Are Grassland Conservation Programs a Cost-Effective Way to Fight Climate Change? Evidence from France

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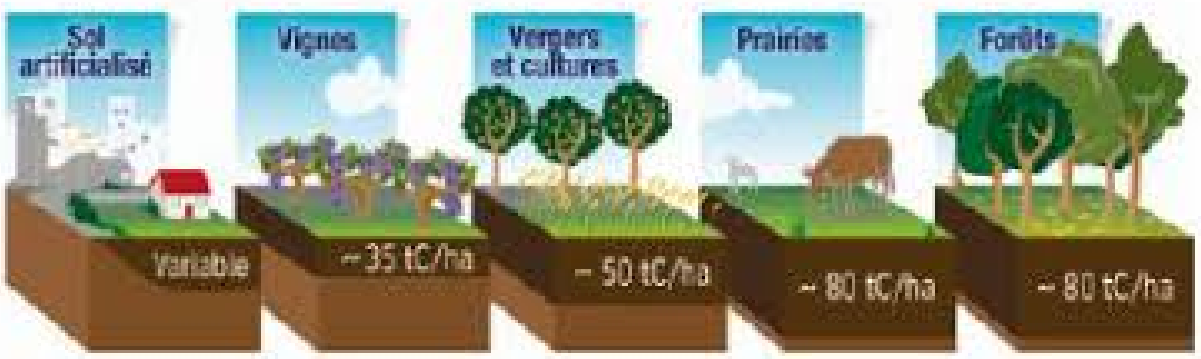
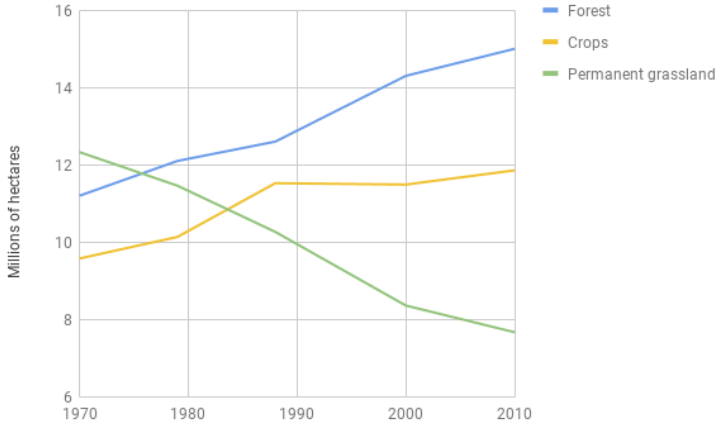
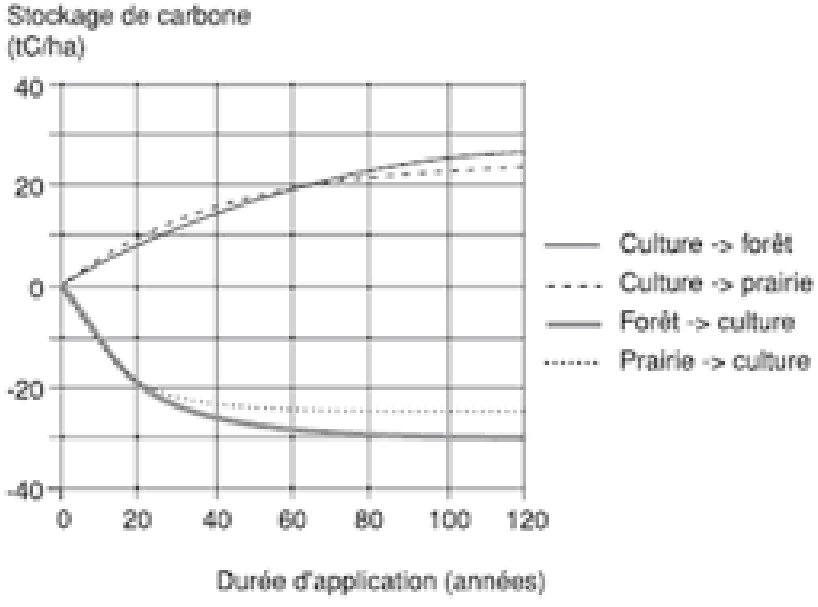
Grassland and climate change







Grassland can avoid the emission of up to 10.55 tCO2/ha/year when

- It replaces crops
- It reduces the number of cows

The French Grassland Conservation Program

- Created in 1993
- 5 year contract
- Farmers receive a yearly subsidy per hectare of grassland
- Yearly budget of **350 million €** in 2003.

Similar Payments for Ecosystem Services (PES) in the world:

- *In the E.U.:* from €76 million in 1992 to €3.03 billion in 2010;
- *In the U.S.:* nearly $2 billion yearly go to the Conservation Reserve Program (CRP).
- *In 57 developing countries:* currently 467 REDD+ projects.

This paper

We use a program expansion in 2003 as a **natural experiment** in order to answer the following questions:

- Is the French Grassland Conservation Program **additional**?
- Is the French Grassland Conservation Program additionality at the expense of **crops or forest**?
- What is the **elasticity** of grassland supply?
- What is the **climate benefit/cost** ratio of the French Grassland Conservation Program?
- How does the French Grassland Conservation Program compare with **Forest Conservation Programs in developing countries**?
- What is the **overall benefit/cost** ratio of the French Grassland Conservation Program?

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  $\Rightarrow$ Low: 0.02 ± 0.03
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  $\Rightarrow$ Low: 0.19 ± 0.37
- How does the French Grassland Conservation Program compare with **Forest Conservation Programs in developing countries**?
  $\Rightarrow$ Unfavorably: 2.4 in Uganda and 1.32 in Brazil
- What is the **overall benefit/cost** ratio of the French Grassland Conservation Program?
  $\Rightarrow$ Low: 0.32 ± 0.62

Literature

Observational Methods - most of the literature so far

- *Evaluations of the impact of EU PES on grassland*: Pufahl and Weiss(2009), Chabé-Ferret and Subervie(2009), Arata and Sckokai(2016).

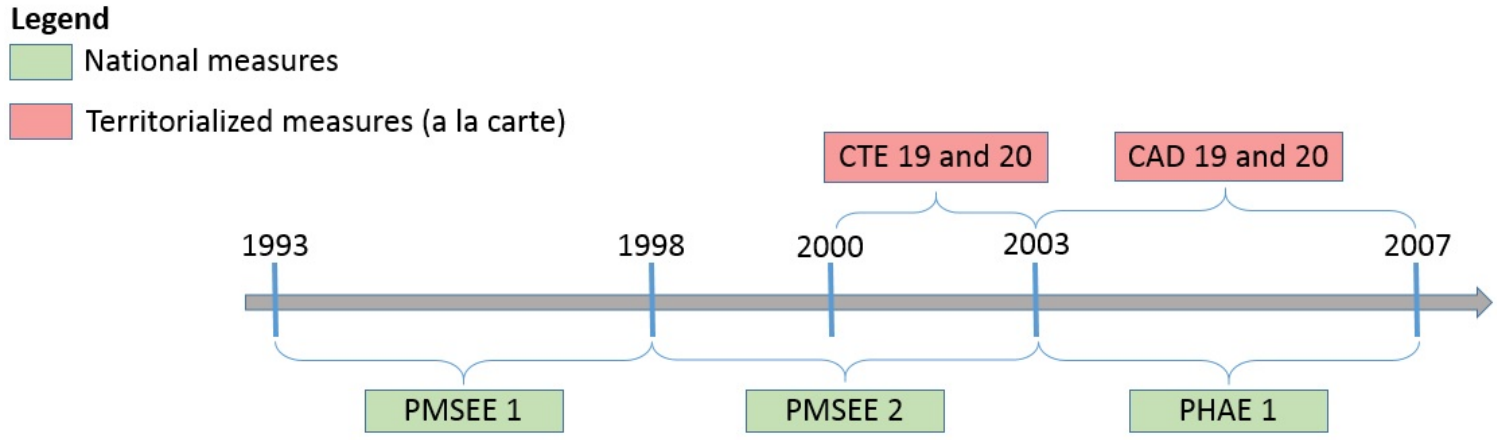
Randomized Controlled Trials - few papers

