IPM RESEARCH FACTSHEETS

Arable crops sector

The DEPHY network in France is one of the five national IPM demo farm networks affiliated to IPMWORKS. During the course of the IPMWORKS project (2020-2025), two PHDs analysed data produced by DEPHY farms in the sector of arable crops, to produce knowledge about cropping systems with reduced reliance on pesticides.

This factsheet synthetizes the main results of the PhD by Romain Nandillon (INRAE – Research unit Agroecology in Dijon, France), about the cost-efficiency of the re-design of cropping systems to reduce pesticide inputs.

COUNTRIES

FRANCE

ÉCOPHYTO PIC | RÉDUIRE ET AMÉLIORER L'UTILISATION DES PHYTOS

HUBS

About **150** hubs distributed across the French territory. Data from 856 to 913 farms were used for the different questions addressed in the PhD

RESEARCH QUESTIONS

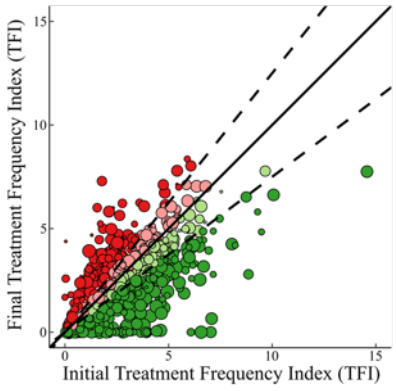
Romain Nandillon analysed detailed data describing the evolution of farming practices, pesticide use and yields over a period from 2010 to 2021 (9 years of monitoring, on average, varying across farms as a function of the year of joining the network), as an effect of cropping system re-design facilitated by DEPHY hub activities. He addressed three main questions:

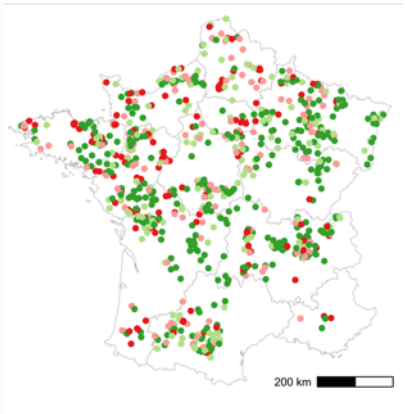
- What did farmers change in their farming practices to be able to reduce PPP inputs, as compared to those farmers who did not reduce PPP inputs, or even increased inputs over the period ?
- What were the consequences of adapting cropping systems and reducing PPP inputs on farm productivity and profitability ?
- What would be the consequences of a general adoption of cropping systems designed to reduce the need and use of PPPs, at the level of the whole France country, on the volumes of production and the agricultural trade balance ?

TREND IN PPP INPUTS OVER THE MONITORING PERIOD

Treatment Frequency Index (TFI) was used to monitor PPP inputs

TFI decreased by 18% on average, with 66% of farms decreasing TFI and 34 % increasing TFI





