Beyond targets: Briefing on market-based instruments to drive pesticides reduction

The use of **pesticides** in agriculture is intended to protect crops from influences that have a negative impact on yield, notably pests, weeds and diseases. However, the use of these **products comes with many unintended side effects on human health and ecosystems**. Various of these negative impacts of pesticides are well known: the Plant Protection Products Regulation (Regulation (EC) No 1107/2009), that regulates the placing of plant protection products, on the market mentions several of them: residues of substances on or in plants, edible products, drinking water or elsewhere in the environment, effects on human health, effects on animal health, and effects on the environment.[1], that regulates the placing of plant protection products, on the market mentions several of them: residues of substances on or in plants, edible products, drinking water or elsewhere in the environment, effects on human health, effects on animal health, and effects on the environment[2].

Synthetic chemical inputs harm biodiversity, as pesticides are one of the major factors in population drops of insects, birds, and aquatic invertebrates[3]. Specifically, it has dramatic consequences on pollinators populations[4], which threatens our ability to farm in the future, as more than 80% of our fruits and vegetables depend on pollination. It hurts farmers first and foremost, as they are more likely to develop diseases such as blood cancer, prostate cancer, Parkinson, respiratory diseases and cognitive troubles than the general population[5]. Inhabitants of surrounding areas are particularly exposed as well, especially children and pregnant women. Synthetic pesticides leave residues that contaminate water, with massive consequences and **costs of depollution, which are now estimated from 5 to up to 100 billion a year only for TFA** (acid trifluoroacetic)[6]. Such residues of PFAs, known as "eternal pollutants", have been found all over Europe, with very high concentrations in drinking water[7]. TFA comes from the degradation of multiple eternal pollutants used by many industrial sectors, but it is also a metabolite of several pesticides such as flufenacet or fluopyram, spread annually by tens of tons in agricultural areas. Catchment points of drinking water can get so polluted that they have to be closed, as it happened to almost 40% of them in France in the last 30 years[8]. The European Environment Agency recently identified agriculture as one of the main pressures on EU water resources and highlighted that the development of organic agriculture should be further supported to improve water resilience[9].

[2] Regulation (EC) 1107 /2009 (Plant Protection Products Regulation) EUR-Lex - 02009R1107-20221121 - EN - EUR-Lex
[3] INRAE-Ifremer, Impacts des produits phytopharmaceutiques sur la biodiversité et les services écosystémiques : résultats de l'expertise scientifique collective INRAE-Ifremer, 2022
Impacts des produits phytopharmaceutiques sur la biodiversité et les services écosystémiques : résultats de l'expertise scientifique collective INRAE-Ifremer | INRAE
[4] "Pesticide Atlas 2022, Heinrich-Böll-Stiftung & others"
https://eu.boell.org/sites/default/files/2023-04/pesticideatlas2022_ii_web_20230331.pdf
and https://www.inrae.fr/actualites/impacts-produits-phytopharmaceutiques-biodiversite-services-ecosystemiques-resultats-lexpertise-scientifique-collective-inrae-ifremer
[5] Inserm Collective Expert Report, The effects of pesticides on health: New data, 2021
https://www.inserm.fr/expertise-collective/pesticides-et-sante-nouvelles-donnees-2021/
[6] Le Monde, Raphaëlle Aubert and Stéphane Horel, PFAS The cost of inaction, 2025. PFAS: The astronomical cost of depolluting Europe
[7] Report TFA: The Forever Chemical in the Water We Drink, PAN Europe, 10 July 2024
TFA: The Forever Chemical in the Water We Drink - Pestizid Aktions-Netzwerk e.V. - Pestizid Aktions-Netzwerk e.V.
[8] Report by IGEDD, IGAS, CGAAER, Prévenir et maîtriser les risques liés à la présence de pesticides et de leurs métabolites dans l'eau destinée à la consommation humaine, June 2024
https://www.igas.gouv.fr/prevenir-et-maitriser-les-risques-lies-la-presence-de-pesticides-et-de-leurs-metabolites-dans-leau-destinee-la-consommation-humaine
[9] EEA Report 07/2024: Europe's state of water 2024: the need for improved water resilience
https://www.eea.europa.eu/en/analysis/publications/europes-state-of-water-2024

When taking into account spending related to biodiversity preservation, palliative water treatment measures, support for conventional agriculture, and health expenditures related to diseases not officially attributed to pesticides, **spending to address the negative impacts of the use of pesticides is estimated at more than €18 billion per year**[10]. In France alone, public spending, including treatment for occupational diseases, water pollution control, and regulatory compliance, thus exceeded €372 million in 2017, according to a minimum estimate.

