Modelling agricultural policies with IFM-CAP: possibilities offered by detailed farm data

28th PACIOLI NETWORK WORKSHOP

Pascal Tillie – European Commission – JRC Seville

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Contents

1. IFM-CAP: a farm-level model built on FADN data

Why 'farm-level' analysis makes sense?

- In the very old CAP, the measures were market-related (tariffs, minimum guaranteed prices, etc.)
  - Evaluation was taking place with aggregated models (e.g. elasticities)
- BUT, the last twenty years, CAP has become farm-specific
  - The CAP measures target at the farm level (e.g. conditionality, eco-schemes)
  - The performance of the policy depends on the reaction of farmers
  - THUS, understanding the farm decision making allows ex-ante policy evaluation
  - Environmental benefits depend on farm-specific characteristics (spatial location, change in behaviour, etc.)

The IFM-CAP model (in a nutshell)

- A model of what?
  - Farmers' production decision, given a set of economic conditions (prices, policies…)
- How does it model the decision?
  - As an optimization problem: maximization of farm income
- Particularities of IFM-CAP?
  - Scales up the behavior of each 80,000 FADN farms of EU
  - 40 crop and 15 livestock activities
  - Easier to model farm-specific policy measures and adoption of practices

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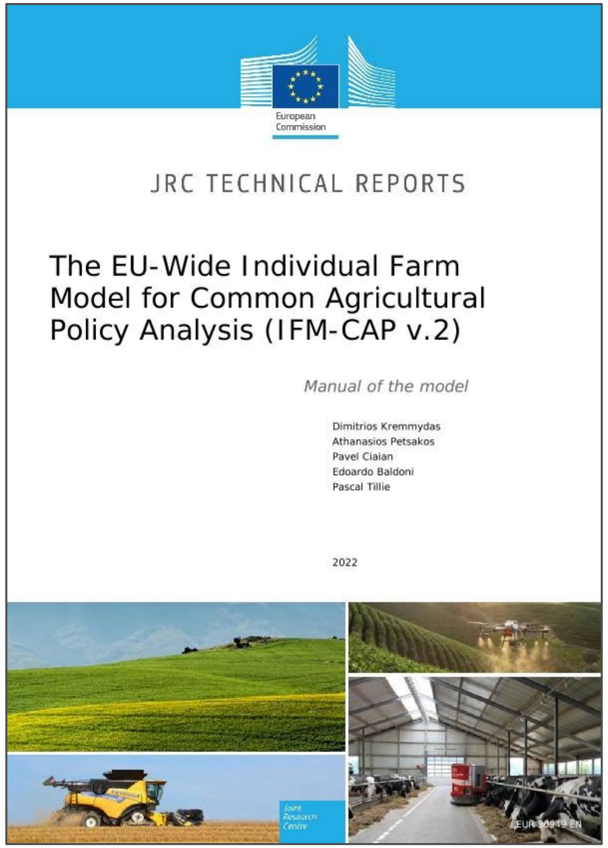
Modelling the behaviour of farmers using individual farm data with IFM-CAP

- IFM-CAP model: An economic model that simulates the decision making of the farmers
- Uses FADN data for 80,000 farms:
  - Yield and Prices for 40 crop and 15 livestock activities
  - Values of various inputs (PPP, Fertilizers, Water, Energy, Feed)
  - Subsidies data (CAP policy)
- Calibrates (reproduces) on a specific situation (baseyear) to construct a business as usual future (baseline) and compare with alternative situation (scenarios)



[Link to JRC report]

2. Examples of use of FADN for policy impact analysis

Modelling the new CAP Legal Proposal

- Objective: Provide DG AGRI with analysis for the impacts of the CAP reform
- Using FADN data and information about future CAP payments (Ecoschemes, Agro-Environmental Measures, CAP capping, convergence) to simulate evolution of production and income and of the adoption rate of eco-schemes
- Shortcomings: lack of EU-wide biophysical information that allow for more accurate environmental indicators

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SUBMITTED ARTICLE

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Farm-level impacts of the CAP post-2020 reform: A scenario-based analysis

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Abstract
We analyze the farm-level economic and environmental impacts of the post-2020 reform of the Common Agricultural Policy (CAP) of the European Union, examining six scenarios constructed around the budget allocated to eco-schemes and the stringency of enhanced conditionality. Results suggest that the CAP post-2020 can improve environmental performance but at a cost for farms. Enhanced conditionality appears to play a greater role than eco-schemes in delivering environmental improvements. The new CAP provides the Member States ample options to choose among different measures. The optimal policy mix will depend on the balancing of income support versus environmental performance that reflects policy priorities.