- Jack(2013) and Jayachandran et al.(2017)

Natural Experiments - some papers

- *Small scale programs*: Khufuss and Subervie(2018), Simonet et al.(2018);
- *National programs*: Alix-Garcia et al.(2015), Alix-Garcia and Sims(2017), Gallic and Marcus (2019).

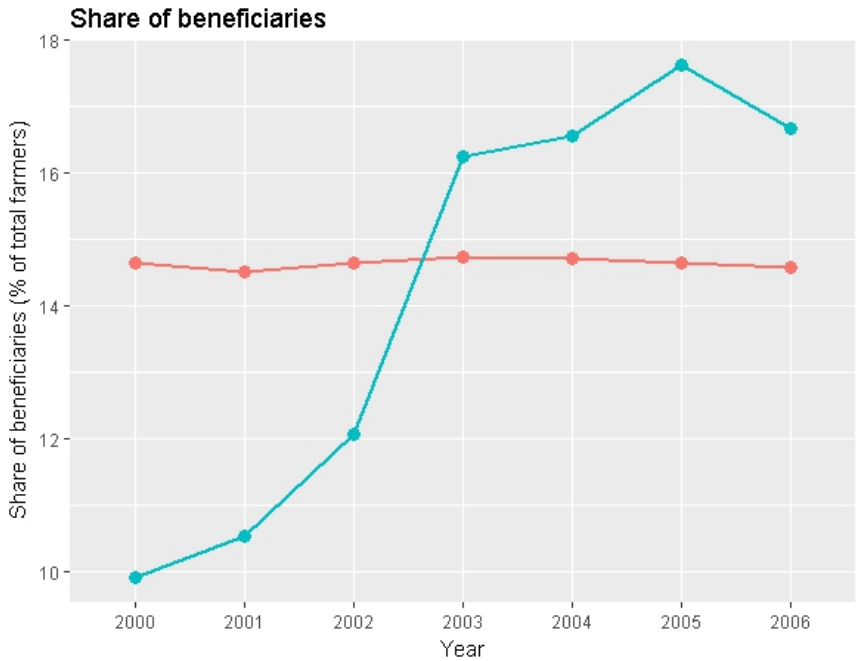
Natural experiment: program expansion

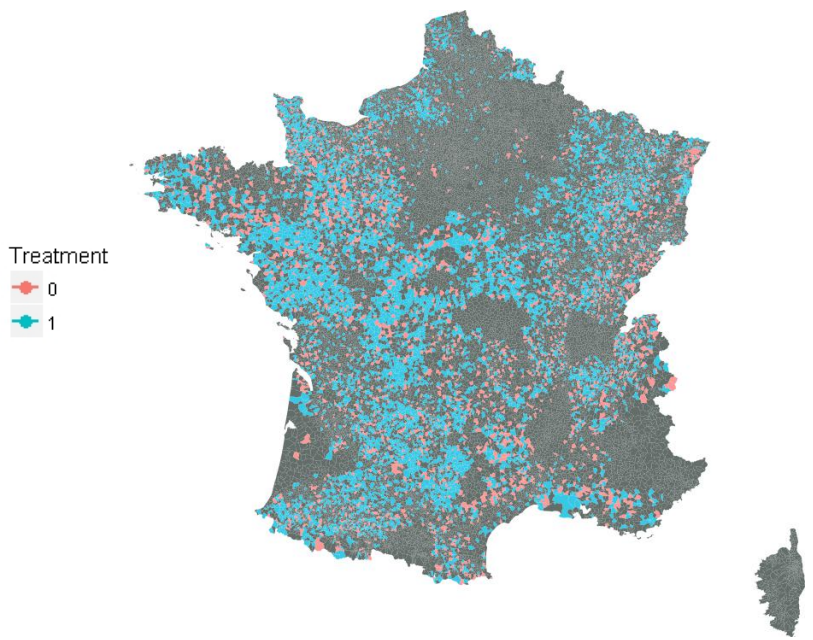


Measure / Eligibility Criteria	PMSEE 2	PHAE 1	CTE/CAD 19 AND 20
Farmer's age	≤ 60 years	≤ 60 years	—
Farm size	≥ 3 ha UAA and ≥ 3 LU	—	—
Specialization Rate (Grassland/Utilised Agricultural Area)	≥ 75%	≥ 50% - ≥ 75% department dependent	—
Loading Ratio (Livestock Units/Fodder Area)	≤ 1.4	≤ 1.4 - ≤ 1.8 department dependent	≤ 1.4 - ≤ 1.8 department dependent
Fertiliser use (Units of Azote/ha of Grassland)	≤ 70	≤ 60	≤ 60
Max amount of subsidy / ha of grassland	**46€**	**76€**	**91€**

Empirical Strategy: Difference-in-Differences design

- we compare outcomes **before and after the policy reform in 2003**,
- for the group of communes where the number of beneficiaries increased between 2000 and years after 2003 (**treatment group**)
- and the group of communes where the number of beneficiaries remained stable (**control group**)





Empirical Strategy: Two-way FE regression

The analysis is conducted at **commune level** in order to account for leakage effects.

The baseline equation:

$$Y_{ct} = \tilde{\alpha} D_{ct} + \tilde{\beta} X_{ct} + \tilde{\eta}_c + \tilde{\theta}_t + \tilde{\epsilon}_{ct} \tag{1}$$

where
Y_{ct} = commune level outcome variable;
D_{ct} = treatment dummy, equals 1 starting in 2003 for treated communes;
X_{ct} = communes level control variables;
η_c and θ_t = commune and year fixed effects;
ϵ_{ct} = error term.

The parameter of interest $\tilde{\alpha}$ captures the **intention-to-treat effect** of the 2003 eligibility criteria change in the Grassland Conservation Program.

Data

1. **Administrative data**
   - Data on every beneficiary of the Grassland Conservation Program from 1999 to 2006 from France's Service and Payment Agency (ASP).

