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SELECTION OF PESTICIDE RISK INDICATORS: GUIDANCE FOR POLICY MAKERS

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SELECTION OF PESTICIDE RISK INDICATORS: GUIDANCE FOR POLICY MAKERS

Environment Directorate
ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT
Paris 2016

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FOREWORD

This document provides guidance for policy makers on both developing new or selecting existing indicators of risk to human health and the environment from the use of crop protection products (i.e., pesticides). These pesticide risk indicators are tools, based on modelling or actual data from monitoring studies or surveys, which predict the potential risk from the use of pesticides, and help policy makers assess the sustainability of pesticide use.

The document is divided into two parts: the first part provides guidance on selecting pesticide risk indicators, and the second part provides case studies which describe how OECD member countries have used such indicators.

This report was developed by OECD's Expert Group on Pesticide Risk Indicators, a sub-body of the OECD Working Group on Pesticides.

The OECD Working on Pesticides (WGP) approved the report on 11 July, 2016. This document is published under the responsibility of the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology which agreed to its declassification on 29 August, 2016.

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INTRODUCTION

1. In 2012, the OECD established the Expert Group on Pesticide Risk Indicators (EGPRI) to develop an overview of existing Pesticide Risk Indicators (PRIs) and to determine how best these indicators could be used to assess the risks associated with pesticide use.

2. As a first step in this initiative, in 2014 a web-based questionnaire was circulated to member countries to collect information on existing PRIs in their countries. Based on the input from this survey, in February 2016, an online Pesticide Risk Indicators database - developed by the EGPRI and hosted by the Julius Kühn Institut - was posted on the Internet: http://sf.jki.bund.de/oecd-prier/secured/index.jsf. At the same time, OECD published a report [ENV/JM/MONO(2016)8] which describes the online Pesticide Risk Indicators database and how to use it.

3. The following guidance builds on the information collected as part of this initiative as well as additional material collected by the EGPRI members. It is designed to help risk managers and policy makers develop and select indicators to assess the sustainability of pesticide use and the effectiveness of measures taken to achieve that aim. Other experts may also benefit from this guidance.

4. Control regimes for pesticides are designed to ensure that products can be used in a manner that does not harm human health or have unacceptable effects on the environment. Using indicators to help assess the potential impact of pesticides is part of an effective post approval control regime[1]. Properly designed indicators and/or suites of indicators can help identify potential risk of pesticide use, and ensure that pesticides are being applied in accordance with good agricultural practice. Indicators can serve as helpful tools to develop an understanding of why particular situations may occur and predict the implications of proposed courses of action.

5. This guidance recognises that OECD member countries will have different interests and goals in relation to sustainable pesticide use. This guidance does not, therefore, prescribe the use of any particular indicator or approach.

6. This guidance builds on previous advice issued by the OECD and includes case studies showing how some member countries have used indicators to help improve the sustainability of pesticide use.

CATEGORIES OF PESTICIDE RISK INDICATORS

7. Pesticide risk indicators can be grouped into two broad categories, based on the type of data upon which they are based:

- *Modelling*. This approach uses modelling systems to assess impacts by estimating exposures. These models vary in their degree of sophistication and may take account of factors such as: physical and chemical properties of pesticides; dose, frequency and sequencing of applications;

[1] The text is from the perspective of national, regional and/or international authorities who use pesticide risk indicators. Other stakeholders may develop and use pesticide indicators as well. General principles apply irrespective of the developer / user.

equipment used; climatic conditions; crop; growth stage; soil type; topography; and location of people/environmental features. Models may help to aggregate results over varying periods of time, geographical areas (for example, fields, water catchments, regions, countries) and compounds.

- *Monitoring/Survey*. This approach generally (but not always) involves interpreting a wide-range of information, such as monitoring and/or survey data. The data/information is often developed for purposes other than to specifically assess the sustainability of pesticide use. Relevant data/information may include: residues in foodstuffs and water; user practices; cropping patterns and pesticide use; incidents; and compliance activities.

8. Often combinations of modelling and monitoring/survey approaches can help achieve the desired outcomes. There is no single approach that will meet all needs. A list of some of the currently available pesticide risk indicators used in OECD member countries has been published by the OECD (*OECD, 2016*).

9. Expert judgement should be applied to interpret the wider message which emerges from indicators to draw conclusions on the degree to which products are being used sustainably. Ideally a range of stakeholder opinions should be brought to bear when designing the approach to indicators, interpreting information/data and formulating conclusions.

GUIDANCE FOR SELECTING PESTICIDE INDICATORS IN POST-AUTHORISATION RISK MANAGEMENT - OECD "CHECK LIST"

10. Previous OECD work (*OECD, 2005*), recommended that pesticide indicators for post-authorisation risk management be:

1. closely related to the major objectives and the protection goals of the risk management policy;
2. complementary to, but not duplicative of, any indicators used for pesticide authorisation purposes;
3. scientifically robust;
4. user friendly; and
5. practical for use by authorities.

This section gives further guidance (i.e., a "check-list"), on the way in which these criteria can be applied in assessing the suitability of potential indicators for pesticide risk management. (*Note*: this check-list is applied against each case study described in the Annex.)

Check List from the Expert Group on Pesticide Risk Indicators (EGPRI)

1. Protection goals of the policy

☑ The protection goal is clearly and specifically identified.

Protection goals are overall goals to be achieved to protect human health and the environment from unacceptable impacts of pesticides. For an impact indicator, a protection goal is further specified in terms of the entity/value to be protected, the level of protection, where it should be protected (spatially explicit), and over what time period (temporally explicit). In a performance indicator other proxies for the protection goal are used. It is essential to have a clear understanding of what (suite of) protection goal(s) (these tend to be set by policy-makers) are to be considered. The protection goals should drive the selection of the (suite of) indicators.

☑ Each protection goal is covered by at least one indicator.

At least one pesticide indicator should generate and show results for one or more of the protection goals. A protection goal may be represented by more than one indicator.

☑ The pesticide risk indicator fits the time/spatial scale of the protection goal

Indicators can be chosen (or developed) for a variety of timescales and/or national, regional, county, district, farm, field or other spatial areas.

2. Indicators which are complementary to those used for pesticide authorisation

☑ Indicators are based on real exposure conditions and/or real pesticide use.

Indicators should be based on recorded exposure parameters (for example, recorded use of pesticides, dose, frequency, place and time of application); use of protection equipment and other mitigation measures; climatic conditions; compliance with regulations; monitoring and surveillance data (residues in foodstuffs or the environment, etcetera). They should, ideally, be based on representative sub-sets of general populations.

Post-use indicators for pesticides can potentially better assess management practices and impacts. Some have the ability to identify areas with specific concerns and issues relating to simultaneous and consecutive use of different pesticides.

3. Scientifically robust

☑ The methodologies of the indicator are validated.

Methods should be demonstrably scientifically robust and have been subjected to robust scrutiny. If applicable, calculation algorithms (ideally) should be peer-reviewed, and outputs verified and validated and a sensitivity analysis conducted. While both modelling and monitoring/survey indicators are covered by this guidance, for monitoring/survey indicators the scientific validation is limited to a contextual frame that is rarely strictly comparable to other situations.

