

# ENVIRONMENTAL AND ECONOMIC SUSTAINABILITY OF PESTICIDE USE REGIMES

## Introduction

The SPRINT project is evaluating the impact of Plant Protection Products (pesticides) on both environmental and human health. Considering the life-cycle sustainability of pesticides, looking beyond the direct effects their active ingredients have when applied to fields, is an important part of achieving this objective.

To do this, the impacts of resource extraction, manufacturing, application, and waste management of pesticides and their packaging were assessed. The results are compared against alternative approaches to plant protection that do not use synthetic pesticides.



## Methods

The environmental impacts of pest control methods were assessed on:

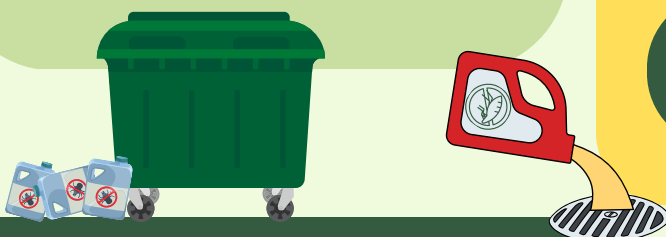
**10**  
countries

**169**  
farms

**189**  
pesticides

We considered the three main farming systems: 1) Conventional farming; 2) Integrated Pest Management (IPM); and 3) Organic farming.

We quantified and compared the environmental impacts associated with different pest control options through their life cycle. We considered the human and ecological toxicity pest control methods at the farm level, and emissions and resource use associated with pest control, including application machinery and manufacturing processes.



## Life Cycle of a Pesticide: Stages to Consider

### INPUTS

Energy, resources (e.g. water), materials, chemical substances

Extraction of raw materials

Chemical synthesis and processing

Product manufacturing and packaging

Product distribution

Product use in agriculture or elsewhere

Packaging end-of-life management

Disposal of obsolete product stocks

### OUTPUTS

Environmental emissions from manufacture, use and disposal



## Findings

- 189 distinct pesticides were investigated.
- Some conventional farms used over 40 pesticides, others just 8.
- The amount of pesticides used on different crops varies greatly, depending on their value and susceptibility to disease.
- Pesticides make up the bulk of the impact of all farming types on human health and ecosystem quality.
- Fuel use for weed control consumes a greater proportion of natural resources, nearly equalling the resources consumed by manufacturing and marketing the pesticides themselves.
- Conventional farming typically has higher impacts on human toxicity and ecotoxicity due to the direct application of chemical pesticides.
- IPM and Organic farming generally have lower impacts on human health and the environment. They use fewer harmful chemicals and more natural or mechanical pest control methods.

### Application methods:

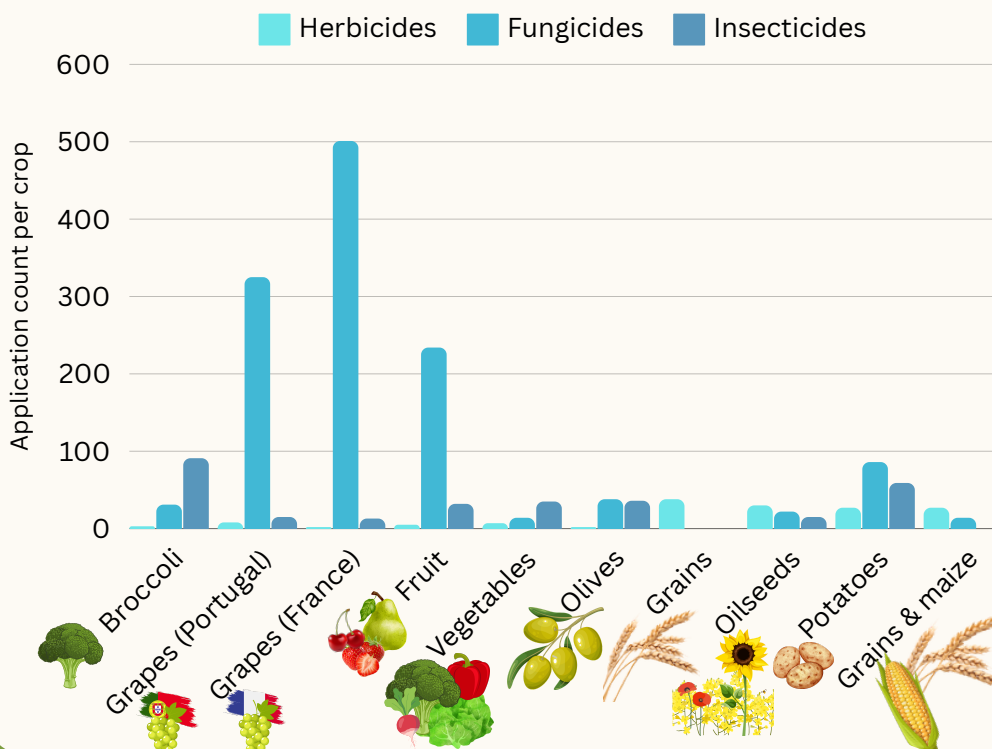
How pesticides are applied, and to which crops, impacts how much lands on the crop, as opposed to the surrounding soil, or getting carried off in the air.