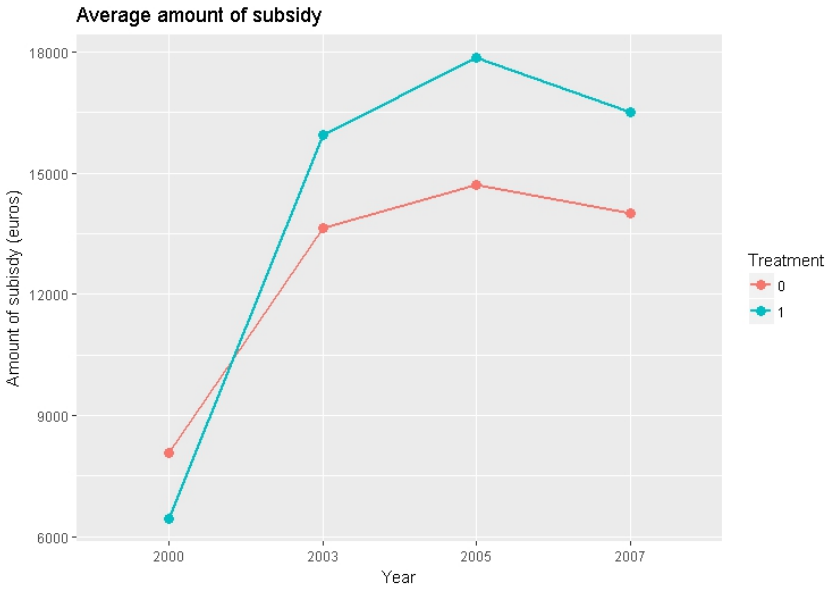
2. **Outcome data**
   - Farm level data from the Ministry of Agriculture:
     - 2000 Agricultural Census
     - 1993, 1995, 1997, 2003, 2005 and 2007 Farm Structure Surveys

Final sample:

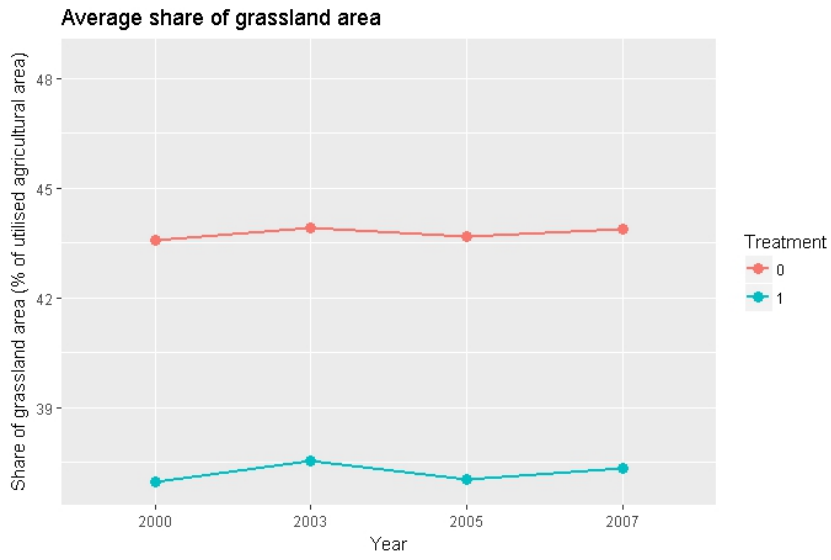
- balanced panel of 9,998 communes from 1993 to 1997
  $\Longrightarrow$ **placebo test**
- balanced panel of 10,468 communes from 2000 to 2007
  $\Longrightarrow$ **treatment effect**