Farms that succeeded in reducing PPPs (green dots) are evenly distributed

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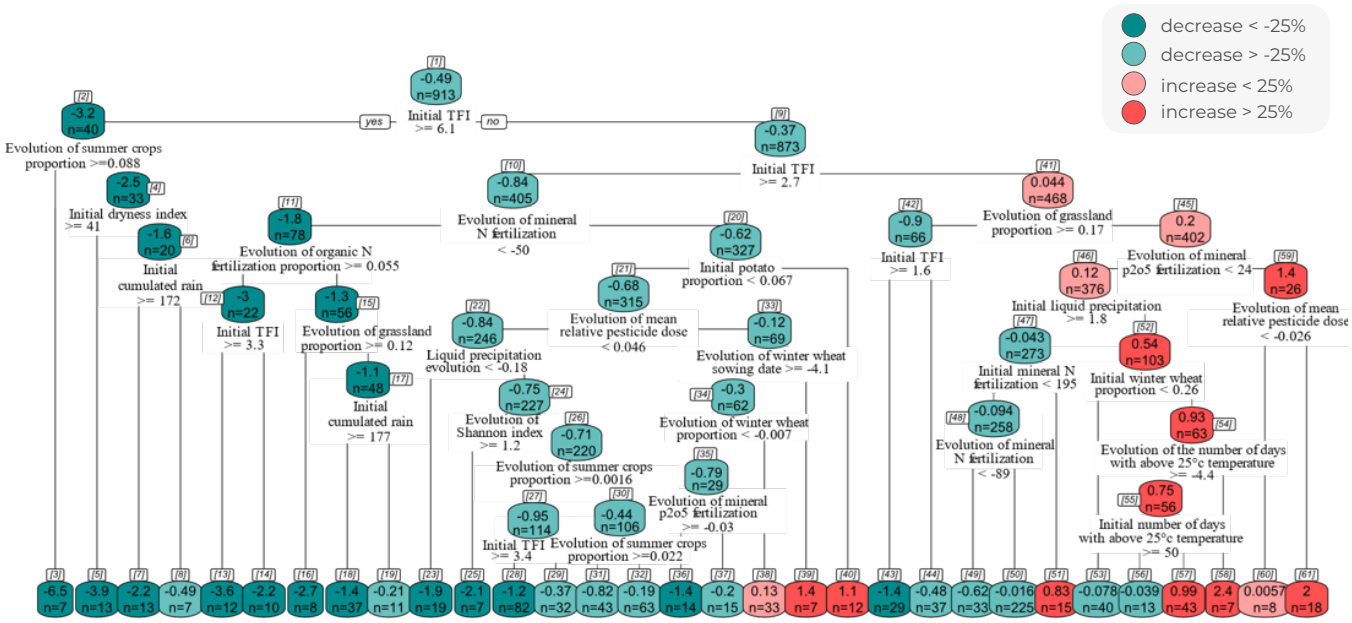
CHANGES IN FARMING PRACTICES ASSOCIATED TO THE DECREASE IN PPP INPUTS

The trend in pesticide use over years (increase or decrease) was analysed as a function of initial practices and changes of practices, to distinguish clusters of farms with similar evolution over time.

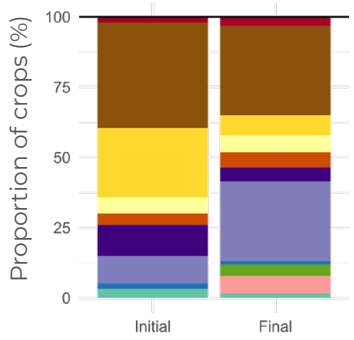
TREND OF TFI 2010-2023



EXAMPLE OF CLUSTER 1

7 farms | initial average TFI : 9.7 | **Average Δ IFT : -67%***

Crop diversification



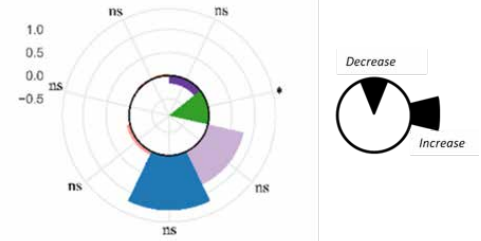
- Sugar beet
- Wheat
- Rapeseed
- Maize
- Grain cereals mix
- Rapeseed mix
- Annual forage mix
- Barley
- Others
- Potatoes
- Grassland
- Soybean
- Sunflower

Re-design of cropping systems

Farmers of Cluster 1 redesigned cropping systems, by (i) diversifying crop rotations, (ii) moderating nitrogen fertilisation (with a higher proportion of organic N), (iii) improving decision making for treatments. This contributed to the decrease in pesticide inputs.

