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Analysis

PROSPECTIVE ANALYSIS AND EVALUATION
—
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Reducing pesticides use: the *Ecophyto 2018* plan
The role of usage indicators in evaluating the achievement of targets

The reduction of pesticides use is a complex issue from more than one standpoint. Firstly, this is so because of the large number of active ingredients and commercial products that can be used at very different dosages, ranging from a few grams to several tens of kilograms per hectare. The number of actors whose decisions have a direct or indirect influence on such use is also very large: farmers, processors and distributors, consumers, among others. And lastly, there are still gaps in our knowledge of the various different impacts and even of the scale of pesticide uses. For this reason, measurement, i.e. the use of monitoring indicators, is a key issue at the heart of this plan, which was put forward in September 2008.

In the 20th century, the agriculture of the developed world has made it possible to achieve targets for security of food supply and safety for health of foodstuffs. Its intensive modes of production are highly reliant on the use of inputs, and plant protection products in particular, in order to guarantee yields by eliminating or reducing competition with weeds or by combating pest pressure.

The global increase in demand for plant products for animal feedstuffs and human food, as well as for non-food uses, has brought these issues of food safety and security back to the fore. France must therefore not only maintain a high level of agricultural production, but it must also produce better, a) by preserving ecological balances in a context of climate change, biodiversity erosion and competition for water resources, and b) by taking into account consumers desire for healthy products.

This goal of limiting the harmful effects of agriculture on the environment and health notably imposes a need to ensure that farms are less dependent on pesticides. This is the objective of the *Ecophyto 2018* plan.

We begin below by presenting the structure of the plan, looking closely at the monitoring indicators and recalling the work that led up to it. The second section contains a presentation of the two indicators chosen at national level, and at the new 'NODU' indicator in particular. We conclude with an update on the roll-out of the plan for individual territories and crops and the indicators to be used at this level.

1. The process leading up to the Ecophyto 2018 plan and its structure

Although the 'tonnage of active ingredient' indicator needs to be treated with considerable caution (because it aggregates materials used at very different dosages), it is the only indicator that exists across all the countries of the European Union and OECD. For this reason it is used to rank France relative to the other countries, in particular for application per farmed hectare. As Table 1 shows, French farming is a major consumer of pesticides: approximately 10% of the consumption of OECD countries and over 80,000 tonnes of active material. Conversely, if this consumption is expressed as a ratio per farmed hectare, France is not far from the average

Table 1 - **Pesticide use in OECD countries**
Evolution in tonnes of active ingredient and quantities of active ingredient per cultivated hectare

	Tonnage of active ingredients *(tonnes)*			Agricultural area *(millions of hectares)* in 2002			Quantity of active ingredients per cultivated hectare *(average kg per hectare 2001-2003)*
	Average 1990-1992	Average 2001-2003	Change (%)	Total	including arable and permanent crop areas	Arable and permanent crop area (% of total)	
OECD	867,588	820,826	– 5				
United States	325,226	313,281	– 4	409.5	175.7	43	1.8
Japan	89,112	65,211	– 27	4.8	4.2	86	15.7
Korea	28,097	25,821	– 8	1.9	1.9	98	13.8
EU 15	339,515	327,372	– 4	138.8	82.9	60	3.9
incl. France	**95,281**	**85,531**	**– 10**	**29.7**	**19.6**	**66**	**4.4**
incl. Germany	32,629	28,982	– 11	17.0	12.0	71	2.4
incl. Spain	36,849	40,783	+ 11	29.4	17.9	61	2.3
incl. Italy	79,844	85,920	+ 8	15.3	10.9	72	7.9
incl. Netherlands	17,744	8,461	– 52	1.9	0.9	48	9.0
incl. UK	34,060	32,064	– 6	15.8	4.5	29	7.1

Cultivated land = arable land + permanent crops.
Tonnages of active ingredients and agricultural area for each country.
Source: OECD – Environmental Performance of Agriculture in OECD Countries since 1990 (June 2008)

for the EU-15 and significantly below the levels of other European countries (Italy, Netherlands, United Kingdom) and the major rice-producing countries in Asia (Japan and Korea).