Results

A large inflow of money:
5000±514 euro ≅ 43±6%

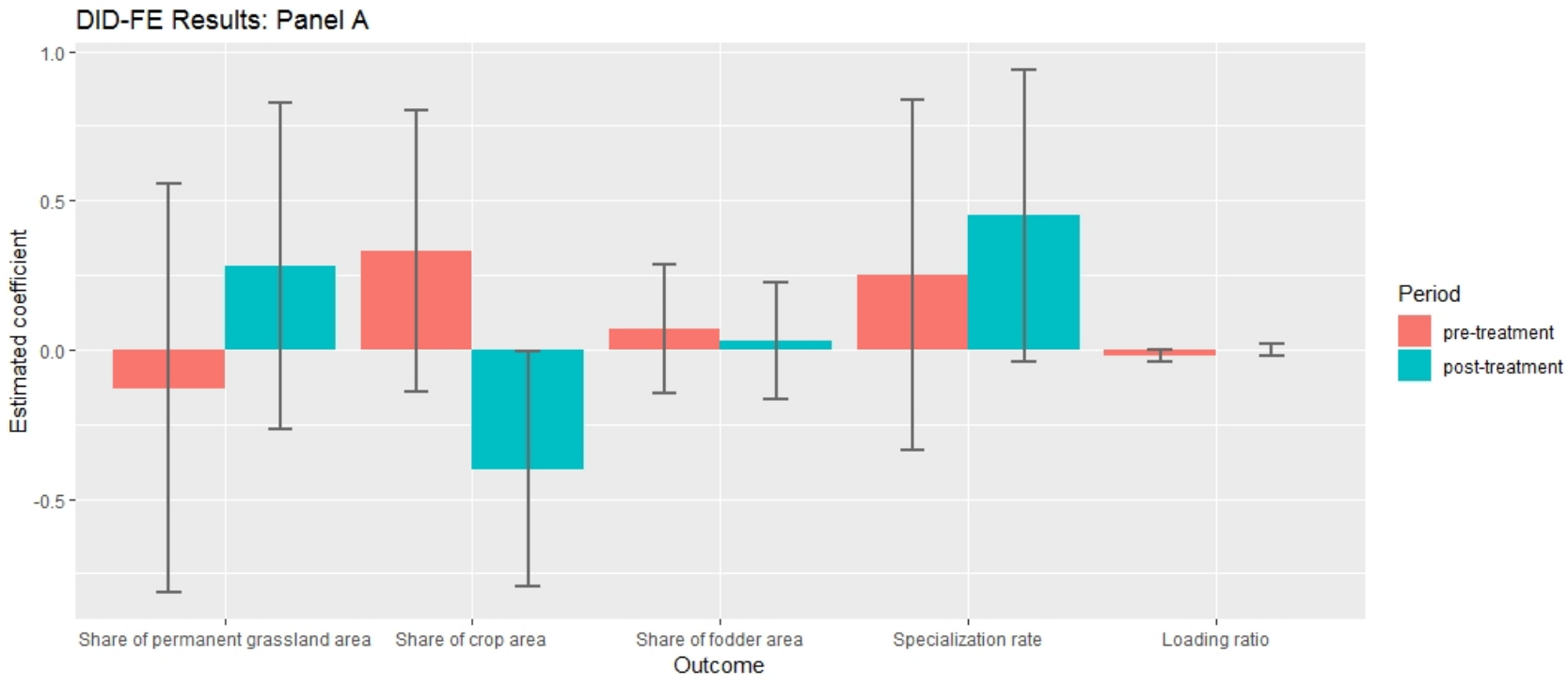


A small increase in grassland area:
4±7 ha per commune ≅ 0.8±1.6%



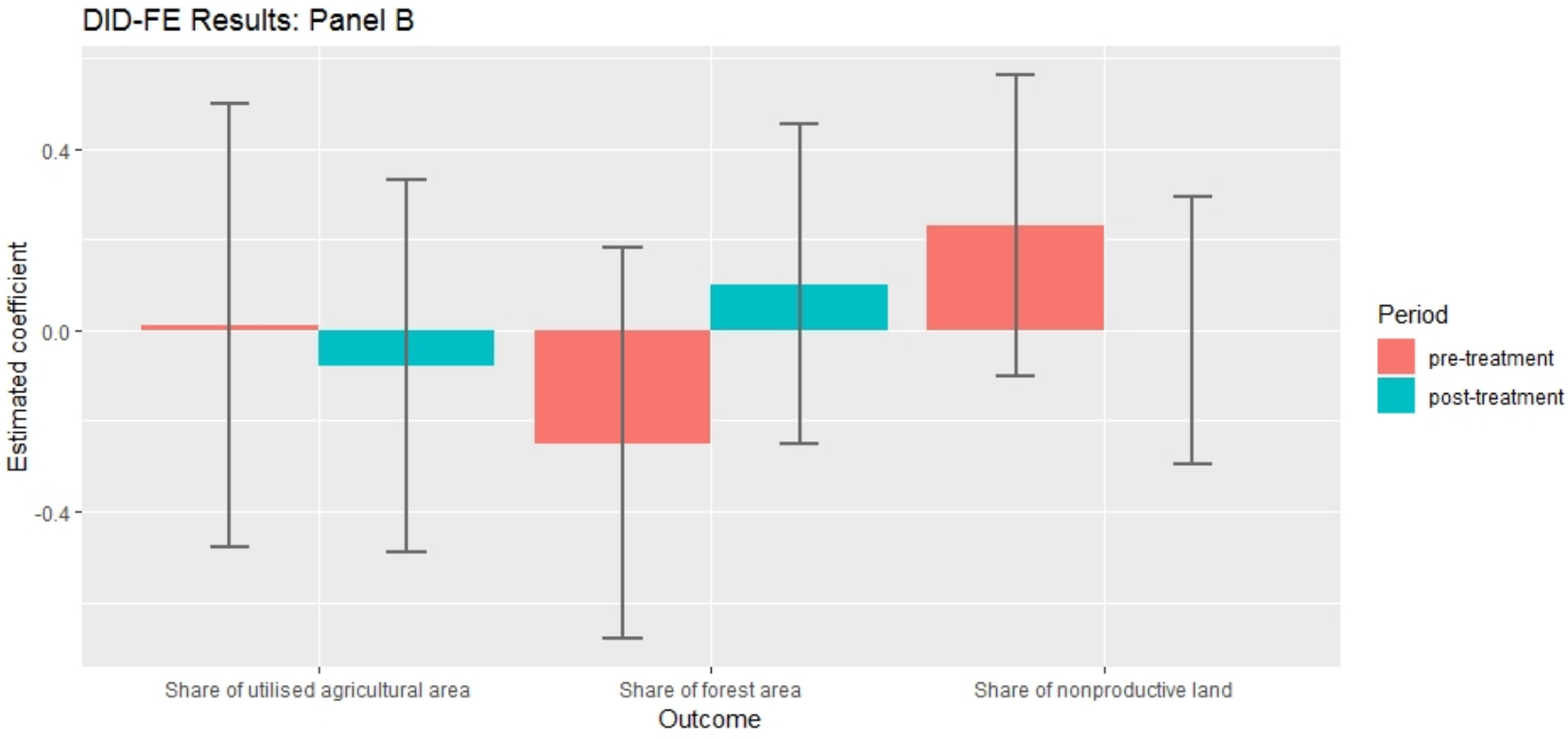
Takeaway: The elasticity of the supply of grassland with respect to the amount of subsidy is low (around 0.02±0.03).

Results: Panel A



Takeaway: The increase in the grassland area comes mainly at the expense of croplands.

Results: Panel B



Takeaway: The increase in the grassland area does not come from forest are or non-productive land.

Computing the climate Benefit/Cost ratio

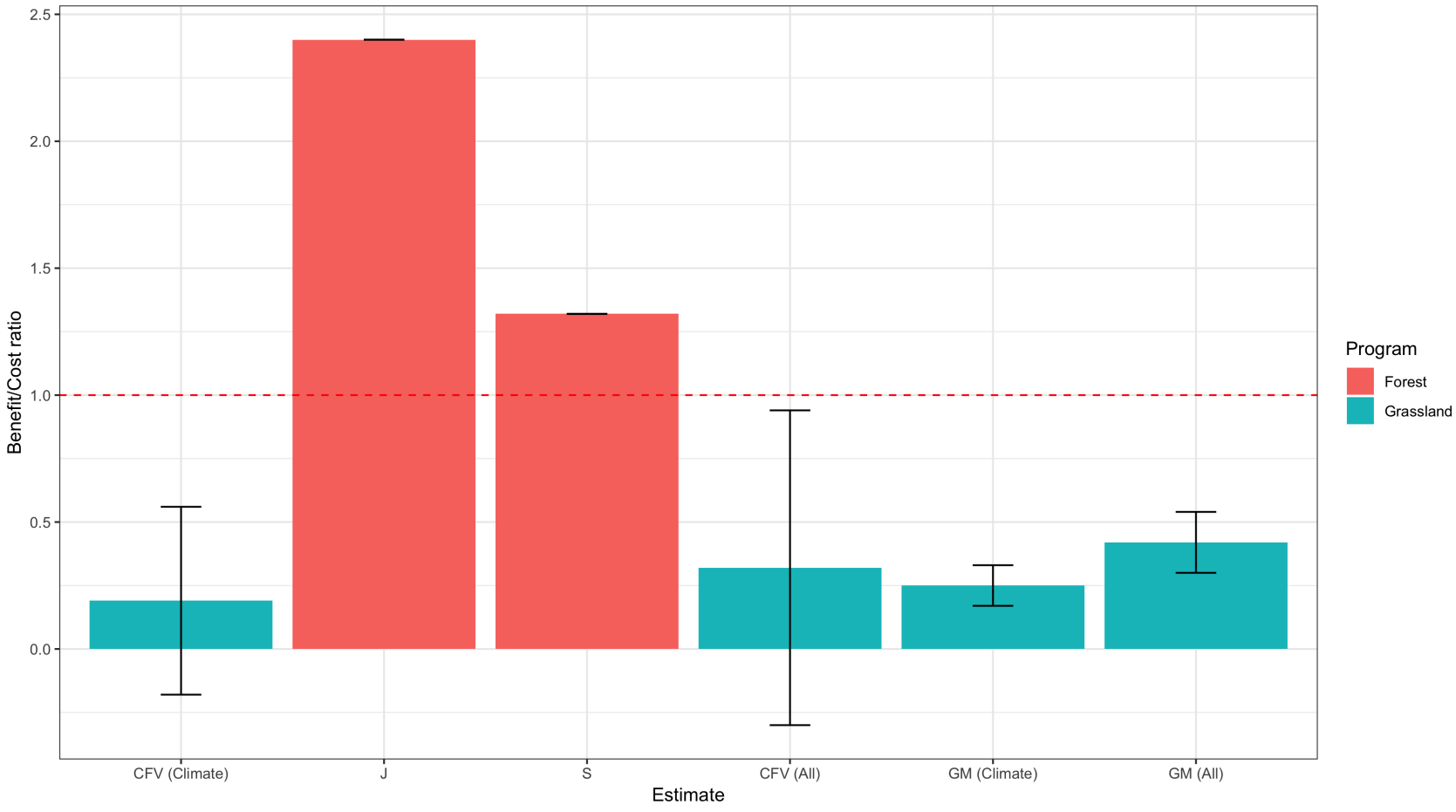
$$\frac{Benefit}{Cost} = \frac{(Grassland^1 - Grassland^0)10.55SCC}{\text{Monetary transfer}}$$

