Received: 18 November 2023 | Revised: 17 December 2023 | Accepted: 21 December 2023

DOI: 10.1111/agec.12817

PERSPECTIVE ARTICLE

AGRICULTURAL ECONOMICS
The Journal of the International Association of Agricultural Economists
IAAE
WILEY

Europe's ambitious pesticide policy and its impact on agriculture and food systems

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Abstract

European countries have set ambitious policy goals to reduce the risks of pesticides to the environment and human health. European agriculture could play a leading role in the transition to a low pesticide risk future, with various societal benefits. However, such a transition also involves trade-offs, costs, and risks for farmers and society. Here, we summarize possible implications for agriculture and food systems in Europe and beyond and discuss avenues for future research.

KEYWORDS
agricultural policy, pest management, pesticides

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Q1

1 | EUROPE INITIATES AMBITIOUS PESTICIDE POLICIES

Current levels of pesticide use are associated with loss of biodiversity, pollution, and degradation of ecosystems, and negative impacts on human health (Möhring et al., 2020; Schneider et al., 2023). Against this background, ambitious policy goals have been set, particularly in Europe, to reduce pesticide use and risks (Möhring et al., 2020). For example, the European Union (EU) has set a goal of reducing the use and risk of chemical pesticides and the use of more hazardous pesticides by 50% by 2030. Other European countries outside the EU are also pursuing similar goals, such as Switzerland, which has set a goal of reducing the risks of pesticide use to the environment by 50% by 2027 (Finger, 2021). While the strategic goals are clear, their translation into policies and their implementation in agricultural practices are highly debated. In particular, the potential trade-offs are currently the subject of public and political debate (e.g., Candel et al., 2023; Schneider et al., 2023).

Achieving the ambitious goals of pesticide policy will require significant changes in agricultural practices and systems (Figure 1). If successful, European agriculture could lead and exemplify the transition to a low pesticide risk future, which in turn would bring benefits to society (Candel et al., 2023). However, such a transition also involves trade-offs, costs and risks (Wesseler, 2022).

In this perspective, we discuss the potential impacts of ambitious pesticide policies on agriculture and food systems in Europe and beyond (Figure 1). We also discuss open questions, areas of conflict, and avenues for future research.

2 | HOW TO ACHIEVE PESTICIDE RISK REDUCTION TARGETS

To achieve the pesticide risk reduction targets, while maintaining yield levels, fundamental changes to current agricultural practices along the efficiency-substitution-

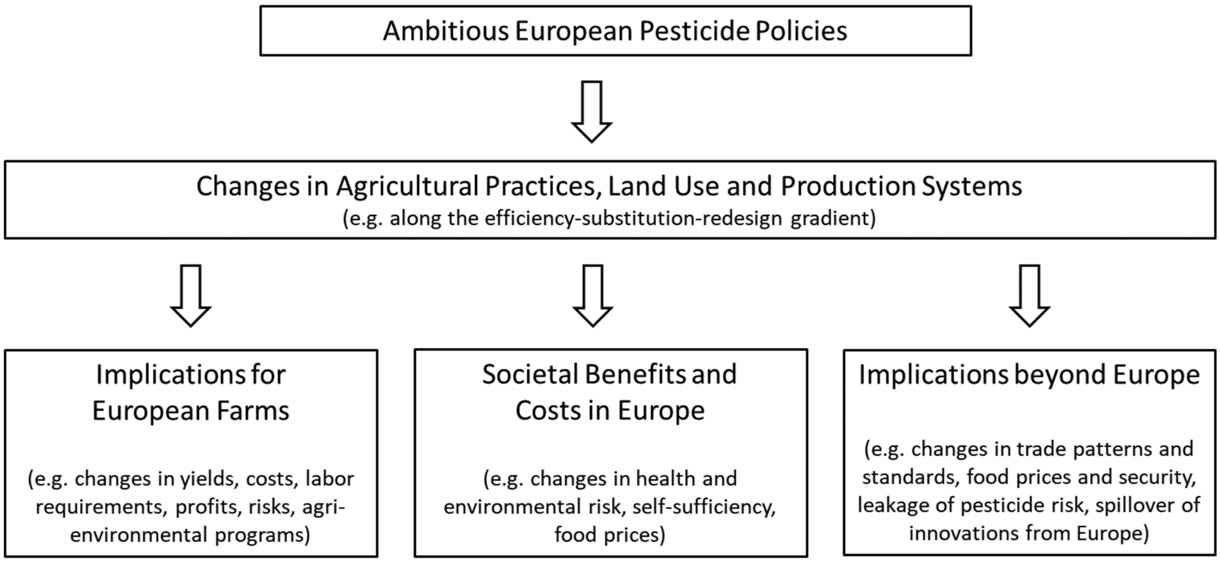

FIGURE 1 Europe's ambitious pesticide policy and its impact on agriculture and food systems.

conversion gradient are required (Finger, 2021). For example, the efficiency of pesticide use can be increased using precision farming technologies. Pesticides can also be replaced by non-chemical or low-risk pesticide strategies. For example, through biological pest control or by replacing herbicides with mechanical weed control. Finally, cropping systems need to be redesigned to reduce pest pressure. This will reduce the need for pest control. For example, through preventative measures, resistant varieties and changes to crop rotations.