From the early 2000s, several official reports were already highlighting the risks to human health arising from the use of pesticides and were pointing to virtually general contamination of water supplies. These observations of fact have been a driver for increasingly stringent controls at European and national levels, controls that could not be limited to the evaluation, however rigorous, of pesticides as such, but had to be extended to include an evaluation of the ways in which they were used.

It was in this context that several major research programmes were conducted prior to the «Grenelle» environment conference in France in order to improve our knowledge of this complex area:

- Firstly, there was the collective scientific expert evaluation (ESCo) conducted by INRA[1] and CEMAGREF[2] on behalf of the ministries of agriculture and ecology: (http://www.inra.fr/l_institut/expertise/expertises_realisees/pesticides_agriculture_et_environnement). This work, which was completed at the end of 2005, provided an update on available knowledge regarding the use of pesticides in agriculture and the ways in which that use could be reduced and its environmental impacts limited.
- Following this was the INRA target set in 2006 and 2007 for the proposal of methods for the calculation of an indicator of frequency of treatment (IFT), along the same lines as that used in Denmark and taking as a basis the data provided by SCEES[3] on the protection of crops (surveys of crop growing practices in 1994 and 2001[4]).

In June 2006, in France, an interministerial plan for 2006-2009 aimed at the reduction of the risks associated with pesticides, or PIRRP *(Plan Interministériel de Réduction des Risques liés aux Pesticides 2006-2009)* was devised. One year later, the «Grenelle» environment conference of October 2007 added further, and highly determined, impetus for policy directed at reducing the risks linked to pesticides. Going beyond the staged elimination of the most hazardous substances – 40 by the end of 2010 – the Ministry of Agriculture and Fisheries defined a plan for a 50% reduction in pesticide use «as far as possible» within a timeframe of less than ten years[5]: this is the *Ecophyto 2018* plan, which was announced to the press in September 2008.

The plan has eight core focuses covering a very wide range of actions relating to research, experimentation, advice to farmers, regulatory and incentive policies, and so on.

Given the very objective of the plan, which sets a quantified target, monitoring indicators have a central role to play: they are the subject of policy focus 1. A special 'indicators' working group was in fact set up as early as the beginning of 2008 to put forward concrete proposals in this area. This group included all the following stakeholders: experts from the ministries with responsibility over agriculture, ecology and health, researchers, agricultural professionals, producers of plant protection products, associations for the protection of the environment, among others.

The Danish Experience

Of all European countries, it is Denmark that has taken the most ambitious steps to reduce pesticide pollution, doing so as long ago as the 1980s. Its aim is to remove the most hazardous substances from the environment and to limit the use of the others. The Danish action plan, launched in 1986, is currently in its third phase. The chosen indicator is the TFI (Treatment Frequency Index: the average number of approved doses applied to the country's total utilised agricultural area [UAA]).

The initial ten-year plan (1987-1997) had as its target a 50% reduction in TFI from a reference baseline of 2.67 (the average for 1981-85). While the tonnage of active ingredients fell by around 40%, TFI declined by no more than 10%, to around 2.45, which clearly reflects the replacement of certain substances by others that weigh less. A second plan was put in place for the period 2000-2002, at the end of which TFI stood at around 2.1. The third plan (2004-2009) set a target of reducing the index to 1.7 by 2009. It is apparent that it is difficult to bring the index down below 2 and the 1.7 target will be very difficult to achieve.

Various instruments are used under these plans, and they are based notably on giving every possible form of advice to farmers and on the use of economic instruments such as pesticide taxes. The latter were initially imposed in 1986 at low rates, which were later increased in 1996 and 1999; they currently stand at 33% for herbicides and fungicides and at 54% for insecticides. It should be pointed out firstly that Denmark's agricultural context differs quite substantially from that of France, in that it has much less diversity in crop types (specifically, Denmark has no vineyards or orchards) and, secondly, cereal crops are used mainly as livestock feedstuffs.

Those indicators should make the following possible:

* Annual monitoring of changing levels of overall pesticide use.
* Coverage of the whole range of uses (agricultural and non-agricultural).
* Ensuring that the burden is properly shared.
* Ensuring that a reduction in the use of pesticides is not accompanied by a worsening of their toxicological profile or their potential for environmental contamination (water, soil, etc.).

The aim is also to connect observed changes in pesticide use with changes in farming practices at the origin of those changes and to refine the monitoring by region and crop type.