☑ The limits of particular indicators are understood.

The limits of an indicator's robustness should be clearly understood (for example, the minimum level of definition, representativeness and/or how aggregation processes operate).

4. User friendly

☑ The indicator has precise and complete instructions.

The process for applying indicators should be 'user-friendly'. Ideally there should be: clear instructions to users; a definition and illustration of inputs; and an illustration of possible results. Clear instructions on system requirements and installation should be available, where applicable. If applicable a graphical user interface (with help function and appropriate error messages) should be provided.

5. Practical for use by the authority

While indicators can help with planning and assessment activities, they may not in themselves contribute directly to more sustainable pesticide use. Care should be taken, therefore, to devote a proportionate amount of resource to this work.

☑ Workload and operational costs should be a consideration when planning to use an indicator.

Indicators can be based upon a wide range of information including, but not limited to: the nature of the pesticide; the method of application; the use of personal protective equipment and other mitigation measures; land use and soil type; climatic conditions; and geographic information associated with the application site. Consequently, the generation and interpretation of indicators can be a relatively resource intensive activity. The availability of resources to obtain input data, to operate and interpret the indicator and take follow-up action should, therefore, be taken into consideration.

☑ Indicator data/requirements must be compatible with available input data.

Indicators should be populated with data which is sufficiently accurate to ensure confidence in outputs. For example, it may be inappropriate to generate indicators demonstrating impacts on a monthly basis if key input data is only available on an annual basis; or at a regional level if reliable data is only available at a national scale.

☑ Indicator output meet demands of end-users.

The output from indicators should meet the needs, and have the confidence, of end users. Ideally end users should be consulted on the format of outputs (this may include text, diagrams, maps, etcetera). Is the output of an indicator ready to use, or is customization needed? Consideration may need to be given to handling indicators which show opposing trends for the same protection goal, or when there are various relevant indicators that have opposing trends.

REFERENCES

OECD (2005), *Summary Report of the OECD Project on Pesticide Terrestrial Risk Indicators (TERI) Series on Pesticides No. 27*

OECD (2016), *Report on the Online Pesticide Risk indicators Database (PRIER) Series on Pesticides No. 83*

ANNEX - CASE STUDIES

The following case studies illustrate how an assessment of available pesticide risk indicators, both single indicators and suites of indicators, could look like. The case studies and checklists presented here, which were prepared by members of the OECD Expert Group on Pesticide Risk Indicators, were selected and discussed by the expert group for this purpose. The examples are not intended to be complete and do not reflect a definitive appraisal of any (suite of) indicators by the EGPRI.

1. Pesticides in water

Ensuring that levels of pesticides in water do not exceed limits which may compromise the UK's ability to comply with EU water quality legislation is a long-standing priority for pesticide regulators.

UK pesticide regulators determined that quantitative information was required and established that environmental agencies were assessing water quality and compliance with EU legislation. The environmental agencies shared their data with pesticide regulators. It was established that detection of a number of active substances used in a variety of situations, were at levels which could compromise compliance with EU legislation.

UK regulators assessed the findings. They concluded that it would not be proportionate to adopt additional regulatory controls, but discussed the findings with industry representative bodies. In response, industry established product specific stewardship programmes and developed and promoted general best practice guidelines. This has raised awareness of the issues associated with the use of these products and improved planning, storage, handling, application and disposal practice.

The indicator is: strongly linked to the protection goal; complements those used in the authorisation process (which do not operate at water-body level); is scientifically robust; and easily understood. It provides an excellent method for assessing progress in meeting a key UK policy goal.

Figure 1. Number of Drinking Water Protected Areas where pesticides exceed the drinking water standard

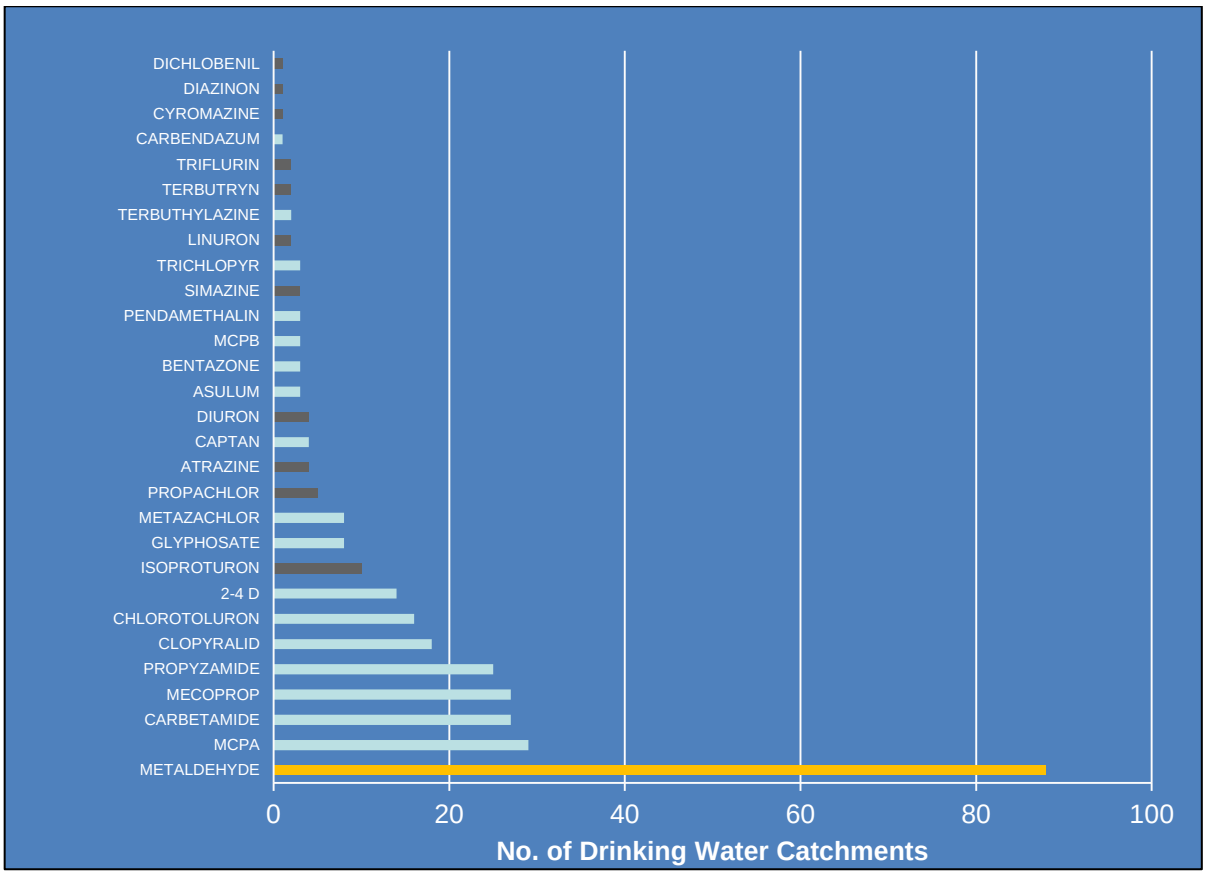


Figure 2. Groundwater bodies failing Water Framework Directive requirements due to pesticides

