

**REPORT OF THE
OECD WORKSHOP
ON
PESTICIDE RISK INDICATORS**

**Copenhagen
21-23 April 1997**

Foreword

The recommendations outlined in this workshop report were presented to the OECD Pesticide Forum in June 1997. The Pesticide Forum is the body which directs the work of the OECD Pesticide Programme. The Forum is composed principally of delegates from OECD Member countries but also includes representatives from the pesticide industry, non-governmental organisations, and other international organisations.

After reviewing the report, the Pesticide Forum agreed that the Pesticide Programme should initiate work to develop pesticide risk indicators in the manner recommended by the workshop. The Pesticide Forum also agreed to follow-up on some of the workshop's recommendations related to improving the quality of the data used in indicators.

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Introduction and Background

1. This report presents the conclusions and recommendations made by the OECD workshop on pesticide risk indicators, held in Copenhagen on 21-23 April 1997. The purpose of the workshop was to advance OECD work on pesticide risk indicators. The workshop had three main objectives:

- (i) to provide an opportunity for OECD countries to discuss and compare existing pesticide risk indicators;
- (ii) to identify the scope, structure and content of pesticide risk indicators that could be used by government authorities to measure risk trends;
- (iii) to identify areas for future work.

2. The workshop was organised by the OECD Pesticide Forum as a first step to respond to the recommendation, made by the OECD/FAO workshop on pesticide risk reduction (October 1995, Uppsala, Sweden), that OECD develop “systems to measure progress in risk reduction.” The workshop also provided an opportunity to discuss the work on pesticide indicators being carried out by the OECD Joint Working Party of the Committee for Agriculture and the Environment Policy Committee (the JWP), and to identify ways to link this to the work of the Pesticide Forum.

3. Background information used in the workshop included:

- an overview of OECD work relevant to pesticide risk indicators, prepared by the OECD Secretariat, with contributions from the Pesticide Programme, the Group on the State of the Environment, and the Joint Working Party for Agriculture and Environment. The overview also included a contribution from Eurostat (the European Union Statistical Office) describing its project to develop guidelines for collecting data on actual pesticide use;
- an overview of existing pesticide risk indicators, by Lois Levitan of Cornell University;
- a review of the key characteristics of pesticide risk indicators used as policy tools, by Andy Hart of the Central Science Laboratory, MAFF, UK.

4. The workshop was hosted by the Danish Environmental Protection Agency (EPA) and chaired by Gunver Bennekou of the EPA. Seventy-seven people attended, including government officials from 24 OECD countries; representatives from the European Commission, the United Nations Food and Agriculture Organisation and the European Plant Protection Organisation; experts from pesticide industry and environmental organisations; and independent experts on pesticide risk indicators (see Annex 2). The workshop participants comprised an equal mix of scientists and policy experts.

Workshop Focus: Risk Indicators as Policy Tools

5. The workshop provided an overview of the different types of indicators being developed today, including farmer decision tools, eco-labels, and policy tools for evaluating the effectiveness of pesticide risk reduction programmes. In keeping with the Uppsala workshop recommendation, however, the workshop concentrated on indicators which could be used as policy tools, to help government officials measure the effectiveness of their programmes and general trends in risk reduction.

Workshop Format

6. The workshop was held in alternating plenary and working group sessions. It began with a plenary session to review the goals and provide background information. The workshop participants were then divided into three working groups to consider:

- (i) the specific purposes and desirable characteristics of indicators that could be used by governments to measure risk trends;
- (ii) the risk parameters and conditions of pesticide use that would be included in such indicators; and
- (iii) recommendations for future work.

7. The working groups' responses to questions (i) and (iii) were discussed and combined in plenary sessions to become one set of conclusions and recommendations from the workshop as a whole. These are provided under the heading "Recommendations".

8. The working groups' responses to question (ii) have not been combined but are provided separately in Annex 1 to this report. They include recommendations for development of indicators in the areas of ecotoxicology, environmental fate, and human health.

