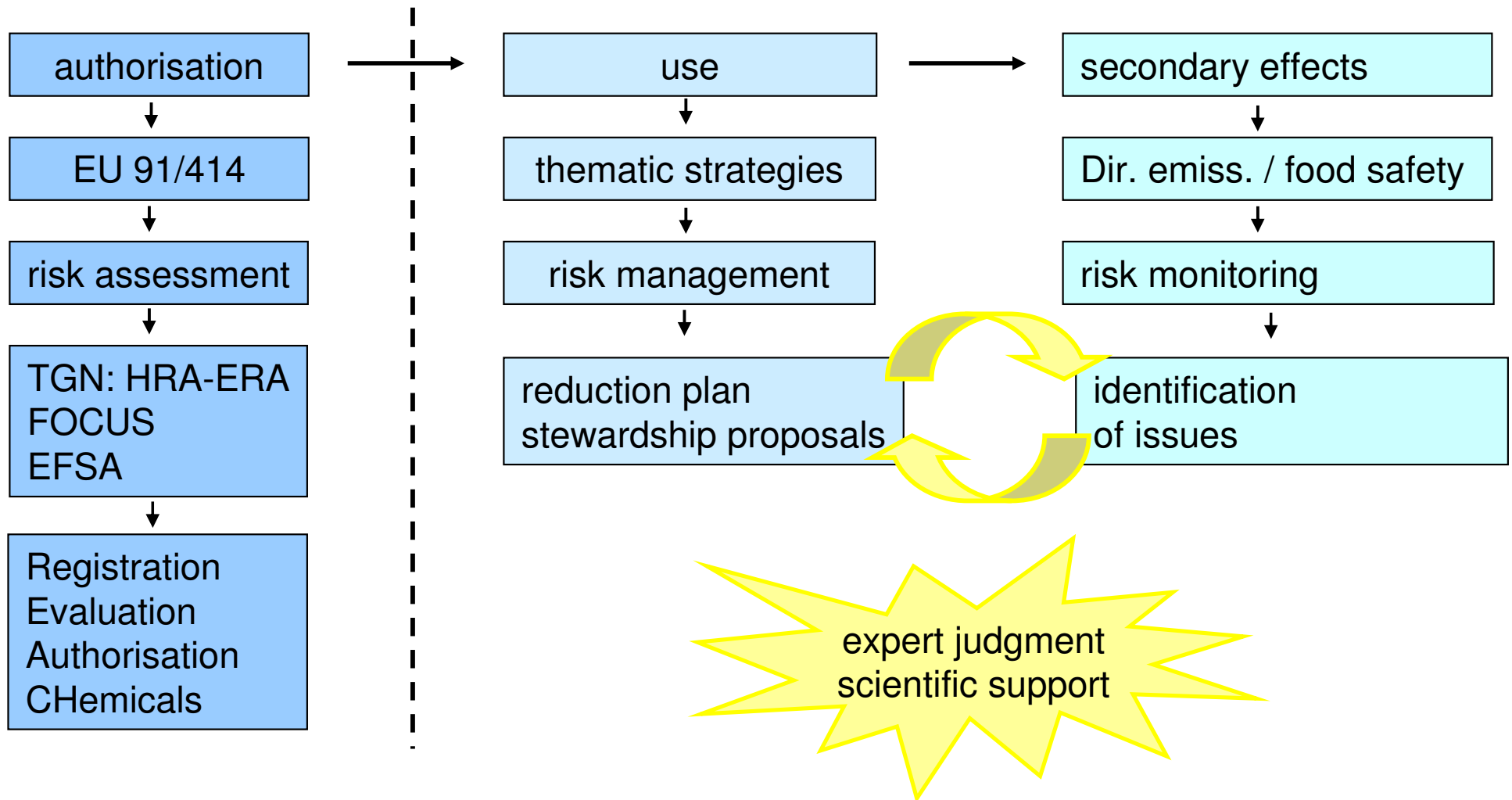
❖ Indicators

- Use: kg, dosis/ha, Frequentie of Application,...
- Single-impact: Seq, GUS,...
- Multi-impact: POCER

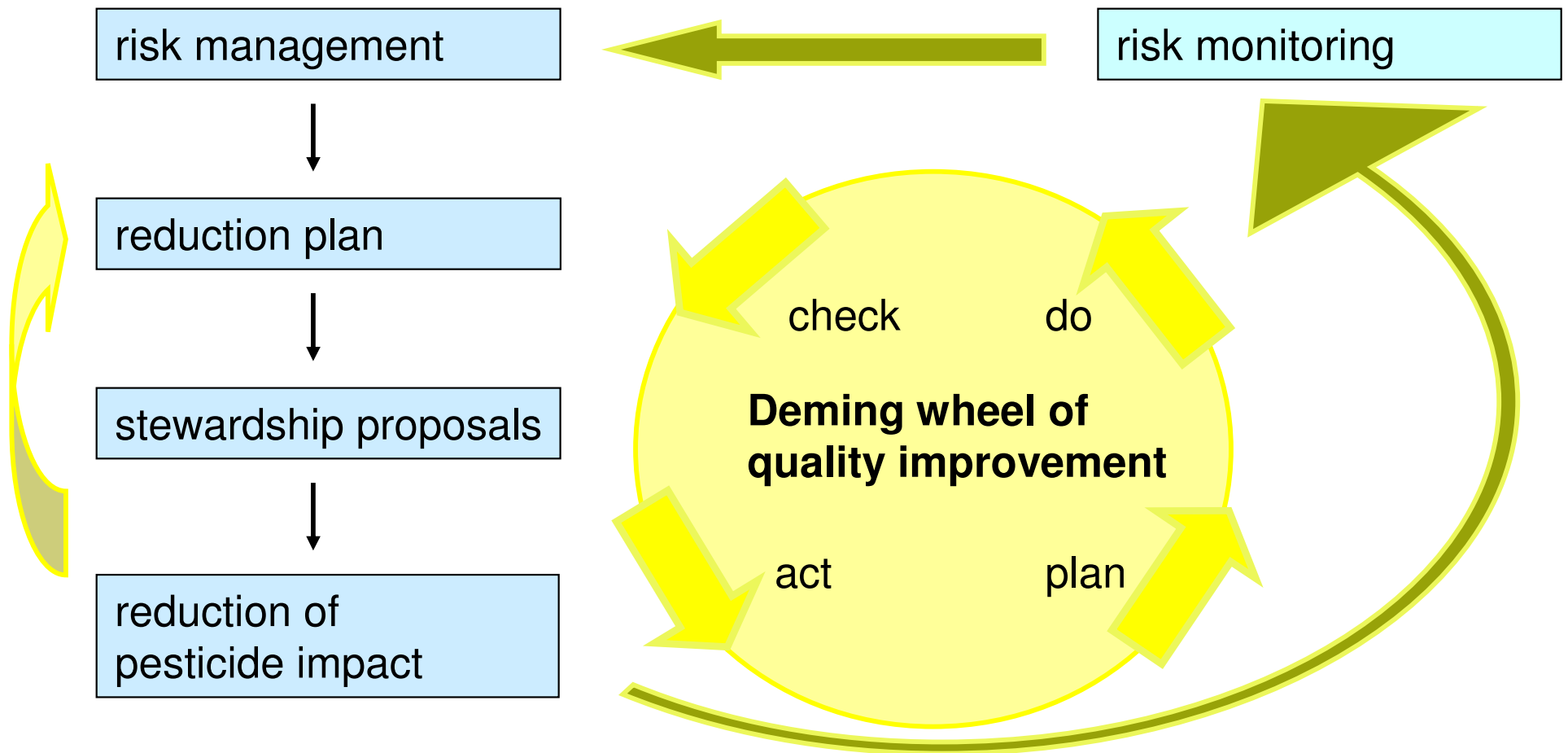
❖ Models

- SEPTWA, PESTLA, Europoem, Hydrus...