In hand sprayed fruit orchards, **66%** of the pesticide lands on the crop.

Vegetable crops treated with a standard fan boom sprayer receive on average only **18%** of the pesticide sprayed...

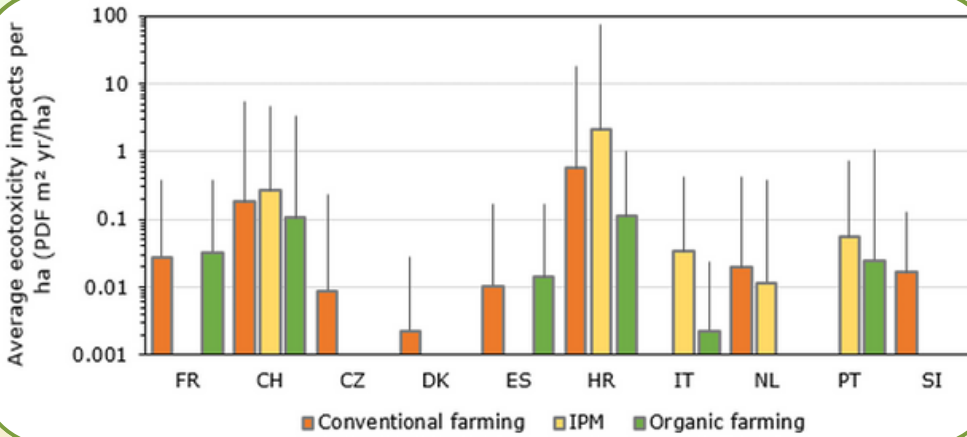
...with **74%** landing on the soil, and **7%** being carried off on the air.

Cereals treated with a drift reduction spray boom receive on average **48%** of the spray, **49%** is left on the soil.



### Pesticide application count by crop.

The number and type of pesticides used varies greatly across different crops. Vineyards producing wine grapes are amongst the highest users of fungicides to control disease. More herbicides are used for field crops which are replanted each season like oilseed rape.

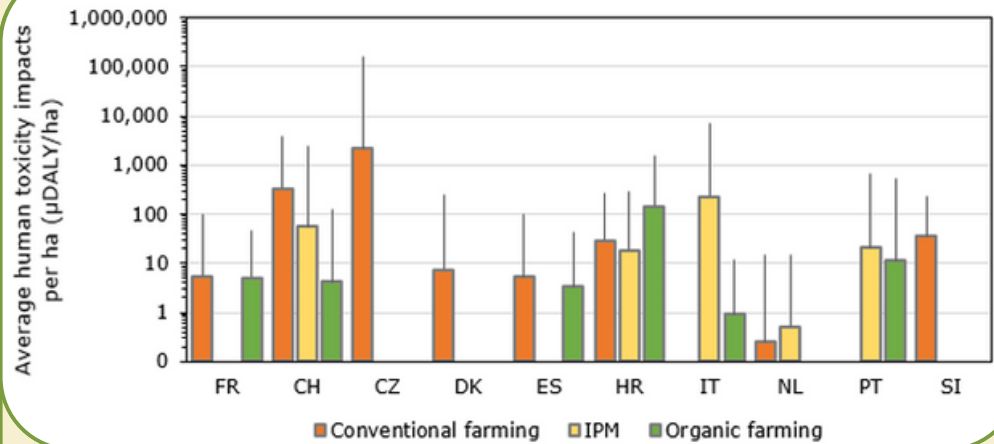


### The Crops Investigated:



### Impact on ecosystems

- Expressed in **estimated species lost** a year from 1m<sup>2</sup> of water per hectare (ha) of treated crop.
- **Highest average ecotoxicity** impacts were found for both conventional farming in the Netherlands, and for IPM in Switzerland, Croatia and Portugal.
- In France, Spain and Portugal, **organic farming related impacts are of similar magnitude as to conventional farming systems**, due to the extensive use of copper-based fungicides in organic farming (and IPM).
- **Highest average per ha impacts are found in Croatia.**
- Overall, **ecotoxicity impact** per ha across farms and farming system ranges between 0.002 and more than 2 PDF m<sup>2</sup> yr, with considerable uncertainty.