3 | STRICTER PESTICIDE POLICIES BRING SOCIAL BENEFITS AND COSTS

Reducing pesticide risks implies lower external costs of the agricultural sector and contributes to the achievement of many agri-environmental policy objectives and the Sustainable Development Goals (Schneider et al., 2023). In particular, it reduces pollution of ecosystems (e.g., water bodies), reduces biodiversity loss and reduces impacts on human health (Möhring et al., 2020; Tang et al., 2021). Reduced pesticide use can also have positive long-term effects on agricultural productivity, for example, through improved soil biodiversity and pollination services (Schneider et al., 2023). However, there may also be negative indirect effects on the environment. For example, if reduced pesticide use makes it more difficult to implement soil conservation measures (Wesseler, 2022).

There are concerns that the transition to low pesticide risk practices may have an impact on domestic food production, especially in the short term. In particular, reducing pesticide use in the absence of suitable and effective alternatives may reduce productivity and yield levels. For example, Barreiro-Hurle et al. (2021) assumed that the implementation of EU pesticide targets would lead to an overall reduction in crop yields of 10%. Expected yield reductions tend to be highly crop- and region-specific. For the same policy objective, Bremmer et al. (2021) found that for some crops and regions there are no yield losses (e.g., for cereals in Finland), while for others there are large yield losses of up to 30% (e.g., for grapes and olives in France and Italy). Yield volatility may also increase, for example, due to greater susceptibility to pest infestation. The transition to a low pesticide risk future may also imply long-term adjustments in what is produced, where, and how. For example, land use may gradually shift away from crops that currently rely heavily on pesticide use. Systematic changes in land use and crop yields and greater variability in production could have an impact on European self-sufficiency in different crops, which is a critical point of discussion in policy negotiations (Schneider et al., 2023).

Stricter pesticide policies can also affect food prices. Lower crop yields can lead to lower supply and therefore higher prices. However, this effect is very crop and country specific. For example, Bremmer et al. (2021) found only a small potential impact on cereal prices at the European level (e.g., for wheat), while prices for specific crops (e.g., wine and olives) would increase. The impact of reduced pesticide use on the intrinsic and extrinsic quality of crops is also important for price effects. For example, reduced pesticide use may reduce extrinsic product quality (e.g., the appearance of dessert apples) and thus lead to price reductions (Bremmer et al., 2021). On the other hand, consumers

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may have a higher willingness to pay for products produced with lower pesticide use (i.e., higher intrinsic product quality), potentially leading to new labels and opportunities for price premiums (Grebitus & Van Loo, 2022).

4 | STRICTER PESTICIDE POLICIES ARE AFFECTING FARMS

Lower and more volatile yields and higher costs due to stricter pesticide policies reduce the economic viability of farms, ceteris paribus. However, the expected impact of stricter pesticide policies on these aspects is not clear. For example, while the costs of purchasing and applying pesticides may decrease, the costs of alternative strategies (e.g., mechanical weed control) may increase. Stricter pesticide policies may also have an impact on farm labor, both by changing the demand for labor (e.g., if alternative strategies require more working hours) and by changing the skills required of workers (e.g., if new technologies are used). Both price premiums and agri-environmental schemes can compensate farmers for adopting low pesticide use practices and the associated changes in yields, costs, and risks. For example, Germany and Switzerland have introduced agri-environmental schemes that compensate farmers for reducing or avoiding pesticide use (Mack et al., 2023; Runge et al., 2022). In view of all these factors, the overall impact on farm incomes is unclear and is likely to be farm-specific. In regions and for crops where it is easy to reduce pesticide use, farmers may benefit from higher prices and additional government payments without facing large yield losses and cost increases. In other regions and crops, however, farmers could experience lower yields and higher costs, especially those with less adaptable cropping systems, such as perennial crops. Overall, then, we expect that stricter pesticide policies could increase income inequality in agriculture if these policies did not take into account the crop- and region-specific context.