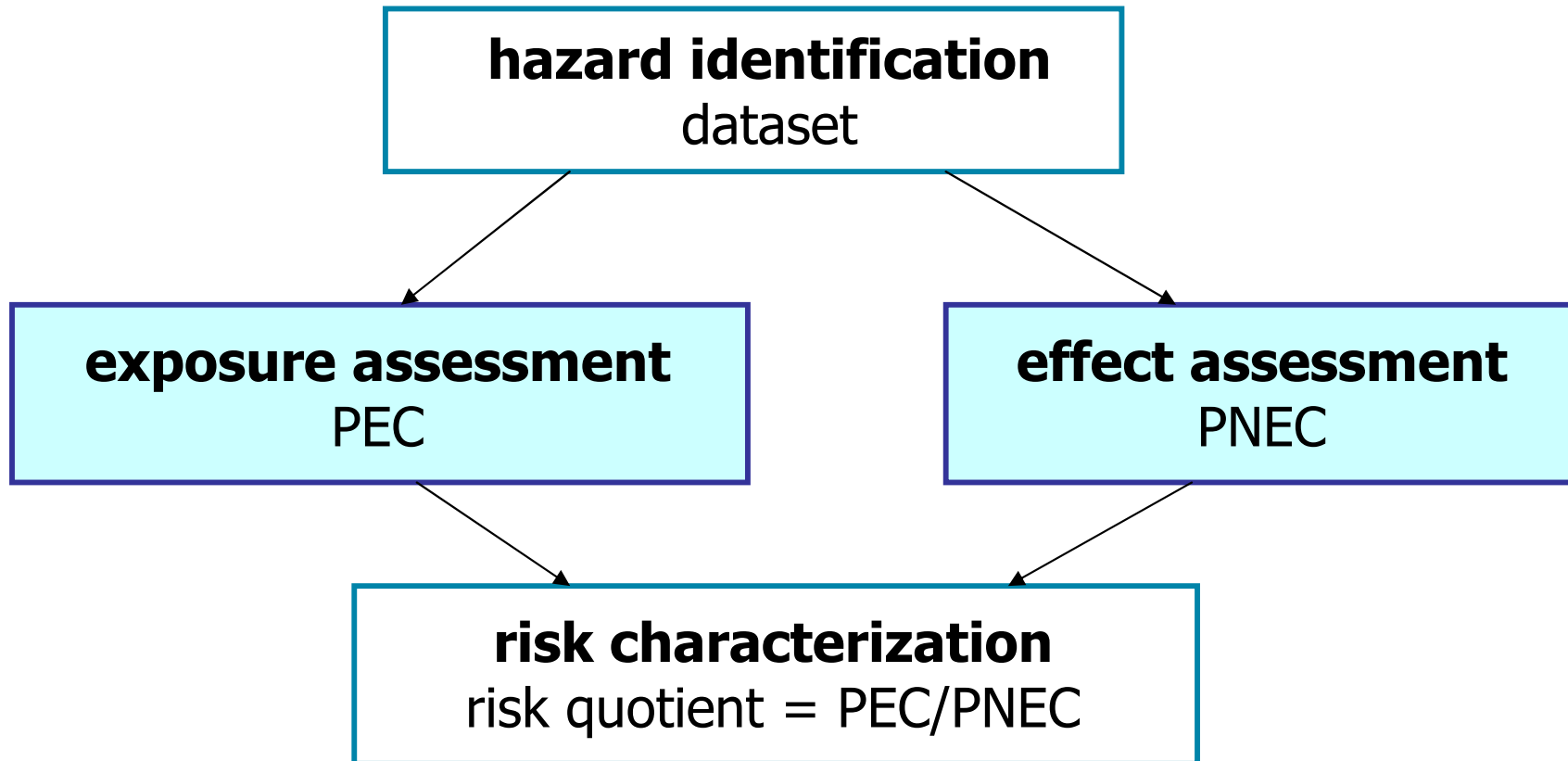
1. Why Indicators?



1. Why Indicators?



2. Principle indicator - risk characterization



3. Overview indicators Belgium

Seq \longrightarrow POCER I \longrightarrow POCER II \longrightarrow PRIBEL \longrightarrow HAIR

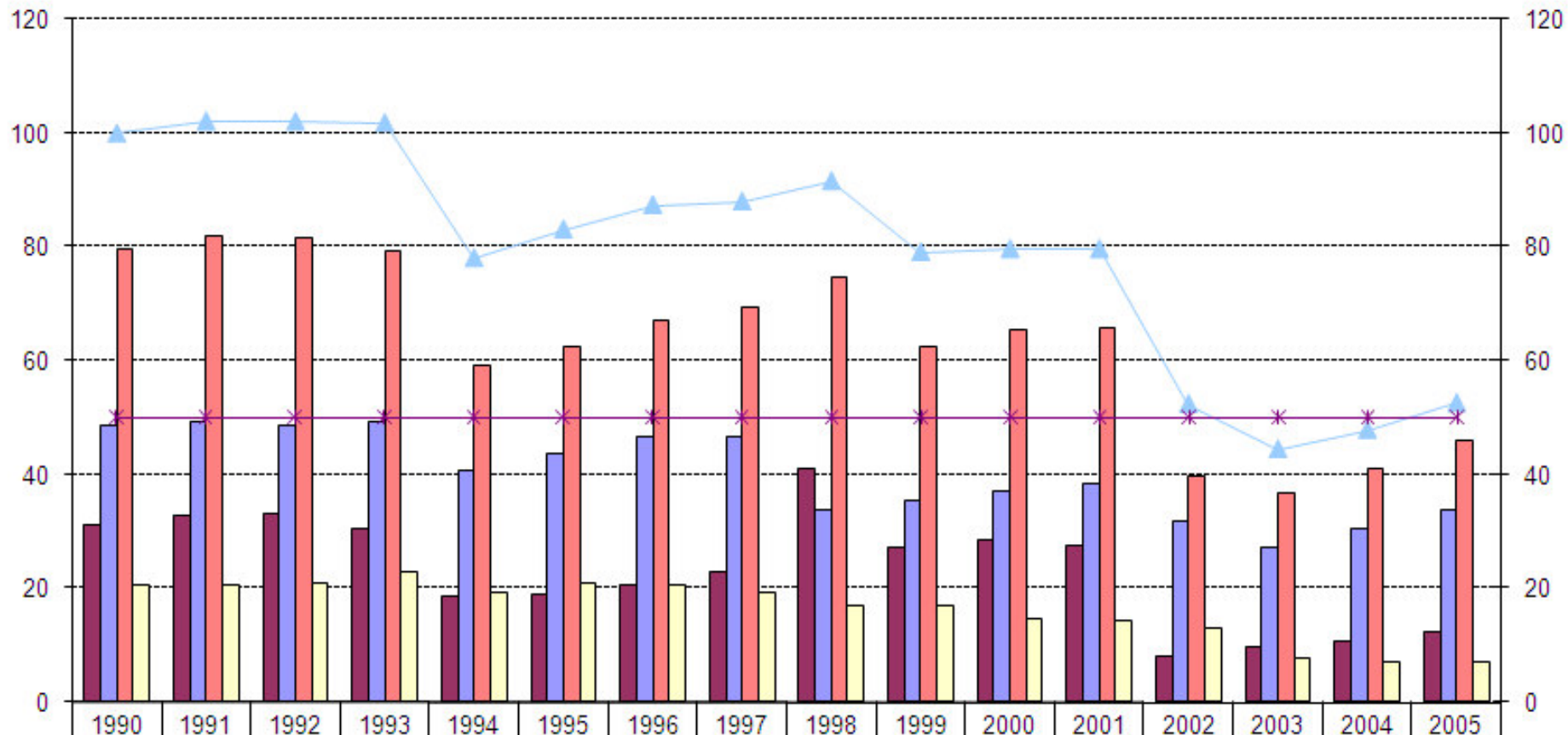
Seq: (use * DT50) / MTC

tool used to evaluate the goal of the Flemish government:
50% reduction 1990 – 2005

! goal obtained by:

- ban on older active substances
- improvements of spraying techniques
- use of beneficial arthropods and biological crop protection
- warning systems
- Code van de Goede Landbouwpraktijken (1999)
- ...

Seq (index 1990 = 100)



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Seq akkerbouw	31,15	32,65	33,01	30,17	18,37	18,89	20,31	22,74	41,04	26,93	28,20	27,24	8,07	9,62	10,46	12,08
Seq tuinbouw	48,30	49,10	48,44	48,98	40,65	43,35	46,58	46,34	33,61	35,42	36,92	38,23	31,51	27,11	30,44	33,59
Seq landbouw	79,45	81,76	81,46	79,15	59,02	62,24	66,89	69,08	74,65	62,35	65,12	65,48	39,58	36,73	40,90	45,68
Seq niet-landbouw	20,55	20,36	20,61	22,69	19,05	20,88	20,54	18,96	16,96	16,79	14,57	14,18	12,82	7,74	6,98	6,91
—▲— totaal Seq	100,00	102,12	102,07	101,85	78,08	83,12	87,43	88,04	91,61	79,14	79,69	79,66	52,40	44,47	47,88	52,59
—*— doel 2005	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00

3. Overview indicators Belgium

Seq → POCER I → POCER II → PRIBEL → HAIR

POCER I: 10 compartments (Vercruyssen & Steurbaut, 2002)

farm level

- applicator
 - worker
 - bystander
 - groundwater
 - persistency
 - surface water
 - earthworms
 - birds
 - bees
 - beneficial arthropods
- } human
- } environment

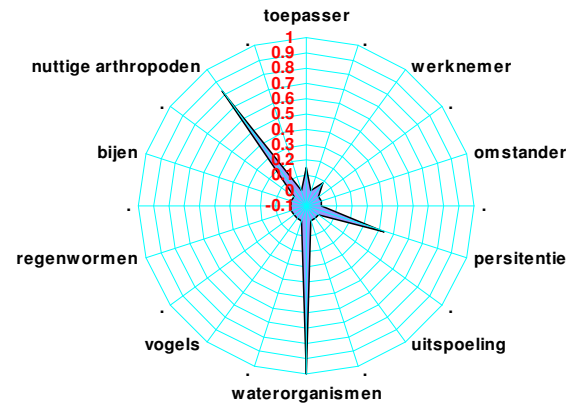
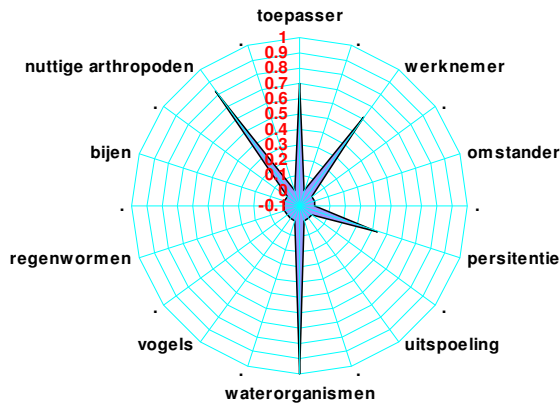
3. Overview indicators Belgium