Recommendations

Rationale for Initiating Work to Develop Indicators

9. The workshop participants noted that many countries are considering, developing or improving pesticide risk reduction activities. The workshop also noted that many countries are interested in the development of scientifically based risk indicators to measure the impact of these risk reduction activities.

10. The workshop acknowledged that development of indicators that are both scientifically robust and user-friendly would not be an easy task. Nevertheless, the workshop agreed that such indicators would be very useful for national governments. *Consequently, the workshop recommended that the Pesticide Forum undertake work to facilitate the development of pesticide risk indicators.*

Purpose of Indicators

11. The workshop agreed that the basic purpose of pesticide risk indicators developed by OECD would be *to combine information on pesticide risk (hazard and exposure) with information on the quantity and conditions of pesticide use.* Such indicators would provide a better measure of progress in risk reduction than could be obtained by simply measuring reductions in the total amount of pesticide used or sold.

12. The workshop emphasized that *indicators would be used to complement, not to duplicate, pesticide risk assessment and registration*. Indicators would not be used to quantify the risks of any one pesticide. Rather, they could help national governments to:

- obtain baseline information about pesticide use and risks, and then track risk trends over time
- identify potential trouble spots and areas where action is needed to reduce risks
- monitor the impacts of agriculture and pesticide policies
- communicate the aims and results of risk reduction policies and programmes
- compare pesticide risks
- obtain information about aggregated risks associated with use of multiple pesticides
- compare pesticide use in different situations (e.g. agricultural production systems using different levels of inputs)
- provide information for other types of indicators, e.g. decision tools for farmers, green labels for food products, indicators of advances in IPM
- plan and prioritise research on pest control methods.

Scope and Structure of Indicators

13. The workshop agreed that indicators used by national governments to measure progress in risk reduction should have a wide scope, covering both human health and environmental risks. The workshop agreed that the indicators should include both data on risk (hazard and exposure) and data on the conditions and quantity of pesticide use (e.g. quantity applied per unit area, total area treated, total quantity of pesticide used, frequency of application, method of application, crop and timing, formulation type). The workshop agreed that indicators should address the different compartments of the environment (e.g. air, water, soil) and different subpopulations of people (e.g. agricultural workers and other pesticide users, consumers, bystanders, and sub-populations of special concern because of age, diet or health status).

14. The workshop agreed that indicators should be neither too simple nor too complex, but that they should be easy to use while providing accurate and meaningful information. The workshop agreed that indicators should be sound analytical tools with sophisticated inputs but with outputs that can be easily understood.

Principles for Development of Indicators

15. The workshop developed and agreed the following set of principles for the development of pesticide risk indicators:

- Risk indicators should be developed on a co-operative, consensual basis, in order to use resources most efficiently and to promote wide acceptance of the indicators developed.
- Risk indicators should be both scientifically based and effective as public policy tools. A balance needs to be struck between these two objectives, although developing indicators that meet both will be challenging.
- It would be better to have a set of indicators dealing separately with risks to human health and to different compartments of the environment, rather than to have one single indicator of pesticide risk. The reason is that different types of risk are of varying importance to different

users, they are often measured on different scales, and no satisfactory method for combining them exists.

- Indicators need to be based on reliable data, including (1) registration data and, where available, post-registration monitoring and incident reports, and (2) data on quantities and conditions of pesticide use. To the extent possible, these data should be compatible in their level of precision.
- Methods for establishing indicators should be transparent, and the data used should be made widely available (i.e. accessible to more than just regulatory authorities).
- The terminology used in developing indicators must be carefully defined as a starting point for international work in this area: the workshop showed that people are using the same terms to mean different things.

Principles for the Use of Indicators

16. The workshop developed and agreed the following principles for the use of pesticide risk indicators:

- Countries need the flexibility to use risk indicators in ways appropriate to national circumstances.
- Countries should be aware of the limitations of risk indicators, and should use them in conjunction with other information relevant to understanding trends in pesticide use and risk.