KEYWORDS
Common Agricultural Policy, eco-schemes, enhanced conditionality, farm model, IFM-CAP

JEL CLASSIFICATION
C61, Q12, Q18

The gradual transformation of price support mechanisms to farm income support (i.e., direct payments [DP]), conditional on respecting specific environmental standards, has been among the most important changes of the European Union's (EU) Common Agricultural Policy (CAP)

Link to article

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Modelling the impacts of the Organic Farming Target of the Farm To Fork

- Objective: Simulate the new target of 25% of Organic Farming in the EU as established by the Farm to Fork Strategy
- Using FADN time series to estimate yield gap, individual data on crop production to infer crop rotation and input use
- Shortcomings: Input costs in the farm level and not in the activity level, no details regarding Plant Protection Products

Modeling organic conversion in an EU-wide farm model

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Introduction

The Farm to Fork strategy (F2F) of the EU Green Deal has set a target of reaching 25% of the EU's agricultural areas under organic farming by 2030. Such a transition represents one of the major objectives of the F2F, aiming to contribute to multiple targets such as nutrient surplus reduction, pesticide risk reduction, increase of biodiversity. To date, only about 8% of the utilized agricultural area is under organic farming in the EU. Consequently, the 25% goal requires a significant number of farms to convert from conventional farming to organic practices.

Organic farming is significantly different from conventional farming, particularly regarding management practices and productivity (Alvarez, 2021; Baker et al., 2020; Reganold & Wachter, 2016; Watson C.A. et al., 2002). For this reason, the wide conversion of EU agricultural areas to organic farming may have a significant effect on the EU agricultural system in general and on the EU farming sector in particular (Meemken & Qaim, 2018; Reganold & Wachter, 2016; Seufert & Ramankutty, 2017; Timsina, 2018). Thus, it is necessary to appreciate the potential impacts of the F2F strategy in order to provide robust evidence-based scientific support to policy-making, given that the F2F targets are still being incorporated in the EU legislation. To this end, the contribution of this paper is to model organic farming conversion in order to assist on policy measures design and to account for the potential impacts of organic conversion.

Four main modeling approaches have been applied in the literature to simulate the impacts of conversion to organic farming: (i) spatially explicit agronomic/biophysical models, (ii) partial equilibrium agro-economic models, (iii) individual or representative agro-economic farm models, and (iv) non-traditional models. In the first approach, the interplay between nutrients inputs, spatially explicit biophysical characteristics, and outputs are explored to analyze the impacts of the conversion to organic production on the whole food system (Barbieri et al., 2019; Jones & Richard Crane, 2014; Lee et al., 2020; Muller et al., 2017). The second approach relies on partial equilibrium models, which capture the behavioral interactions of the agriculture sector at the regional or country-level (Barreiro Hurle et al., 2021; Bremmer et al., 2021). In the third approach, the scale is either the individual (Acs et al., 2007, 2009; Kerselaers et al., 2007) or representative farms (Smith et al., 2018), where the allocation of activities is usually modeled as a constrained optimization problem.[1] This approach,

[1] A 'representative farm' is a virtual farm aggregating several farms in contrast to an 'individual' farm where we use individual data. Possible confusion between the two terms may arise when an individual farm is part of a