POCER beperkende maatregelen: gebruik van beschermende kledij in appelteelt

**BIFENTHRIN (TALSTAR 8 SC)
ZONDER BESCHERMENDE KLEDIJ**



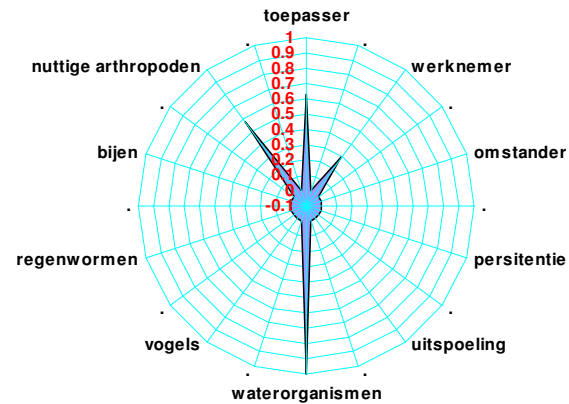
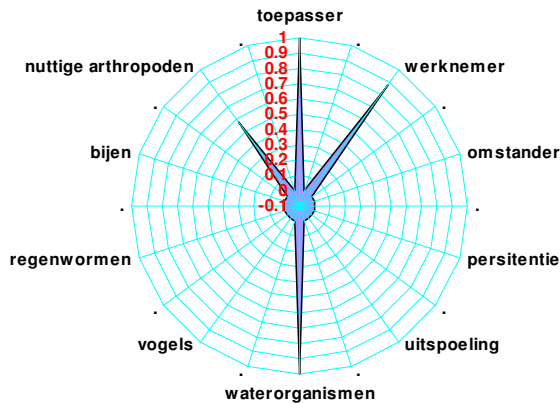
**BIFENTHRIN (TALSTAR 8 SC)
MET BESCHERMENDE KLEDIJ**



**AZOCYCLOTIN (PEROPAL)
ZONDER BESCHERMENDE KLEDIJ**



**AZOCYCLOTIN (PEROPAL)
MET BESCHERMENDE KLEDIJ**



3. Overview indicators Belgium

Seq → POCER I → POCER II → PRIBEL → HAIR

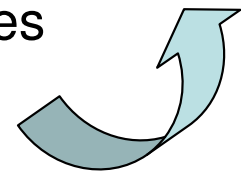
POCER II: 14 compartments (Van Bol et al., 2004)

- consumer
- air
- farm cost
- resistance induction

+ **automation** of the worksheet

different input databases linked with calculation sheet

- physico-chemical properties
- climate characteristics
- crop properties
- ...



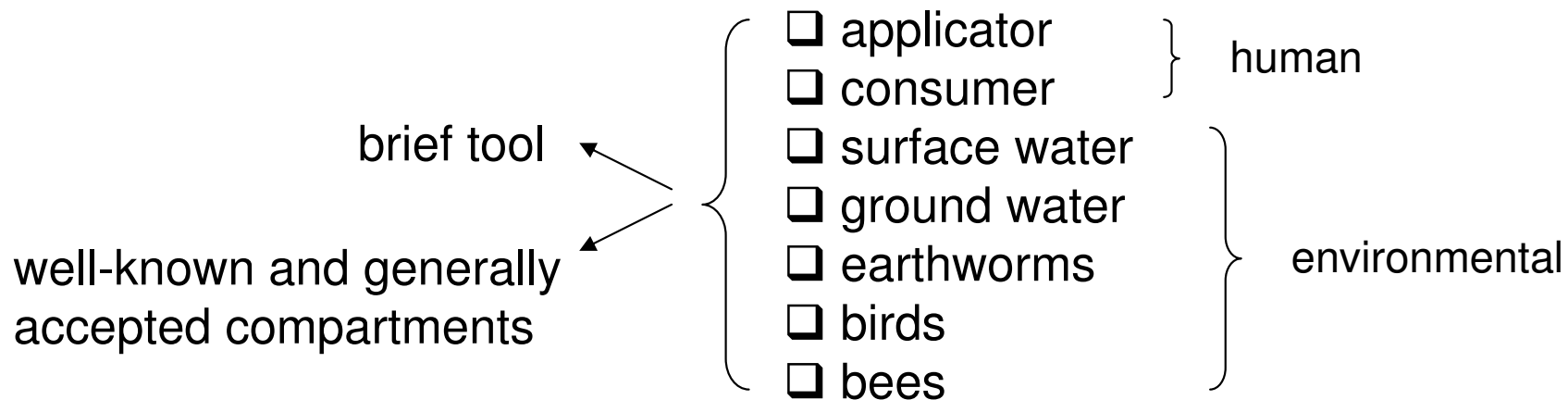
3. Overview indicators Belgium

Seq → POCER I → POCER II → PRIBEL → HAIR

PRIBEL: 7 compartments (Vergucht et al., 2006)

goal Federal Government (PRPB): 25% reduction
2001 - 2010

national level



3. Overview indicators Belgium

Seq → POCER I → POCER II → PRIBEL → HAIR

HAIR: Harmonised environmental Indicators for pesticide Risk
(Luttik et al., 2003 – 2007)

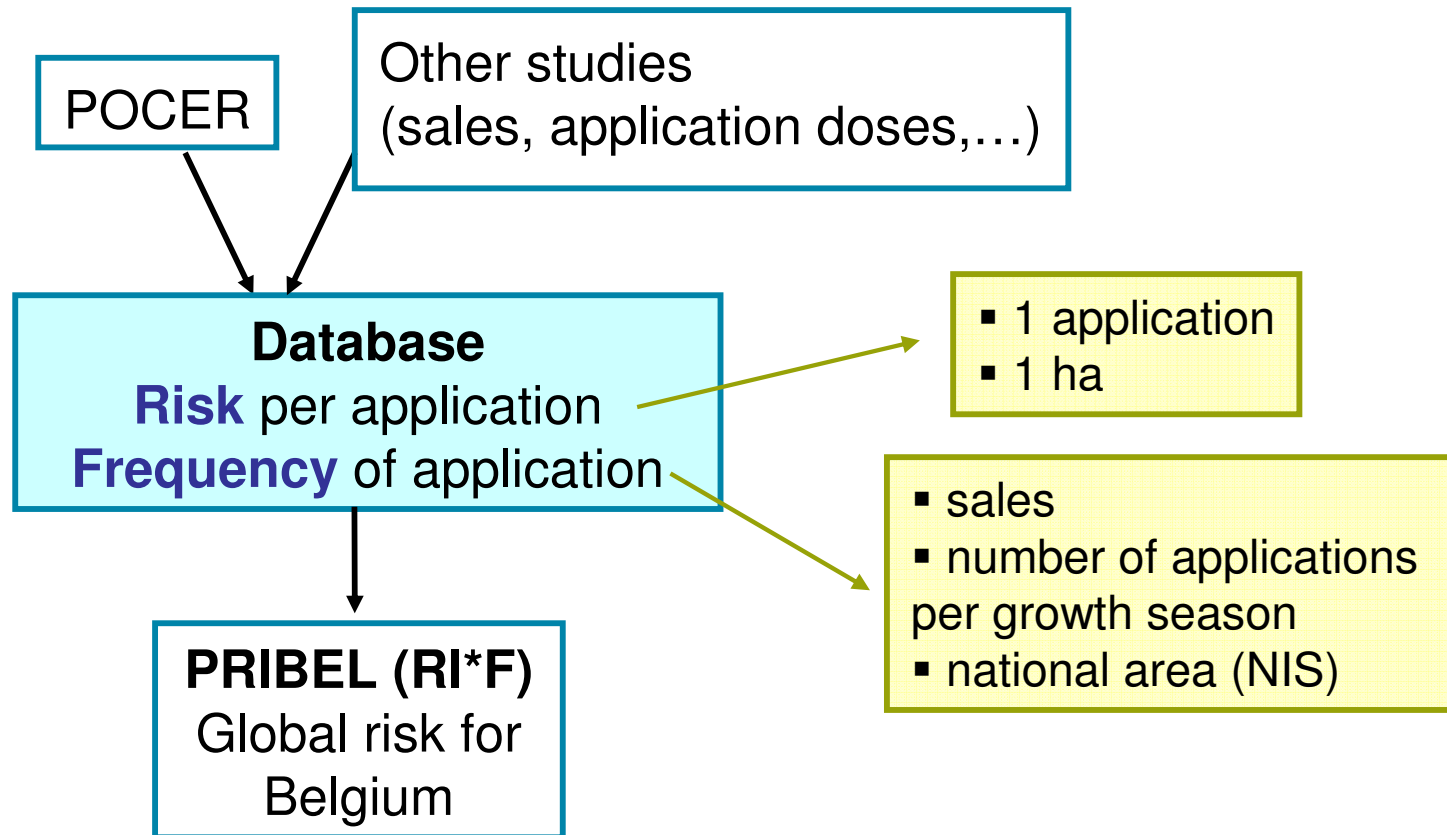
*European
level*

5 general parts:

- applicator, worker and bystander (F. Garreyn, UGent)
- consumer
- terrestrial part (mammals, earthworms, birds, bees and arthropods)
- ground water
- surface water

+ total aggregation methodology (J. Pineros, Coda)

4. PRIBEL concept



4. PRIBEL concept

❖ PRIBEL



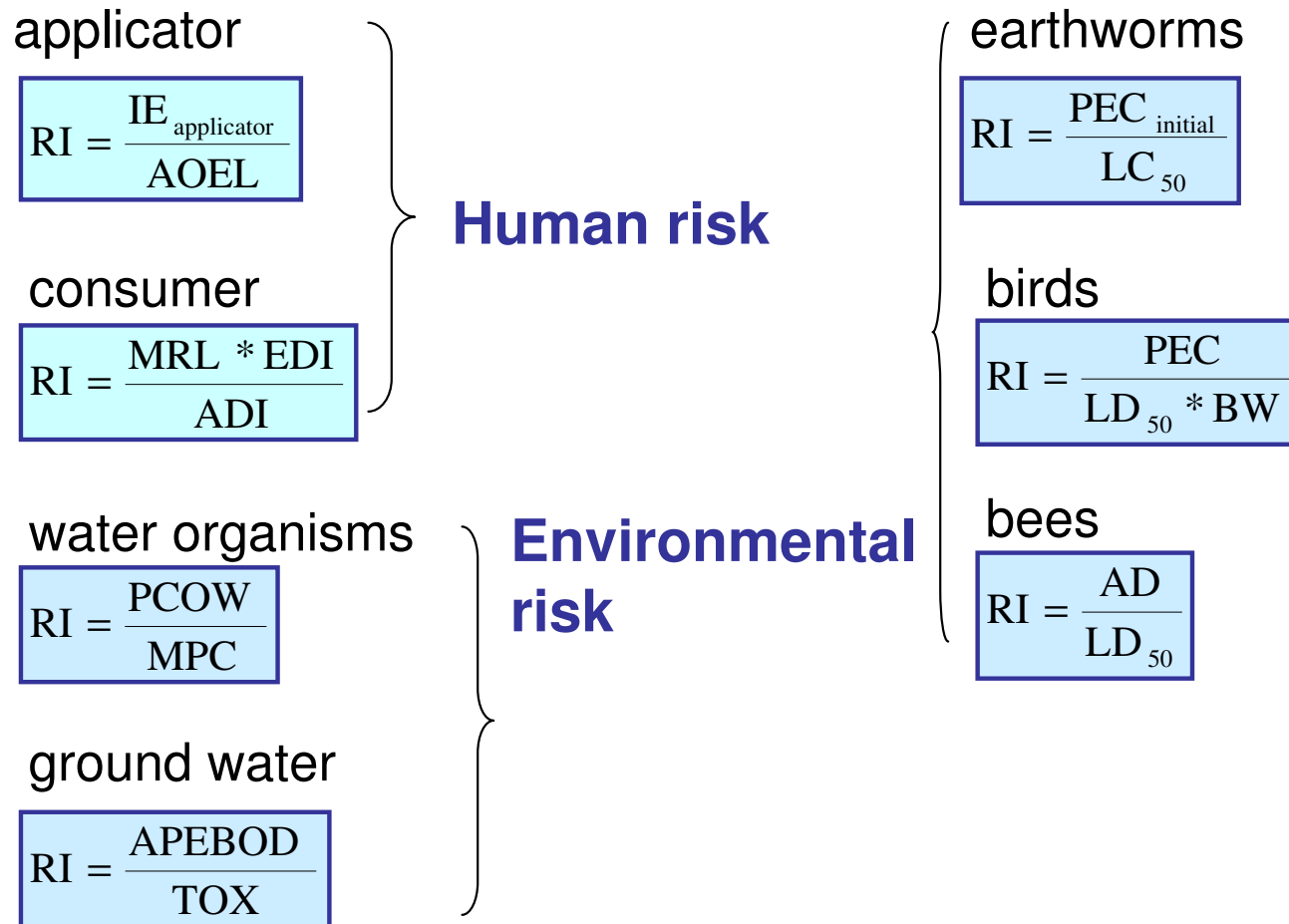
- Overall principles: acceptance criteria from 91/414/EC, Annex VI

- applicator
- consumer
- water organisms
- ground water
- earthworms
- birds
- bees



4. PRIBEL concept

PRIBEL (RI*F)
Global risk for
Belgium



RI is calculated using the appropriate algorithm for each risk event : one hazard for one compartment at one moment (= pesticide application) on one parcel (= 1 ha)

4. PRIBEL concept

PRIBEL (RI*F)
Global risk for
Belgium

Seq → POCER I → POCER II → PRIBEL → HAIR

PRIBEL: 7 compartments (Vergucht et al., 2006)

- ❑ RI is calculated for every pesticide-crop combination existing in Belgium

+ link with *frequency* database

- ❑ national sales
- ❑ national area per crop
- ❑ number of applications per crop

+ link with *statistical programme* R

- ❑ aggregation
- ❑ 25th, 50th, 75th and 95th percentiles

4. PRIBEL concept

PRIBEL (RI*F)
Global risk for
Belgium

Frequency (F)

❖ For one specific pesticide-crop combination, RI occurs at a given frequency

- **Repartition coefficient** =
$$\frac{\text{used amount of a.s. in crop x [kg]}}{\text{sum of used a.s. in all the crops [kg]}}$$
- **Used amount per crop** in Belgium [kg/yr] =
sales [kg/yr] * repartition coefficient
- **Frequency** (number of risk events) [1/yr] =
$$\frac{\text{used amount per crop in Belgium [kg/yr]}}{\text{AR [kg/ha]}}$$

4. PRIBEL concept

Repartition coefficient =

$$\frac{\text{used amount of a.s. in crop x [kg]}}{\text{sum of used a.s. in all the crops [kg]}}$$

