Analysing the relationship between yields and farmers' incomes to help the design of more sustainable cropping systems

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Analysing relationships between crop diversity, pesticides use and farmers' incomes to help the design of sustainable cropping systems

Introduction

- High demand for low pesticide cropping system in Europe.
- How to achieve this with mutual benefits for farmers and other stakeholders ?
- Assumption of potential effects of crop diversification on pesticide use, and farmer's income.

Objectives

- Is pesticide use (at cropping system scale and at crop scale) correlated to cropping system diversity ?
- What are the production situation facilitating crop diversification strategies ?
- Is maximising cropping system productivity the only way to maximise farmers' income ?

Materials & Method

- Database collecting DEPHY farmers practices
- Data mining (Random forest, Classification and regression tree-CART)
- Comparing indicators of crop diversity

Metrics of cropping diversity

- Number of crops in the cropping system
- A more specific diversity index based on:
  - Number of species
  - Number of taxonomic families
  - Number of growing seasons/sowing periods
  - Cover crops, temporary grasslands…
- Ecological index (Shannon, Specific richness, Frequency of occurrence, …)
- …

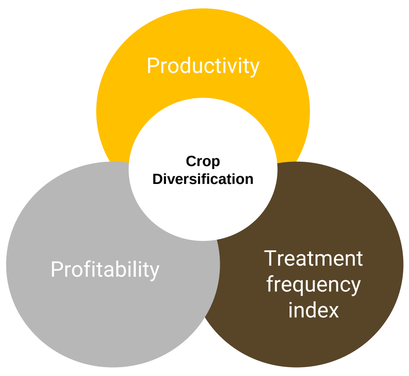
Descriptors of production situations

- Soil depth, soil type, climate condition, topography
- Transportation convenience (Domestic and exportation, port city)
- Distance to food processing industry
- Presence of livestock in the farm (ruminants, poultry, pigs…)
- Market availability
- …

Metric for assessing pesticide use : the Treatment Frequency Index (TFI)

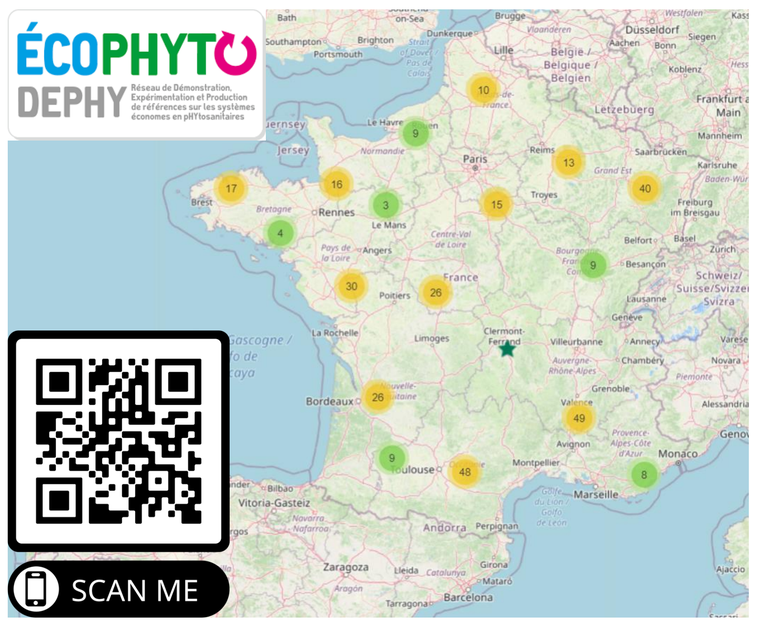
Number of treatments, weighted by the relative dose to full registered dose, and by the % area treated → to quantify pesticides use

Production situation



The DEPHY farmers network

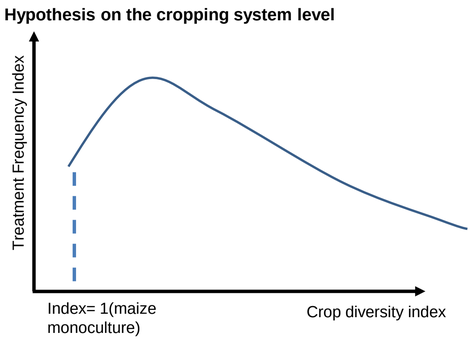
- A major action of the French Ecophyto National Action Plan.
- The DEPHY network coordinates 2000 farmers
- Farmers are engaged to demonstrate that reducing pesticide use is possible and cost-effective
- Through a holistic approach of pest management.