Assumptions leading to an upper bound

- Permanent sequestration (even after transfer stops)
- Transfer lasts for 5 years
- Additional grassland replaces cropland

Precision: Delta Method

Benefit/Cost ratios



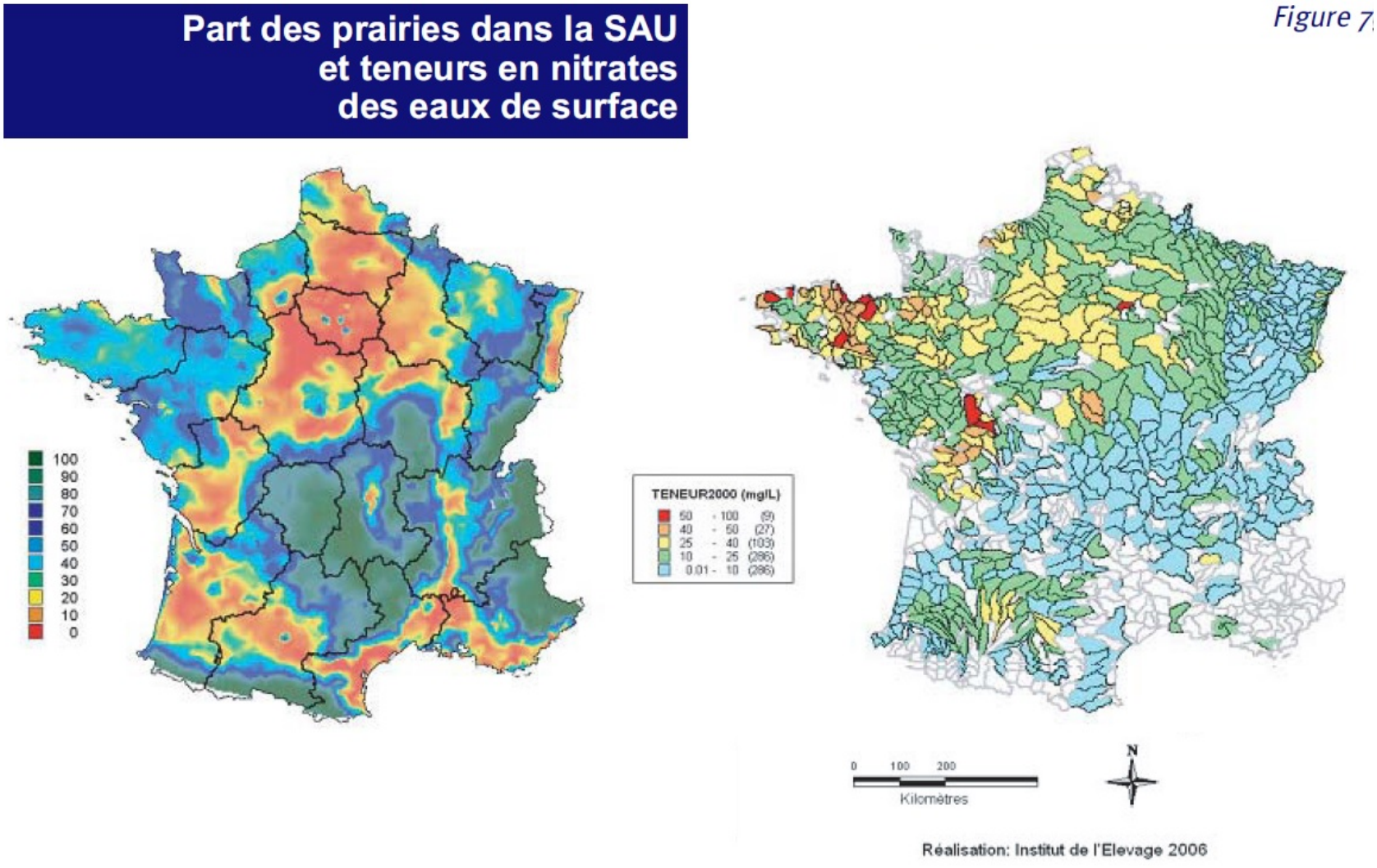
Conclusion

- Despite low precision, our results clearly reject the French Grassland Conservation Program as being cost-effective
- Diverting grassland from cropland in developed countries is very costly (1200€/ha of additional grassland vs 76€/ha of subsidized grassland)
- Forest conservation efforts in developing countries are much cheaper than grassland conservation in developed countries
- Carbon price required to make the French Grassland Conservation Program cost-effective: 127€/MTCO2

Thank you!

Grasslands have a positive impact on water quality

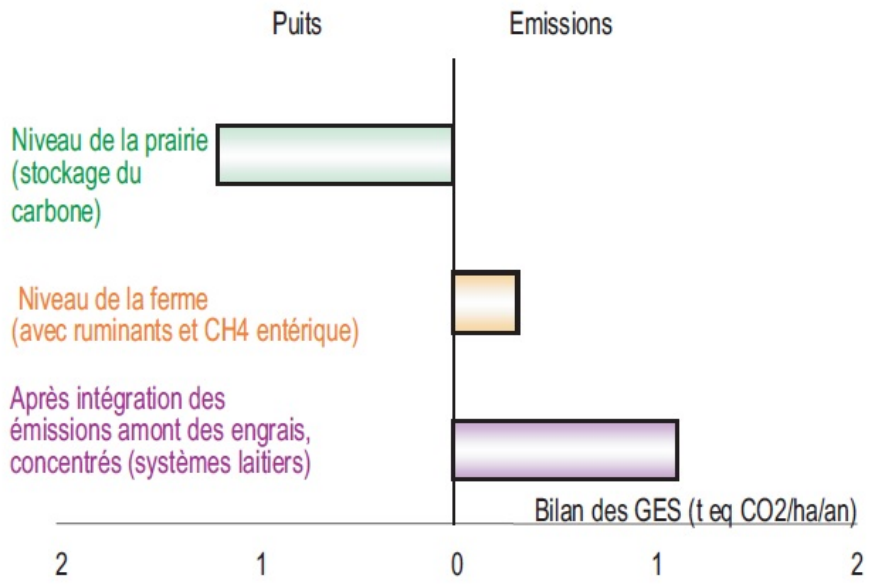
Figure 7



Grasslands store carbon in the soil

Estimation du bilan des gaz à effet de serre à différentes échelles

Figure 13



Source : Adapté de Soussana et al. 2005

The Grassland Conservation Program (budget and number of beneficiaries per program)

La prime à l'herbe en 2003 en France

Figure 18

Année	Types de mesures	Surfaces en millions d'ha	Montants payés en millions d'euros	Bénéficiaires
1997	PMSEE 1	5	228	100 000
2001	PMSEE 2	4,689	175	74 115
2003	Mesures 19 *	1,04	53	16 000
	Mesures 20 **	3,561	282	75 630
	Dont Part consacrée à la PHAE au sein des mesures 19 et 20	3,179	211	56 360