5 | THE POTENTIAL IMPACT GOES WELL BEYOND EUROPE

European agriculture is not isolated, and the transition to lower pesticide risk production systems has implications for agricultural and food systems worldwide. For example, introducing stricter pesticide policies in Europe may lead to shifts in trade flows. For example, Bremmer et al. (2021) note a potential increase in net imports into Europe for crops such as rapeseed and citrus fruits, while net exports for tomatoes, olives, and wine will decrease. Changes in trade flows also risk shifting environmental impacts from Europe to other parts of the world, that is, leakage (Tang et al., 2022). More specifically, if lower footprints in Europe mean lower productivity that must be compensated by higher imports, this may increase the intensity of production and land use in other parts of the world, leading to a shift in environmental and human health impacts (Barreiro-Hurle et al., 2021). If Europe requires more imports of certain crops, some regions outside Europe may benefit economically from increased export opportunities, but an overall decline in agricultural production may contribute to higher global food prices, threatening global food security (Wesseler, 2022). In addition, the approaches to low pesticide production emerging in Europe may become the benchmark for imports and future trade agreements (e.g., as new sustainability standards), with potentially major implications for trading partners (Beckman et al., 2020). Finally, the innovation triggered by European pesticide policy may also spill over globally. An ambitious pesticide policy can trigger the development and widespread use of new low- and pesticide-free production systems and new technologies. This will reduce the costs and uncertainties associated with such a transition, making it easier for other countries to follow suit. In this sense, Candel et al. (2023, p. 272) state that Europe can become "a role model for the transition towards low-pesticide-risk futures, paving the way for other countries to meet goals defined in the Kunming-Montreal Global Biodiversity Framework". Europe could thus set in motion a global momentum for the much-needed transition to more sustainable agricultural practices. An open question, however, is whether and how new technologies and policies can be transferred from Europe to other regions.

6 | OPEN QUESTIONS AND IMPLICATIONS FOR AGRICULTURAL ECONOMICS RESEARCH

We summarize here open questions as well as key avenues for future agricultural economic research to support practitioners, industry, and policy makers in the transition to low pesticide agricultural systems.

Several of the above impacts on yields, costs, and risks, as well as the implications for farmer decision making and markets, are not well understood, are highly uncertain, and thus require further analysis. Quantifying the impacts of transitioning to currently unknown production systems at large scales with heterogeneous impacts at the farm level also requires new research approaches, such as combining expert knowledge with agent-based bioeconomic modeling approaches (Mack et al., 2023). There is also a need for the coherent consideration of stricter pesticide policies and the emergence of new low- and no-pesticide production systems and standards on global trade dynamics and policies.

Better quantification of the environmental and human health benefits of stricter pesticide policies is needed. This includes an assessment of the costs of not adopting stricter pesticide policies right now. Agricultural economic research can provide better approaches to quantify and value the environmental and human health impacts, ecosystem services and disservices associated with crop protection.

In addition, the long-term effects, dynamics, and feedback loops between environmental, agricultural, and economic systems are not well understood. For example, we do not know how farmers adjust land use and production systems over the long term to avoid negative impacts on yields, costs and labor requirements. We also lack long-term and causal evidence on the adoption of low pesticide risk practices and their impact on productivity, yields and economic viability. As a result, the relevant dynamics are not included in the economic models currently used. In this sense, reduced reliance on pesticides may contribute to higher income risks and greater income inequality. Although this has important implications for agricultural and policy decision-making, empirical evidence is still largely lacking, and new research approaches are needed.

Farmers need effective and economically viable alternatives to pesticides, especially for those pesticides that pose high risks to the environment and human health. At the same time, these alternatives should not reduce crop yields or increase food prices and should be socially acceptable. In addition, these alternatives need to be implemented quickly to meet the ambitious short-term targets. In reality, however, these alternatives are often not yet attractive to farmers, are associated with major uncertainties, and face political obstacles. Agricultural economic research shall therefore address the economic and political aspects of alternatives to pesticide use. This may include new farming systems as well as digital innovations such as precision agriculture, robots, and the use of digital technologies to redesign future agricultural landscapes (Möhring et al., 2020). It may also include new production systems based on agroecological crop protection and the use of new breeding technologies to create pest-resistant varieties (Ewert et al., 2023).

Finally, agricultural economic research should support the development and evaluation of innovative policies. For example, measures to support the reduction of pesticide use, the introduction of alternative strategies, and the reduction of trade-offs between pesticide use and other policy objectives. Innovative instruments could include, for example, the taxation of pesticides according to pesticide risks (Nielsen et al., 2023) and the use of performance-based payment schemes to prevent pollution of water and ecosystems and to achieve biodiversity objectives in relation to crop protection. The latter may require new policies at the landscape level, extending beyond individual farms. In contrast to pesticide bans, such innovative measures give farmers the freedom and flexibility to reduce pesticide risks in the most cost-effective way and provide incentives to shift from high-risk to low-risk production systems. In addition, research is needed on new policy approaches to ensure that inequalities are reduced, that is, that the losers of stricter pesticide policies, for example, certain farms and consumers, are compensated.

ACKNOWLEDGMENTS

I thank the editors of Agricultural Economics as well as Niklas Möhring and Kevin Schneider for helpful feedback on earlier versions of this paper.

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How to cite this article: Finger, R. (2024). Europe's ambitious pesticide policy and its impact on agriculture and food systems. *Agricultural Economics*, *55*, 265–269. https://doi.org/10.1111/agec.12817