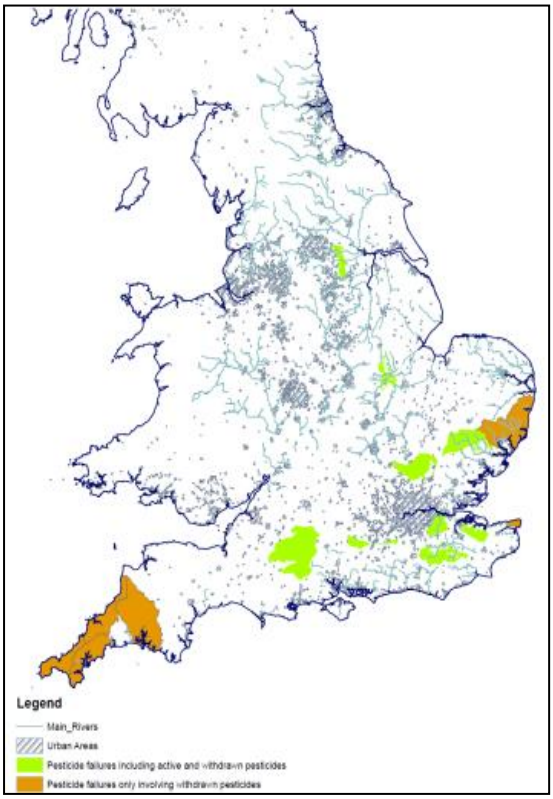
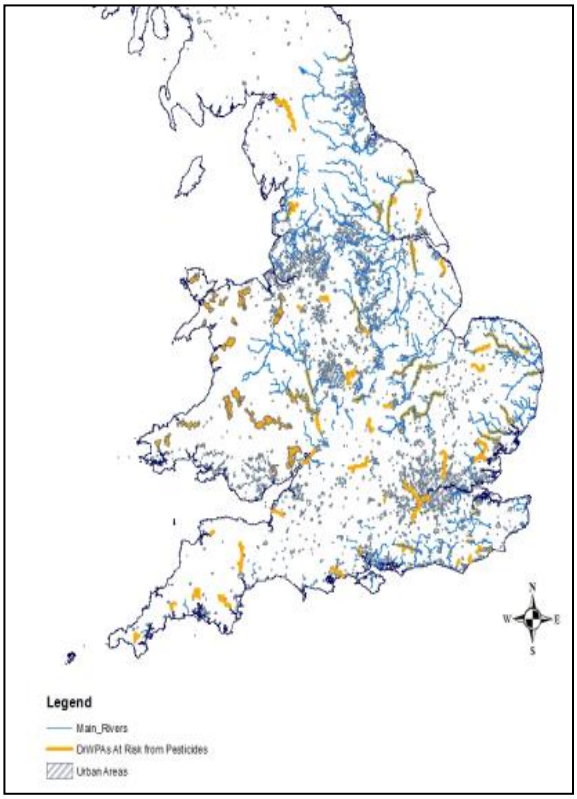


Figure 3. Surface water Drinking Water Protected Areas (DrWPAs) in England and Wales where assessments indicate pesticides are putting Water Framework Directive compliance at risk



Other data considered can be found in Annual Reports of the Pesticides Forum. The UK Pesticides Forum includes a range of stakeholders who provide advice to the government on issues concerning the use of pesticides.

EGPRI Guidance criteria

EGPRI Check-list		**Comments**
The protection goal is clearly and specifically identified.	Yes	The indicator fits the protection goal (Water Framework Directive compliance).
Each protection goal is covered by at least one indicator.	Yes	Indicators are available assessing the extent to which pesticides impact on the ecological and chemical quality of surface and ground waters.
The pesticide risk indicator fits the time/spatial scale of the protection goal.	Yes	Indicators are used to assess compliance with relevant water quality legislation.
Indicators are based on real exposure conditions and/or real pesticide use.	Yes	Based on water monitoring data.
The methodologies of the indicator are validated.	Yes	EU guidance available.
The limits of particular indicators are understood.	Yes	The data are assessed and reported upon by experts from the Pesticides Forum.
The indicator has precise and complete instructions.	Yes	EU guidance available.
Workload and operational costs should be a consideration when planning to use indicator.	Yes	Collection of data is legal requirement for environmental regulator. Relevance/use of indicators is assessed on annual basis by Pesticides Forum.
Indicator data/requirements must be compatible with available input data.	Yes	It is making use of available data.
Indicator output meets demands of end-users.	Yes	Relevance/use of indicators is assessed on annual basis by Pesticides Forum. Report prepared by an indicators sub-group comprised of a range of stakeholder bodies.

2. Use of pesticides in the amenity sector

Reducing the risk associated with the use of pesticides in the amenity sector is a long-standing priority for UK pesticide regulators. However the sector is exceptionally diverse, covering applications to areas such as: public spaces; transport infrastructure; industrial sites; and sporting facilities. It was difficult to establish where best to target activity and which practices be prioritised for improvement.

UK regulators concluded that a combination of qualitative and quantitative information was required and conducted surveys of the sector to better understand use and practice, effectively creating a new suite of risk indicators. This enabled the regulators to establish that both the level of understanding of risk and the adoption of appropriate mitigation measures could be higher. Therefore, when pesticides were applied to hard surfaces in public spaces, there was a higher degree of risk to the environment.

As a result, regulators were able to work with industry-led initiatives, resulting in the development of a programme of work, including; a new standards scheme for those applying and/or contracting use of pesticides in amenity situations; a continuing professional development scheme for users in the sector; and specific guidance.

The indicators developed as a result of the survey work: meet the policy aim (assessing user understanding and practice); complement those used in the risk assessment process (assessing usage practice); and are user friendly and practicable (prepared as research report). Surveys of the sector are now conducted on a regular basis and are used to assess progress with improving practice and to build evidence of practice in amenity situations.

Figure 4. Pesticides in groundwater in England and Wales 2006: top 10 substances (including metabolites) detected