*: maintien de l'ouverture des espaces à gestion extensive
** : gestion extensive de la prairie par la fauche et le pâturage

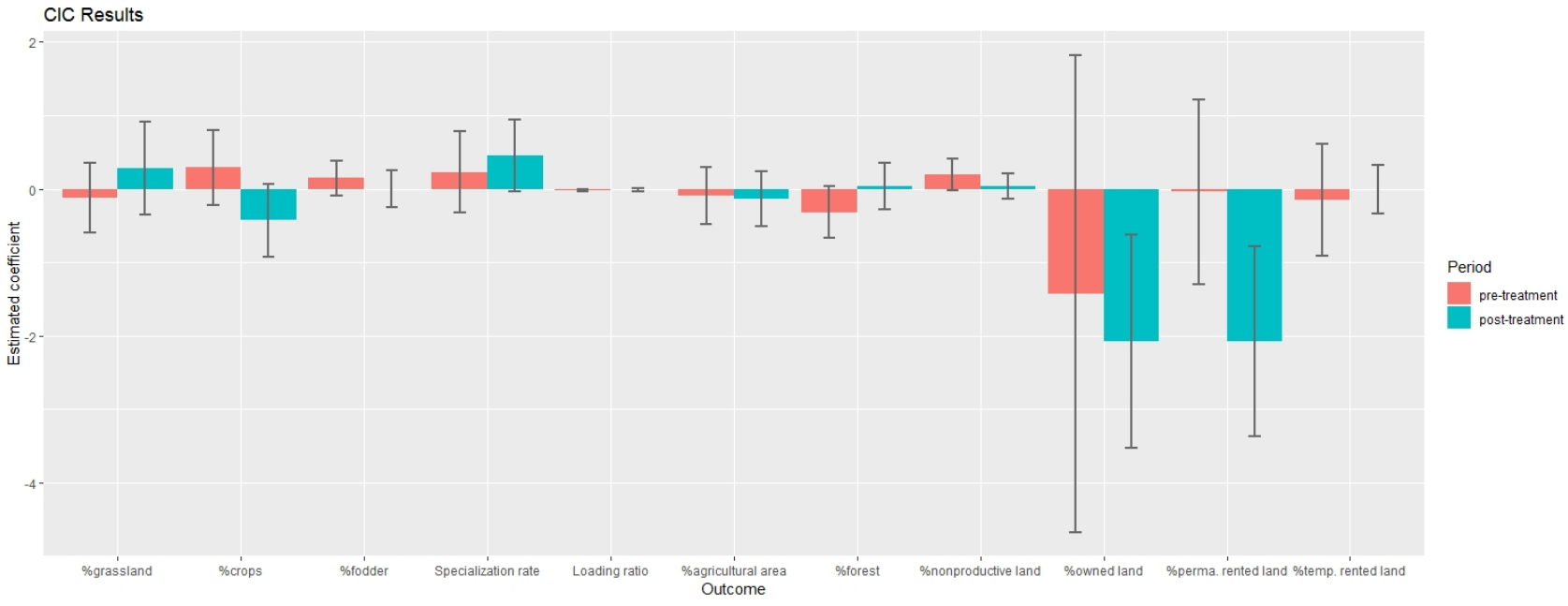
Source : SIDAM

Summary Statistics

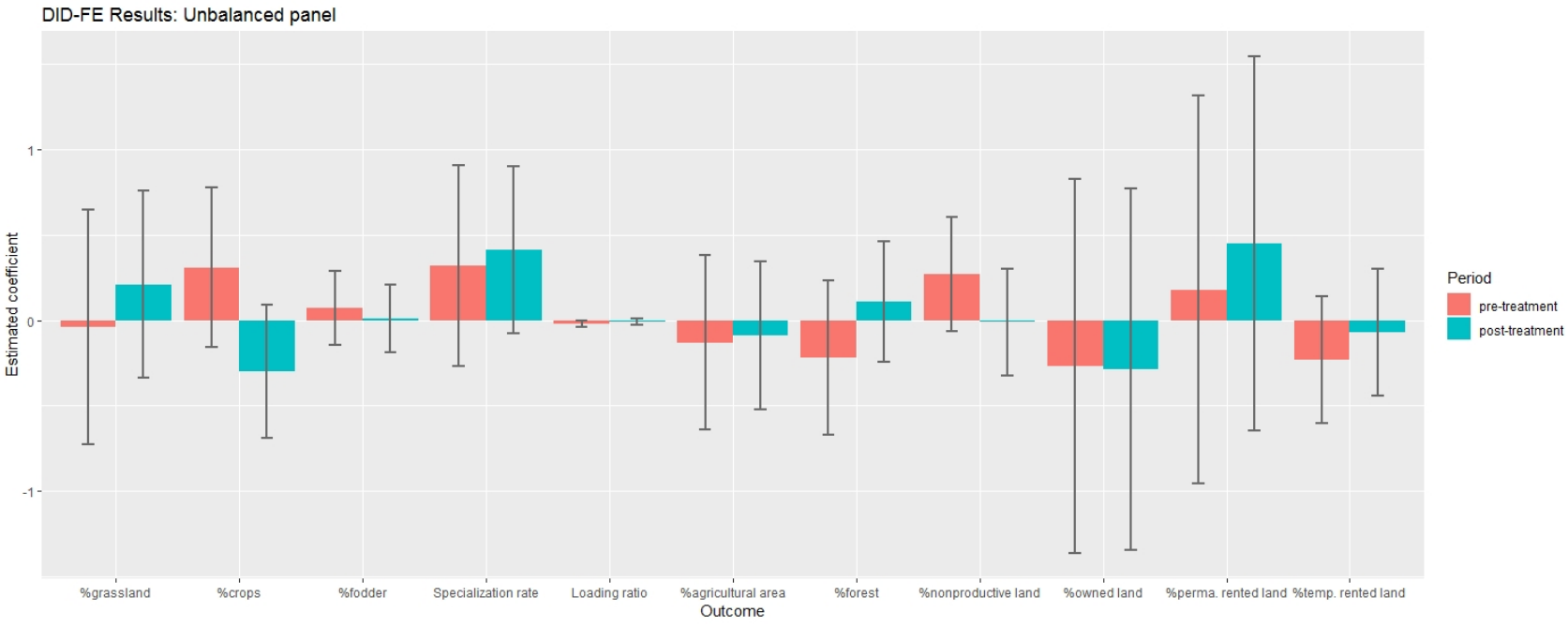
Table: Mean and standard deviation of outcome variables, by treatment group and by sample