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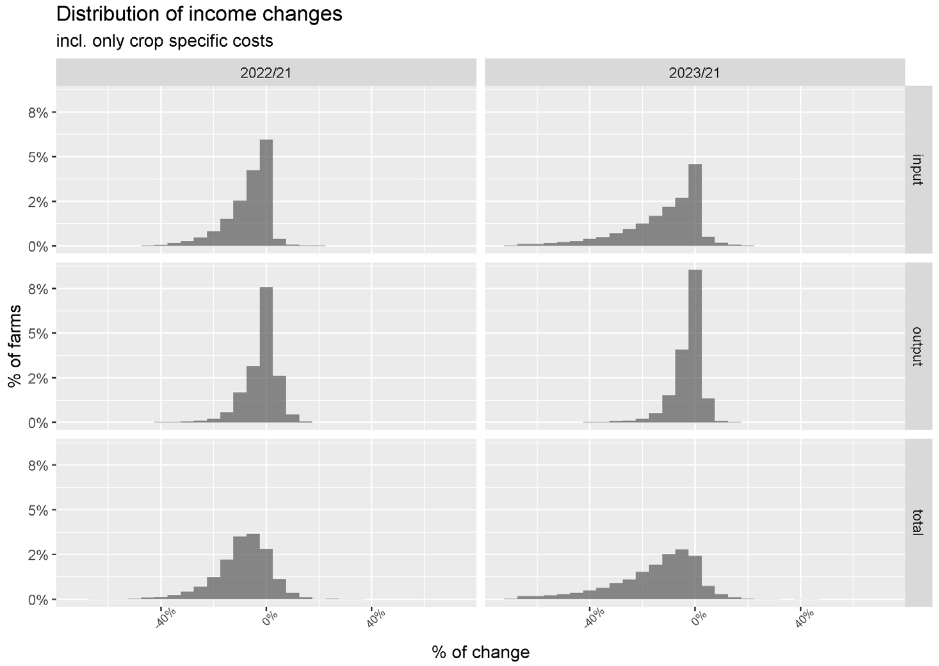
Modelling the impacts of the high prices of fertilizers

- Objective: Provide an overview of the impacts of the increase in fertilizer and energy prices on the income and production of EU farms

- Data used: Individual data for production, income, fertilizer use at farm level

- Limitation: no crop specific data on fertilizer use, no interactions between input quantity and yield