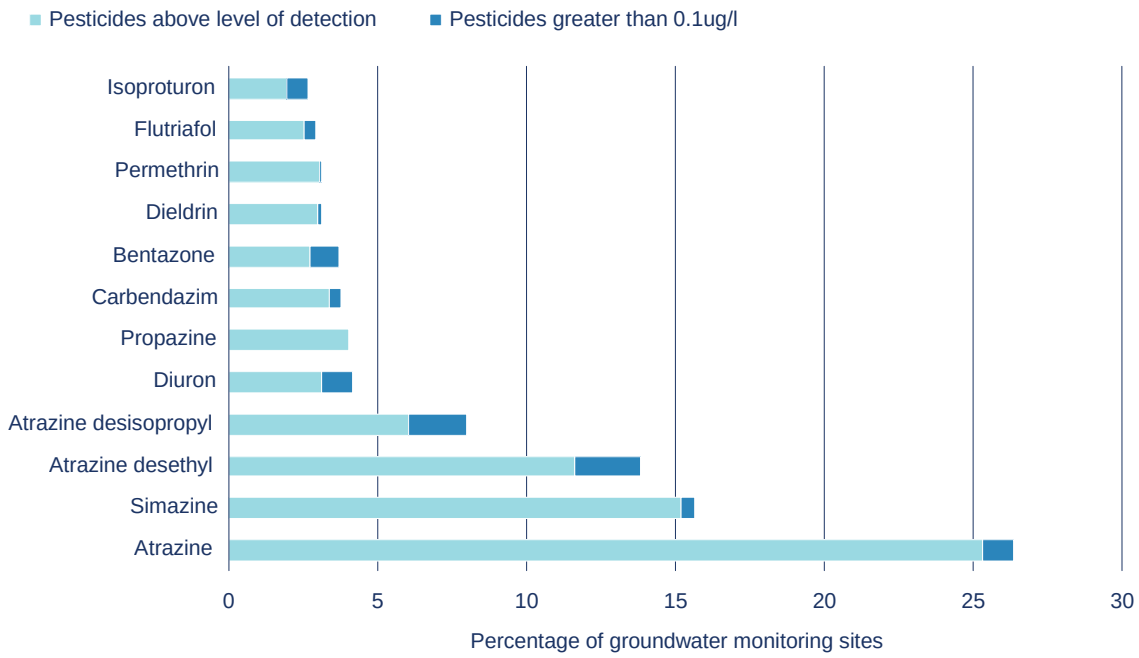


Figure 5. Top 9 pesticides detected in surface water

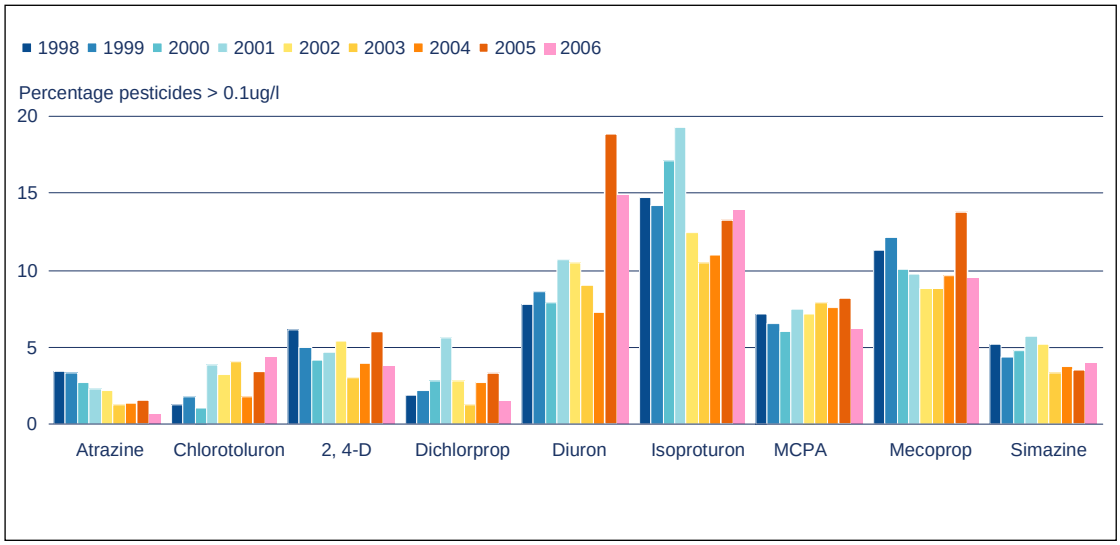


Figure 6. Percentage of users with 'good' or 'very good' knowledge of the Code of Practice

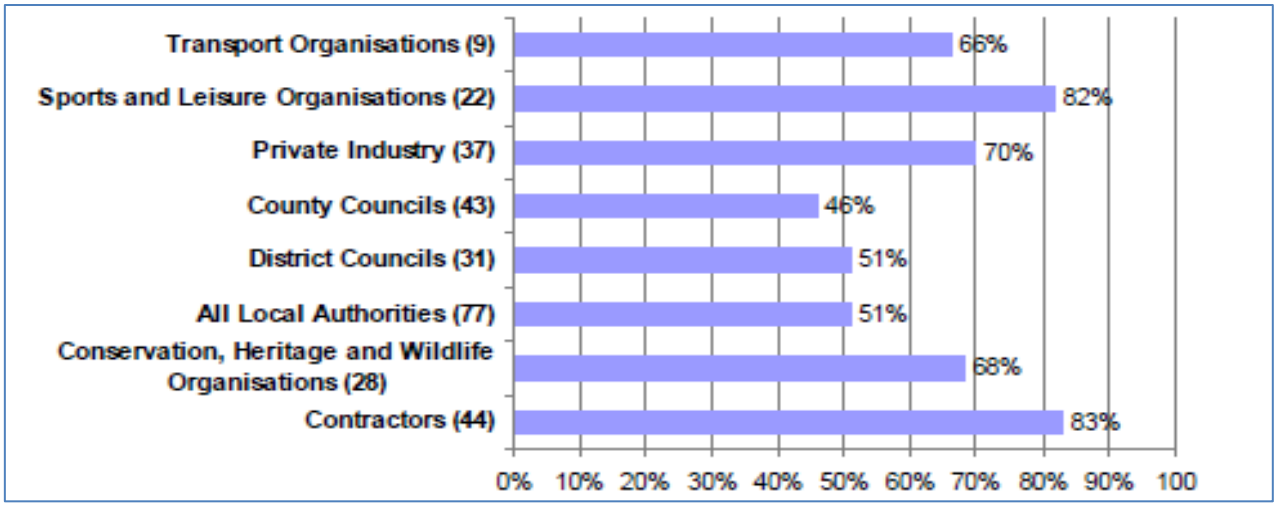
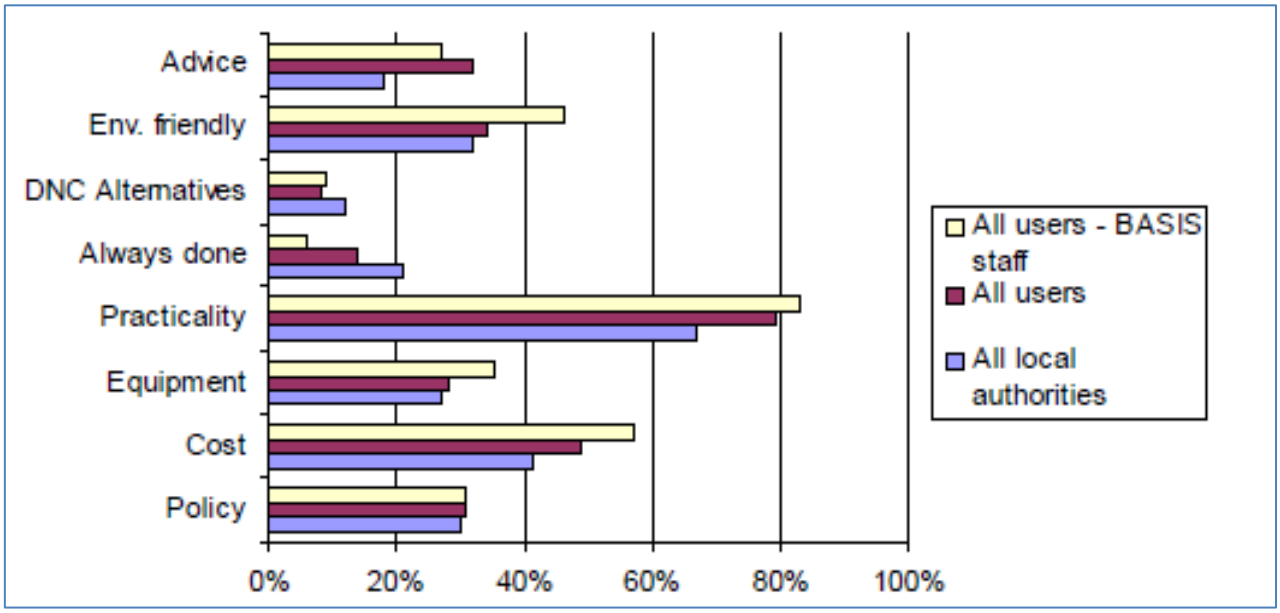