	1993-1997		2000-2007	
	Treated group	**Control group**	**Treated group**	**Control group**
Panel A				
Share of permanent grassland area	41.24	48.20	37.22	43.76
	(31.87)	(34.66)	(30.41)	(34.41)
Share of crop area	31.67	25.18	35.00	28.33
	(26.97)	(26.49)	(27.62)	(27.94)
Share of fodder area	6.15	4.69	6.19	4.89
	(8.63)	(8.01)	(7.96)	(7.81)
Specialization rate	50.52	56.32	47.97	53.49
	(31.97)	(34.32)	(31.35)	(34.60)
Loading ratio	1.68	1.42	1.73	1.47
	(3.07)	(2.76)	(4.41)	(2.96)
Panel B				
Share of utilised agricultural area	92.09	90.13	94.17	92.91
	(13.36)	(16.09)	(10.75)	(13.42)
Share of forest area	4.96	6.20	3.69	4.42
	(10.77)	(12.57)	(9.06)	(10.66)
Share of nonproductive land	1.61	2.45	1.10	1.69
	(6.22)	(8.42)	(4.32)	(6.85)
Observations	**6,827**	**3,171**	**7,243**	**3,225**

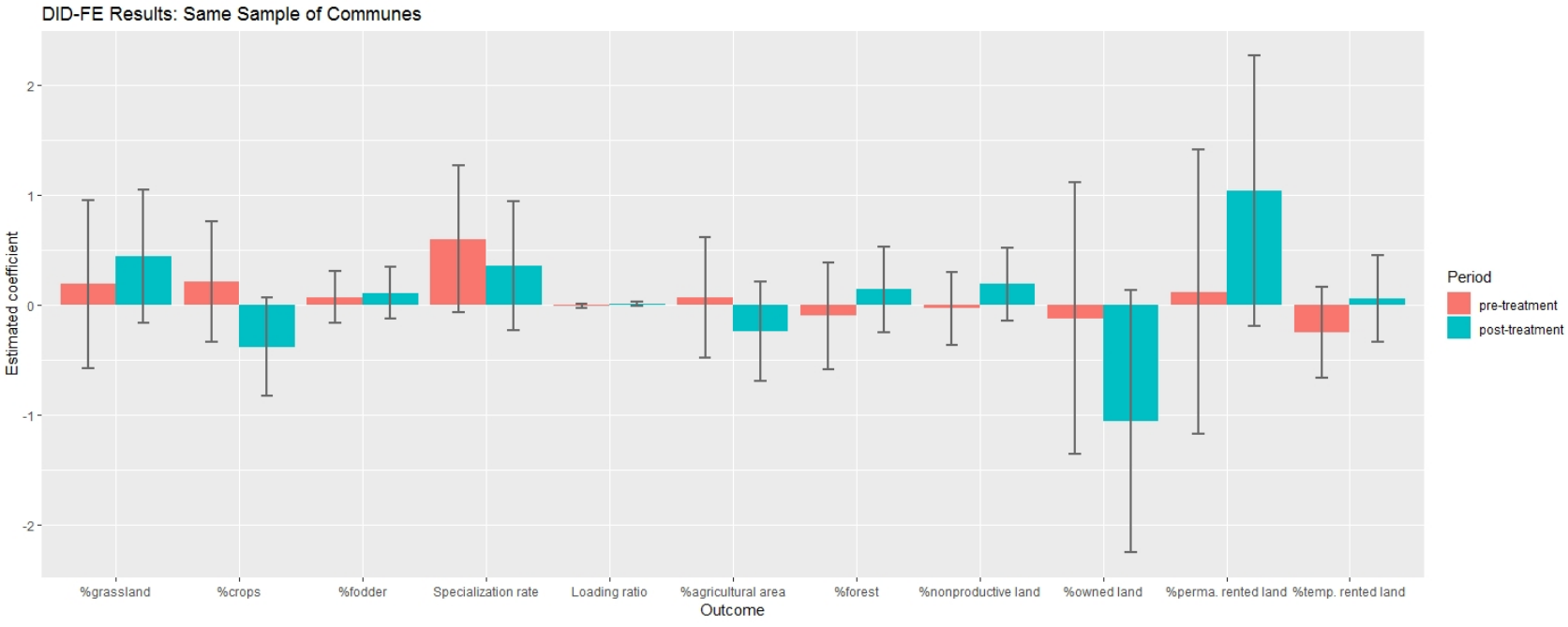
Robustness check 1: Changes-in-changes



Robustness check 2: Unbalanced panel



Robustness check 3: Same sample of communes



This Paper

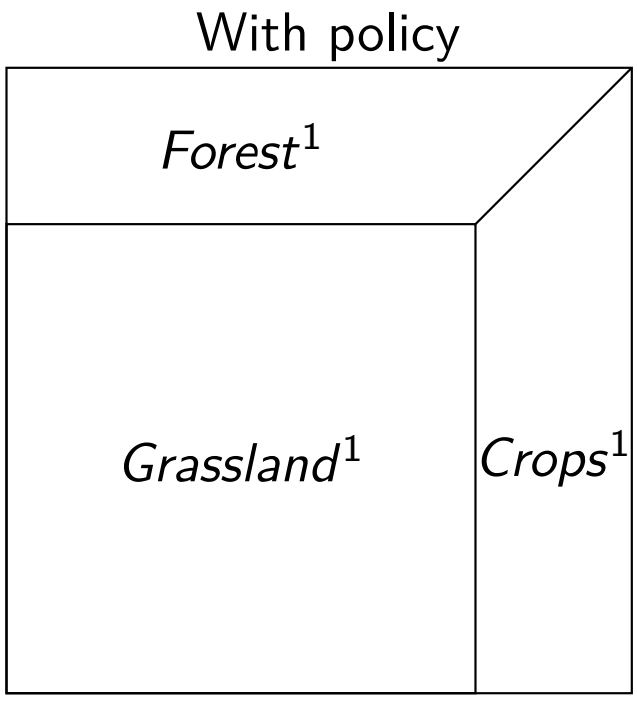
We estimate the cost-effectiveness of a major Payment for Ecosystem Services (PES) program, **the French Grassland Conservation Program**.

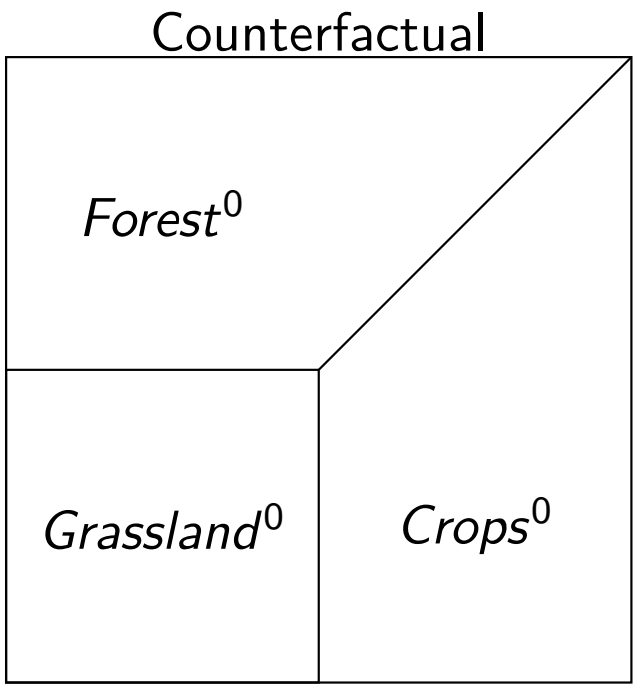
How?
We use the **natural experiment** of the change in eligibility requirements that occurred between 2000 and 2003 in a **Difference-in-Differences (DID)** design.

