

An aerial photograph of a brown, tilled agricultural field. A diagonal line of green trees and shrubs runs across the middle of the frame. The field is marked with numerous small, light-colored rectangular flags or markers.

Data for the evaluation of effects on emissions

DIMITRIS SKURAS (HELPDESK EXPERT)

Emissions from agriculture

FADN provides a suitable sample and information source for:

- Estimating farm level GHG emissions and,
- Evaluating impacts of rural programmes and policies

Contents:

- ❖ A quick reminder of I.07
- ❖ Where the FADN sample fits in the assessment exercise
- ❖ Use FADN returns to estimate emissions
- ❖ Face the challenges and overcome the barriers
- ❖ Data related recommendations for the ex-post
- ❖ Recommendations for the CAP post 2020
- ❖ Appendix – Case Studies from European Union countries

Impact Indicator I.07

Emissions from agriculture – National Data: Databases

I.07. Emissions from agriculture ([CAP Context Indicator 45](#))

- 1) GHG emissions from agriculture including agricultural soils
- 2) Ammonia emissions from agriculture

Main Databases:

GHG Emissions: [European Environment Agency \(EEA\)](#)

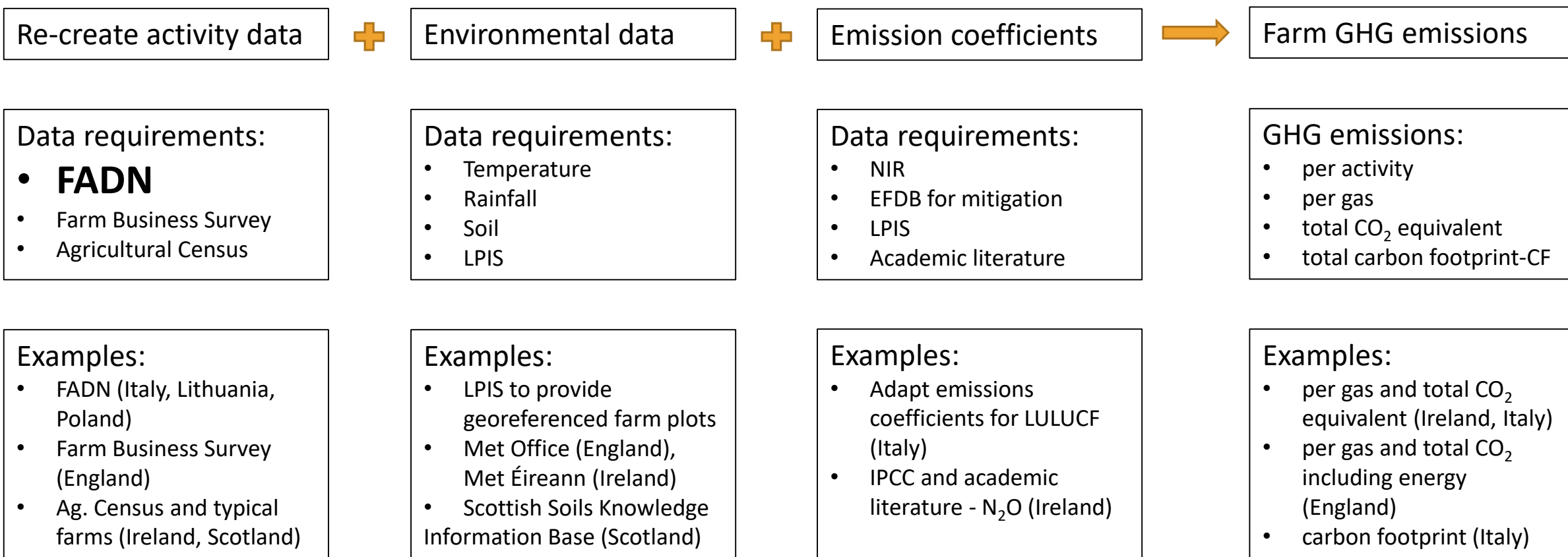
Ammonia emissions: [European Environment Agency \(EEA\)](#)

Other data sources:

UNFCCC, Eurostat, Eionet, Convention on Long Range Transboundary Air Pollution

Evaluating RDP and Ag. Policy Impacts

Data requirements of evaluation strategies at farm level



Evaluate GHG emissions using FADN Data: The Basic Idea

The FADN Farm Return



Activity Data - FADN

Table J – Livestock
Activity Data Example:
SE 125D – Dairy Cows



Table H – Inputs
Activity Data Example:
SE 296 – Fertiliser N



Table I – Crops
Activity Data Example:
SE 110D – Wheat



Implied Emission Factor

160.59 Kg CH₄/head/year
26.49 Kg CH₄/head/year
0.62 Kg N₂O/head/year

0.01 Kg N₂O-N/Kg N

0.01 Kg N₂O-N/Kg N

NIR and IPCC 2006

GHG Emission

CH₄ enteric fermentation
CH₄ manure management
N₂O manure management

N₂O agricultural soils –
Inorganic N fertilisers

N₂O agricultural soils –
Crop residues returned

FADN **Is Not** an environmental database

Challenges using FADN

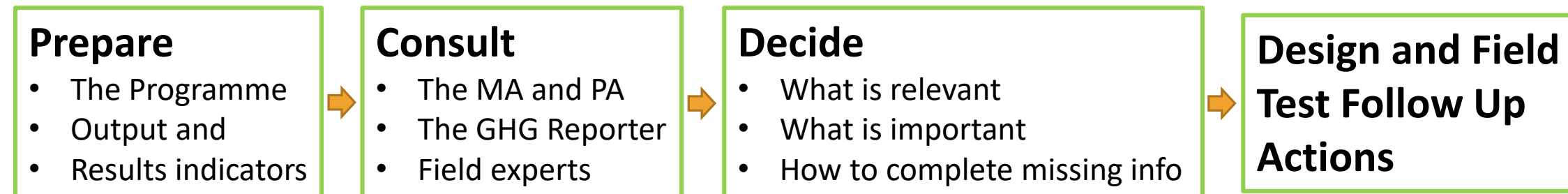
Management practices are not reported by FADN returns:

Example: Manure management practices, manure spreading, winter/cover crops, etc.

Activity data may be missing:

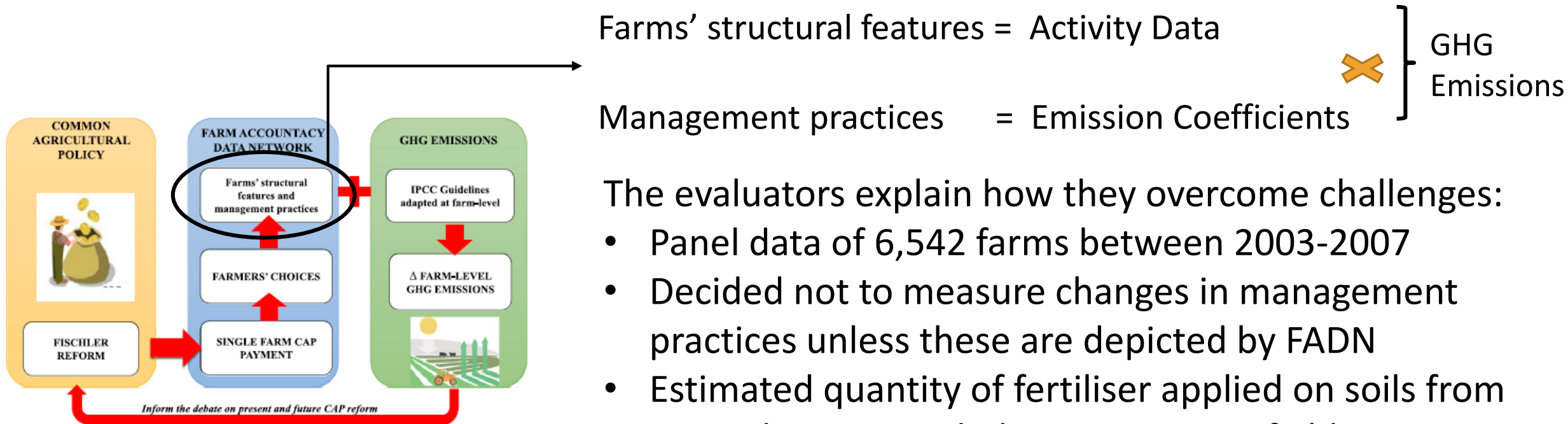
Example: Usually quantities of fertilizers or of other soil improvers are not recorded (but expenditure for these substances is recorded)

What to do:



Facing challenges using FADN: Example

Silvia Coderoni and Roberto Esposti: CAP payments and agricultural GHG emissions in Italy, 2018.



