The Evolution of Agricultural GHG Emissions in Italy and the Role of the CAP. A Farm-level Assessment.

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Outline of the presentation

- Policy framework
- Research question
- GHG emission reconstruction at farm level
- The FADN sample
- Some (preliminary) results

Policy contest

- The European 2050 Strategy to combat climate change and the role of agricultural GHG emission (-42/49% of agri GHG emissions)
  - Effort Sharing Decision n. 426/2009/UE
  - LULUCF-Land Use Land Use Change and Forestry accounting framework. Dec. n.529/2013/UE (i.e. accounting for cropland and grasslands management)
- Common Agricultural Policy: climate change challenge both in pillar I and II
  - Pillar I and the role of the greening
  - Pillar II e.g. climate as objective of RDPs, agri-climate-environment, etc.

Research question

Agricultural GHG emission in Italy (and in Europe) have declined from 1990 to 2012 (EEA, 2014)

→ **Do we observe a decline at the farm level? Where and Why?**

- Define a methodology for the reconstruction of agricultural GHG emissions (i.e. Carbon Footprint-CF) at farm level and of its evolution over time.
- Interpretations of the differences observed across farm typologies and territories and, above all, of the farm-level CF evolution over time with specific reference to the possible role of the CAP:
  - the 2003 Reform of its First Pillar
  - those Second Pillar's measures targeted to activities and practices that have a direct impact on the CF

GHG emissions at farm level

- **What:** emissions on which the farmer has a direct control/makes choices (no Supply Chain/Life Cycle Assessment)
- **How:** using Intergovernmental Panel on Climate Change (1997, 2000, 2006) methodolody adapted at farm level (Coderoni *et al.*, 2013), FADN activity data & ISPRA/IPCC default emission factors

→ **one synthetic farm-level emission measure: the farm CF**

IPCC CATEGORY	SOURCE	GHG
4A	Enteric Fermentation	CH_4
4B	Manure Management	N_2O, CH_4
4C	Rice	CH_4
4D	Agricultural Soils	N_2O, CH_4
1A	Energy	CO_2
5A	Forest land	CO_2
5B	Cropland	CO_2
5C	Grassland	CO_2

5 Carbon Footprints categories

GHG emission sources and the respective FADN activity data

Emission sources	CF category	FADN data
N_2O manure management	**CF livestock**	Animal numbers
CH_4 manure management	**CF livestock**	Animal numbers
CH_4 enteric fermentation	**CF livestock**	Animal numbers
CH_4 rice crops	**CF crops**	Rice area (UAA)
N_2O agricultural soils	Various	
Direct emissions		
Use of synthetic fertilisers	**CF fertilizer**	Fertilisers expenditure
Biological N fixation	**CF crops**	N-fixing crop area
Crop residues	**CF crops**	Crop area (UAA)
Indirect emissions[1]		
Atmospheric deposition	**CF fertilizer/ CF crops**	Fertil. expe . & animal numbers
Leaching and run-off	**CF fertilizer/ CF crops**	Fertil. expe . & animal numbers
CO_2 Energy	**CF Fuel**	Fuel expenditure
CO_2 Forest land	**CF Land use**	UAA
CO_2 Cropland	**CF Land use**	UAA
CO_2 Grasslands	**CF Land use**	UAA

The FADN sample

We need a constant sample of farms yearly observed over the pre and post-2005 period: balanced panel extracted from the FADN-Farm Accountancy Data Network (RICA) database:

5,036 farms observed over years 2003-2007 with all the needed information to compute the respective CF

Note: FADN excludes a significant (in terms of numerosity) amount of Italian small farms: does this matter for the assessment of CF evolution over time?