Recommended Approach

17. The workshop recommended that work to develop pesticide risk indicators and to improve the quality of the data used in them be initiated as follows:

Developing risk indicators

- The workshop recommended that the **Pesticide Forum** offer to take the lead in developing pesticide risk indicators for the OECD Joint Working Party for Agriculture and Environment (JWP), taking into account work already done in this area.
- In order to address the JWP's concern about providing a product at the Spring 1998 OECD Agriculture and Environment ministerial meetings, the workshop recommended that the **Pesticide Forum** undertake to develop a workplan and begin work before these meetings. This should include:
 - the setting of clear instructions and priorities by the Pesticide Forum
 - development of a workplan by a steering group or task force
 - creation of expert groups, one for the environment and one for human health, to test examples of alternative types of indicators and develop detailed proposals for indicators that would be useful to national governments
 - creation of a means for regular interaction between scientists participating in the expert groups and policy experts.

- The workshop recommended that the **Pesticide Forum** promote information exchange on risk reduction measures.

Improving the quality of the data used in indicators

- The workshop recommended that the Pesticide Forum review the forthcoming Eurostat guidelines for collecting data on actual pesticide use (first draft expected in September 1997) and consider adopting these as OECD guidelines in light of the recommendations from this workshop.
- Recognizing the importance of incident reporting and post-registration monitoring (e.g. of ground water, surface water, farmer health, fish, wildlife), the workshop recommended that the **Pesticide Forum**: (1) develop guidelines for post-registration monitoring, (2) develop an inventory of existing incident reporting schemes, and (3) consider ways to incorporate incident and monitoring data in pesticide risk indicators.
- The workshop recommended that **national governments** consider implementing new programmes, and/or extending existing ones, to collect data on actual pesticide use and exposure. The workshop noted that consideration should be given to the level of precision needed in these data such that they will be compatible with data available on risk. If collection of actual use data is not possible for every year or every purpose, the workshop agreed that countries should be encouraged to collect annual sales data which can be used to derive information about actual use.

Annex 1

Recommendations for Information to be Included in Indicators: Reports of the Working Groups on Ecotoxicology, Environmental Fate, and Human Health

The working groups on ecotoxicology, environmental fate, and human health were each asked to consider the types of information on pesticide risk and use that should ideally be included in pesticide risk indicators. Specifically, they were asked to identify:

Risk parameters

- the specific information and endpoints that should be included in indicators used by governments for measuring risk reduction;
- the extent to which existing indicators include these parameters;
- how risk data should be used (e.g. use the most sensitive organism, the average, or hazard categories? how and when to combine hazard and exposure/fate?);
- the data that are actually available, the data that would be optimal for such indicators, and an approach for obtaining the optimal data.

Quantity and conditions of pesticide use

- the conditions of pesticide use that should be included in indicators because they have an important effect on risk (e.g. application rate and frequency, method of application, formulation type);
- the extent to which existing indicators include such information;
- the data on conditions of pesticide use that are actually available, the data that would be optimal, and an approach for obtaining the optimal data.

The three working groups addressed these issues to the best of their ability in the short time available at the workshop. Their responses are summarised in the reports that follow. It should be noted that these reports represent a *first attempt* to address a very complex subject. A much more detailed consideration of the issues will need to be undertaken by small expert groups, if the Pesticide Forum decides to initiate work on risk indicators.

Report of the Ecotoxicology Group

Parameters to be Included

Simple risk indicators could be produced using existing data on hazard and exposure but better data on usage is needed. In the longer term, it will be necessary to address risks to the wider ecosystem, for which new types of data would be desired. These include toxicity to a wider range of organisms (see Tables below), exposure away from the site of application, and longer term effects.

Risk indicators at the national level will usually be based on chronic toxicity data. For some taxa, e.g. birds and beneficial arthropods, the inclusion of both acute and chronic toxicity data may be appropriate.

