147th EAAE Seminar

CAP Impact on Economic Growth and Sustainability of Agriculture and Rural Areas

A TWO-STEP MODELING APPROACH FOR THE IMPACT ASSESSMENT OF GREENING IN ITALY

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CAP reform development

- Key strategic objectives of the new CAP are **food production, balanced territorial development, crop diversification and sustainable management of the natural resources.**
- The CAP founded the direct intervention mainly on two payment components: the basic payment and **green payment (30% of direct payments).**
- An important topic of the reform was the way to progressively achieve, over the period 2015-2019, a more equitable and balanced distribution of direct support per hectare between farmers.
  - broad margin of flexibility and partial convergence at 2019
- Greening was one of the major areas of negotiation between the Commission, the Parliament and the Council and it was the subject of severe ex-post critiques
- **The potential effects of the greening measures have been substantially mitigated** by enlarging the minimum thresholds and introducing new criteria of exclusion.

Objectives and methodology

Objective

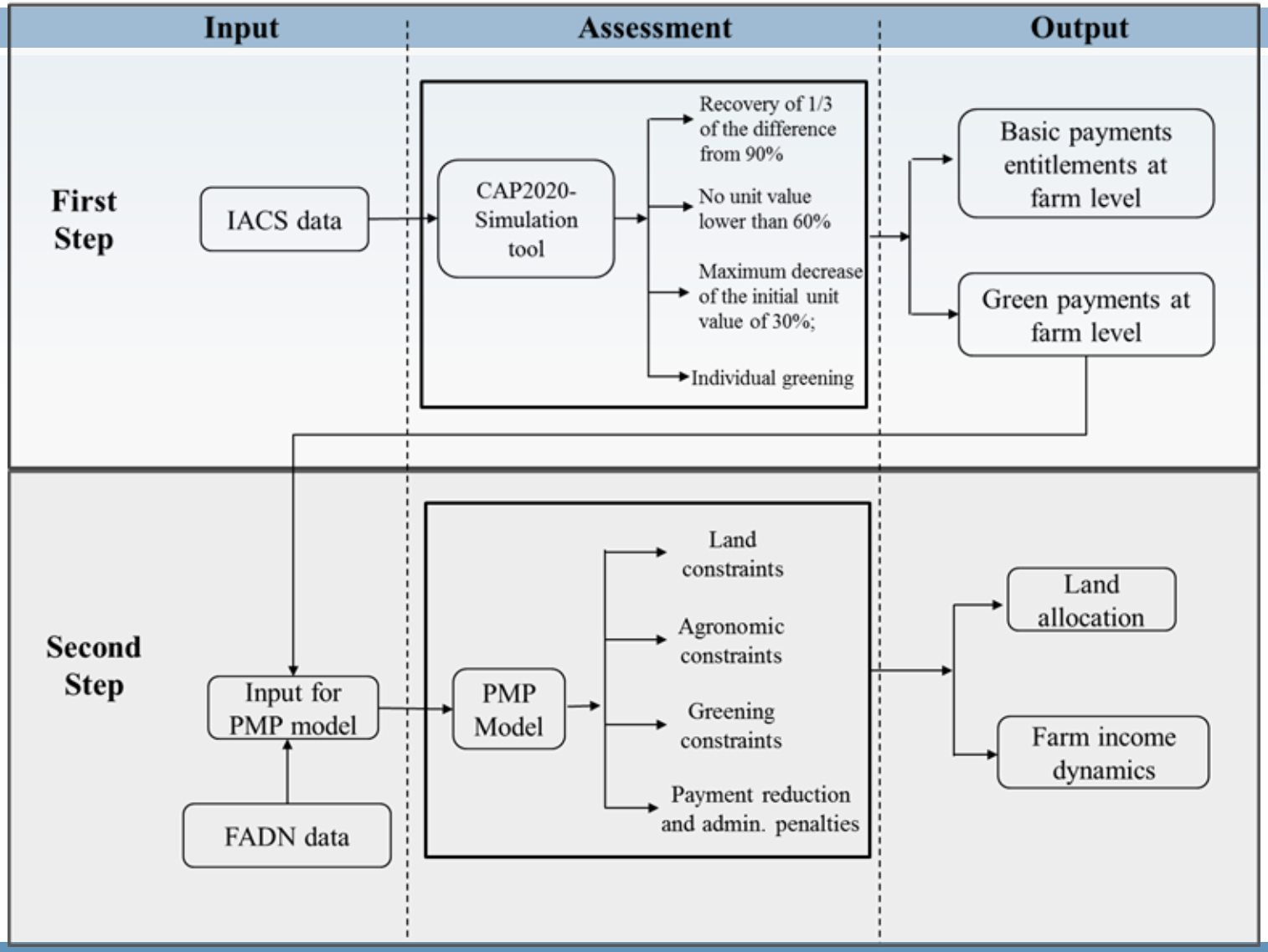
- Evaluate the potential **effects of the Greening at farm level**
- The results provide information on:
  - changes in **land allocation**
  - **impact on farm incomes**
  - **effectiveness of the system of sanctions** in discouraging non-compliance with the greening requiremets.