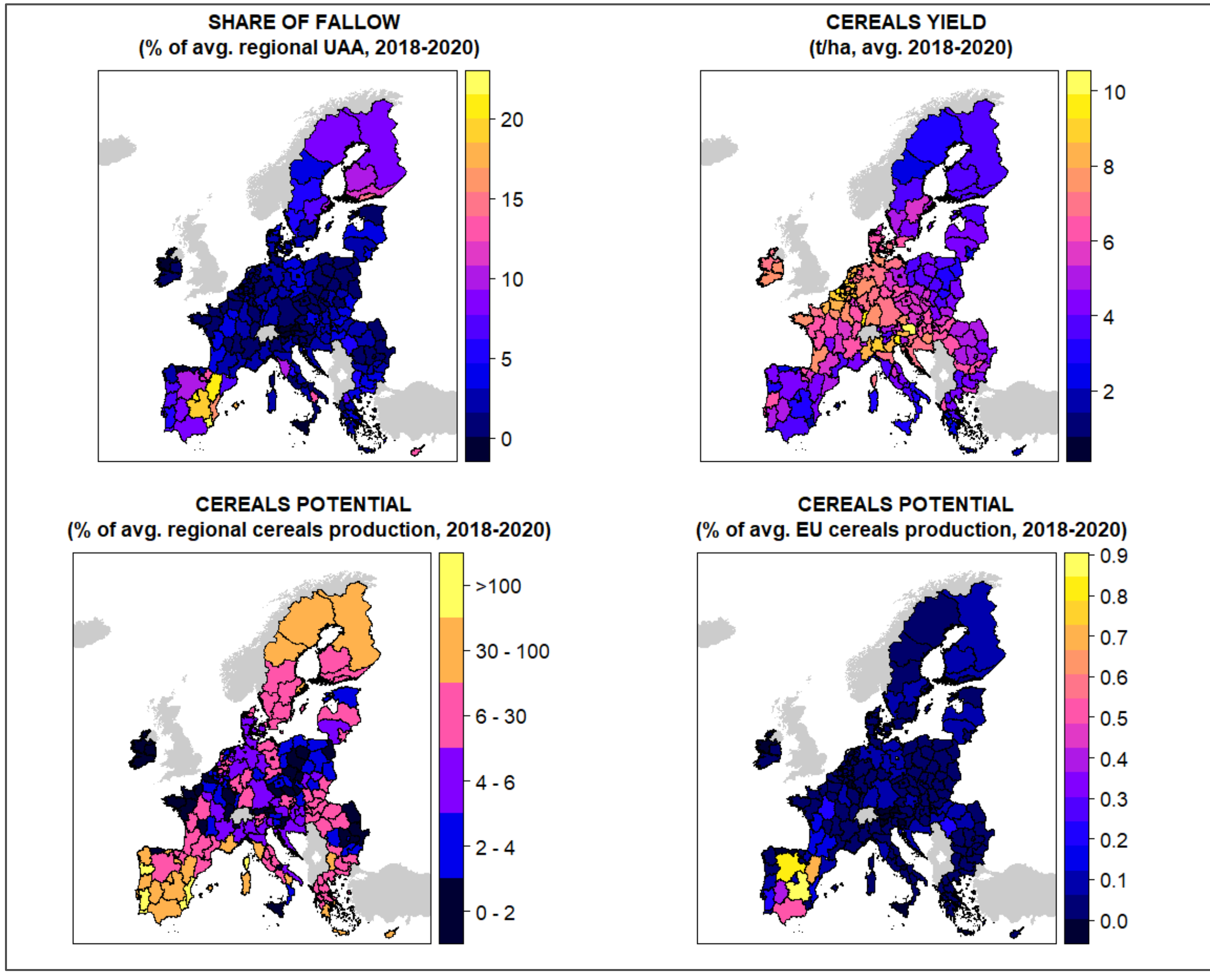


Impacts of relaxing the Ecological Focus Area restrictions

- Objective: Estimate the potential increase in production that could be obtained from a relaxing of the EFA restrictions in the context of the Russian Federation aggression in Ukraine

- Data used: Estimate of EFA areas per farm, Potential increase in specific crops (spring crops)

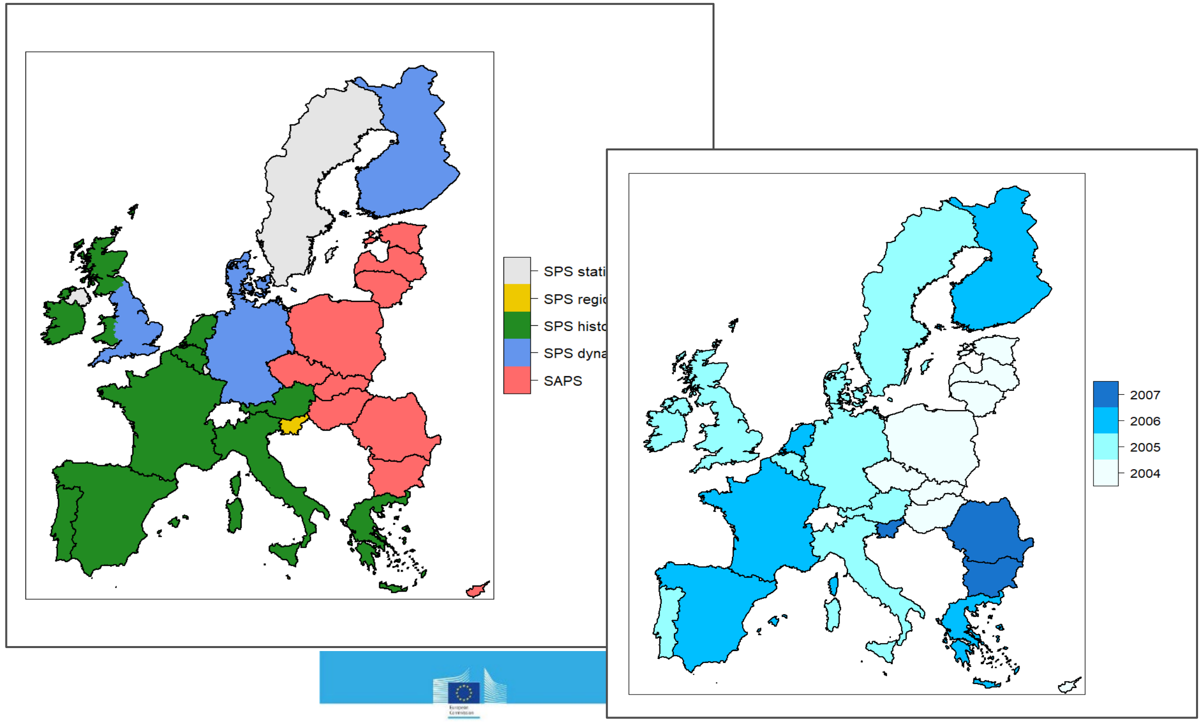
- Limitations: no distinction between winter and spring crops, definition of EFA in FADN data