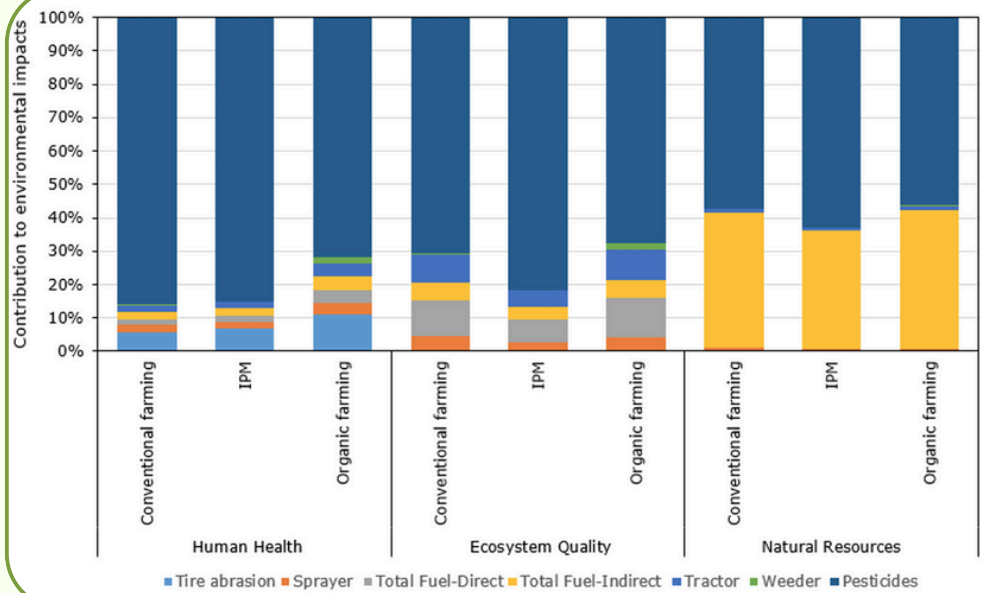


### Impact on human health

- Measured in micro disability adjusted life years (µDALYs), which equate to roughly half a minute of healthy human life lost, per hectare (ha) of treated crop.
- Highest average impacts are from conventional pesticide use.
- The exception is Croatia (crop studied: olives), where extensive **copper-based fungicide** use leads to higher average per ha human toxicity impacts.
- **Human toxicity impact per ha** ranges between **0.2 and more than 2000 µDALY**, with considerable uncertainty.
- Estimated human toxicity impacts **can reach beyond 100,000 µDALY per ha in Czech Republic**, which corresponds to 1 tenth of a healthy life year lost per ha treated crop area. This is a substantial health burden from pesticide exposure.

### Relative impact of different areas of pest control.

- Pesticides dominate the overall impacts of every production system on human health, ecosystem quality, and natural resource use.
- At the highest, pesticides make up 80% of the measured harms of conventional farming and IPM.
- Fuel use makes up nearly half of the natural resource consumption of pest control.
- In organic farming, pesticide related impacts are less dominant, although the use of copper-based fungicides means some impacts remain.



### Externalised costs of pest control

Typical range		Extreme
Min 25	Max 800	10,000
€/ha	€/ha	€/ha

- Combined economic costs from the impacts of pest control on human health, ecosystem quality and natural resource use are difficult to accurately calculate.
- There was no significant differences between the economic costs of organic, IPM and conventional farming practices.
- This is largely due to the use of copper-based pesticides in organic and IPM farming having a high impact.

### Conclusions

- The impacts of pest control on human health, ecosystem quality and natural resource use are largely from pesticides.
- High impacts are often driven by a few specific substances.
- While these results are not yet comprehensive, they constitute the first step to understanding the wider impacts of pest control in SPRINT.

### Recommendations

- Improve the methods of applying pesticides
  - Reduce spray escape into the wider environment
  - Develop and mainstream more sustainable pest control practices.
- This is core to SPRINT's ongoing work.

### Limitations

The available techniques for life cycle assessment are helpful in understanding the impacts of pesticides, but due to methodological limitations, it is likely that the impacts on soil ecosystems, pollinators, farm worker and rural bystander health have been underestimated in this work.

Based on: [Report on environmental and economic sustainability of pesticide use regimes.](#)

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