The evaluators explain how they overcome challenges:

- Panel data of 6,542 farms between 2003-2007
- Decided not to measure changes in management practices unless these are depicted by FADN
- Estimated quantity of fertiliser applied on soils from expenditure recorded on FADN using field experts, an external database and extensive consultation
- They did not estimate any LULUCF tables

Data and Database related recommendations for the ex-post

1. Does the evaluation focus only on I.07 or on a number of environmental indicators (water, soil, biodiversity)
2. Establish contact with your national reporters for GHG and ammonia
3. Decide if the core farm database will be a panel or a cross-section
4. Make heavy use of IACS
5. Will you use a GHG calculator to convert activity data to GHG emissions?
6. Which external databases do you need to link to the core database

Recommendations for setting up the data management system for the CAP post-2020

1. The future sounds “integrated” and “sustainable”
2. This points out to “holistic” evaluations instead of piecemeal assessments fragmented by the type of impact or by the resource base (water, soil, biodiversity)
3. Evaluations will target the environmental sustainability of the farm
4. Think that you may have to link environmental evaluations to ecosystem services and ecosystem accounts

For “farm level” evaluations:

Design open systems that will be able to connect and integrate various environmental databases and parameters

The major challenge is to make use of national and EU environmental data infrastructure (e.g., LUCAS, ESDAC, Farm Birds, Waterbases) that is generated outside the conventional statistical system

Thank you

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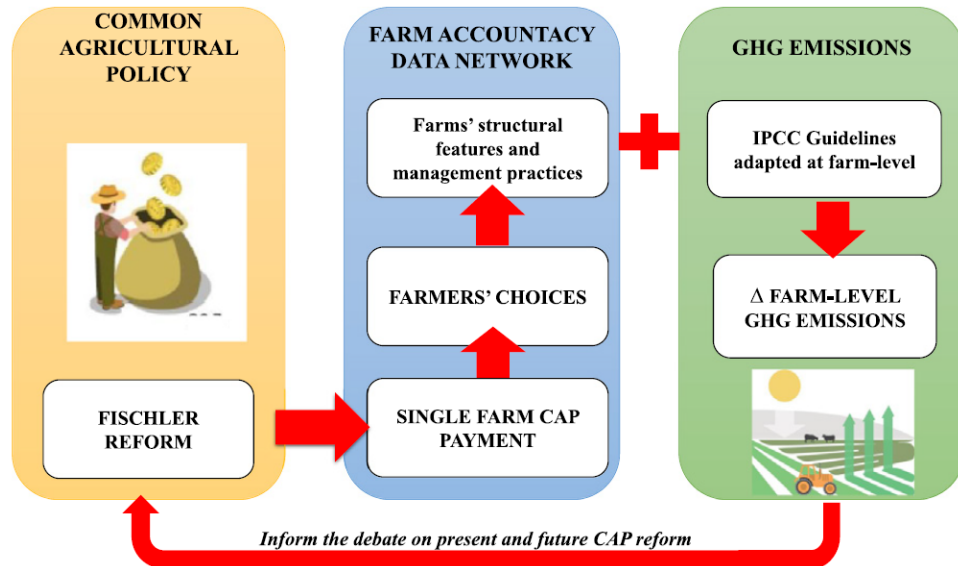
Download the presentation
notes [here](#)



Appendix – Case Studies

Case Study 1: Italy

Using FADN data to evaluate the effects of CAP payments including RDP on GHG emissions



The evaluation logic

Table 1
Likely impact of FR CAP instruments on GHG emissions.

Measures	Actions	Expected impact on GHG mitigation
Decoupling	Reduced incentives for intensive production (less fertilizer use, extensification); Farmers more careful to market signals	+++
Modulation	Structural measures More resources for rural development (agri-environmental measures, training, etc.)	+ / +++ +
Cross-compliance	Soil erosion reduction Better management of soil organic carbon	+ +
Set aside*	Reduction of fertilizers use Potential carbon sequestration improvement	+ / +++ + / +++
Energy crops	Potential fossil fuel replacement, but higher emissions from land conversion	?
Agri-environment	F1-Low environmental impact F2-Organic Farming H-Afforestation-costs of planting H-Afforestation-maintenance H-Afforestation-loss of revenue I1-Afforestation non-agricultural areas E-Less Favourite Areas (IFA) I6-Reforestation for natural disturbances	+++ ++ +++ +++ +++ +++ + +++

* until 2008.

Table 2

Summary of GHG emission sources considered for each CF category and the respective FADN activity data used.