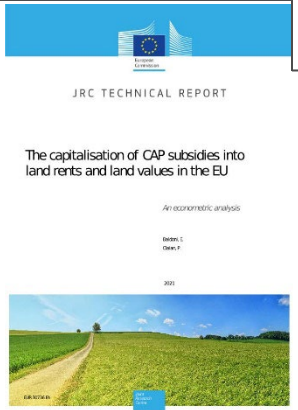


Impact of CAP subsidies on land prices

- Objective: estimate the impact of FADN subsidies on rental price of land and on land values
- Data used: FADN 1989-2016. Long time-series allows to estimate the impact of different types of subsidies (coupled, decoupled with implementation details, RDP) and land market dynamics
- Limitations: no specific information on land quality

Decoupled Payments implementation under the 2003 CAP reform (type and dates)




JRC TECHNICAL REPORT

The capitalisation of CAP subsidies into land rents and land values in the EU

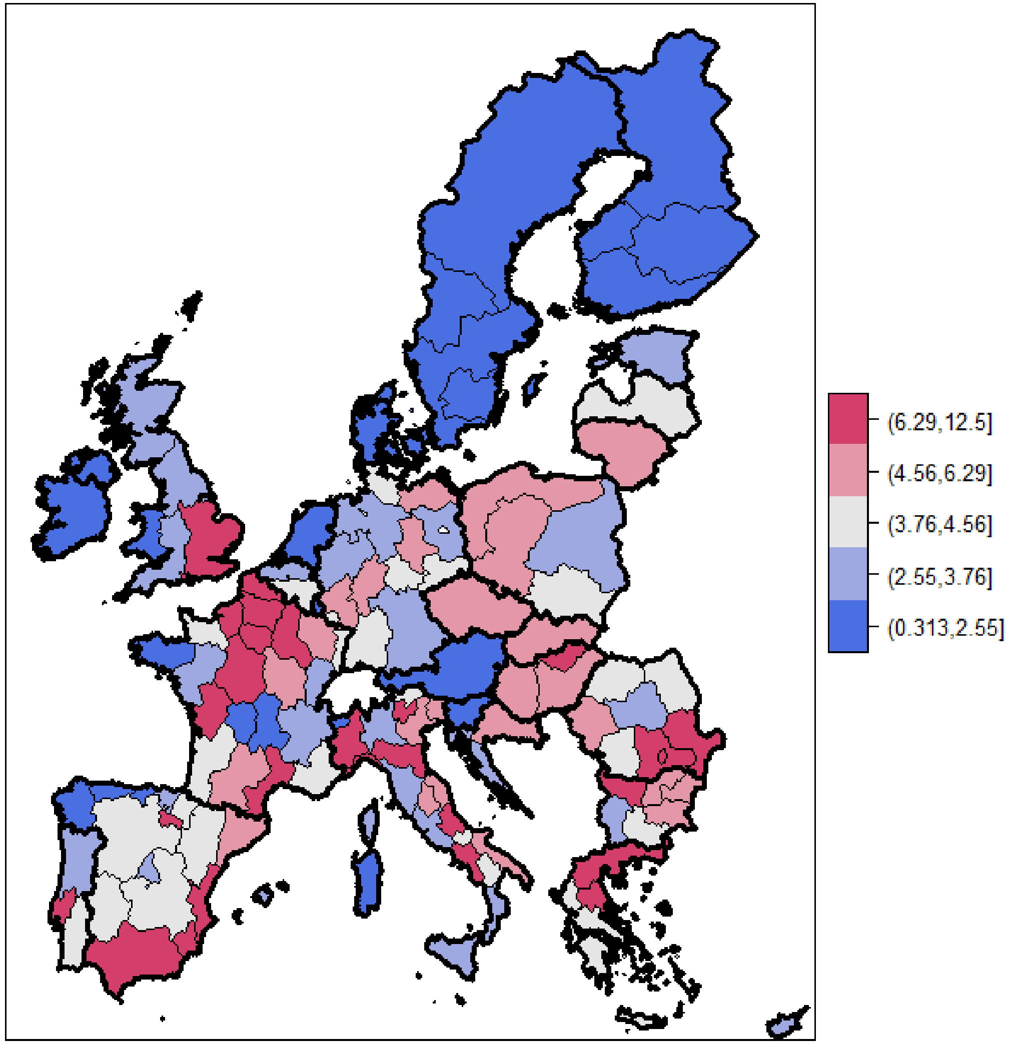
An econometric analysis

[Link to JRC report]()

Use of pesticide or Plant Protection Products by EU farmers

- Objective: Understand pattern of PPPs usage by EU farmers in the context of the Farm To Fork and target for reduction of risk and use
- Data used: total expenditure on crop protection, analysis at FADN region level
- Limitations: no specific data on chemical/non-chemical PPP, type of PPP, prices, quantity applied, active ingredients, risk level, number of applications, etc.