It should be added that the ministries of agriculture and ecology have asked INRA to conduct a major study with two main dimensions:

- Prospective reflection based on an ex-ante evaluation of the economic and environmental impacts of different scenarios ranging from 'conventional' to organic farming, doing so for the four crop types particularly implicated in pesticide use (major field crops, wine growing, fruit growing and vegetables), which account, according to Table 2 below, for the majority of expenditure on pesticides.
- Design of a network for the acquisition of references in close conjunction with the technical institutes.

The evaluation of economic impacts relates to both the microeconomic and macroeconomic aspects. This is important because systems that make more economical use of pesticides may be viable in microeconomic terms but result in smaller production volumes at national level.

1. INRA: *Institut national de la recherche agronomique* or 'National Institue for Agricultural Research'.
2. CEMAGREF or *Institut de recherche pour l'ingénierie de l'agriculture et de l'environnement*, or 'Agricultural and Environmental Engineering Research'
3. SCEES: *Service Central des Enquêtes et des Études Statistiques*, or 'central department for surveys and statistical studies', which became the SSP *(Service de la statistique et de la prospective/*department of statistics and prospective studies) in 2008 (Ministry of Agriculture and Fisheries).
4. France is the only EU country with this type of survey of farming practices. The survey of crop growing practices was repeated in 2006 for major field crops and winegrowing.
5. This is the formulation of the main objective of the plan, the original of which is available on the Ministry of Alimentation, Agriculture and Fisheries website.

2. Two pressure indicators adopted at national level

It must be possible for the *Ecophyto 2018* plan's national monitoring indicators to be quantified on an annual basis in order to calculate three-year rolling averages taking account of variations in pest and weather pressure from one year to the next. This is because the number of treatments applied can easily double from one year to the next, especially where fungicides and insecticides are concerned.

In order to measure pesticide consumption, the first indicator that comes to mind is the quantity of active ingredients sold (*Quantité de Substances Actives* or QSA), which is, among others, the indicator used by the OECD (cf. Table 1). It is an indicator that is easily understood and calculated, but it does aggregate very different active ingredients, some being used at dosages of several kilograms per hectare, such as mineral fungicides, while others are applied at levels of less than a hundred grams per hectare. Until now, it was calculated and published each year by the *Union des Industries de Protection des Plantes* (UIPP), a plant protection industry union. From 2009 on the administration will be in a position to do this work, under the traceability requirements of the law on water and aquatic environments[6].

The indicator of frequency of treatment (IFT), whose method of calculation was developed by INRA in 2006, can be only calculated for the years in which the SSP surveys of crop growing practices have been conducted (1994, 2001 and 2006). Secondly, certain crops such as orchard fruit and vegetables are not yet included in these surveys[7]. For both these reasons, this indicator could not be used for regular national monitoring purposes; conversely, it will be used for individual regions and crops (see below).

A third indicator has therefore been chosen as the indicator of reference at national level. This is the NODU (*Nombre de Doses Unités* or number of unit doses) indicator, which expresses the quantity of each active ingredient as a number of 'unit' doses specific to it, thus also providing an assessment of the intensity of pesticide use. The structure of the NODU indicator is undoubtedly more complex than that of QSA (cf. appended insert on methodology), but their comparison will improve our knowledge of changes in pesticides use. Unlike IFT, NODU is not based on farming practices observed at the level of the individual field, but on sales data aggregated at national level and available every year. It is less precise than IFT because it is based on the convention that active ingredients are applied to the entire surface of the crop growing area for which they have been officially approved, but unlike IFT, it takes all crops into account and can be calculated every year. QSA and NODU are expressed as a ratio to utilised agricultural area (UAA less pasture and set-aside). They will be calculated every year and changes in their level will also be examined on the basis of a rolling three-year average in order to smooth variations between years due to weather conditions.

The graph provided below compares changes in QSA and NODU levels over the period 2000-2006, during which it was possible to calculate NODU. Only the agricultural uses of pesticides (excluding seed treatment) have been included initially. It can be seen that between the beginning and the end of the period, despite production levels that have remained virtually unchanged[8], pesticides use has declined by around 18% according to QSA and by 7% according to NODU, with a fall recorded only for the first part of the period. This result confirms that certain active ingredients have been replaced by new materials that are effective at smaller dosages.