CF category	Emission sources	FADN data
CF Livestock	N ₂ O manure management	Animal numbers
	CH ₄ manure management	Animal numbers
CF Cultivation	CH ₄ enteric fermentation	Animal numbers
	CH ₄ rice cultivation	Rice area (UAA)
	N ₂ O Biological N fixation	N-fixing crop area
	N ₂ O Crop residues	Crop area (UAA) or crop yield
CF Fertilizer	N ₂ O Atmospheric deposition	Animal numbers
	N ₂ O Leaching and run-off	Animal numbers
	N ₂ O Use of synthetic fertilizers	Fertilizers expenditure
CF Fuel	N ₂ O Atmospheric deposition	Fertilizers expenditure
CF Land use A and B	CO ₂ Energy	Fuel expenditure
	CO ₂ Forest land	UAA
	CO ₂ Cropland	UAA
	CO ₂ Grasslands	UAA

Objective: Evaluate the effects of the Fischler CAP reform on GHG emissions.

Database: A balanced panel of 6,542 Italian Farm Accountancy Data Network observed over years the 2003–2007.

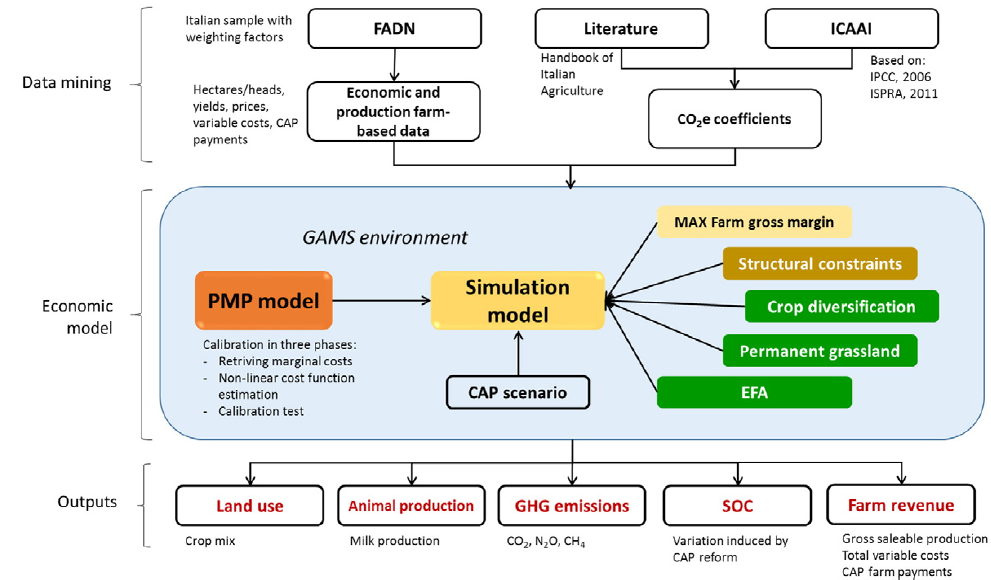
Evaluated measures: Pillar and I (decoupling, modulation), Pillar II (Set aside, agri-environment) and Conditionality measures (table 1 above)

Evaluated emissions and sectors: CH₄, N₂O, CO₂ see table 2 above for sectors

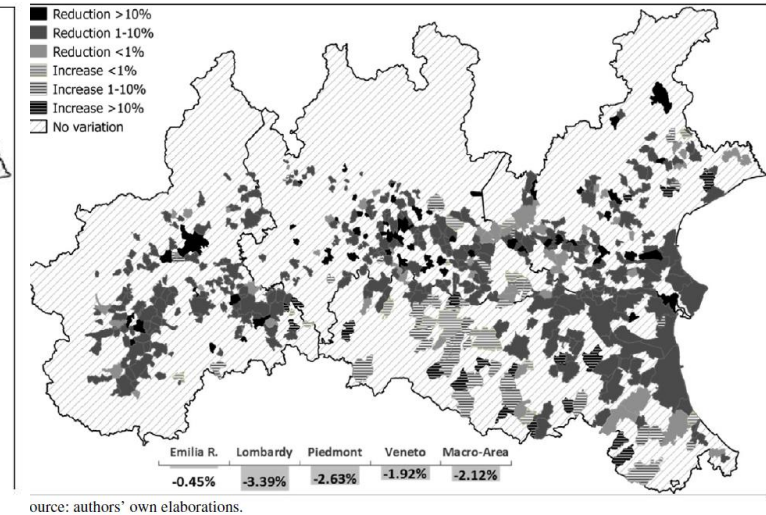
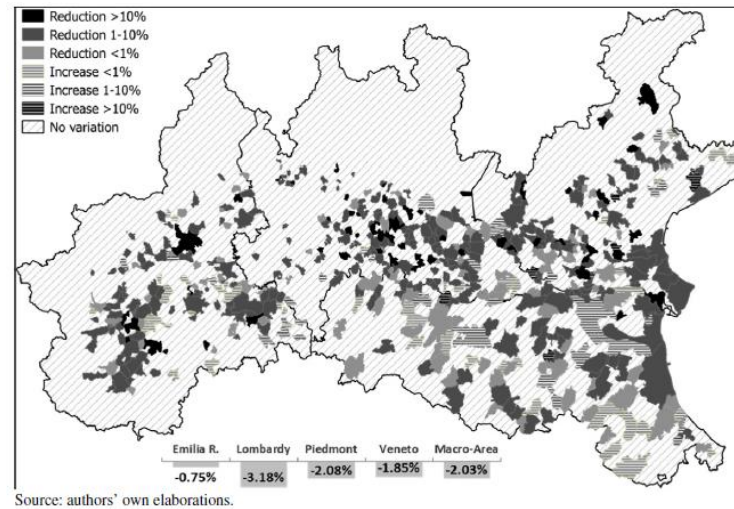
Information: [Coderoni, S. and Esposti, R. 2015](#); [Coderoni, S. and Esposti, R. 2018](#); [Coderoni, S. and Bonati, G. 2013](#); [Coderoni, S., Valli, L. and Canavari, M. 2015](#)