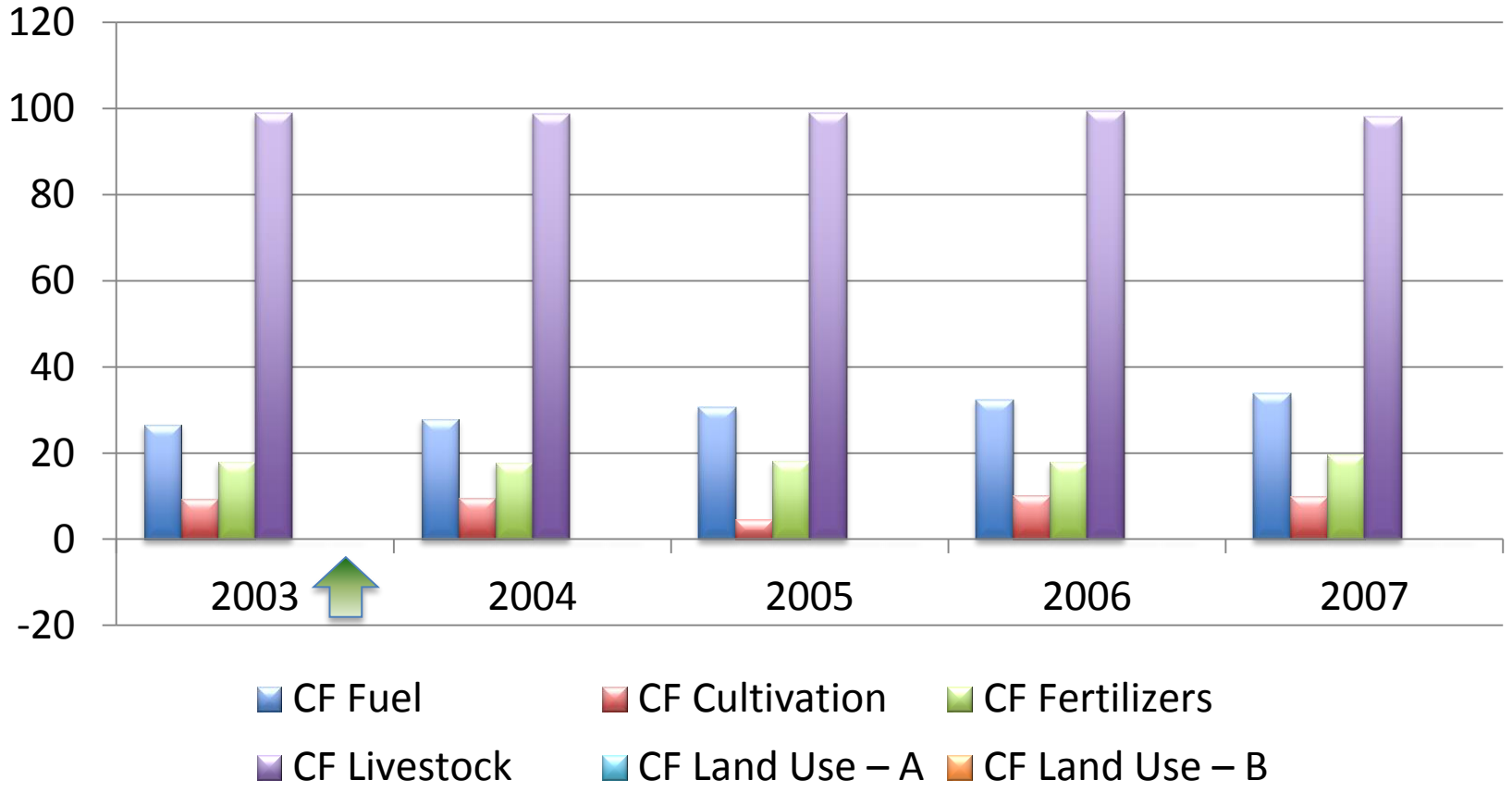
2003-2007 evolution of the 5 farm-level CF categories

CF category	2003	2004	2005	2006	2007	Var. 07-03 (%)
CF Fuel	26.6	27.9	30.6	32.4	33.8	27.1
CF Crops	9.4	9.6	9.5	10.1	9.9	5.4
CF Fertilizers	17.9	17.7	18.2	17.9	19.6	9.8
CF Livestock	98.9	98.8	99.0	99.3	98.0	-0.9
CF Land Use – A	2.8E-03	2.7E-03	2.6E-03	2.6E-03	2.6E-03	5.0
CF Land Use – B	-4.8E-03	-5.0E-03	-5.1E-03	-5.0E-03	-5.0E-03	-4.3
CF Total – A	152.8	153.9	152.3	159.7	161.4	5.6
	(499.5)	(504.1)	(507.7)	(566.9)	(563.1)	(1.3)
CF Total – B	152.8	153.9	152.3	159.7	161.4	5.6
	(499.5)	(504.1)	(507.7)	(566.9)	(563.1)	(1.3)

ton CO_{2e} per farm avg.; st. dev. in parenthesis. A: ISPRA IEF; B: JRC based IEF. Source: own elaborations