Risk indicators should be devised in such a way that new relevant parameters can be included if and when appropriate (e.g. potential endocrine disrupters).

Table 1. Parameters to be considered for aquatic ecosystems including the agro-ecosystem

Taxa	Data type	Availability/ desirability
algae	NOEC	available
vascular plants	(Lemna)	desired
pelagic invertebrates	LC50, NOEC	available
benthic invertebrates	(NOEC)	desired
amphibia	no standard	optional
fish	LC50, NOEC	available
fish-eating birds	LD50, NOEC by extrapolation, BCF	available
mammals	LD50, NOEC by extrapolation, BCF	available
inhibition of biodegradation	no standard	may be possible by extrapolation
biodiversity	(models?)	desired

It was concluded that those types of existing data shown in bold formed a **core set** which should be included in initial approaches to risk indicators for aquatic ecosystems, together with others for terrestrial ecosystems (see below).

Table 2. Parameters to be considered for terrestrial ecosystems including the agro-ecosystem

Taxa	Data type	Availability/ desirability
micro-organisms	inhibition of respiration and nitrification	available
mycorrhiza	forestry applications and atmospheric transport	insufficient data
vascular plants	no standard	desired
invertebrates in soil	LC50, NOEC for earthworms	available
	Collembola - no standard	desired
invertebrates on soil	no standard -Carabids, spiders, other beneficials	desired but specific to crops, countries etc.
invertebrates on plants	honeybees LD50, NOEC	available
	other pollinators, other beneficials	desired
amphibia	no standard	optional
reptile	no standard	optional
birds - primary exposure	LD50, NOEC	available
birds - secondary exposure	BCF, LD50, NOEC	available
mammals - primary exposure	LD50, NOEC	available
mammals - secondary exposure	BCF, metabolism studies, LD50, NOEC	available
biodiversity	(models?)	desired

It was concluded that those types of existing data shown in bold formed a **core set** which should be included in initial approaches to risk indicators for terrestrial ecosystems, together with others for aquatic ecosystems.

Other Issues to be Considered

- indirect effects of pesticides (e.g. through reduction of food supply)
- use of non-standard data e.g. field tests, field monitoring
- metabolites
- it would be desirable to address risks in estuarine and marine environments separately from freshwater environments as issues for the longer term
- validation of indicators
- guidance for extrapolation between species to deal with missing data
- ways to deal with variation in sensitivity between species, e.g.:
 - using the most sensitive species
 - the distribution of sensitivity between species
 - giving relative importance to different trophic levels (possibility of using weighting factors)

The group **recommended** that these issues be taken up by an expert group after the workshop.

Exposure

Exposure should be assessed using data on the use and fate of pesticides and their metabolites. The group considered which parameters of use would affect each taxonomic group, so as to enable indicators to reflect the effects of risk reduction measures.

The parameters considered were:

- total volume used per country
- total area treated per country
- application rate (e.g. kg/ha)
- frequency of applications
- interval between applications
- formulation
- crop
- timing of application
- method of application (including risk management practices)

These parameters would need to be available for each product separately.

It was concluded that risks to most of the taxa would be affected by changes in most of these parameters.

Approaches to the Assessment of Exposure

The group considered examples of two basic approaches:

- a simple method of predicting concentrations in different media for standardised scenarios (PEC approach)
- a simple method of converting fate variables into scores and combining them into an overall score for exposure (scoring approach)

The two methods are basically different ways of combining use and fate variables to obtain a measure of exposure. In the PEC approach the method of combining the variables is explicitly based on mechanisms. In the scoring approach the variables may be transformed and combined using a variety of functions such as those reviewed in the background documents. For their development, both approaches require expert knowledge of pesticide use, fate and behaviour.