Case Study 2: Italy

Using FADN data to evaluate the effects of greening on GHGs



The evaluation logic



Impacts of greening on CO₂ (left) and N₂O (right)

Objective: Evaluate the potential benefits from greening in terms of GHG emissions in four regions of Northern Italy.

Database: A cross section of more than 3,000 farms from Emilia-Romagna, Piedmont, Lombardy and Veneto of the 2012 Italian FADN sample.

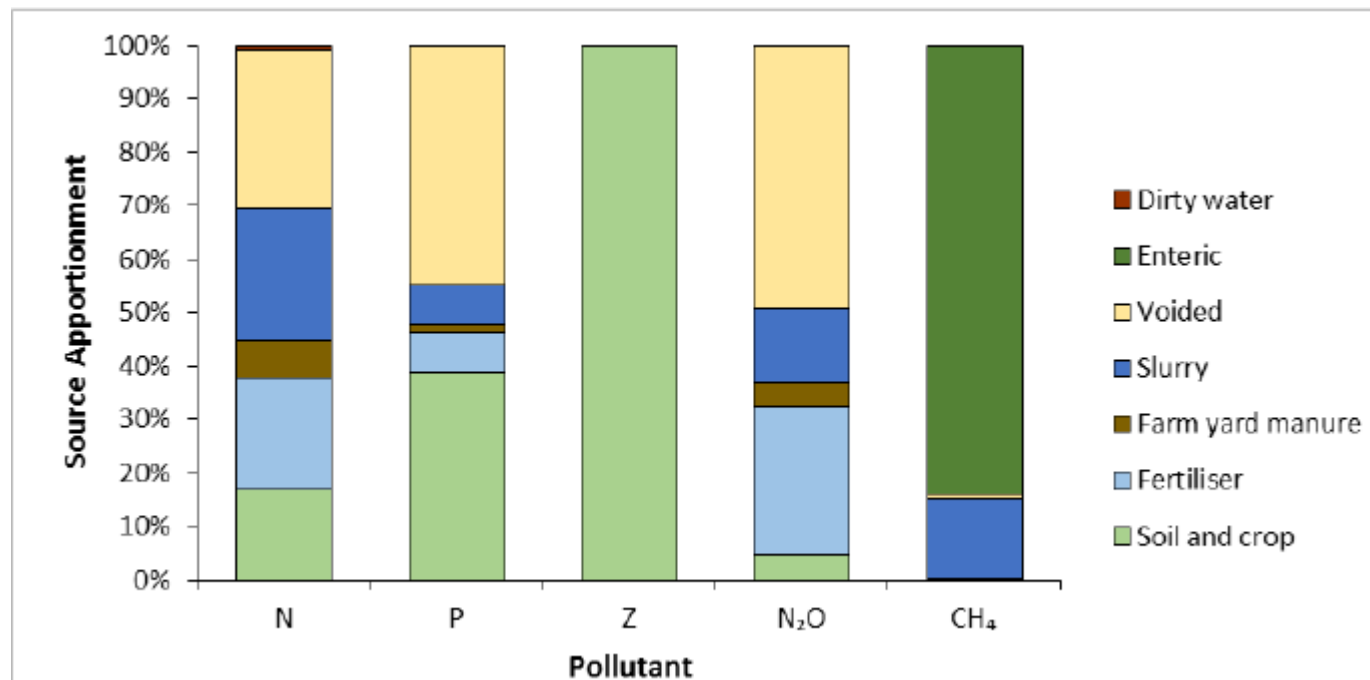
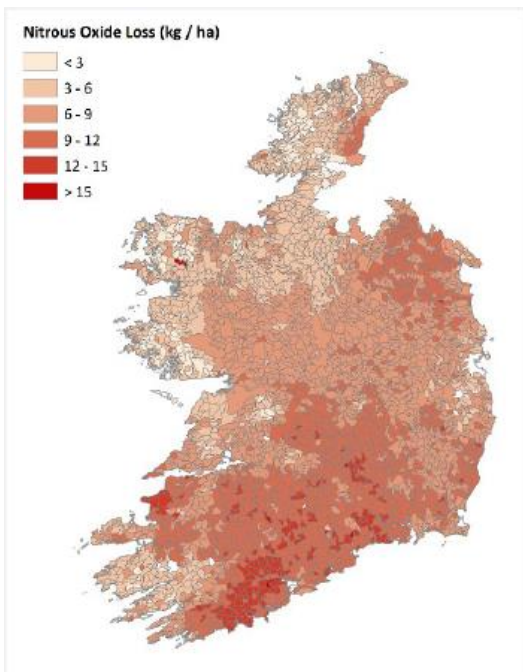
Evaluated measures: Greening proposals of the Commission (crop diversification, permanent grassland, EFA, Entitled IPSO Fatto)