Share of crop protection costs in total costs (%)



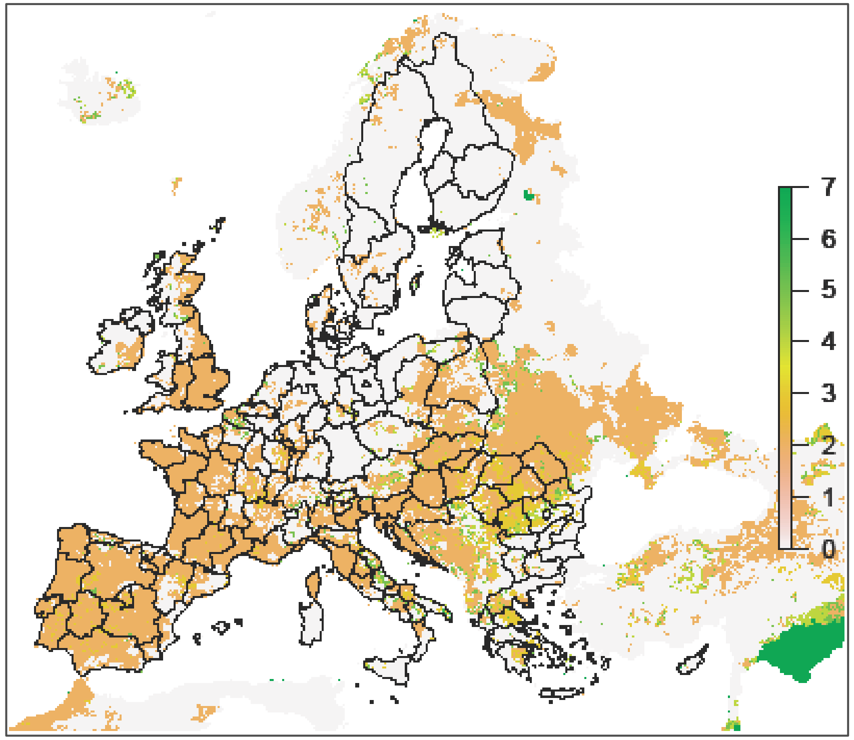
Yield impacts of drought in the EU

- Objective: Quantify the impact of drought on yields of major crops

- Data used: time-series of FADN regional data on yields, farm assets, input expenditure, irrigation and land use; Combined Drought Indicator from European Drought Observatory (EDO); JRC grids of spatial crop distribution; Copernicus weather data

- Limitations: cannot link spatially drought with crop production due to missing farm location; no reliable info on irrigation; no crop-level info on input use.

Combined Drought Indicator



Code	CDI Level	Description
0	No drought	Normal conditions
1	Watch	Precipitation deficit
2	Warning	Negative soil moisture anomaly, usually linked with precipitation deficit
3	Alert	Negative anomaly of vegetation growth, usually linked with precipitation deficit and negative soil moisture anomaly
…	…	…

3. Possibilities offered by detailed data

Estimating the cost of externalities using Italian and Dutch individual farm data

- Objective: estimate the farm-level cost of reducing Greenhouse Gazes (GHG) emissions and nutrient surplus
- Data used: Dutch and Italian FADN data from national agencies
- Specificities:
  - ❑ NL: livestock feeding strategy (e.g. type and quantity of feed concentrate, grasses) to estimate farm-level GHG emissions, fuel quantities
  - ❑ IT: average weight of animals, manure reuses, urea quantities, fuel expenditure/quantity

Estimating environmental impacts of EU farms

- Objective: Estimate the **farm N surplus** (N inputs – N outputs) and **GHG emissions** (livestock and manure management, managed soils, enteric fermentation) from EU farms
- Data used: FADN and IFM-CAP outputs, secondary data (CAPRI, NIR, IPCC)
- Limitations: Due to lack of data, assumptions needed to be made:
  - Quantities of manure/fertilizer purchased
  - Actual fertilizer/manure application
  - Actual feed intake (type, quantity)
  - Manure quantity and management
  - …