Analysis on a Nothern Italian macro-region (Emilia-Romagna, Lombardy and Veneto).

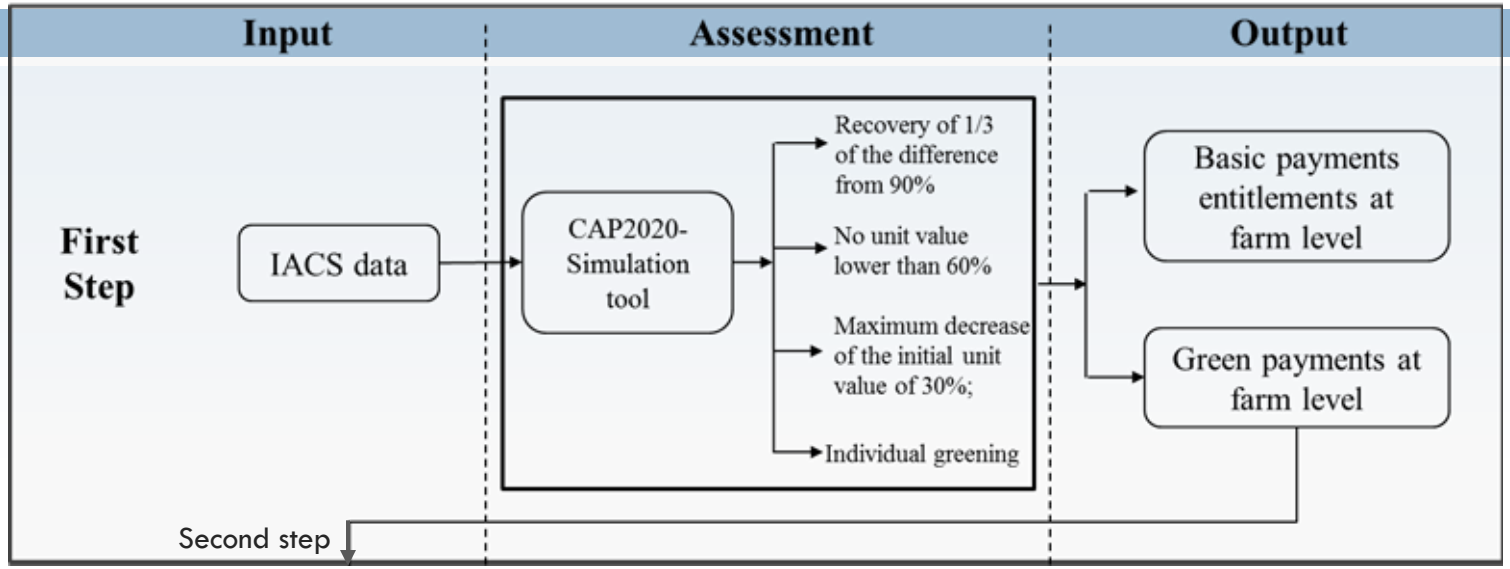
Methodology

- **Two-step modeling approach** for the impact assessment of greening at farm level:
  - i) First step: estimates the amount of basic and **green payment** per farm in 2019
  - ii) Second step: assesses **farmers behavior** due to the greening application, with the possibility of full or **partial non-compliance** and conseguent **payment reduction**.