Evaluated emissions and sectors: CH₄, N₂O, CO₂ and SOC

Information: [Solazzo, R., Donati, M., Tomasi, L. and Arfini, F. 2016](#)

Case Study 3: Ireland

The Green Low Carbon Agri-Environment Scheme (GLAS)



Objective: Evaluate the effects of GLAS on a series of environmental indicators including GHG emissions.

Database: Agricultural Census data at holding level for 2015 to determine cropping / livestock within catchments and use it with export coefficients.

Evaluated measures: All GLAS Measures

Evaluated emissions and sectors: Greenhouse gas (methane, nitrous oxide) and ammonia emissions

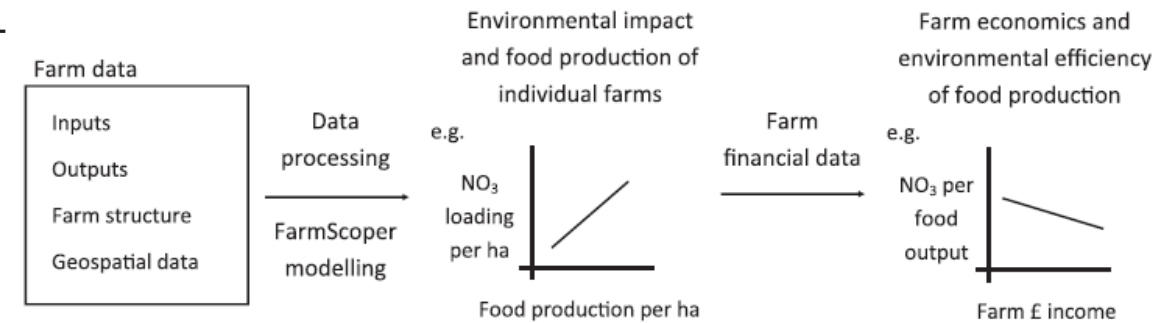
Information: [Gooday, R. 2018](#); [Baseline Analysis of Actions under GLAS: Full Report](#); [Model Evaluation of GLAS](#);

Case Study 4: England

The use of Farm Business Survey data for estimating on farm GHG emissions

Table 1
Summary of FBS derived data for input into the Farmscoper tool.

