O.10 - Environmental risks due to pesticide use at a national scale: indicators calculation on the Belgian pesticide sales database

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Abstract

Belgian pesticide sales statistics are analysed on a period from 1991 to 2005. Risk indicators are calculated in order to compare the effect of pesticides used in agriculture on earthworms, birds, bees and aquatic organisms. These indicators are considered along with the Frequency of Application indicator and a pesticides sales indicator. In general, the risk decreases except for bees. The sales for pesticides used in agriculture are slightly decreasing while the application frequency has increased by 20%. It appears very clearly that the risk pattern is very much influenced by a few active substances. Single risk indicators generally provide divergent analysis of the statistics. The comparison of pesticides sales and the Frequency of Application indicator shows that the reference dose (maximum dose allowed for each application) was reduced about 15% over the analysed period.

Introduction

A Directive of the European Parliament and of the Council establishing a framework for Community action to achieve a sustainable use of pesticides was proposed by the Commission in July 2006. This proposal is presently discussed both at the Council level and at the Parliament level. It is expected this proposal will be adopted for 2009.

In the article 14 of this proposal it is asked that Member states establish harmonised risk indicators as referred into one of the annexes of the proposal. However, due to the fact that these harmonised risk indicators are still in development and that some Member States already have their own indicators, Member States may continue to use existing national indicators or adopt other appropriate indicators in addition to the harmonised ones.

The objective of this paper is to present and analyse the outputs of simple indicators for the Belgian Programme for Reduction of Pesticides and Biocides.

Method

For each pesticide, the total amounts of pesticide used in agriculture are derived from the Belgian official statistics on sales of pesticide from 1991 to 2005.

Pesticides were grouped into categories: herbicides, fungicides, insecticides, and soil disinfectants. On the basis of the packaging of Plant Protection Products (PPP) and their sales in Belgium in 2001, the partition between professional and non-professional use was calculated in order to restrain the analysis of the latter category. The reference doses are based on the maximum authorised dose for each active substance in

Belgium. The following indicators were calculated: Frequency of Application (Gravesen, 2000), bees risk, birds risk and earthworms risk based on Index of Load (Gravesen, 2000), aquatic organism risk based on Spread Equivalent Global (Buyck and Coelus, 1996). For each indicator, active substances responsible for min. 5 % impact on the indicator output, on average, for the 15 year period were identified as major contributors. The active substance chemical, physical and (eco)toxicological values were taken from the PRIBEL compendium edited in 2006 by Vergucht et al.

Results and discussion

Quantity used

When analysing the data for the years from 1991 and 2005 for all the categories of PPP it appears that, on average the agricultural usage is 71 % of the total sales that are about 9,400 tonnes of active substances per year. When these results are combined to the Utilizable Agricultural Area1 it appears that, on average over the period, there is 4.8 kg of active substances applied per hectare every year. Mancozeb alone accounts for 15 % of the sales for agriculture.

Frequency of Application

The averaged Frequency of Application (FA) for Belgium was 6.552 thousand of ha-dose on a yearly basis. This means that there were about 6,550,000 applications of the reference doses registered in the Belgian national authorisations. On average, there were 4.7 applications/ha during the 1991-2005 period. We nevertheless have to mention that FA is calculated, for each active substance, on a reference dose based on the maximum dose authorised in Belgium for agricultural crops. Due to the fact that the real doses are probably lower than these values, the FA indication might be an underestimation.

Aquatic risk

The Spread Equivalent Global (SEG) for Belgium was calculated to be 40.3 m³ per ha on average. This represents the quantity of water that is yearly required to reduce by dilution the PPP concentration in the water to an acceptable level. This is about 0.5% of the yearly rainfalls. This indicator is for 32% explained by the evolution of Lindane use.