Figure 7. Percentage of users influenced by the listed factors not to use alternatives to pesticides



Other data considered can be found in reports of amenity pesticide use published in 2008, 2011 and 2014.

EGPRI Guidance criteria

EGPRI Check-list		**Comments**
The protection goal is clearly and specifically identified.	Yes	The 'goal', in this case is directed at improving practice in the non-agricultural sector in order to achieve a number of objectives, in particular reducing risks to water quality.
Each protection goal is covered by at least one indicator.	Yes	Regular surveys, collecting a range of detail on usage and practice, are conducted. Survey data/information is used to assess compliance with the protection goal.
The pesticide risk indicator fits the time/spatial scale of the protection goal.	Yes	Initial survey establishes a baseline and then subsequent surveys monitor progress over time.
Indicators are based on real exposure conditions and/or real pesticide use.	Yes	Based on interviews with users/suppliers in sectors.
The methodologies of the indicator are validated.	Yes	EU legislation requires the submission of 'quality reports' detailing the approach to interview surveys. Water monitoring data is collected in accordance with EU guidelines.
The limits of particular indicators are understood.	Yes	The data are assessed and reported upon by experts from the Pesticides Forum and the sector.
The indicator has precise and complete instructions.	Yes	Data is collected under contract. Contractors work to instruction of pesticide regulatory authorities.
Workload and operational costs should be a consideration when planning to use indicator.	Yes	Collection of the data on pesticide usage and water quality is a legal requirement under EU statistical and water quality legislation. It is used in conjunction with data on the practice of users to assess the impact of policies to improve practice in the non-agricultural sector.
Indicator data/requirements must be compatible with available input data.	Yes	Data is collected on the basis that it will be required for indicator outputs.
Indicator output meets demands of end-users.	Yes	Government and industry partners determine data needs and instruct contractors to collect relevant data.

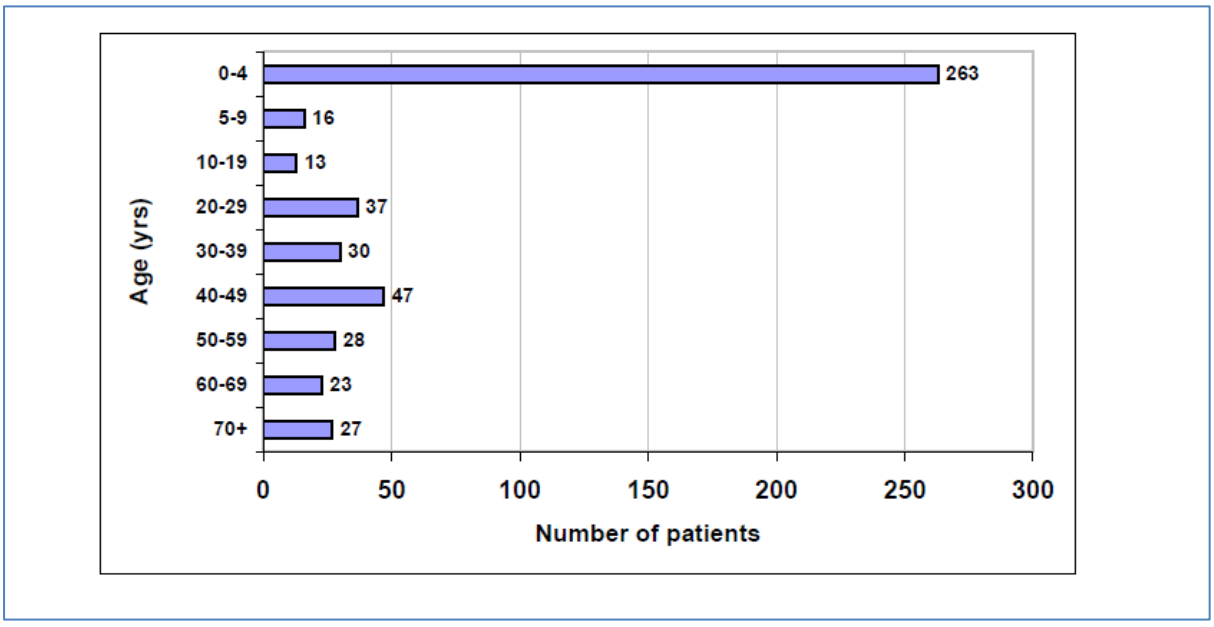
3. Reported human health incidents

Ensuring that pesticides do not harm human health is a key obligation for regulatory authorities, and reports of quantitative and qualitative monitoring studies are assessed on an annual basis. UK regulators noted that a disproportionately large number of incidents reported to the National Poisons Information Service involved garden pesticides and children.

Although most of these incidents were not serious, the regulator's conclusion, following an assessment of the data, was that a number of regulatory measures should be adopted to minimise risks. These included: improved product labelling; product formulation specifications; and the use of child-resistant and flow-restricting containers.

Indicators assessing the impact of pesticides on human health are carefully selected and assessed, particularly when used as the justification for additional regulatory controls. They are: very closely related to a key protection goal (preventing harm to human health); complement that used in the authorisation process (by measuring actual impacts); are scientifically robust (cases being assessed by experts); and easily understood and practicable (being detailed reports of cases of ill-health). These reports continue to be used to monitor the impact of pesticides on human health.

Figure 8. Age distribution of patients involved in reported acute accidental exposure cases



Other data considered, included that showing products: marketed for non-professional use in domestic gardens accounted for 45% of exposures; and products used for the control of slugs accounted for 15% of the cases.

EGPRI Guidance criteria

EGPRI Check-list		**Comments**
The protection goal is clearly and specifically identified.	Yes	The indicator fits the protection goal (protection of human health).
Each protection goal is covered by at least one indicator.	Yes	Indicator based on monitoring data produced by the National Poisons Information Service. Other data sources are also used.
The pesticide risk indicator fits the time/spatial scale of the protection goal.	Yes	Data is collected on a quarterly basis and reviewed annually.
Indicators are based on real exposure conditions and/or real pesticide use.	Yes	Based on reported incidents.
The methodologies of the indicator are validated.	N/A	Not applicable. Methodology of data collection process is explained in reports submitted to the pesticide regulator.
The limits of particular indicators are understood.	Yes	The data are assessed and reported upon by experts from the Expert Committee on Pesticides and the Pesticides Forum.
The indicator has precise and complete instructions.	Yes	Collected and reported under contractual arrangement.
Workload and operational costs should be a consideration when planning to use indicator.	Yes	A review of the reporting and collection of information of possible adverse impacts of pesticides on human health is currently underway to ensure the UK receives the best possible information at a proportionate cost.
Indicator data/requirements must be compatible with available input data.	Yes	Data is collected on the basis that it will be required for indicator outputs.
Indicator output meets demands of end-users.	Yes	Government and independent experts determine data needs and instruct contractors to collect relevant data.