In order to refine the analysis further, it is planned under *Ecophyto 2018* to use these two indicators in relation to a range of categories:

- One method involves identifying the various categories of use (herbicide, fungicide, insecticide, acaricide, or other products). This is because the risks associated with these products and the means available for reducing their use are not the same.
- Another method involves grouping products together to reflect the risk they present for the environment (ingredients

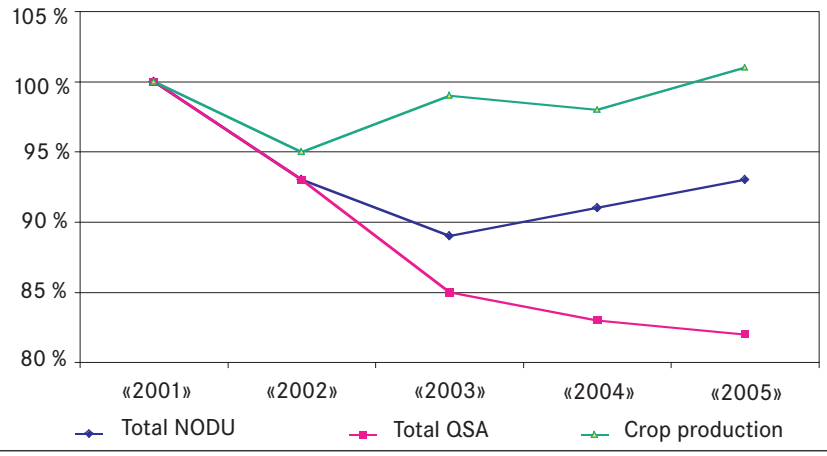
Table 2 - **Expenditure on pesticides by type of farming carried out by professional agricultural holdings[9]. Holdings growing 'major field crops' account for half of all expenditure on pesticides in France**

Type of farming conducted by holdings	Number of holdings *(thousands)*	Utilised Agricultural Area (UAA) *(thousands of hectares)*	Pesticide expenditure		Share of pesticide expenditure in gross agricultural output
			(€ per hectare of UAA)	Share of each type of farming	
All types taken together	346.2	26,475	89	100%	4.3%
All 'major field crop' holdings	77.8	8 ,805	128	48%	9.0%
Market gardening & horticulture	11.1	72	671	2%	1.9%
Quality wine	33.5	650	364	10%	3.3%
Other wines	12.6	407	259	4%	7.7%
Fruit	10.1	282	382	5%	5.3%
All livestock farms	142.3	10,770	26	12%	1.4%
All mixed farm types	58.9	5,535	82	19%	4.5%

Source: SSP (FADN- average 2004-05-06)

Figure 1 - **Comparison of QSA/NODU levels and crop production**

Sliding three-year average: base 100 in '2001' (average 2000-2002)



Source: data processed by Ministry of Agriculture and Fisheries (SSP)

6. Law 2006-1772 of 30 December 2006.
7. Provision is however made for it in the 2009-2013 SSP medium-term programme.
8. Changes in plant production "in volume" in the national agricultural accounts submitted to the Commission for the Nation's agricultural accounts.
9. In 2007, professional agricultural holdings accounted for 92% of total Utilised Agricultural Area (UUA).

classified as «N» versus unclassified ingredients[10]) or human health. In this context, it is planned that the two indicators will be calculated on the basis of a distinction between three categories: carcinogenic, mutagenic or reprotoxic substances (CMR1 or 2); highly toxic products (T+) or toxic products (T); and all other products.

3. Roll-out of Ecophyto 2018 by region and by crop

In order to supplement the analysis at national level of the utilisation of plant protection products, it is necessary to monitor practice on the ground. For this reason, *Ecophyto 2018* contains the following provision under focus 1: «to assist farmers in seeking to reduce their use of pesticides and to assess newly acquired references by means of a pressure indicator based on farming practices» in individual regions and for individual types of crop. This is the treatment frequency indicator (IFT).

This indicator, which is very similar to NODU, measures the intensity of pesticide application on the basis of a count of the «number of approved doses» applied to a plot of land during a growing campaign. IFT plays a major educational role in that it enables the practice of each farmer to be positioned within a defined region in relation to the most widely used techniques and relative to a target to be achieved.