- Mostly smooth variations
- Large heterogeneity but some robust evidence emerges
- Only CF livestock declines
- Land Use does not matter much

2003-2007 evolution of the 5 farm-level CF categories



ton CO_{2e} per farm avg.; st. dev. in parenthesis. Source: own elaborations

2003-2007 evolution of the farm-level total CF across farm typologies

Farm typology:	2003	2004	2005	2006	2007	Var. 2007-2003 (%)
Economic Size:						
ES 3-4	19.3	12.1	12.7	13.0	13.0	-31.5
ES 5-6	40.2	40.1	41.7	40.7	41.1	2.7
ES>=7	398.4	396.4	401.1	415.8	417.6	4.8
UAA:						
UAA < 10 ha	33.9	36.1	38.2	36.0	35.8	5.6
UAA 10-50 ha	121.9	120.6	118.5	118.2	123.5	1.3
UAA >50 ha	655.5	656.0	632.7	688.7	687.2	4.8
Correlation coefficient UAA-CF	0.5	0.5	0.4	0.5	0.5	0.01

ton CO_{2e} per farm avg. Source: own elaborations

2003-2007 evolution of the farm-level total CF across farm typologies

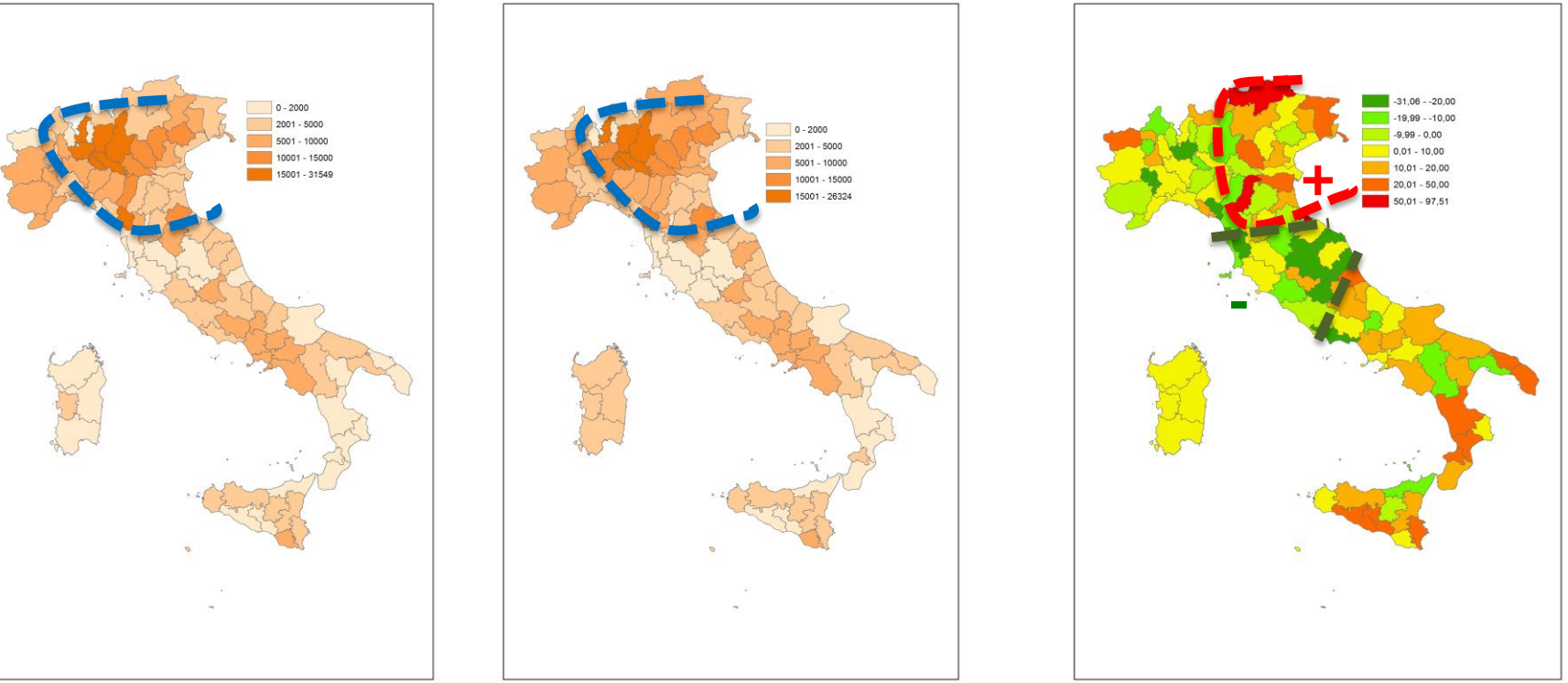
Farm typology:	2003	2004	2005	2006	2007	Var. 2007-2003 (%)
COP	110.1	110.7	80.3	138.4	141.1	43.3
Other fieldcrops	82.0	83.5	84.8	75.9	88.3	36.0
Horticulture	48.5	54.4	50.0	51.7	52.4	27.2
Wine	36.2	35.2	39.3	43.7	46.7	35.1
Orchards – fruits	22.5	25.9	33.4	32.5	38.5	78.7
Olives	18.7	19.5	20.0	19.0	21.6	33.6
Permanent crops combined	48.9	50.0	49.2	53.1	55.7	37.7
Milk	466.0	464.3	474.6	550.7	563.5	38.1
Sheep and goats	107.5	164.1	143.8	130.3	137.3	35.4
Cattle	458.3	468.1	493.0	391.0	420.3	0.6
Granivores	773.3	757.2	746.3	961.3	941.9	2.8
Mixed crops	64.7	60.5	69.7	65.8	61.7	47.3
Mixed livestock	604.0	521.2	678.7	412.5	371.0	-8.4
Mixed crops and livestock	268.4	278.8	262.2	189.7	204.6	9.2