A brief consideration identified the following issues which would need to be resolved:

- how to deal with regional/local variability (e.g. soil types, climate, etc)
- how to address uncertainty
- how to assess the reliability of trends over time in the risk indicator

The group **recommended** that it would be necessary to test a range of approaches with real data in order to identify satisfactory ways of dealing with these issues.

Aggregation of Data

The group **recommended** that issues relating to aggregating across crops, pesticides and taxa should be taken up by expert groups, including whether or not it will be possible to produce combined risk indicators covering different ecosystems.

Report of the Environmental Fate Group

The environmental fate group's initial discussions concentrated on environmental fate parameters, both hazard and exposure, which are needed for the development of risk indicators. The discussion focussed on three environmental components: soil, water, and air. The following parameters listed in each compartment are considered to be the most important to be included in the development of indicators.

Soil

1. Parameters for pesticide fate in soil

- Henry's constant (volatility)
- solubility in water
- Koc (organic carbon partitioning coefficient)
- DT50 (degradation time to 50% of original mass under field conditions)

2. Situation-specific parameters for fate in soil

- surface area treated and rate (kg/ha)
- climate
- site specific characteristics (topography, hydrology, erosion index, etc.)
- use

Water

1. Parameters for pesticide fate in surface water

- DT50 in water body
- DT50/90 in water/sediment systems
- hydrolysis 1/2 life
- Koc
- water/sediment partition over time

2. Situation specific parameters for fate in surface water

- dilution
- drift
- sediment area
- field surface area treated and rate (kg/ha)
- climate
- use

3. Parameters for pesticide fate in groundwater

- DT50 in soil by soil layer (data not readily available by soil depth)
- Koc
- Kd
- solubility in water

4. Situation specific parameters for fate in groundwater

- use
- surface area treated and rate (kg/ha)
- site specific characteristics (topography, hydrology, erosion index, etc.)

Air

1. Parameters for pesticide fate in air

- Henry's constant
- quantity of pesticide per volume of air
- co-evaporation with water (data not readily available)
- DT50 in air

2. Situation specific parameters for fate in air

- drift
- surface area treated and rate (kg/ha)
- climate
- site specific characteristics (topography, hydrology, erosion index, etc.)
- use

Summary of Discussion Around the Parameters

With respect to existing indicator models, none of those reviewed by the environmental fate group contained all of the parameters the group had identified as important, but all of the models had some of the parameters identified. The group believed that in most cases, the data needed in indicators were available to governments (regulatory agencies). However, the group thought that the information would not be available for all products and not all products would have relative modelling or monitoring information.

Other Issues

The environmental fate group also identified the following issues for consideration in future work on pesticide risk indicators:

- selection of appropriate values: mean, mode, worst case...
- missing data
- the need for sensitivity analysis
- the need for a list of available databases with criteria for "selected" values
- concern about hazard versus risk indicators
- role of monitoring and relationship with validation of indicators
- role of modelling to improve ability to use parameters and to improve predictive ability
- information (use data, data on pesticide characteristics) that is used and the approaches taken in the development of indicators must be transparent, and available
- other possible indicators: number of trained farmers; sprayer maintenance/calibration, container disposal, etc.

Pesticide Use Data

The following information related to pesticide use is important:

- product name (formulation)
- rate of application (kg/ha)
- timing of application (crop stage, present crop, date)
- area treated
- crop treated (including variety)
- target pest including weeds, insects, pathogens, etc.
- method of application (granular, broadcast, incorporated, etc.)
- crop rotation (can effect pesticide choice and kg/yr over the life of the rotation)
- tank mixture combinations (less critical)

Pesticide use data are essential for:

- developing risk indicators
- providing feedback to the registration process (e.g. worker exposure)
- identifying where risk reduction programmes are needed
- identifying unnecessary applications (rate and frequency)
- identifying “hot spots” that warrant a more detailed evaluation

Report of the Human Health Group

A Few Observations About Existing Indicators

Existing indicators have been developed for a variety of reasons. The group noted a number of factors including:

- Existing indicators reviewed by the workshop participants are focused more on environment than human health. It is important that risk indicators include a range of possible human health effects.
- Some of these indicators rank different pesticides.