Contribution of each PPP category to the indicators

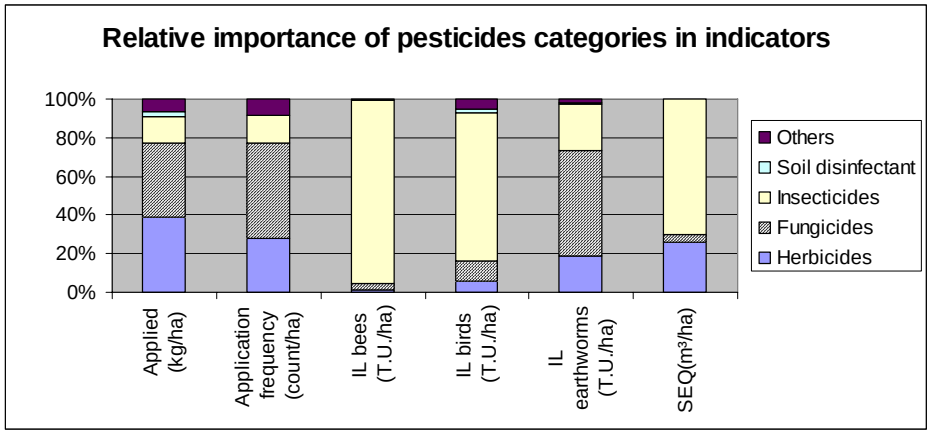


Figure 1 - Contribution of PPP categories to indicators during the period 1991-2005

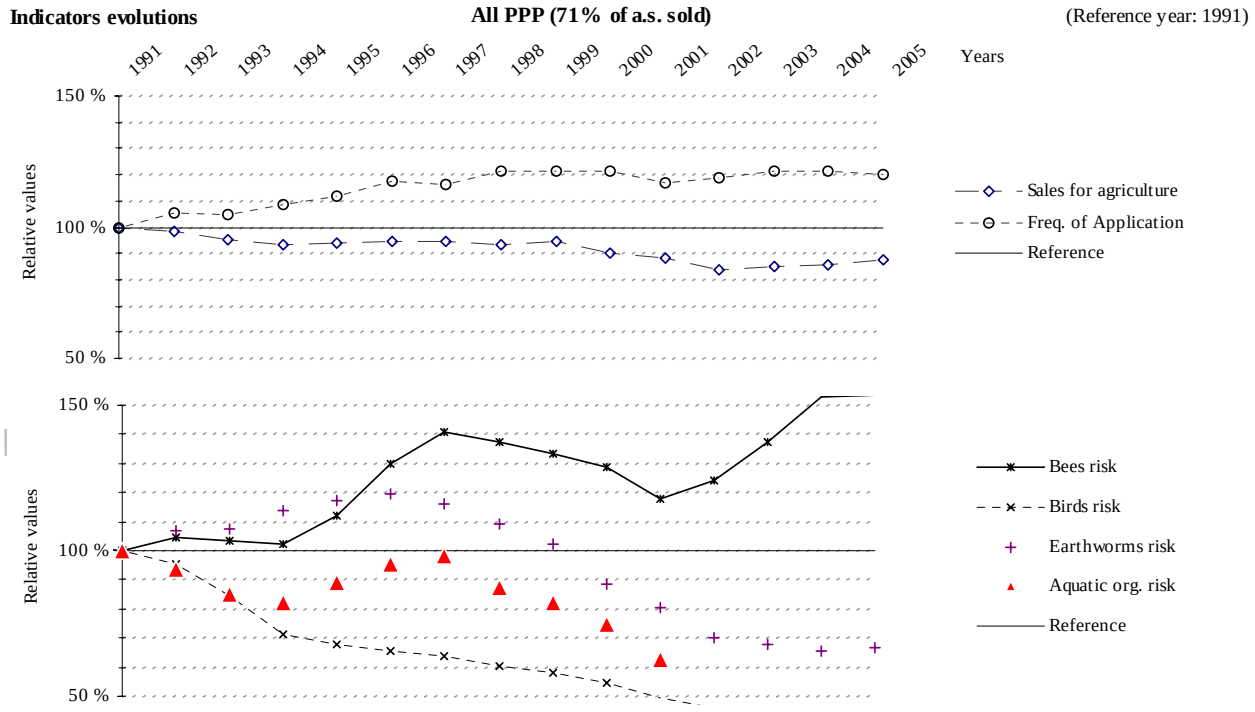
The Belgian market of PPP is concerned for 80 % (of a.s. mass) by fungicides and herbicides (each about 40 % of the market). The FA indicator shows that fungicides are much more frequently applied than other categories of PPPs. The risk indicators show a very big effect of insecticides for bees, birds and aquatic organisms. For earthworms, more than 50% of the impact would be due to fungicides.