Changes in crop management

- Mechanical weeding frequency
- Mean relative PPP dose
- Shannon index (crop diversity)
- Total N fertilisation
- Ploughing frequency
- Proportion of Organic N
- Shallow tillage frequency



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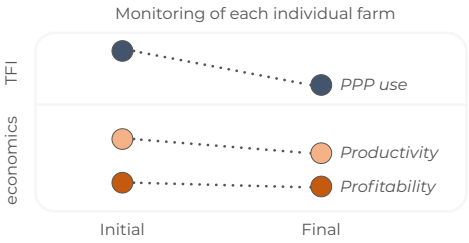
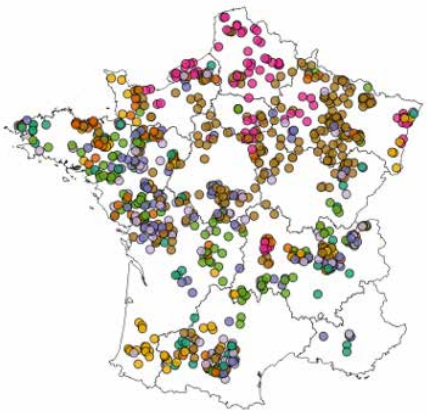
TREND IN FARM PRODUCTIVITY AND PROFITABILITY ASSOCIATED TO THE DECREASE IN PPP INPUTS

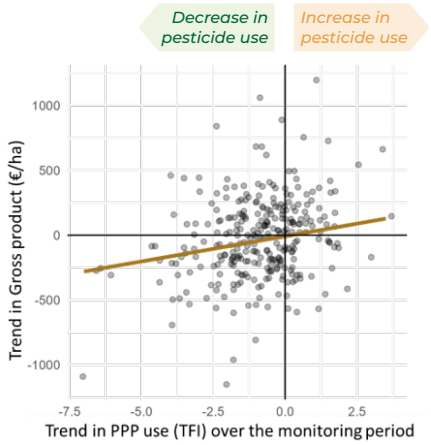
The trend in farm productivity and profitability over the monitoring period was analysed as a function of trend in pesticide use. The analysis considered a typology of farm types (8 farm types).





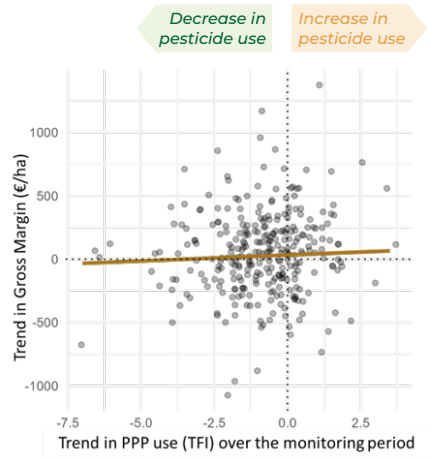
Type
- Cereals
- Summer crops
- Minor crops
- Industrial crops *(sugar beet, potatoes...)*
- Maize
- Maize-Winter wheat
- Temporary grasslands
- Others

EXAMPLE OF THE CEREAL-BASED CROPPING SYSTEMS



Statistical analyses demonstrated a trend for slightly lower productivity (Gross Product) in cereal-based farms where cropping systems have been re-designed so as to decrease PPP use. However, this relationship is not significant

The choice of cultivars according to the sensitivity to diseases (rather than according to yield potential only), the delay in cereal sowing to escape weeds, diseases, and insect pests, and the moderation of N fertilisation, are all technical options that tend to decrease the yielding potential in cereals



No significant relationship between the decrease in PPP use over time and any trend in farm profitability

The slight (non significant) decrease in productivity was offset by the decrease in input costs (PPP, fertilisers)

This result was observed in all farm types

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SCENARIOS OF GENERAL ADOPTION OF HOLISTIC IPM

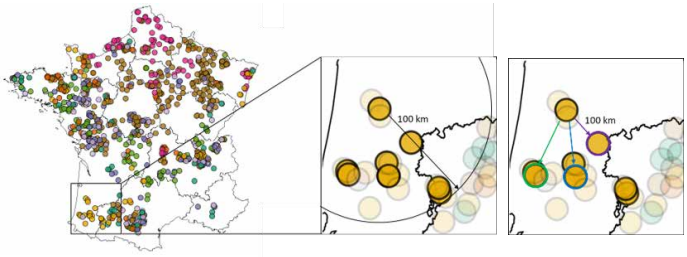
What if... all French farmers of the arable field crop sector would adopt the strategies and crop management of neighbour DEPHY farmers who successfully decreased their PPP inputs, in the same farming context?