To a certain extent, legislation attempts to mitigate these negative consequences, for instance through risk management measures for their use and the general imperative to promote low pesticide-input pest management. On this aspect, Directive 2009/128/EC on the Sustainable Use of Pesticides (SUD) aims to give, wherever possible, priority to non-chemical methods, specifically to Integrated Pest Management (IPM) and organic farming.[11] In other words, some pesticides are approved, and their use is legal, even though it is known that they have side effects. In addition, **the costs associated with these side effects remain unaddressed by the legislation and are not reflected in the prices**.

In 2020, both the Farm to Fork and the EU Biodiversity strategies rightfully highlighted the reduction in the use and risk of chemical pesticides by 50%, and reaching 25% of agriculture land under organic management by 2030, as central policy objectives to make our food system sustainable. But the proposed Sustainable Use of Pesticides Regulation, which included **the 50% pesticides use and risk reduction as a legally binding target for Member States, was narrowly rejected** by the European Parliament in November 2023 after a polarized debate and later withdrawn by the Commission in February 2024.

The fact that so many externalities linked to the use of pesticides are not taken into account in the price of pesticides leads to two key questions:

1) What instruments, other than regulatory, do exist to reduce the use of pesticides and hence, to limit their negative side effects?
2) How can the costs for these negative side effects can internalized?

This briefing takes a closer look at the possibilities of using price or quantity instruments to influence the use of pesticides and to internalize the costs of pesticide use. Such a market-based approach aligns with the intention of the European Commission to design agricultural policies relying on incentives rather than on regulatory law alone (such as reduction targets).

1. Instruments: taxes/levies and certificates/quota

Several instruments can address the price or the available quantity of pesticides:

- **Price can be raised by a tax or levy**. The levy can either be tied as a fixed value to a quantity of active substance sold or designed as a percentage of the value in the form of a value added tax. While the levy may be affected by inflation, the tax will be affected by price fluctuations.[12]
- **Quantity can be steered with certificates or quota**. A reduction in quantity, in turn, is expected to influence price.

According to Ekardt et al. (2024), quantity instruments are easier to implement than price instruments as detailed information is not required[13] A defined maximum quantity of certificates would be emitted, and if a reduction is desired over time, the reduction in the number of certificates emitted over time is fixed. In contrast, reaching a given quantity or reduction target with price instruments is complex because substantial information is needed to define a tax level that would lead to the desired outcome.

For ease of implementation, Ekardt et al. suggest that certificates should be emitted to the manufacturers of active substances, and not to pesticide retailers or users. This would, to some extent, counter the risk discussed

[10] BASIC, Analyse de la création de valeur et des coûts cachés des pesticides de synthèse, 2021. Pesticides-un-modele-qui-nous-est-cher_Rapport-complet.pdf

[11] Directive 2009/128/EC (Sustainable Use of Pesticides Directive) Directive - 2009/128 - EN - EUR-Lex

[12] Ekardt, F., Klimm, K., Holz, W. *et al.* EU-Pestizid-Governance: Pflanzenschutzmittel-Ordnungsrecht oder Mengensteuerung?. *NuR* **46**, 589–599 (2024). https://doi.org/10.1007/s10357-024-4435-7

[13] Ekardt et al. (2024)

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by the EFI report (2024) that large agricultural holdings might buy up large quantities of quotas, thus concentrating the application of pesticides at certain locations.[14]

2. Price elasticity of demand – how much reduction in pesticide use could be achieved by higher prices for pesticide products?

Both a tax on pesticides and a system of certificates will affect the prices of pesticides, making plant protection products more expensive. **The extent to which the increase in prices would result in an actual reduction in purchase (and use) of such products depends on several factors**, such as short- or long-term effects on demand and the type of pesticides concerned. For instance, price effects are stronger for herbicides than they are for insecticides. These considerations are discussed in detail by Möckel et al. (2021).[15]

A recent publication by Neumeister (2025), published by a group of German NGOs, indicates relatively **strong price effects on pesticide reduction**. They show that price increases for pesticides (an increase of about 20 % in the year 2023 relative to the year 2021) had an effect of about 21 % reduction in sales of pesticides in 2023 in Germany, as compared to the year before. This effect was seen even though 2023 was a particularly rainy year in Germany – circumstances which usually lead to an *increase* in pesticides use. Nevertheless, Neumeister concludes that the price effect on pesticides sales should be seen in the larger context of a general increase in prices for agricultural inputs. To keep their producer prices relatively stable, farmers had to reduce production costs and may have chosen to purchase less plant protection products as one way to achieve this goal. Consequently, all other costs being equal, a sole increase in pesticide prices of 20 % may not be sufficient to achieve such a drastic reduction in purchase and use of plant protection products, and a stronger price increase would be needed.[16]