1 including the grasslands

Any risk management policy only based on one indicator would probably be engaged in a wrong way. It is interesting to notice that a reduction in PPP sales and/or in FA would be preferentially achieved with a lower fungicide use, which would have a significant impact on earthworms risk only. On the contrary, a general reduction of insecticides use, by the way of various tools (e.g. biological control), would have potentially an important impact on every living organism.

Evolution of the indicators from 1991 to 2005

Figure 2 - Trends of indicators for all PPP



rem : values are averaged on three years (x ±1) except for 2005 where the average is calculated only on 2004 and 2005

From the analysis of the differences between indicators during the period 1991-2005 it appears that major risks evolutions are due to insecticides. For earthworms only, it appears that the main modifications in the risk pattern are due to fungicides. A relatively large increase is observed for bees risk while a large decrease is observed for birds and aquatic organism risks. Herbicides also have a significant impact on the indicators and a regular decrease is observed for aquatic organisms.

When looking in detail in the database for the reasons for such trends, it appears that the indicators evolution is sometimes only due to few major active substances. For example, Imidacloprid explains alone 40 % of the ILbees indicator and, more, the single evolution of Imidacloprid is highly correlated to the trend of the indicator for all pesticides. We have then to be careful with such a result because, the ILbees indicator is designed for spraying application. In the case of Imidacloprid, only a very small part of the uses is directly sprayed onto the crops, the major part being devoted to seed dressing. Then here, it may be possible that the risk is overestimated.

Another example is given by the analysis of detailed results for herbicides, where the aquatic organisms risk indicator is highly decreased between 1991 and 2005. Paraquat accounts for 63% of this result, and for most of its variations in time. A major limitation in these risk assessment approaches is the exposure

parameter, which is only based on the pesticide dose independently of the context of application. This assumption implies that pesticides effects are considered as equivalent everywhere, whenever and, especially for FA, for every not-targeted organism. The case of Paraquat is a good illustration of the caution that must be taken with these indicators. This cationic molecule, which influences 63 % of aquatic risk indicator, is quasi non-bio-available due to its specific physico-chemical properties and consequently does not present any risk for aquatic organisms in the environment.

There is no general correlation between all indicators (Figure 2). At the farm level a reduction of the use of pesticides and a change of the pesticides selected was observed. Pesticides were less used in terms of quantity but not in terms of application frequency. It can be concluded that pesticides were used more frequently in 2005 than in 1991 but with lower doses. A reduction of the risk indicators should then be related to the use of less dangerous active substances for birds, earthworms and aquatic organisms, but not for bees. It seems that FA is not related to any risk consideration.

Conclusions

In Belgium, FA of the agricultural sector is about 4.7 applications per hectare for the 1991-2005 period. Due to the calculation parameters for the FA indicator, this value is probably an underestimation of what occured really. Major contributors to environmental risks are insecticides and fungicides. From the point of view of the quantity sold, herbicides are in first place.

When taking into account all PPP sold in Belgium during the period, we observe a decrease of about 0.5% of the mass of the active substances in average every year and an increase of about 20% of the application frequency.

IL and SEG risk indicators studied in the 1991-2005 period give the information of a lower impact of pesticides on earthworms, birds and aquatic organisms. Bees would have been more endangered during the same period. A detailed analysis of the results for each category of pesticides shows that risk patterns are often due to only few active substances that can be identified. On the basis of these identifications, it can be then concluded that risk is probably overestimated for bees and aquatic organisms.

Large divergences exist between various approaches and each indicator explains a specific aspect of the problem. None of them alone is sufficient to understand the situation and results are complementary. It appears very clearly that FA and sales indicators are not related to any specific risk indicator. All indicators have limitations due to the oversimplification of the exposure model or the calculation procedure.

Results are to be analysed by experts in order to compensate the limitations and bias of the indicators.

For example, exposure approaches in such “global” indicators are very simple and could be improved by an expert judgment in order to avoid some big overestimations of the risk as can be the case for *Paraquat* and *Imidacloprid*.

References

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