Used amount per crop in Belgium [kg/yr] =

$$\text{sales [kg/yr]} * \text{repartition coefficient}$$

Frequency (number of risk events) [1/yr] =

$$\frac{\text{used amount per crop in Belgium [kg/yr]}}{\text{AR [kg/ha]}}$$

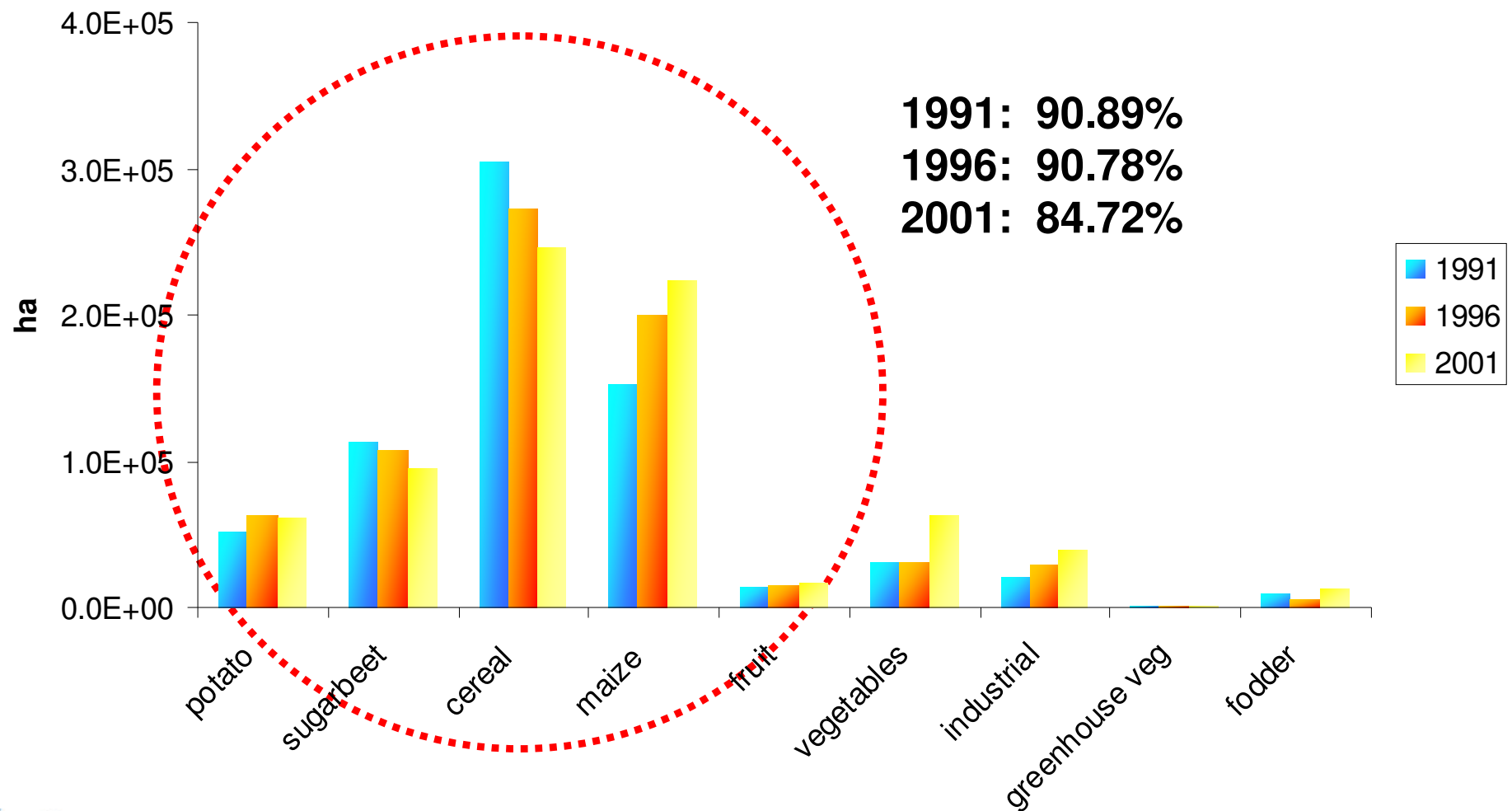
Example

- E.g. lindane in potatoes in 2001 in Belgium:
- Repartition coefficient : $496 \text{ kg} / 31\,200 \text{ kg} = 0.016$
- Used amount per crop: $40170 \text{ kg} * 0.016 = 643 \text{ kg}$
- Frequency: $643 \text{ kg} / 0.87 \text{ kg/ha} = 739 \text{ risk events}$

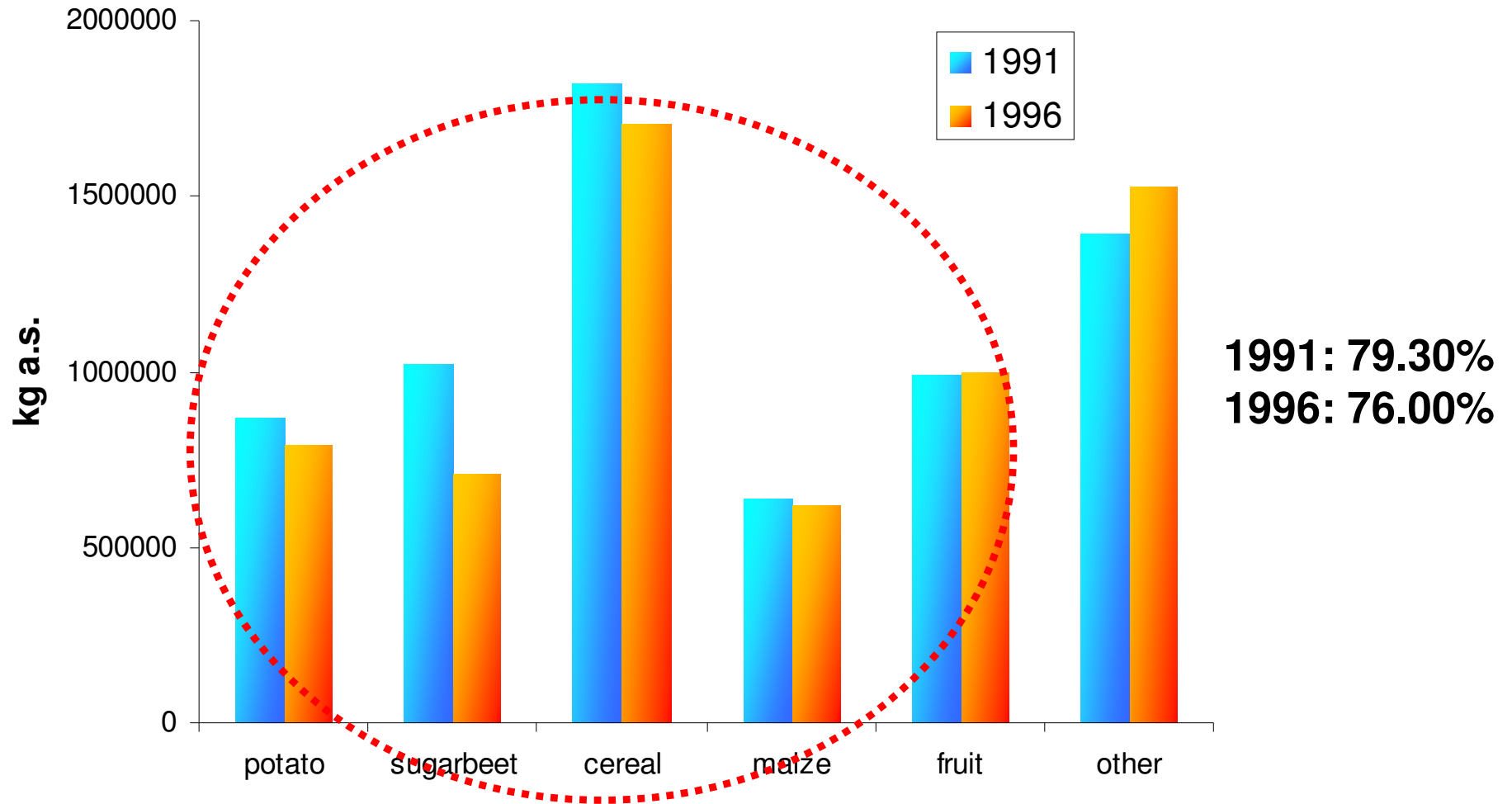
2. Case Study – Pribel 1991-1996

- ❖ 1: Selection of relevant crops
- ❖ 2: Definition of reference application doses
- ❖ 3: Determining (eco)tox and physico-chemical characteristics of each active substance
- ❖ 4: Partition of sales over the different crops
- ❖ 5: Impact evaluation with PRIBEL
- ❖ 6: Comparison of impact evolution with 2001
- ❖ Conclusions

1: crop selection: area representativeness

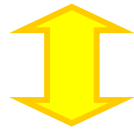


1: crop selection: usage representativeness



2: Reference application doses

2001: doses from inquiries (Van Lierde et al.)



1991 and 1996: shortage on appropriate inquiries



Lijst der erkende gewasbeschermingsmiddelen voor
landbouwkundig gebruik ('90 & '96)



maximum doses

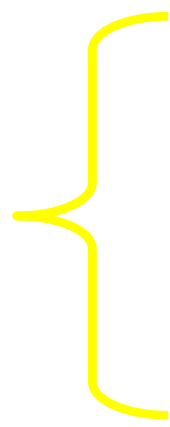


g as / ha

3: Determining (eco)tox data of all a.s.

Completeness check of UGent database

All (eco)tox data originate from **public sources**

- 
1. European Union dossiers
 2. CTB – The Netherlands
 3. Pandora's Box
 4. The Pesticide Manual
 5. Extoxnet
 6. Toxnet
 7. Other sources

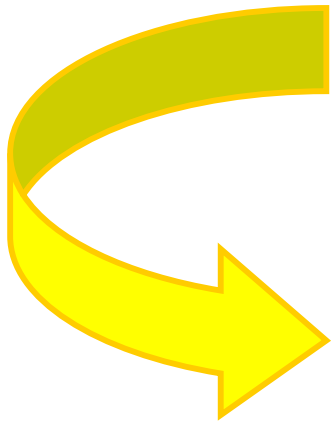
4: Partition of sales over the different crops

No sufficient usage data \longrightarrow national sales (Fontier, FOD)

❖ weighted mean:

$$sales_{1991*} = \frac{sales_{1990} + sales_{1991} + sales_{1992}}{3}$$

❖ top 100



Divide sales over the crops \longrightarrow repartition key

4: Partition of sales over the different crops

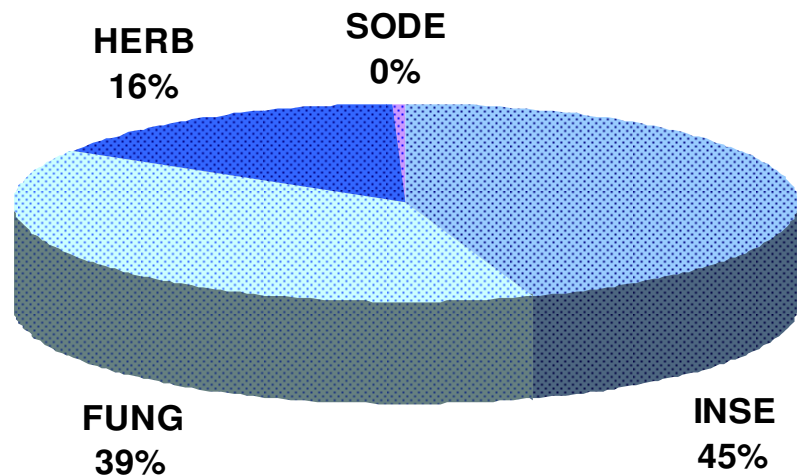
Thanks to the expert committee

Annie Demeyere
Laurent De Temmerman
Frans Goossens
Jozef Van Melckebeke
Michel Van Himme