3. Grading by toxicological profile and treatable area

While it is possible to implement a levy or a certificate system for pesticides indiscriminately, in practice, further differentiation is recommended by most authors and is also implemented in practice. A good example is the Danish pesticide tax, which is graduated according to the toxicological profile of pesticides and their effect on health and environment.[17] The Danish pesticide database contains information on the value of the tax for each pesticide product.[18] This type of **differentiation intends to create an incentive for users to successively substitute more dangerous substance with less dangerous ones**. It also better reflects the **internalization of side effects and costs:** higher health or environmental costs are directly translated into a higher tax (or, in a quota system, into a lower number of certificates emitted).[19]

A problem with a quantity (not value) based tax is that it unfairly discriminates against substances that are used in higher total quantities per hectare, even if they are less harmful. It is therefore **essential to normalize the taxed quantity based on the treatable area.** Details about different approaches to calculating the treatable area per dose of pesticide are given in a study by Burtscher-Schaden et al. (2024), who also introduce a new approach to determining the toxicological profile of individual substances.[20] More generally, the effectiveness of a tax based solely on quantity, without considering treatable area and toxicological profile, will be difficult to measure, since it may lead to a reduction in sold quantities of pesticides, but not necessarily to a reduction in harmful effects.

4. Shortcomings of price or quantity instruments

One shortcoming of the discussed instruments is that they would apply indiscriminately across all crop types and sectors. While some crops such as cereals may have a larger potential for pesticide reduction, others such as horticultural crops use pesticides more intensely and may have less reduction potential. As a result, price

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[14] EFI – Commission of Experts for Research and Innovation (2024): Report on Research, Innovation and Technological Performance in Germany 2024, Berlin: EFI.

[15] Möckel, S., Gawel, E., Liess, M. and Neumeister, L., Study: Pesticide Tax in the EU. Various levy concepts and their impact on pesticide reduction. Helmholtz Centre for Environmental Research – UFZ (2021).

[16] Neumeister, L., Marktwirtschaft als Umweltmotor. Lehren aus dem Rückgang des Pestizidverbrauchs (2025) Published on the website of Deutscher Naturschutzring e.V.

[17] Pesticidafgift - Miljøstyrelsen

[18] BMD - Miljøstyrelsen

[19] Ekardt et al. (2024)

[20] Burtscher-Schaden, H., Durstberger, T., Linhard, D., Revision of the Harmonised Risk Indicator 1 (HRI1). (2024) Published on the website of IFOAM Organics Europe

instruments would disproportionately affect sectors such as horticulture.[21] In other words, producers who can reduce pesticides at the lowest cost will reduce more than farmers for whom pesticide reduction comes at a higher cost.[22] Specifically, organic farming uses plant protection products only when needed and when no alternative tools and measures for crop protection are available. And only natural substances are allowed as plant protection products in organic agriculture. In most cases such natural substances have no toxicity profile, or a low toxicity profile, are biodegradable, are therefore less efficient than synthetic substances and allowed in higher amounts per hectare precisely because of their low toxicity profile[23]. Therefore, price elasticity should be extremely low in this sector as further reduction in use due to increased pesticide prices (without reducing cropped surfaces) is unlikely. **Exempting inputs allowed in organic** (but also used in conventional) farming from a tax, as is the case in Norway (see next paragraph), is the solution to this.

Another possible scenario is that farmers would move from pesticide intensive crop types to producing crop types that use less pesticides. While this would comply with the objective of inducing pesticide reduction, it also means that certain crops could be produced less (and potentially be replaced by imported crops from countries with less constraints on pesticide use). Instead of price instruments, Ekardt et al. (2024) suggest **regulatory instruments** to address this caveat, namely **prohibiting pesticides for certain crop types**.

5. Experience with pesticide taxes

A good overview of the pesticide tax experience in four different countries (Sweden, Norway, Denmark and France) is given in an IFOAM Organics Europe publication by Sachse and Bandel (2018) on "Taxation as a tool towards true cost accounting"[24]. Interestingly, in Norway, products allowed for organic farming are exempted from the tax.[25] In Denmark, the tax was originally a value added tax on the sales price, with differentiated rates according to product type (herbicide, insecticide etc.). This tax, contrary to what had been expected, was hardly effective. This led to redesigning the tax and differentiation according to harmfulness was introduced. The authors have evaluated data from 1900 farms and looked at pesticide use before and after the redesign of the Danish pesticide tax. Basic pesticide prices were not adjusted to buffer the new taxes, meaning that manufacturers passed on the tax to the buyer, which is reflected in increased market prices. They found a 16 percent reduction in pesticide load, indicating a substitution from more harmful to less harmful products. Moreover, they highlighted that the response of farmers to the pesticide tax varies depending on crop types.[26] While the Danish tax has an elaborate differentiation according to toxicological profile of substances, it also applies a simple quantity (active substance per L) approach and consequently, does not address the problem of favoring highly effective substances used in low quantities.