France DEPHY interactive map (Scan the QR code above to access)

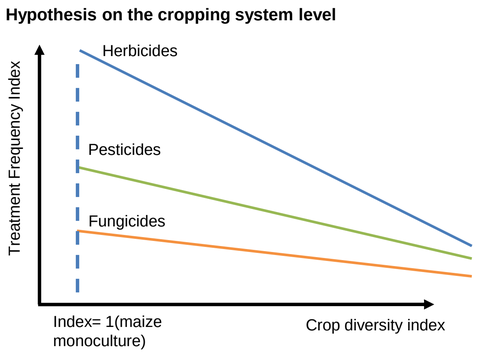
Hypothesis & Expected results

Hypothesis on the cropping system level



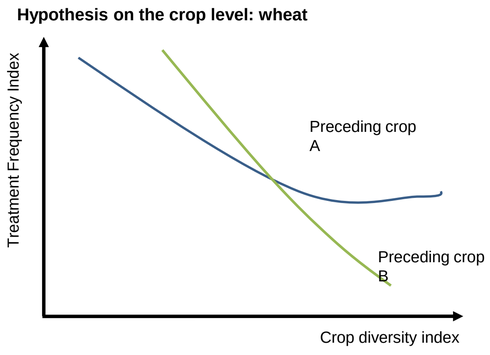
Hypothesis 1: Higher crop diversity cropping system will contribute in lower TFI in general. Maize monoculture could contribute to low TFI on the cropping system level

Hypothesis on the cropping system level



Hypothesis 2: TFI on herbicides, pesticides, fungicides will decrease disproportionately in relation to 1 unit increase or crop diversity

Hypothesis on the crop level: wheat



Hypothesis 3: Different preceding crop will influence the TFI on the following crops. Eg. TFI for Wheat following maize or soy beans

PROCESSOR
*"Our customers are demanding a stricter screening on the **pesticide test** and **heavy metal test** for food ingredients." (A manufacturer of the US)*

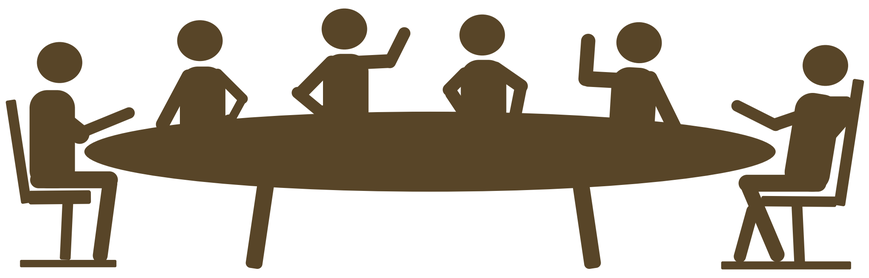
FOOD COMPANY
*"With the increasing market of organic or eco-friendly food, we are looking for inspirations of **healthy food & drink product.**" (A R&D manager of Turkish food start-up)*

RETAILER
"We are looking for good quality food products, that's where consumers are willing to spend their money. Market for organic & biodynamic products are growing much faster than conventional products." (A shop assistant of dm-drogerie markt of Germany)

FARMER
*"Diversified crops needs a market to sell, and our priority is **to have stable contract** to sell those crops, how can we diversify with so many limitations?" (A farmer from Alsace, France)*

CONSUMER
*"We **don't have enough knowledge** and judgement about the Pesticide-free or Organic standards, so we **rely more on the product labels.**" (Report of Organic Trade Association, 2022)."*

SEED COMPANY
"From yield-based breeding, to quality-based breeding, to the current stage of nutritional-based breeding, is it possible for us to move towards a world of life-based breeding? The nature of seed is life itself" (A seed breeding company from China)



SCIENTIST
*"Achieving pesticide-free society needs to go through **a transition phase** where **agroecological practices** have to be implemented and accepted to reduce slowly the use of pesticides till the pesticide-free era." (A junior researcher at INRAE, France).*

A discussion from stakeholders along the agriculture and food value chain

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