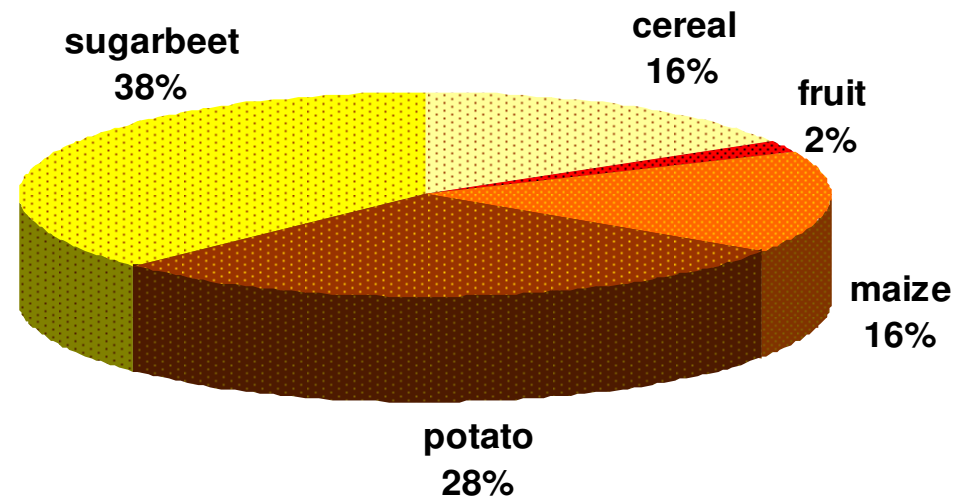
a.s.	crop	% in 1991	dosis (g/ha)	form.	% in 1996	dosis (g/ha)	form.
LINDAAN	graan						
LINDAAN	mais	20	1500	L	50	1500	L
LINDAAN	biet	50	1500		25	1500	
LINDAAN	aardappelen						
LINDAAN	fruitteelt						
LINDAAN	rest	30			25		

5: Impact evaluation with PRIBEL

OPERATOR 1991



Relative contribution of pesticide groups



Relative contribution of crop groups

a.s. with highest impact: lindane used in sugarbeet

- ❖ high toxicity
- ❖ high application dose
- ❖ high national sales

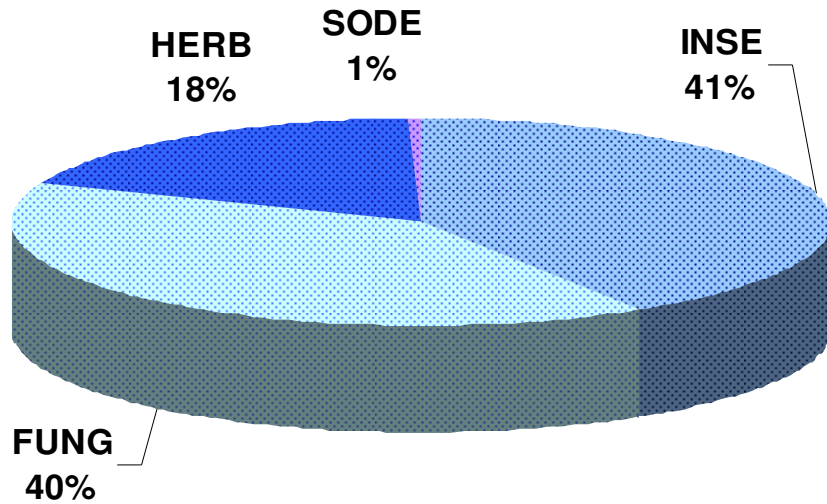
5: Impact evaluation with PRIBEL

OPERATOR 1991

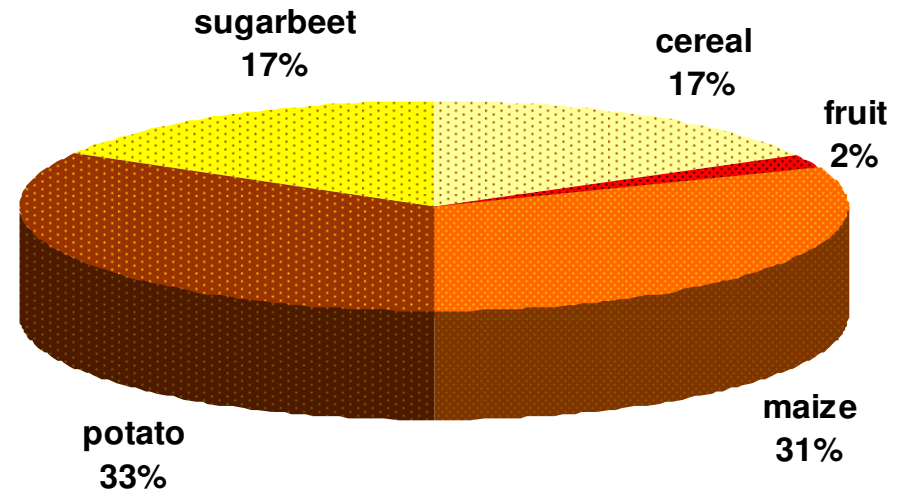
A. S. Name	AR 1991 (g/ha)	Crop group	Pesticide group	RI*F
lindane	1500	sugarbeet	INSE	
fentin hydroxyde	400	potato	FUNG	
lindane	1500	maize	INSE	
fentin acetate	400	potato	FUNG	
atrazine	4000	maize	HERB	> 10 ^E +7
fenpropimorf	750	cereal	FUNG	
isoproturon	2250	cereal	HERB	
zwavel	6000	sugarbeet	FUNG	
maneb	3200	potato	FUNG	
maneb	1600	cereal	FUNG	
parathion	250	sugarbeet	INSE	
alachloor	2400	maize	HERB	
aldicarb	1000	sugarbeet	INSE	
dinoterb	1250	cereal	HERB	
mancozeb	1600	cereal	FUNG	
mancozeb	3200	potato	FUNG	
mcpa	1500	cereal	HERB	
metamitron	3500	sugarbeet	HERB	
fenpropimorf	750	sugarbeet	FUNG	
prochloraz	450	cereal	FUNG	> 10 ^E +6

5: Impact evaluation with PRIBEL

OPERATOR 1996



Relative contribution of pesticide groups



Relative contribution of crop groups

a.s. with highest impact: lindane used in maize (↔ sugarbeet)

- ❖ maize area expanded (+ 30%)
- ❖ increase of soil insects (e.g. wireworms) in maize required higher usage
- ❖ terminated use of combination lindane + tri-allaat in sugarbeet

—————> see repartition key

5: Impact evaluation with PRIBEL

OPERATOR 1996

A. S. Name	AR 1996 (g/ha)	Crop group	Pesticide group	RI*F
lindane	1500	maize	INSE	
fentin hydroxyde	400	potato	FUNG	
lindane	1500	sugarbeet	INSE	
isoproturon	2250	cereal	HERB	
atrazine	4000	maize	HERB	
fentin acetate	400	potato	FUNG	
fenpropimorf	750	cereal	FUNG	
mancozeb	1600	cereal	FUNG	
fluazinam	200	potato	FUNG	
mcpa	1500	cereal	HERB	
parathion	250	sugarbeet	INSE	
mancozeb	3200	potato	FUNG	
maneb	1600	cereal	FUNG	
sulcotrione	450	maize	HERB	
epoxyconazole	187,5	cereal	FUNG	
metamitron	3500	sugarbeet	HERB	
maneb	3200	potato	FUNG	
carbofuran	150	maize	INSE	
endosulfan	180	potato	INSE	
diquat	975	potato	HERB	> 10 ^E +6

disappeared:

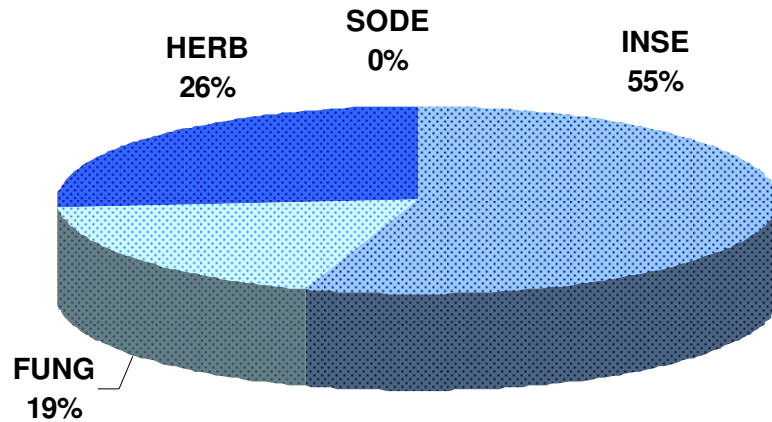
- ❖alachloor
- ❖dinoterb

appeared:

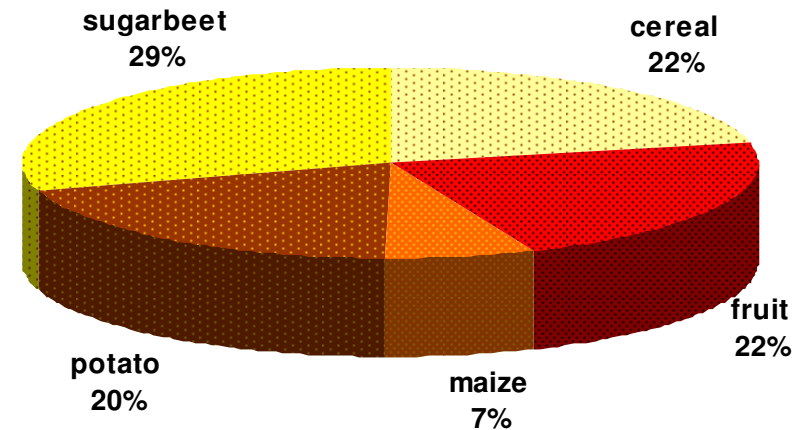
- ❖fluazinam
- ❖sulcotrione
- ❖epoxyconazole
- ❖carbofuran
- ❖endosulfan

5: Impact evaluation with PRIBEL

Aquatic organisms 1991



Relative contribution of pesticide groups



Relative contribution of crop groups

- ❖ insecticides high (aqua tox. against fish, daphnia, algae)
- ❖ lindane, parathion and diethatyl-ethyl in sugarbeet

5: Impact evaluation with PRIBEL

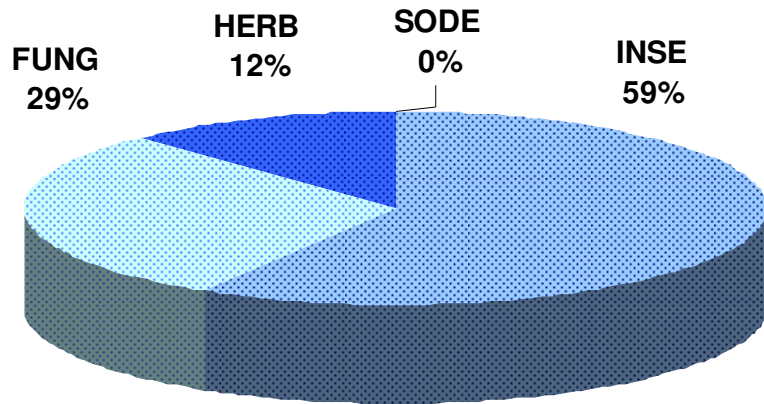
Aquatic organisms 1991

A. S. Name	AR 1991 (g/ha)	Crop group	Pesticide group	RI*F
lindane	1500	sugarbeet	INSE	
parathion	250	fruit	INSE	
DNOC	5000	fruit	INSE	
fentin acetate	400	potato	FUNG	
dinoterb	1250	cereal	HERB	
endosulfan	180	potato	INSE	
parathion	250	sugarbeet	INSE	
diethatyl-ethyl	2040	sugarbeet	HERB	> 10 ^{E+7}
DNOC	5000	cereal	INSE	
bifenox	748	cereal	HERB	
carbofuran	150	sugarbeet	INSE	
lenacil	800	sugarbeet	HERB	
lindane	1500	maize	INSE	
aclonifen	2400	potato	HERB	
propamocarb	1100	maize	FUNG	
carbofuran	150	maize	INSE	
propamocarb	1100	cereal	FUNG	
chloortoluron	2500	cereal	HERB	
mancozeb	1600	cereal	FUNG	
fentin hydroxyde	400	potato	FUNG	> 10 ^{E+6}

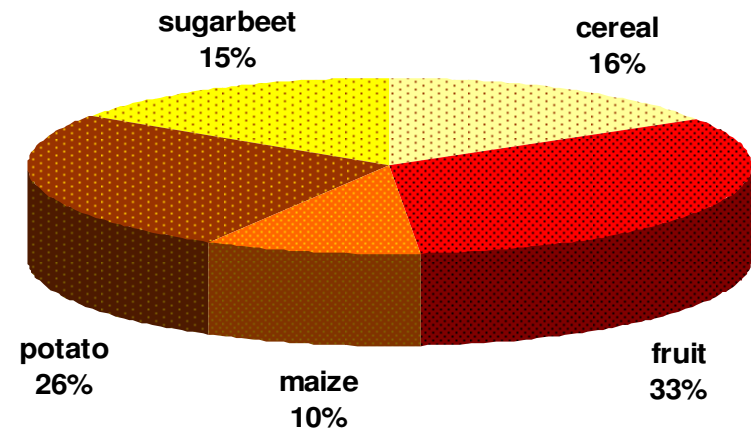
Surface water is the
Compartment with the
Highest amount of
Already banned
Pesticides included
In the impact top 20
Of 1991

5: Impact evaluation with PRIBEL

Aquatic organisms 1996



Relative contribution of pesticide groups



Relative contribution of crop groups

- ❖ Compared to 1991 the fungicide proportion increased, the herbicide decreased
- ❖ Endosulfan heads (sales increased) the list, followed by DNOC
- ❖ Fungicide dodine sales doubled, fenpropidin new, sold in high amount.
- ❖ Herbicide dinoterb, diethatyl-ethyl disappeared

5: Impact evaluation with PRIBEL

Aquatic organisms 1996

A. S. Name	AR 1996 (g/ha)	Crop group	Pesticide group	RI*F
endosulfan	180	potato	INSE	
DNOC	5000	fruit	INSE	
dodine	600	fruit	FUNG	
parathion	250	fruit	INSE	
carbaryl	675	fruit	INSE	
fenpropidin	375	cereal	FUNG	> 10 ^{E+7}
lindane	1500	maize	INSE	
parathion	250	sugarbeet	INSE	
lindane	1500	sugarbeet	INSE	
fentin acetate	400	potato	FUNG	
DNOC	5000	potato	INSE	
carbofuran	150	sugarbeet	INSE	
propamocarb	1100	maize	FUNG	
lenacil	800	sugarbeet	HERB	
propamocarb	1100	cereal	FUNG	
carbofuran	150	maize	INSE	
bifenox	748	cereal	HERB	
aclonifen	2400	potato	HERB	
mancozeb	1600	cereal	FUNG	
prosulfocarb	4000	cereal	HERB	> 10 ^{E+6}

Lindane less impact

6: Comparison of evolution with 2001

All	applicator	consumer	aquatic organisms	ground water	earthworms	birds	bees
1991	2.53E+08	4.98E+05	2.35E+08	3.17E+08	4.09E+05	2.29E+08	6.59E+06
1996	2.03E+08	4.41E+05	2.18E+08	1.77E+08	3.12E+05	4.52E+07	1.14E+07
2001	1.49E+08	7.04E+04	1.85E+08	8.50E+07	2.69E+05	5.92E+07	7.52E+06
<i>change 96 - 91</i>	80.24	88.55	92.77	55.84	76.28	19.74	172.99
<i>reduction 96 - 91</i>	19.76	11.45	7.23	44.16	23.72	80.26	
<i>change 01 - 96</i>	73.40	15.96	84.86	48.02	86.22	130.97	65.96
<i>reduction 01 - 96</i>	26.60	84.04	15.14	51.98	13.78		34.04
<i>change 01 - 91</i>	58.89	14.14	78.72	26.81	65.77	25.85	114.11
<i>reduction 01 - 91</i>	41.11	85.86	21.28	73.19	34.23	74.15	

- ❖ 96-91: reductions in all compartments, except bees
- ❖ 01-96: reductions in all compartments, except birds
- ❖ 01-91: reductions in all compartments, except bees

6: Comparison of evolution with 2001

BEES

1991: highest impact for parathion (fruit) and dimethoate (fruit & potato)

1996: succes of **imidacloprid** (°1992) in fruit:



- ❖ ~ target group as parathion
- ❖ more efficient
- ❖ smaller doses
- ❖ higher toxicity