4. Consumer exposure to pesticides

Policy goals /Protection goals: to reduce the risk to consumers from exposure to pesticides when consuming fruit and vegetables available on the market.

PRI tool: The PRI describes the pattern of the risk posed to consumers of fresh fruits and vegetables in a given place (Belgium for instance) for a given period (yearly). The pattern of risks is obtained by combining the output of the annual monitoring of pesticides residues in food with the average diet of the population. The annual monitoring of pesticides residues in food is realised by the authorities. The average diet of the population comes from an inquiry.

Example of PRI for consumer exposure to pesticides: Claeys, W.L., et al., *Exposure of several Belgian consumer groups to pesticide residues through fresh fruit and vegetable consumption.* Food Control, 2011. **22**(3–4): p. 508-516.

Table 1. Exposure of young children (2-5 years) to pesticide residues (%ADI) based on the average residue concentration and consumption data reported by the BfR (2005) (deterministic approach, middle bound scenario).

Pesticide residue	Average consumption		High consumption[a]	
		PF (2)[b]		PF (2)
Chlorpropham	3.2	0.5	16.8	2.9
Chlorpyrifos	2.6	0.7	25.2	6.1
Difenoconazole	2.2	0.6	17.8	4.7
Dithiocarbamates	3.0	0.8	43.9	11.7
Imazalil	28.0	4.8	310.1	53.0
Iprodione	1.2	0.4	30.4	9.2
Lambda-cyhalothrin	2.8	2.8	35.8	35.8
Prochloraz	10.5	1.9	151.0	26.2
Thiabendazole	3.9	0.8	33.7	5.9
Thiacloprid	1.4	0.4	30.2	9.3

[a] i.e. P90, P95, P97.5 and maximal consumption, dependent on the percentile given by the BfR (2005).
[b] application of processing factor PF from Juraske et al. (2008).

Policy measures: the indicator is still under development and has not yet resulted in any policy measures.

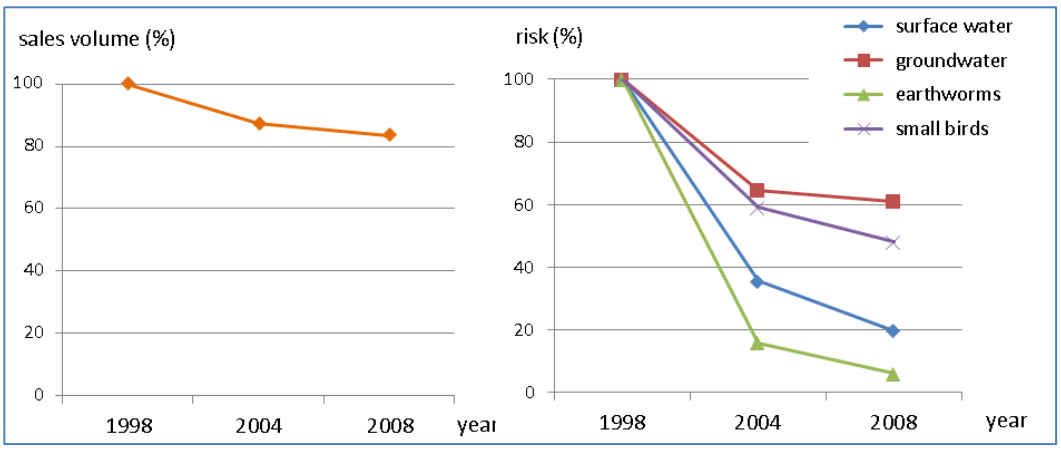
EGPRI Guidance Criteria:

EGPRI Check-list	CEP	Comments
The protection goal is clearly and specifically identified.	yes	Consumer risk (acute) from residues on fruit and vegetables.
Each protection goal is covered by at least one indicator at minimum.	yes	Indicators available for different types of foodstuff, diet, etc.
The pesticide indicator fits the time/spatial scale of the protection goal	yes	Yearly risk at the country (Belgium) level. The variability of both the residue content and the diet are manageable with the indicator.
Indicators are based on real exposure conditions and/or real pesticide use.	yes	Both diet and residues are based on real parameters from monitoring.
The methodologies of the indicator are validated.	yes	Peer-reviewed methodology.
The limits of particular indicators are understood.	yes	These are documented in the scientific articles.
The indicator has precise and complete instructions.	no	Only few experts are up to now able to manage the indicator.
Workload and operational costs should be a consideration when planning to use indicator.	yes	(Additional) costs of the indicator are due to the time necessary for handling the data and operating the CEP.
Indicator data/requirements must be compatible with available input data.	yes	Data are available.
Indicator output meets demands of end-users.	Not yet	Still in development

5. Exposure toxicity ratio type pesticide risk indicators for addressing environmental protection goals in European countries

The Dutch crop protection plan for the period 2013-2023 addresses protection goals for the aquatic ecosystem, terrestrial habitats, groundwater and several human groups. The previous policy plan was evaluated in 2012 with regard to target achievement and lessons learned for the future (ref1). Trends in environmental risks were calculated for environmental compartments and terrestrial habitats with the NMI indicator package (Figure 9). Survey data and sales volumes were used to derive a set of applications, fully covering PPP use in the major Dutch agricultural crops. Calculated exposures were divided by surface water quality standards, the drinking water criterion (groundwater), or no-effect concentrations (earthworms, small birds). Environmental impact was calculated to be reduced between 40% (groundwater) and 95% (in-soil organisms). Aggregated results for all applications, crops and substances showed a similar trend.

Figure 9. Reduction in sales volume and risks for surface water, groundwater, earthworms and small birds, as calculated with the NMI package (ref2)



The overall trends as given in Figure 9 can be analysed in more detail by zooming in, for example by arranging results by product group, chemical class or substance, or by cropping system, agricultural sector or crop.

Figure 10. Relative contributions of crop sectors (left) and major arable crops (right) impacting in-soil organisms in the year 2008.