This indicator is already operational at the national and regional levels for the major field crops and wine growing. It is planned under *Ecophyto 2018* to look closely at whether it might be extended to include fruit and vegetables over a relevant regional scale in order to allow farmers and growers to assess their own systems of production within a given context of soil, climate and economics.

Special emphasis is placed on pesticides use as a focus of the 2009-2013 medium-term programme for agricultural statistics: the survey of crop growing practices is likely to be renewed in 2011 for major field crops, in 2013 for wine growing and extended in 2012 to include vegetables and orchard fruit.

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As has already been stated at several points, the problem of pesticides use is complex and it is worth noting that public management of this area is characterised by all of the following:

- Strong political will to show the way forward, setting a quantified target with real power to mobilise efforts of all stakeholders.
- Concerted management involving the ministries of agriculture and ecology.
- Mobilisation of the whole apparatus for agricultural innovation and development (i.e. technical institutes, chambers of agriculture, and so on) in the direction of the design and roll-out of alternative agronomic solutions.
- Intensive research involvement, in close conjunction with the two public bodies commissioning research, with a view to expanding our knowledge, developing indicators and conducting studies of more prospective character focused on the various impacts.
- Intensive involvement also on the part of the public statistics system, this being notably reflected in the surveys of crop growing practices already conducted and to be repeated over the period 2009-2013, in addition to the inclusion of questions relating specifically to this issue in the questionnaire for the future farm census scheduled for 2010.

After Denmark, France is the second European country to commit to such an ambitious plan for the reduction of pesticides use. This plan anticipates the implementation of the Framework Directive on the sustainable use of pesticides adopted by the European Parliament on 13 January 2009, which requests that each Member State should set targets for the reduction of usage or risks. A range of considerations – such as the experience of Denmark – including the changes in pesticides use in France since the early 2000s, demonstrate that the target for a reduction of 50% will not be easy to achieve, especially if efforts are made at the same time to produce as much or indeed more. Major field crops account for approximately 70% of all pesticide use, and price levels for these crops higher than those recorded for the early 2000s, as shown in most forecasts (OECD, FAPRI[11], DG Agri), would make that target even more difficult to attain. This will therefore require new technical and economic approaches to be found with a view to maintaining high levels of production while at the same time minimising the use of inputs.

The method used to calculate the NODU indicator

The NODU indicator has been calculated until now only for the agricultural uses of pesticides (excluding the treatment of seeds). It is based on the definition of a single 'unit' dose for each active ingredient used in French farming.

The Ministry of Agriculture and Fisheries publishes the 'e-phy' database on its website (**http://e-phy.agriculture. gouv.fr/**) listing all authorised «uses» of pesticides in France. Each such «use» is defined specifically in relation to the crop to which the substance is to be applied, the designated target (i.e. a bioagressor) and an approved dose, this being the dose for effective application of that substance for that specific use. For each active ingredient there is therefore in most cases more than one dose of active ingredient: the same active ingredient can be included in more than one pesticide and each of those pesticides may be authorised for more than one use.

The unique 'unit' dose is calculated on the basis of these approved doses in two stages, as follows: a) for each 'active ingredient + crop' coupling a list is drawn up of all authorised uses and a 'unit dose per crop' is defined as the maximum of the doses calculated for this 'active ingredient + crop' coupling; b) the unique 'unit' dose for each active ingredient is then defined as the mean of the unit doses per crop obtained in the preceding step, weighted by the percentage area of each crop in total national UAA (area data are extracted from the annual agricultural statistics available on the Agreste website: **http://agreste.agriculture.gouv.fr/page_accueil_82/donnees_ligne_2.html**

This 'unit' dose is not a reference value in agronomical terms but simply a convention for calculation enabling a common unit to be defined for the aggregation of very different active ingredients. For each active ingredient, the quantity sold is expressed in terms of the unique unit dose calculated as described above. The NODU indicator is the sum of these 'normalised' quantities for all the active ingredients sold. The NODU indicator can also be calculated for each category of active ingredient.

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10. N: noxious, harmful to the environment.
11. FAPRI : *Food and Agricultural Policy Research Institute* (based in the USA in Iowa).

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