→ sales parathion ↓
→ clearly highest impact of imidacloprid

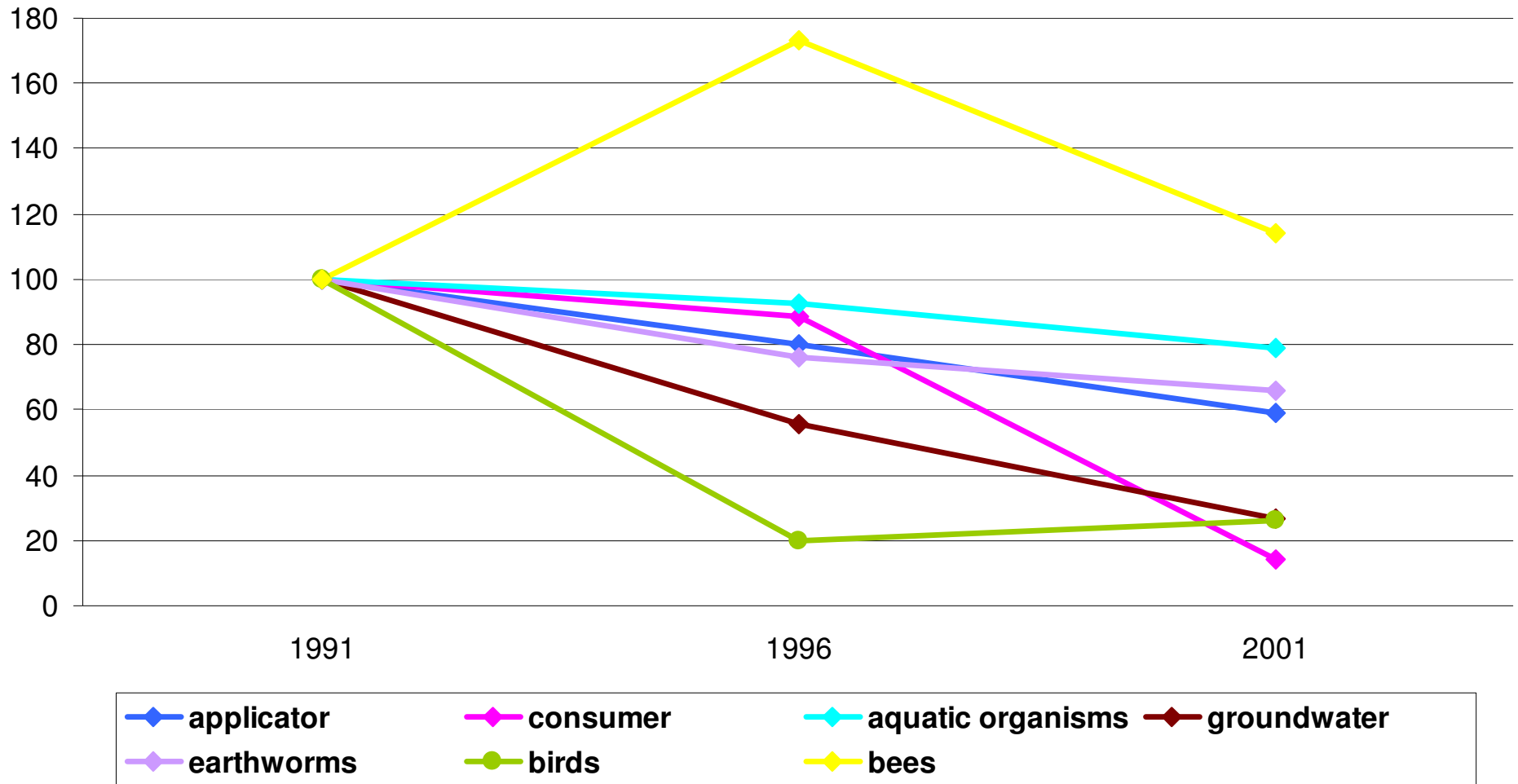
+
❖ chloorpyrifos, carbaryl and dodine: higher sales
❖ DNOC also in potatoes
❖ higher usage of sulphur in fruit

6: Comparison of evolution with 2001

BIRDS

- 1991:
- ❖ aldicarb (GR) in sugarbeet
 - ❖ carbofuran (ZB) in maize and sugarbeet
 - ❖ methiocarb (GR) in different crops
- 1996:
- ❖ similar as 1991
 - ❖ imidacloprid (ZB) came up → aldicarb in sugarbeet
- 2001:
- ❖ oxamyl (GR)
 - ❖ fipronil (°1998) (ZB)
 - ❖ carbosulfan (GR)
- 
- 

6: Comparison of evolution with 2001



6: Comparison of evolution with 2001

Pesticide groups and crop groups

reduction 01 - 91	applicator	consumer	aquatic organisms	ground water	earthworms	birds	bees
INSE	61.13		30.47		75.35	75.29	
FUNG	19.45	87.18					
HERB	35.92	22.03	28.59	71.51	25.86	41.52	
SODE	100.00	81.82	100.00	29.01	85.73		100.00

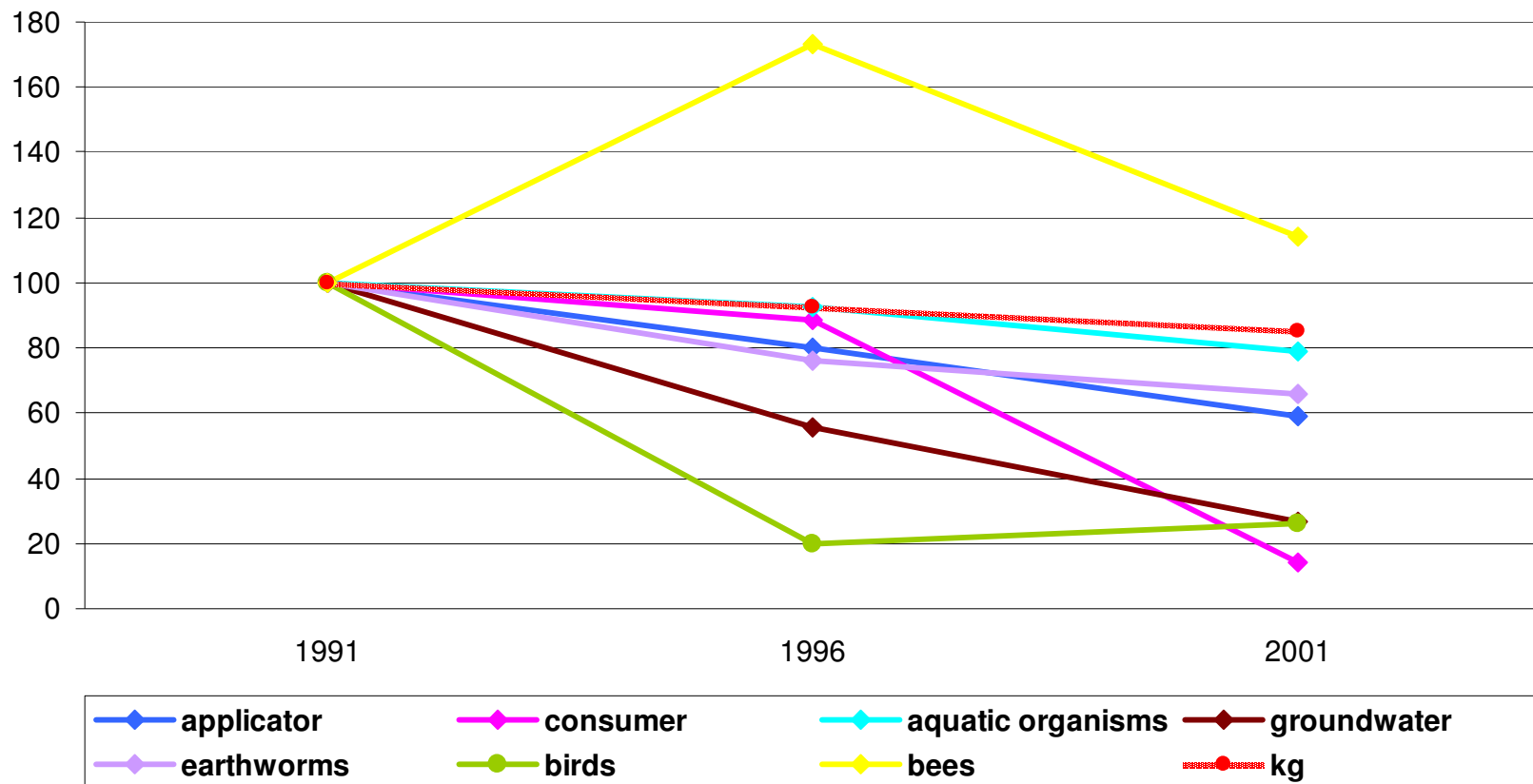
reduction 01 - 91	applicator	consumer	aquatic organisms	ground water	earthworms	birds	bees
Cereal	51.96	NR	40.00	86.89	19.97	57.87	NR
Fruit	77.00	87.06		74.34	51.38	97.95	2.80
Maize	50.51	NR	15.18		48.34	43.78	NR
Potato							
Sugarbeet	71.73	NR	57.26	80.84	50.28	76.82	NR

6: Comparison of evolution with 2001

KG ↔ IMPACT REDUCTION

Reduction 2001 - 1991

bees	kg	aq. org.	earthworms	operator	groundw.	birds	consumer
(-14)	17	21	34	41	73	74	86



6: Comparison of evolution with 2001

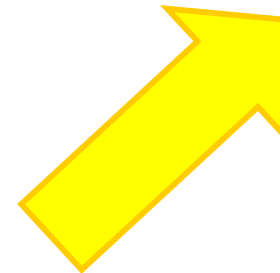
frequency of application



multi-impact indicator

- ❖ only usage considered
- ❖ no exposure assessment
- ❖ no toxicity assessment
- ❖ no application rate (kg/ha)
- ❖ no application circumstances

PRIBEL



- ❖ toxic a.s. replaced by less toxic ones?
- ❖ smaller application rate (2 times 2 kg/ha instead of 1 time 4 kg/ha)?
- ❖ bufferzones, drift reduction?
- ❖ protective clothes?
- ❖ ...

Conclusions: Pribel '91-'96-'2001

❖ General aspects about PRIBEL

- impact indicator: trends and evolutions
- only environmental aspects: no indication about economics or efficiency

❖ Specific impact reduction results

GOOD RESULTS!

- One or two a.s. often influence the result to a great extent
 - use changes or restrictions
 - replace by less toxic as

Conclusions: Pribel '91-'96-'2001

❖ Limitations of the study

1991 & 1996



2001

different databases and repartition key

- comparison of global results (all crops per compartment): ok
- difficulties to compare the evolution in impact per crop