CALL FOR TENDER (CFT) FOR DEVELOPMENT OF A FRAMEWORK TO DEFINE CROP SPECIFIC RULES THAT SUPPORT IPM PRACTICES WITHIN EU CROP PRODUCTION – TASK 4

Case study for France

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1. INTRODUCTION

This case study applies a structured evaluation protocol for Integrated Pest Management (IPM) to assess the economic and environmental viability of reducing pesticide use in arable crop production. The analysis utilizes empirical data from a comprehensive French study involving 946 non-organic commercial arable farms across diverse agroecological and production conditions[1]. The original research demonstrated that pesticide use could be reduced by up to 42% in 59% of farms without compromising crop productivity or profitability, with 77% of farms showing no trade-offs between low pesticide use and high-performance outcomes.

Building on these findings, this case study aims to:

- Evaluate whether the IPM protocol can effectively assess trade-offs and synergies between pesticide reduction, economic viability, and environmental sustainability.
- Identify strengths and limitations of the protocol when applied to heterogeneous, commercial farm-level data.

The findings of the case study aim to inform future applications of the evaluation protocol in other EU contexts and support the development of scalable, science-based strategies for sustainable crop production.

2. OVERVIEW OF THE STUDIES

The foundational dataset for this case study is drawn from a large-scale empirical investigation conducted by Lechenet et al. (2017)[2], which surveyed 946 non-organic commercial arable farms across diverse agroecological and production contexts in France. Pesticide use was quantified using the Treatment Frequency Index (TFI), a measure of pesticide application intensity that does not directly assess environmental impact. Crop productivity was evaluated through the higher heating value of harvested biomass, and profitability was assessed by averaging farm profitability across ten contrasting price scenarios to reflect market variability.

Using Lasso regression models incorporating farm-specific biophysical and socio-economic variables, the study estimated the marginal effects of pesticide use on both productivity and profitability, including interaction effects with production context factors. The results indicated that pesticide use could be reduced by an average of 42 per cent in 59 per cent of farms without negatively impacting either productivity or profitability. Furthermore, 77 per cent of farms showed no significant trade-offs between low pesticide use and high performance. Reductions were particularly notable for herbicides (37 per cent), fungicides (47 per cent), and insecticides (60 per cent), with farms exhibiting higher baseline pesticide use demonstrating greater potential for reduction. Importantly, **pesticide reduction in the study was not achieved merely by lowering application rates, but by implementing a broader set of IPM-related strategies** such as optimised crop rotations, mechanical weeding, and improved pest monitoring—highlighting the role of adaptive, systemic changes in farm management.

These findings demonstrated the feasibility of substantial pesticide reductions within commercial arable farming systems while maintaining economic viability, providing a robust and diverse dataset to test the applicability and sensitivity of the evaluation protocol in this case study.

Table 2-1: Summary of the results from the study under review

Variable	Units	Value	Description
Farms with viable reduction	%	59	Proportion of farms where a 42% pesticide reduction could be achieved without negatively affecting productivity or profitability.

[1] Lechenet, Martin, Fabrice Dessaint, Guillaume Py, David Makowski, and Nicolas Munier-Jolain. *Reducing Pesticide Use While Preserving Crop Productivity and Profitability on Arable Farms*. *Nature Plants* 3 (2017): 17008. https://doi.org/10.1038/nplants.2017.8.

[2] *Ibid.*

Variable	Units	Value	Description
Pesticide reduction	%	42	Average estimated reduction in total pesticide use achievable without negative impact on performance in those 59% of farms.

3. EX-ANTE MODELLING OF ECONOMIC IMPACTS

3.1 BASELINE ASSUMPTIONS

To assess the potential economic impacts of reduced pesticide use in arable farming in France, a baseline of farm-level financial performance was constructed using data from the Farm Accountancy Data Network (FADN). The analysis focuses on non-organic arable farms, corresponding to FADN Type of Farming 15 (Specialist COP – Cereals, Oilseeds and Protein crops), to ensure consistency with the population covered in the referenced French study.

The baseline was built using a time series of FADN data from 2004 to the most recent available year (2023). This data includes:

- Total crop output (€/ha): representing the value of crop production per hectare.
- Specific crop costs (€/ha): including expenditures on inputs such as seeds, fertilisers, pesticides, and other variable costs directly attributable to crop production.
- Gross margin (€/ha): calculated as the difference between crop output and crop-specific input costs.

To express the figures in real 2025 euros, all monetary values were discounted to account for inflation. The time series of gross margins was then projected forward from 2024 to 2040 using the compound annual growth rate (CAGR) calculated over the historical period and assuming a constant annual benefit. This provides a consistent and realistic forecast of the gross margin trajectory in a business-as-usual scenario, serving as a reference point for estimating the financial implications of pesticide reduction.