What do we find?

- a small increase in grassland area in treated communes, increase that comes mainly at the expense of croplands
  $\Longrightarrow$ increase in carbon storage;
- the cost of carbon storage is 127 euro/ton of CO_2;
- program's costs $>$ social benefits.

Is the French Grassland Conservation Program additional?





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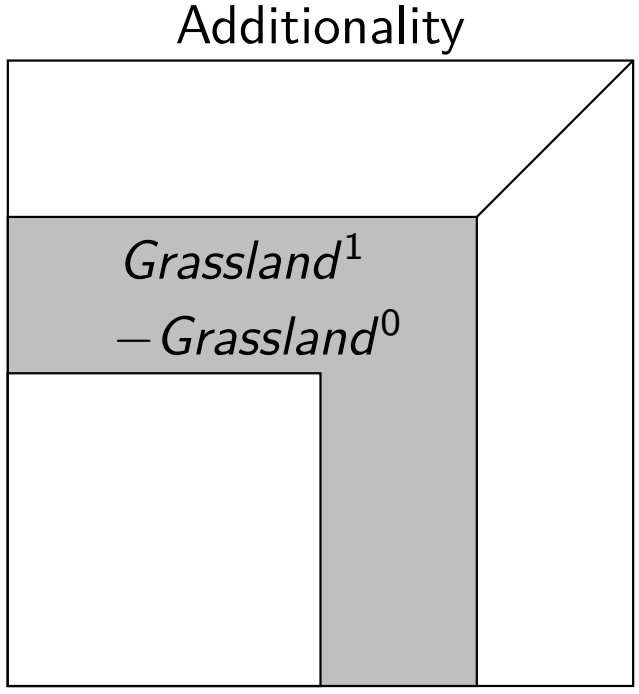

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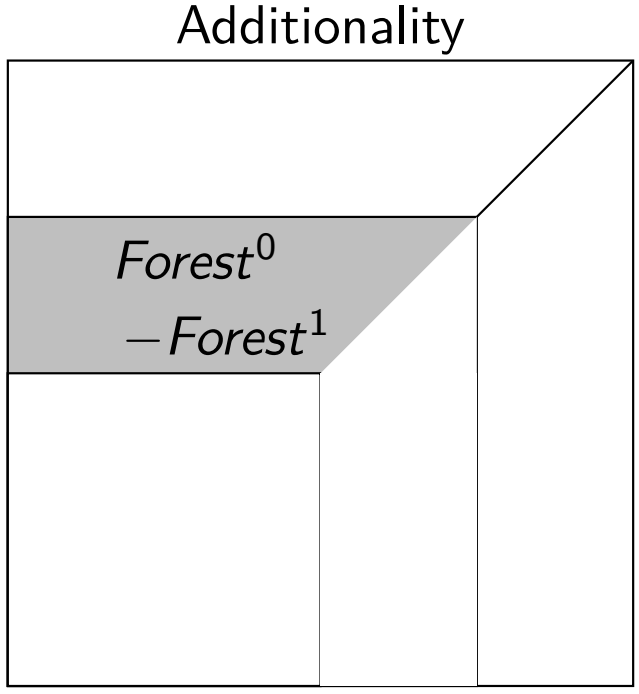

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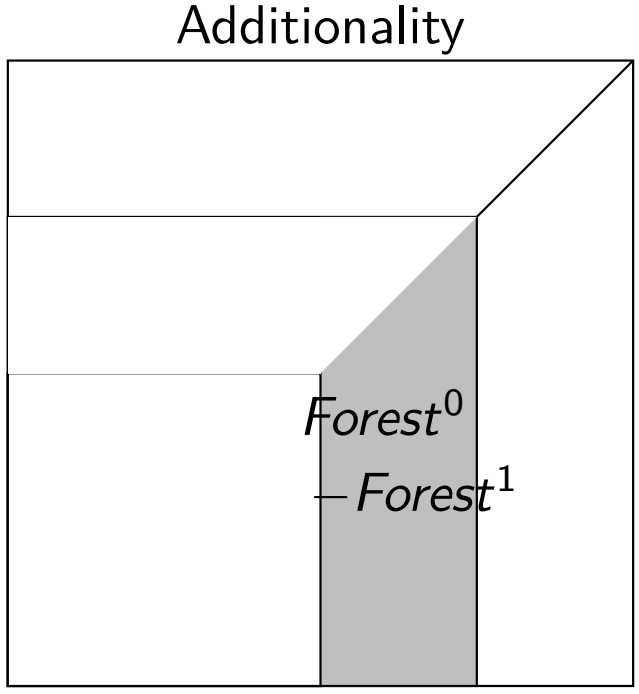
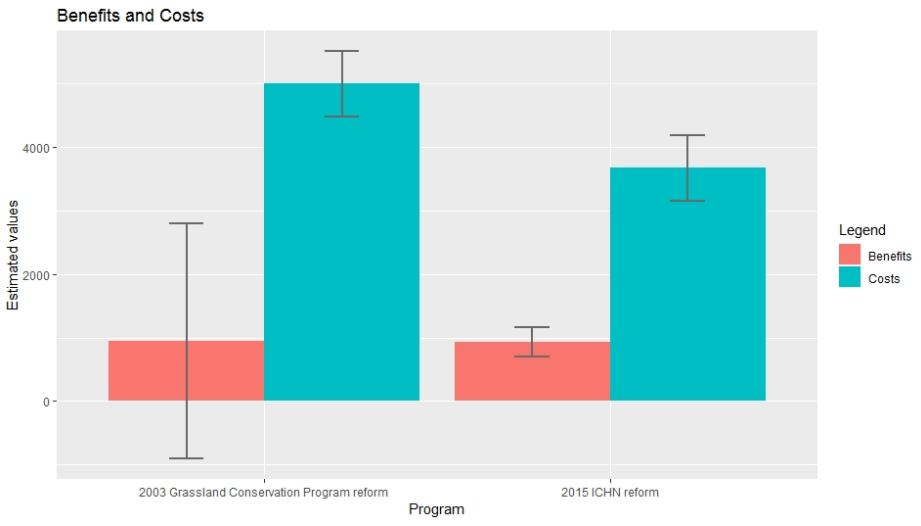


The Cost of Averted CO_2 Emissions

Source	Type of PES	Euro/ton
Jayachadran et al. (2017)	**Forest conservation** in Uganda (RCT)	**0.40**
Simonet et al. (2018)	**Forest conservation** in Brazil (REDD+)	**0.73**
Gallic and Marcus (2018)	**Grassland conservation** in France (2015 ICHN reform)	**94**
Chabe-Ferret and Voia (2019)	**Grassland conservation** in France (2000-2003 CTE/PHAE reform)	**127**
Social Cost of Carbon (EPA)		**30**

Takeaway: Grassland Conservation Programs in developed countries are not the most cost-effective way to fight climate change.

Cost-Benefit Analysis



Program	Benefit-Cost Ratio
2003 CTE/PHAE reform	**0.19** $\pm$ **0.37**
2015 ICHN reform	**0.25** $\pm$ **0.22**

Takeaway: The costs of the French Grassland Conservation Program are large and the social benefits in terms of added carbon storage are not enough to compensate the costs.