6. Can the revenues from a pesticide tax mitigate the social costs of pesticide use?

As shown above, the EU Plant Protection Products Regulation mentions side effects of pesticides but does not address their costs. This conceals the fact that the external costs are considerable and are borne by society, for example the cost of drinking water treatment.[27] **These actual costs of using pesticides, and of mitigating their negative impacts, are not reflected in the price. The use of pesticides therefore appears more profitable** and convenient than it should, and farmers have little market incentives to decide against the use of pesticides. Sachse and Bandel (2018) estimate the external cost of pest and disease control in conventional potatoes to be 1,298 euros per hectare, as opposed to 40 cents per hectare for organic potatoes. For conventional potatoes, if the costs were to be internalized, i.e. if the producer had to pay an additional 1,298 euros on top of the expenses for purchasing pesticides (estimated at 400 euros for one hectare of conventional potatoes in 2018), this would translate into an additional production cost of 2.7 cents per kilogram of potatoes. Looking at these numbers from

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[21] Ekardt et al. (2024)

[22] Ørsted Nielsen, H., Hedegaard Konrad, M. T., Branth Pedersen, A., Gyldenkærne, S., Ex-post evaluation of the Danish pesticide tax: A novel and effective tax design (2023). Land Use Policy 126 (2023)

[23] https://www.organicseurope.bio/news/scientific-study-shows-synthetic-pesticides-significantly-more-dangerous-than-natural-ones/
https://www.organicseurope.bio/content/uploads/2023/02/230223_FactCheck_pesticides-in-conventional-and-organic-farming.pdf?dd

[24] https://www.organicseurope.bio/content/uploads/2020/06/ifoameu_final_study_on_taxation_as_a_tool_towards_true_cost_accounting.pdf?dd

[25] Sachse, I. and Bandel, T., Taxation as a tool towards true cost accounting: Study on the reduction of VAT for organic products & increased taxes for environmentally unfriendly pesticides (2018).

[26] Ørsted Nielsen, H., Hedegaard Konrad, M. T., Branth Pedersen, A., Gyldenkærne, S., Ex-post evaluation of the Danish pesticide tax: A novel and effective tax design (2023). Land Use Policy 126 (2023)

[27] #StopHarm - Stop subsidising harm, Make Europe agroecologic

the perspective of a pesticide tax, if the additional costs of pesticide use had to be internalized by a tax, the tax rate in our example would amount to 325%. It is hardly likely that such tax rates could be politically feasible.[28] **Consequently, a tax can be seen more as an instrument to induce a reduction in use of pesticides** (and by this, reduced social costs), **rather than an instrument that would generate enough revenues to actually cover the external costs to society.**[29] To achieve a targeted reduction level, the tax (or cost of a certificate in a quantity-based system) needs to be sufficiently high to make buying (and using) a pesticide less profitable than not buying (and using) it. Setting such high tax levels can be politically challenging. On the other hand, if tax levels for environmental taxes are too low, their impact on behaviour is negligible.[30]

Conclusion

The impact of a tax, levy or certificate system to reduce pesticide purchase and use depends on several factors and must be well designed to achieve the desired effects. Specifically, attention should be paid to:

- Differentiate between types of pesticides based on their toxicological profile and their impact on health and the environment. This will allow for targeted approach that encourages substitution of the most hazardous substances with the less dangerous ones and to internalize their side effects in the price.
- Normalize the tax based on the area treated rather than on the volume used. This will avoid penalizing substances that are used in higher quantity per hectare but that are less harmful.
- Exclude substances allowed in organic farming. These are only used when preventive and agronomic methods are insufficient and no alternatives exist, making additional disincentives unnecessary.

Finally, it should be acknowledged that **no tax could fully reflect and internalize health and environmental costs of synthetic pesticides use.** Such tax would be too high to be politically acceptable. Therefore, **a combination of policy tools –notably regulatory and fiscal- is essential to achieve meaningful pesticide reduction target and ensure coherency with domestic policies and import standards**. Market-based instruments such as taxes can be a useful tool to incentivise farmers to switch to less harmful pesticides if they are well designed, but they should be used in complement to targeted regulatory approaches, aimed for example at the protection of water catchment areas, which on average represent only 12% of agriculture land in the European Union.

[28] Sachse, I. and Bandel, T. (2018)

[29] Ørsted Nielsen et al. (2023)

[30] Ørsted Nielsen, H., Hedegaard Konrad, M. T., Branth Pedersen, A., Gyldenkærne, S., Ex-post evaluation of the Danish pesticide tax: A novel and effective tax design (2023). Land Use Policy 126 (2023)