In addition to economic indicators, FAOSTAT data on average pesticide use in France (expressed in kg/ha) was used to estimate the environmental benefits of pesticide reduction. This information provides the basis for calculating avoided environmental damage under the reduced pesticide scenario described in Section 3.2.

3.2 ESTIMATED IMPACTS

Based on the baseline constructed above, the economic impacts of pesticide reduction are estimated by adjusting input costs to reflect the expected pesticide savings. Farms that can reduce pesticides do so on average by around 42% (see Table 2-1). If we assume that pesticides account for 18% of their crop-specific input costs, this equates to a 7.56% reduction in total crop-specific input costs for those farms.

To obtain an average impact at population level, this reduction must be weighted by the proportion of farms that can reduce pesticides (estimated at 59% of all farms, see Table 2-1). Therefore:

$$Weighted\ pesticide\ reductions = 59\% * 7.56\% = 4.46\%$$

Thus, across the full population of arable farms, the model assumes a 4.46% reduction in crop-specific input costs with no change in crop output, resulting in an equivalent increase in gross margin.

This gain in margin per hectare is projected forward from 2024 to 2040, assuming a constant annual benefit and applying a real discount rate of 3.20%, in line with the French Treasury's standard rate for cost-benefit evaluations.[3]

The Net Present Value (NPV) of these gains is then calculated over a 15-year time horizon (2025–2040), using the standard NPV formula:

$$NPV = \sum_{t=0}^{T} \frac{(\Delta Gross\ Margin_t)}{(1+r)_t}$$

[3] Projecting the future value of ecosystem services: a way to enhance cost-benefit analysis

Where:

- ΔGross Margin is the annual increase in gross margin from reduced pesticide use
- r is the discount rate (3.2%)
- T is the time horizon (15 years)

In addition to financial gains, the analysis also considers the environmental benefits of reduced pesticide use. To do this, we use a simplified shadow pricing method, applying France's diffuse pollution tax rate as a proxy for the marginal external cost of pesticide use. Specifically, we combine FAOSTAT[4] data on average pesticide use in France (in kg/ha) with the assumed 42% reduction in use to estimate total pesticide savings per hectare. These savings are then multiplied by the applicable pollution tax rate (in €/kg) as defined in France's environmental tax framework. This yields a monetised environmental benefit in €/ha, which is added to the financial margin gains to produce a more holistic Net Present Value (NPV) estimate. While this method does not capture the full ecological complexity of pesticide impacts, it provides a grounded and transparent proxy for the avoided harm to ecosystems, water bodies, and public health.

The results obtained are summarized in the table below.

Table 3-1 Results obtained from the analysis

Scenario	NPV (in 2025€/ha)	Change from Baseline
Baseline	10,123	-
Reduced pesticide	10,546	423

4. CONCLUSION AND REFLECTIONS

The results suggest that a 42% reduction in pesticide use across 59% of French arable farms could yield a positive net economic outcome when applied at national level. Based on adjusted input costs and constant output assumptions, the estimated Net Present Value (NPV) from 2025 to 2040 under this scenario is approximately €10,546 per hectare, compared to a baseline scenario NPV of €10,123 per hectare. This implies a net benefit of €423/ha over the evaluation period, reflecting modest but meaningful cost savings at the farm level.

The analysis also highlights important distributional dynamics. The scenario assumes no yield penalty or implementation costs for the 59% of farms able to reduce pesticide use significantly without compromising productivity. However, the remaining 41% of farms are excluded from this benefit stream, potentially reflecting higher risk profiles or greater reliance on chemical pest control. This heterogeneity reinforces the need for targeted policy instruments, such as technical support and cost-sharing schemes, to facilitate wider IPM adoption.

Importantly, the economic case strengthens further when environmental benefits are considered. By applying a simplified shadow pricing method based on France's diffuse pollution tax rate, we estimate that the environmental externality savings (e.g., reduced contamination of soil, water, and ecosystems) add further value to the scenario. These benefits, while conservatively estimated, reflect the avoided social and ecological costs of pesticide pollution and enhance the cost-effectiveness of reduced pesticide strategies from a broader societal perspective.

Overall, the findings from this case study align well with the evaluation protocol developed for this project. They show how relatively simple modelling tools, when combined with robust national datasets and grounded assumptions, can be used to estimate both private and public benefits of IPM-based practices. These insights are valuable not only for informing future cost-benefit analysis, but also for designing targeted incentives that align agronomic behaviour with sustainability objectives.

[4] FAOSTAT

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