Input data	Units	Source	Notes/conversion
Farm structure			
Main farm type	n/a	Direct extraction	Defined as enterprise groups (e.g. cereals) accounting for >2/3 total Standard Output
Utilised agricultural area	Ha	Direct extraction	Total area excluding land, roads and buildings
Land use	Ha	Direct extraction	Individual main crop, fodder crop, grass and grazing areas
Livestock counts	No.	Direct extraction	
Crop production			
Total production of major crop product	T	Main crops: direct extraction Fodder crops: typical yields	Typical fodder crops yields per hectare (SAC Consulting, 2012)
Straw production	T	Direct extraction	
Livestock and dairy production			
Livestock sales	No.	Direct extraction	
Milk Production	Litres	Direct extraction	Separated into milk and milk products (litres milk equivalent)
Inputs/resource use			
Fertiliser inputs	Kg N Kg P Kg K	Direct extraction and/or Conversion from expenditure	Where fertiliser input data available, extracted directly. Where not available, expenditure used to estimate inputs (see text)
Electricity	kWh	Conversion from expenditure	Assumes rate of £0.0069/kWh (SAC Consulting, 2012)
Machinery and vehicle fuels	Litres	Conversion from expenditure	Assumes all red diesel, at a cost of £0.63l (SAC Consulting, 2012)
Heating fuels	Litres	Conversion from expenditure	Assumes all kerosene, at a cost of £0.53l (SAC Consulting, 2012)
Water use	m ³	Conversion from expenditure	Rate of £0.95/m ³ (AHDB, 2011)
External geo-referenced data			
Long-term annual precipitation	mm	Geo-referenced extraction	Correlated farm location with Met Office UKCP09 observed climate data (UKCP09, 2015)
Dominant soil type	n/a	Geo-referenced extraction	Correlated farm location with British Geological Survey Soil Parent Material Model (British Geological Survey, 2011).



Estimation logic (above) and correspondence between the FBS variables and emissions extraction (left).

Objective: To demonstrate how the FBS (an enhanced FADN for England) can be used to extract emissions data at the farm level.

Database: Data were extracted from the FBS for a sample of East Anglian cereal farms and southwestern dairy farms.

Evaluated measures: No particular measures are evaluated

Evaluated emissions and sectors: Farm-level estimates of greenhouse gas emissions were generated using the Farmscoper mode

Information: [Lynch, J., Skirvin, D., Wilson, P. and Ramsden, S. 2018.](#)

Case Study 5: Lithuania

A Comparative Analysis of On-farm Greenhouse Gas Emissions from Family Farms In Lithuania

GHG emission sources accounted in the paper

Emission sources	FADN activity data	Source in IPCC, 2006
N ₂ O manure management	Animal numbers	Equation 10.25, 10.26, Annex 10A.2, Tables 10A-4 to 10A-8
CH ₄ manure management	Animal numbers	Equation 10.22
CH ₄ enteric fermentation	Animal numbers	Equation 10.19, 10.20
N ₂ O agricultural soils		
<i>Direct emissions</i>		
Use of synthetic fertilizers	N fertilizers	Equation 11.11, Table 11.1
<i>Indirect emissions</i>		
Atmospheric deposition	N fertilizers, animal numbers	Equation 11.9, Table 11.3
Leaching and run-off	N fertilizers, animal numbers	Equation 11.10, Table 11.3

Objective: Comparative analysis of on-farm greenhouse gas emissions across family farm types and farm size classes using FADN data in Lithuania.

Database: A sample of 1,304 family farms from the 2014 FADN database

Evaluated measures: Adaptation of the IPCC guidelines using Lithuanian emission factors from Lithuania's NIR and activity data from Lithuanian FADN

Evaluated emissions and sectors: CH₄, N₂O, CO₂ and CO₂ equivalent

Information: [Dabkienė, 2017](#)

Case Study 6: Poland

Assessing Greenhouse Gas Emissions from Conventional Farms Based on the Farm Accountancy Data Network

Table 2. Summary of GHG emission sources considered and the respective FADN data applied.

Emission source	Emission category	FADN data
N ₂ O manure management	Animal production	Animal numbers
CH ₄ manure management	Animal production	Animal numbers
CH ₄ Enteric fermentation	Animal production	Animal numbers
N ₂ O agricultural soil		
N ₂ O direct emissions		
Use of N mineral fertilizers	Fertilizers	N quantities
Use of N organic fertilizers	Fertilizers	Animal numbers
Crop residues	Crop production	Crop area (UAA) and crop yield
Urine and dung depositing by grazing animals	Crop production	Animal numbers
N ₂ O indirect emissions		
Atmospheric deposition	Fertilizers	N quantities / Animal numbers
Leaching and run-off	Fertilizers	N quantities / Animal numbers / area and crop yield
CO ₂ Urea	Fertilizers	Urea quantities
CO ₂ Energy	Fuel	Fuel quantities

Source: Our own elaboration based on Coderoni et al. 2013

Table 3. Economic and environmental farm level data for different farm types; standard deviations are shown in brackets.