ton CO_{2e} per farm avg. Source: own elaborations

Farm-level total CF/UAA across space

Farm-level total CF/UAA (Kg CO_{2e}) across Italian provinces and over time: 2003 (a), 2007 (b), var. 2007-2003 (%) (c)

(a) (b) (c)



Kg CO_{2e} per farm avg.; st. dev. in parenthesis. Source: own elaborations

The role of the CAP: farm-level total CF and 1st pillar payments

Farm-level total CF (ton CO_{2e}) and first pillar payments, FPP (avg. 2003-2007) (per farm avg.)

Farm groups:	2003 CF	2007 CF	Var. CF 2007-2003 (%)
FPP/GPV <10%	201.5	212.7	36.5
FPP/GPV 10-30%	46.3	48.2	2.98
FPP/GPV 30%	31.7	35.0	3.71
Correlation coefficient FPP – CF	-0.10	-0.09	-0.01

Source: own elaborations

- Negative but negligible correlation between FPP and CF
- More supported/dependent farms→better emission perfomance (levels and variations)
- Apparently, 1st pillar reform did not change CF patterns

The role of the CAP: farm-level total CF and 2nd pillar payments

Farm-level total CF (ton CO_{2e}) and second pillar 2003-2007 payments (i.e. 2000-2006 Programming Period (per farm avg.)

Farm groups:	2003 CF	2007 CF	Var. CF 2007-2003 (%)
With second pillar payments	242.0	141.1	-42.0
No second pillar payments	145.0	162.0	12.0
Correlation coefficient second pillar payments-CF (a)	0.4	0.5	-0.1

(a) only farms with second pillar payments

Source: own elaborations

- Positive correlation between 2nd pillar payments and CF (levels)
- Positive correlation between 2nd pillar payments and CF (variations)
- Apparently, 2nd pillar promoted a change in CF patterns

Some concluding remarks

- Novelty of the paper: farm-level comprehensive GHG emission/CF calculation
  - A methodology based on international standards
  - An application to an Italian FADN balanced panel
- This allows assessing:
  - Whether/How emission performance evolves over time at the farm-level
  - What drives this evolution; the role of the CAP
- Still several data and methodological issues to be fixed (e.g. land use changes) but some robust evidence emerges:
  - Assessment of the role of the CAP in its initial stage
  - Apparently the 2nd pillar measures had a role more than 1st pillar reform (whose purpose did not concern the CF)

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Thank you

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