Modelling the biophysical and economic interactions at farm-level

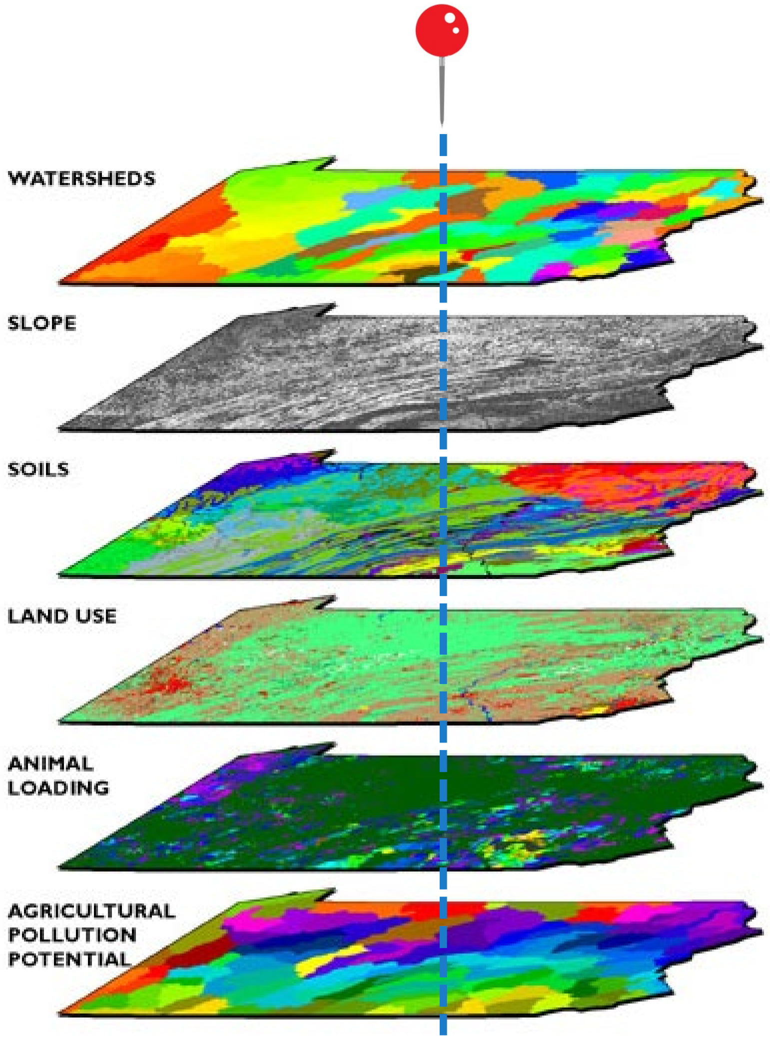
- Objective: better represent the interactions between soil, farming practices (including input use) and yield, in order to generate more meaningful environmental indicators (GHG emissions, soil erosion, biodiversity) and develop scenarios for Climate Change
- Data required: input (Fertilizers, PPP, manure) use at crop or plot level, soil quality, water use (quantity and cost) and irrigation on the farm

Environmental and climate farming practices

- JRC and DG AGRI are managing a targeted literature review on more than 30 farming practices (FP) based on meta analysis
- Meta analysis are scientific papers collecting results from many individual papers: possibility to have a non-biased review and extract quantified coefficients on FP impacts
- Results:
  - included in a dedicated website
  - Used to feed models, label FP in CAP monitoring dashboards, background for variables in FSDN

Using location of farms to retrieve additional information

- Modelling the impact of farming practices requires bio-physical data
  - Soil type or quality, slope, SOM content, biodiversity, landscape features,…
- Linking with environmental data for contextual output indicators
  - Water pollution risk
  - PPP risk and health issues
  - Biodiversity and species richness



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Analysing the social sustainability of EU Food System

- Objective: indicators on the composition and characteristics of the farm's workforce will allow conducting analyses on social sustainability
- Data required: level of agricultural training, age, gender, country of origin
- Examples based on MS-specific FADN data:
    - ❑ (Baldoni, Coderoni, Esposti, 2021) Relation between agricultural productivity and presence and composition of immigrant workforce
    - ❑ (Antonioli, Severini, Vigani, 2023) Labour cost differentials between national and foreign workers in dairy farms

Thank you

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