METHODS

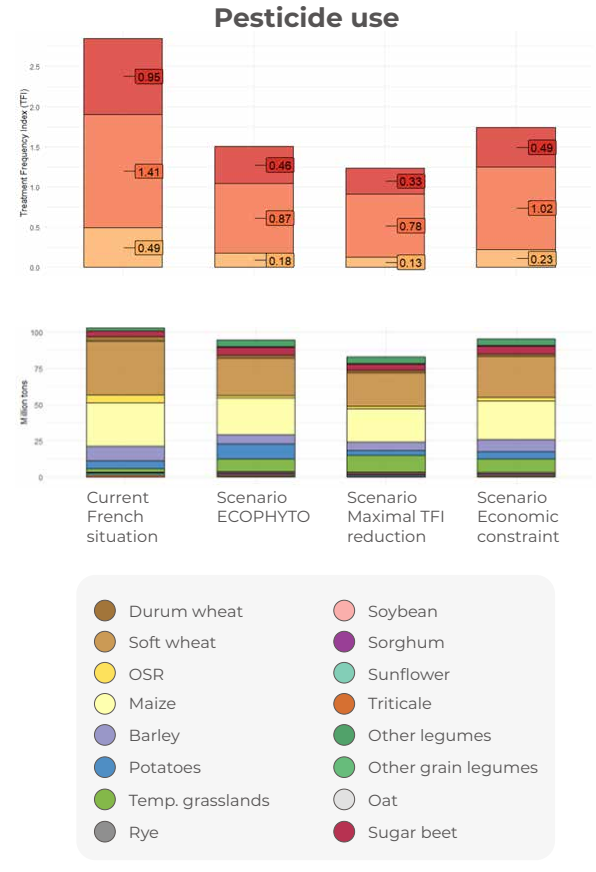
For each DEPHY farm, all farms of the neighbourhood (<100 km) with the same farm type, same soil type, same type of cattle (if any) are selected as potential benchmarks. Among these, three benchmarks are selected, corresponding to three scenarios:

- *Scenario ECOPHYTO : benchmark corresponding to an average reduction of 50% of TFI (Target of the National Action Plan)*
- *Scenario 'Maximum reduction' : benchmark corresponding to the lowest TFI in conventional farms*
- *Scenario 'Economic constraint' : benchmark with the lowest TFI but a gross margin equivalent or better for each farm*

Then the effects of the general adoption of the strategies and practices of the benchmarks are aggregated at the level of the whole French agricultural area for arable field crops

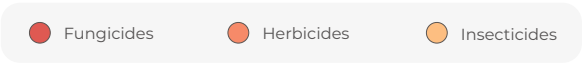


RESULTS



PPP inputs

As compared to the current situation in French agriculture, the average Treatment Frequency Index would be decreased by 50%, 56%, and 39% in the three scenarios, respectively



Productivity – Profitability

Scenarios of general adoption of IPM-based systems with reduced reliance on PPPs would **increase the diversity of crop production**, slightly **decrease the overall production** (-8%, -20%, -7%, respectively). This would **decrease exports of cereals** (wheat, barley, maize), partly offset by the **decrease in imports of plant proteins, potatoes, and fertilisers** (and/or energy required for fertiliser production).

The profitability would not be affected on average for individual farms, except slightly for the Scenario of maximal TFI reduction (-9%)

Trade balance

Overall, the French agricultural trade balance would remain positive, but the surplus would be decreased by 30%, 72%, and 36%, respectively

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