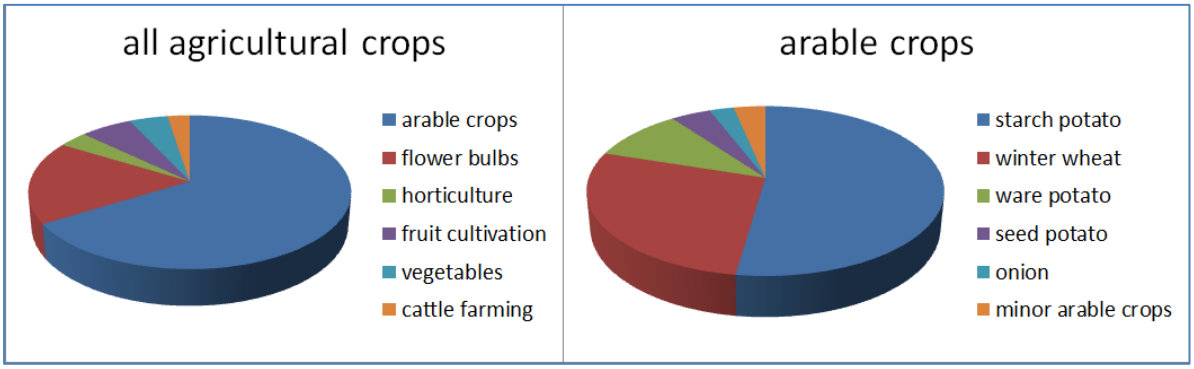
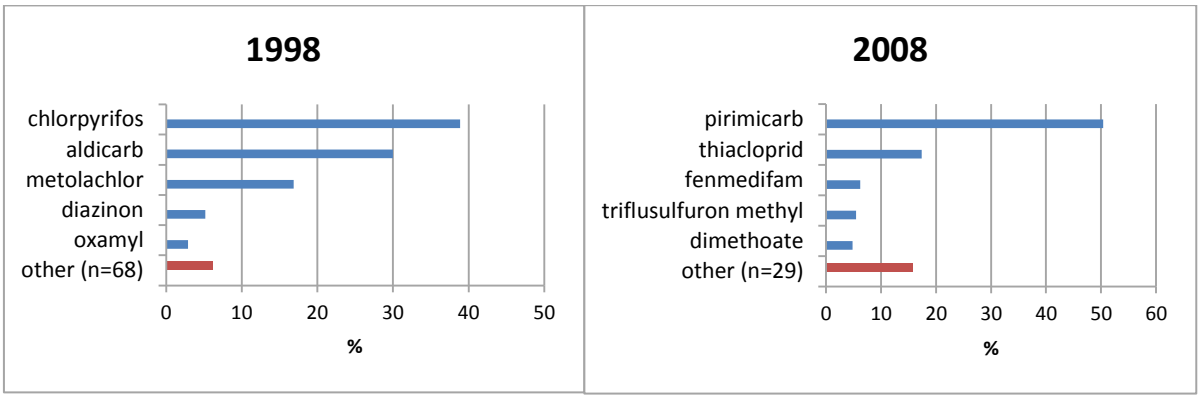


Figure 10: The use of pesticides in arable crops in 2008 contributed to 64% of the impact on in-soil organisms resulting from the use of PPP in all agricultural crops (left). The use of pesticides in winter wheat in 2008 contributed to 28% (18% of total) of the impact on in-soil organisms resulting from the use in arable crops (right), calculated with the indicator for chronic risk to earthworms in HAIR (ref3, ref4).

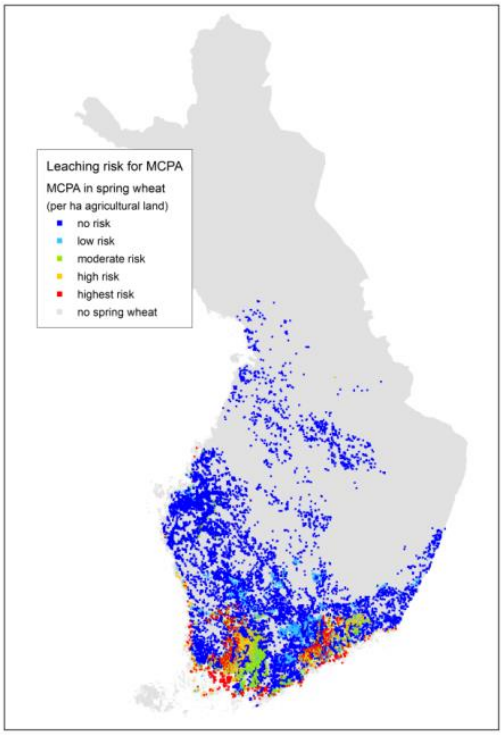
Figure 11 gives the contribution of changes in crop protection in sugar beets to the impact calculated with the risk indicator. Replacement of substances by less harmful substances contributed most to the overall reduction (99%) in this case. The instrument allows for distinctions between effects of substitution as well as other policy instruments (e.g. drift reduction towards surface water).

Figure 11. Top 5 substances impacting in-soil organisms in sugar beet cultivation in 1998 and 2008 respectively, calculated with the indicator for chronic risk to earthworms in HAIR (ref3, ref4).



Spatially distributed output is available for risk indicators which depend on soil properties, such as the groundwater risk indicator. Figure 12 shows an example of the use of regional average applications of MCPA in spring barley in Finland (ref5). In this case, high leaching risk is found in areas with high soil pH.

Figure 12. Leaching of MCPA to groundwater in Finland as calculated with the HAIR groundwater indicator (ref 6).



References

Ref1: http://www.pbl.nl/sites/default/files/cms/publicaties/PBL-2012-Duurzame-Gewasbescherming-Engelse-samenvatting.pdf
Ref2: http://library.wur.nl/WebQuery/edepot/242787
Ref3: http://edepot.wur.nl/177944
Ref4: http://www.pesticidemodels.eu/hair/home
Ref5: http://urn.fi/URN:ISBN:978-952-487-466-3
Ref6: http://edepot.wur.nl/325915

EGPRI Guidance Criteria:

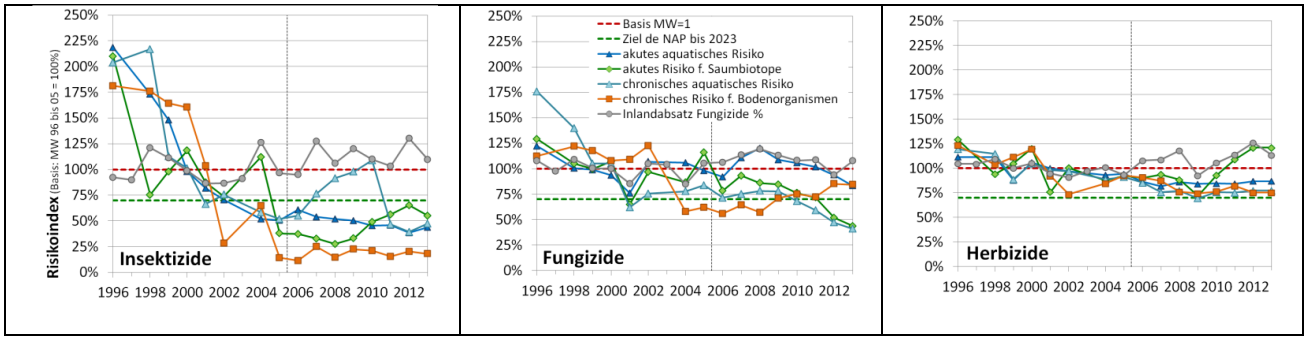
EGPRI Check-list		Comments
The protection goal is clearly and specifically identified.	yes	user can select from various protection goals (groundwater, surface water, soil)
Each protection goal is covered by one indicator at minimum.	yes	dependent on the protection goal, the user can select from options
The pesticide risk indicator fits the time/spatial scale of the protection goal.	yes	basically indicators act on use data at the field scale
The pesticide indicators are based on real exposure conditions and/or real pesticide use.	yes	in principle, usage data from surveys are used. Scenario calculations can be performed.
The methodologies of the indicator are validated.	yes	calculation approaches are derived from more advanced (simulation) models
The limits of particular indicators are understood.	yes	user should be aware that zooming in is limited because of limitations of underlying geographical information and usage surveys
The indicator has precise and complete instructions.	yes	user manual is available
Workload and operational costs should be a consideration when planning to use indicator.	yes	Maintenance of the pesticide properties database and usage survey are two major aspects.
Indicator data/requirements must be compatible with available input data.	yes	essentially the indicators were aligned with available input data
Indicator output meets demands of end-users.	yes	End user usually is national or regional government. The indicators are designed for this level.