Variable	Unit	Total	Field crops	Perm. crops	Fruits	Dairy	Grazing livestock	Pigs	Poultry	Mixed crops and livestock
<i>Economic data</i>										
Farm represented		688,967	136,104	28,353	30,644	93,350	30,013	25,814	4,769	339,922
Sample farms		11,701	3,185	348	402	2,703	428	768	73	3,794
Economic size	Euro	47,557	43,330	72,318	25,369	49,881	32,827	100,578	216,776	37,204
Total utilized agricultural area	ha	36	55	7	14	32	31	33	23	29
Total livestock unit (LU)	LU	28	3	1	0	41	31	108	200	25
Total output	PLN	235,075	241,512	379,157	181,707	234,824	119,276	440,615	1,689,403	165,764
<i>Emissions data</i>										
GHG farm	Mg CO ₂ eq.	96.47 (113.8)	65.4 (80.4)	14.0 (19.2)	12.6 (14.2)	184.9 (144.2)	108.2 (119.6)	111.4 (121.9)	93.9 (87.9)	71.3 (80.0)
Emission intensity	g CO ₂ eq. PLN ⁻¹	410 (300)	270 (270)	40 (20)	70 (70)	790 (590)	910 (830)	250 (170)	60 (60)	430 (420)
Emission intensity per ha	Mg CO ₂ eq. ha ⁻¹	2.7 (2.7)	1.2 (1.3)	2.1 (1.9)	0.9 (1.3)	5.7 (6.4)	3.5 (3.3)	3.3 (3.3)	4.1 (2.8)	2.5 (2.9)
Emission intensity per LU	Mg CO ₂ eq. LU ⁻¹	3.5 (2.11)	2.2 (9.5)	24.3 (7.9)	-	4.5 (4.6)	3.5 (3.9)	1.0 (9.1)	0.5 (0.4)	2.8 (2.9)

Source: own calculation based on FADN data

Objective: Assess how the FADN can be used to estimate GHG emission

Database: A cross section of 11,701 farms from the Polish Farm Accountancy Data Network observed over years 2003–2007.

Evaluated measures: No specific measures evaluated

Evaluated emissions and sectors: CO₂ equivalents

Information: [Syp, A. and Osuch, D. 2018.](#)

Impact Indicator I.07

Going regional

Locating or deriving regional values for I.07 is not easy.

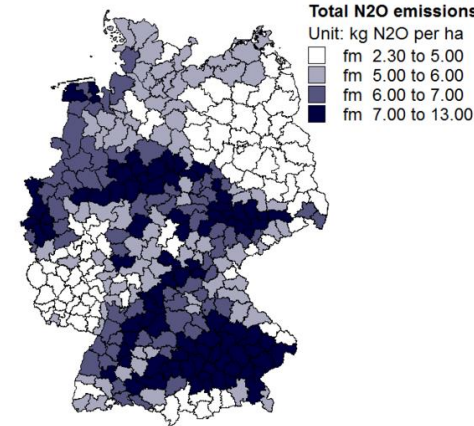
Certain tables can be regionalised, e.g. emissions from enteric fermentation or manure management, because activity data and coefficients are regionally available.

Certain tables, e.g., emissions from agricultural soils, require data such as the use of inorganic and organic fertilisers that usually do not exist at regional level.

Certain MSs produce their own regional estimates of GHG or ammonia emissions (box 1).

The JRC has used European wide estimates of GHG emissions based on simulations based on the CAPRI model for 2016 (box 2).

Box 1. Projected regional estimates of N₂O emissions in



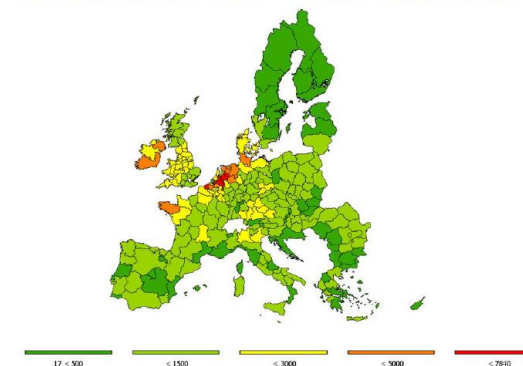
Projected direct and indirect nitrous oxide emissions from agricultural land use in 2020 by integrated modeling (© Thünen-Institut/René Dechow)

Statistical approaches are developed which are trained on data sets of measured GHG emissions and related anthropogenic and natural factors. These models are used to regionalize GHG emissions and mitigation potentials from land use in Germany.

More Information: [Thünen Institute](#)

Box 2. Environmental Impacts of CAP Greening – European Union

Figure 1: GHG emissions in reference scenario (kg CO₂ equivalent/total ha)



Among others, GHG emissions per total area, measured by the global warming potential of agriculture (GWPA) in kg of CO₂ equivalent, are estimated for the reference scenario, i.e. a baseline development of the agricultural sector as a counterfactual to greening scenarios.

More Information: [JRC](#)