Purpose of Risk Indicators

- Risk indicators could answer different questions than risk assessments for individual pesticides (e.g. Is pesticide use today on cotton more/less risky than 10 years ago?).
- Risk assessments for individual pesticides are an important basis for developing human health risk indicators.
- Data on human health hazard are available from pesticide registration and other sources, but better use/exposure data are necessary.

Risk Parameters

- Careful definitions of populations need to be developed. How these are defined will determine relevant exposure pathways.
- Populations of interest may include:
 - Consumer (mostly dietary exposure by food and drinking water)
 - Domestic user (mostly exposure by application)
 - Farmworker/operator (mostly exposure by application, re-entry, mixing/loading)
 - Worker (non agricultural operator, manufacturer)
 - Bystander (mostly exposure by drift)
- Subpopulations at particular risk are in all populations of interest.
- There are different ways to organize populations:
 - by principle exposure pathway (consumption - application)
 - by population of interest
- More data are available for indicators of dietary exposure (consumer) than for other routes of exposure.
- There is need for more exposure information and data for farmworkers, workers, domestic users, bystanders.

Post-registration Monitoring and Adverse Effects/Incident Data

- Post-registration monitoring is any systematic planned collection of data following registration. Adverse effects/incident data are not planned but may be reported by pesticide users, health care professionals and others.
- Such data can provide feedback on regulatory decisions and regulatory policies or programmes and usage.
- Several countries have systems for collecting adverse effects/incident data.
- The post-monitoring data and adverse effects/incident data can be useful for developing risk indicators.
- Post-registration data can pertain to individual chemicals or aggregations of chemicals.

Measure Trends in Health Effects of Concern by Specific Populations (e.g. farmworker)

- Use profile is needed.
- Risk information (registration data and post-monitoring data) is needed.

Health Effects of Concern and Other Data Helpful for Assessing Human Risks

- Proposals for these data may include:
 - acute effects (all pathways as appropriate to populations of interest; dermal, inhalation, oral)
 - skin and eye irritation
 - sensitization
 - subchronic and chronic toxicity including effects of specific concern
 - endocrine disrupters
 - neurotoxicity
 - immunotoxicity
 - carcinogenicity
 - mutagenicity
 - reproduction
 - incident report
 - monitoring data
 - bioaccumulation
- Different risk indicators for several populations could be developed with specific core data relating to health effects of concern depending on each pesticide's toxicological profile.
- For consumers, mainly chronic oral toxicity endpoints must be considered, whereas for the other groups also acute/subacute toxicity endpoints (including irritation, sensitization and reproductive effects) are of importance.
- Possible core data sets were discussed, but no consensus was reached. Much more work needs to be done. Countries need the flexibility to determine the core data sets appropriate to the individual pesticide and to the national circumstances.
- There is a need to define in future work
 - which people are included in the populations of interest

- which pesticides these populations are exposed to
- which are the core data for each of the populations of interest (input for risk indicators)

Existing Use/Exposure Data

- Proposals for data on exposure/use conditions may include:

Consumer

- residues in food & drinking water
- dietary intake including differentiation of subgroups
- processing information
- percent crop treated

Farmworker

- formulation type
- type of packaging
- frequency
- kg/ha; total amount per year
- concentration
- application method
- number of users
- treated crop
- training
- other ingredients
- tank mixtures
- use of protective equipment
- cleaning, washing
- re-entry
- area treated
- climatic conditions

Bystander

- formulation type
- frequency
- kg/ha; total amount per year
- concentration
- application method
- number of users
- drift
- training
- use of protective equipment
- re-entry
- area treated
- climatic conditions

Domestic user

- product availability

- climatic conditions
- hygienic habits
- location treated
- use instructions
- frequency
- volume of package
- formulation/concentration
- application method
- info on persistency (indoor)

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