6. Risk trends for a national action plan

Article 4 of the German Plant Protection Act (PSchG, 2012) stipulates that the German National Action Plan (NAP, 2013) must contain quantitative objectives, targets, measures and timetables for the reduction of risks and adverse impacts of the use of plant protection products on the environment and on human and animal health. The global target requirements of the NAP relate to the area of plant protection, operator protection, consumer protection and protection of the environment. Specific requirements and timetables underpin the attainment of these targets. Examples of this are a 30% risk reduction in the environment (water bodies, the terrestrial environment) by 2023 based on risk assessments with the risk indicator SYNOPS.

SYNOPS evaluates the risk potential for terrestrial (soil and field margins) and aquatic (surface water) organisms. It combines use data of pesticides with their application conditions and their inherent properties. The exposure of the considered organisms is calculated by sub-models considering drift, run-off and drainage. SYNOPS-Trend calculates the environmental risk on the basis of sales data. The sales data of active ingredients are available on an annual basis and allow only indirect conclusions about the actual usage of the active ingredients. These conclusions are made according to comprehensive assessment procedure developed by Gutsche and Roßberg (1999) for eleven main arable crops (wheat, barley, rye, triticale, oats, maize, rape, sugar beet, potatoes, pulses and field vegetables) and three permanent crops (fruits, vine, hops). The environmental risk to surface water organisms, soil organisms and non-target Arthropods is calculated for each use with SYNOPS-Trend based on a realistic worst-case environmental scenario (Gutsche and Strassemeyer, 2007). The assessed risks of the uses were aggregated by calculating the weighted mean for herbicides, fungicides and insecticides (post processing). This procedure was repeated since 1996 on an annual basis. The calculated risk indices were further post processed and expressed relatively by relating the absolute values to a reference value corresponding to the average of a ten-year period from 1996 to 2005.

Figure 13. Relative risk trends for surface water organisms, soil organisms and non-target Arthropods calculated with SYNOPS-TREND



The risk trends are shown in figure 13 and the corresponding relative risk indices are summarized in Table 1. The risk linked to the insecticides shows a clear decrease for all risk indices. For the fungicides, the chronic aquatic risk in 2013 was reduced by 59% compared to the base period but the acute risk was only reduced by 17%. The terrestrial risk of the NTA was reduced by 56% and of the soil organisms by 25%. The herbicides show in 2013 a risk reduction for the aquatic organisms of 13% (acute) and 23% (chronic) and a 25% reduction for the soil organisms. Whereas the risk for NTA increased by 21%.

Table 2. Relative risk indices in relation to the base period (1996-2005) for surface water organisms, soil organisms and non-target Arthropods calculated with the SYNOPS-TREND (red: increase of risk, yellow: risk reduction but NAP goal of 30% not reached, green: risk reduction and NAP goal of 30% reached)

	insecticides				fungicide				herbicides			
	acute aquatic	chronic aquatic	acute field margins	chronic soil	acute aquatic	chronic aquatic	acute field margins	chronic soil	acute aquatic	chronic aquatic	acute field margins	chronic soil
2006	61%	55%	37%	11%	92%	72%	78%	56%	86%	85%	90%	91%
2007	54%	76%	33%	25%	111%	75%	93%	64%	82%	76%	94%	87%
2008	52%	92%	28%	15%	120%	78%	86%	57%	86%	77%	88%	76%
2009	50%	98%	33%	23%	109%	78%	85%	71%	84%	69%	72%	74%
2010	46%	109%	49%	21%	106%	68%	76%	75%	84%	76%	93%	76%
2011	46%	47%	56%	15%	102%	59%	72%	72%	84%	75%	109%	82%
2012	38%	39%	65%	20%	94%	47%	52%	85%	87%	77%	121%	75%
2013	44%	47%	55%	18%	83%	41%	44%	84%	87%	77%	121%	75%

The overall trends as given in Figure 13 and Table 2 can be analysed in more in more detail for single active ingredients. Spatial distribution of risk indices are not considered with SYNOPS-TREND, since the sales data which is the driving input data set for pesticide use, is not available on regional level.

References

Gutsche, V. und Roßberg, D. (1999), A proposal for estimating the quantity of pesticide active ingredients applied by crop based on national sales data. Report of the OECD Project in Pesticide Aquatic Risk Indicators – Report of Phase 1, Annex 1, OECD, Paris, 1999, 44-49.

Gutsche, V., Strassemeyer, J. (2007), SYNOPS - ein Modell zur Bewertung des Umwelt-Risikopotentials von chemischen Pflanzenschutzmitteln, Institut für Folgenabschätzung im Pflanzenschutz, Biologische Bundesanstalt für Land- und Forstwirtschaft.

PflSchG (2012), Gesetz zum Schutz der Kulturpflanzen, http://www.gesetze-im-internet.de/bundesrecht/pflschg_2012/gesamt.pdf

NAP (2013) National Action Plan on Sustainable Use of Plant Protection Products http://www.nap-pflanzenschutz.de

EGPRI Guidance Criteria:

EGPRI Check-list		Comments
The protection goal is clearly and specifically identified.	yes	The indicator fits the protection goal (protection of environment: soil, surface water, non-target arthropods (NTA)).
Each protection goal is covered by at least one indicator at minimum.	yes	Aquatic risk: 5 reference organisms, soil: 2 reference organisms; 2 NTA
The pesticide risk indicator fits the time/spatial scale of the protection goal.	yes	Annual basis or multi annual was for the trend approach sufficient. For the spatial scale the national level was chosen. More detailed scales are possible
The pesticide indicators are based on real exposure conditions and/or real pesticide use.	no	In this case sales data were converted to pesticide use per crop on national level. Assessment wit pesticide usage data are possible
The methodologies of the indicator are validated.	yes	Implemented sub models are peer-reviewed methodologies
The limits of particular indicators are understood.	yes	Human risk assessment is not possible
The indicator has precise and complete instructions.	no	Introductory workshop is necessary to run the indicator
Workload and operational costs should be a consideration when planning to use indicator.	yes	costs of the indicator are due to the time necessary for handling the data and operating SYNOPS
Indicator data/requirements must be compatible with available input data.	yes	Pre-processing of the sales data information is necessary
Indicator output meets demands of end-users.	yes	Output must be post-processed to aggregate the risk indices into one national value.