Two step approach modeling



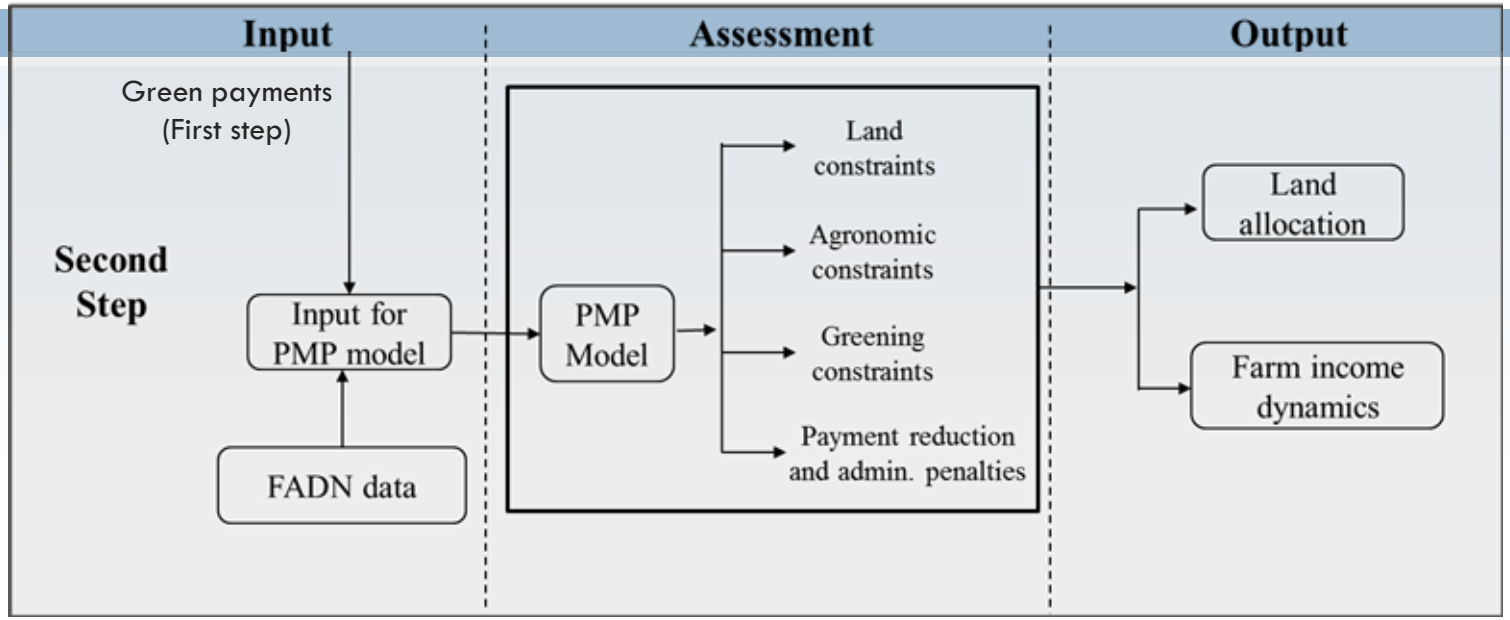
Two step approach modelling
First step



- The CAP2020-Simulation tool **estimates the amount** in 2019 of Basic and **green payments** at farm level.
- The tool uses **data** from the National Integrated Administration and Control System (**IACS**)

- Structured into **3 phases**:
  - i) implementation of **"Irish model"** of partial convergence: payment entitl. with an iuv<90% of the national uv in 2019 shall increase by at least 1/3 of the difference;
  - ii) implementation of the **"minimum guaranteed level"**: no payment entitlement <60% of nuv 2019;
  - iii)**"maximum loss"**: maximum decrease -30% of the initial unit value.
- The tool estimates the **green payment "entitlement"** by farm as a proportion of Basic Payment.

Second step
the assessment of greening



The values of the estimated green payments at farm level (in the first step) were used, in the *second step*, as exogenous information within a **Positive Mathematical Programming** (PMP) model:

- The model aims to evaluate **economic and productive impacts of greening** measures on farmers behavior in **3 Italian regions**: Emilia-Romagna, Lombardy and Veneto.
- The data on observed land use, yields, prices and costs are collected from the Italian Farm Accountancy Data Network **(FADN)** 2012 considering all the **2,038 farms located in the area** (160,423 farms according to the FADN weighting system).

The three phases of PMP model

1.

$$\max_{\mathbf{x}_r \geq 0, \mathbf{x}_l \geq 0} GM = (\mathbf{p}_r - \mathbf{c}_r)'\mathbf{x}_r + (\mathbf{p}_l - \mathbf{c}_l)'\mathbf{x}_l$$

prices of realized (*r*) and latent (*l*) crops

costs of realized (*r*) and latent (*l*) crops

quantities of realized (*r*) and latent (*l*) crops

$$S.t. \quad \mathbf{A}_r\mathbf{x}_r + \mathbf{A}_l\mathbf{x}_l \leq \mathbf{b} \quad (\mathbf{y}) \longrightarrow$$ Structural constraint

$$\mathbf{x}_r \leq \bar{\mathbf{x}}_r + \varepsilon \quad (\boldsymbol{\lambda}_r) \longrightarrow$$ Calibrating constraint for realized crops $\bar{\mathbf{x}}_r$

$$\mathbf{x}_l \leq \bar{\mathbf{x}}_l + \varepsilon \quad (\boldsymbol{\lambda}_l) \longrightarrow$$ Calibrating constraint for latent crops $\bar{\mathbf{x}}_l$

2.

$$\begin{bmatrix} \mathbf{c}_r \\ \mathbf{c}_l \end{bmatrix} + \begin{bmatrix} \boldsymbol{\lambda}_r \\ \boldsymbol{\lambda}_l \end{bmatrix} = \begin{bmatrix} \bar{\mathbf{x}}_r \\ \bar{\mathbf{x}}_l \end{bmatrix} \mathbf{Q}_{rl} \longrightarrow$$

Marginal cost, where Q is the decision matrix estimated by GME

3.

$$\max_{\mathbf{x}_r \geq 0, \mathbf{x}_l \geq 0} \quad \mathbf{p}_r'\mathbf{x}_r + \mathbf{p}_l'\mathbf{x}_l - \frac{1}{2}\begin{bmatrix} \mathbf{x}_r & \mathbf{x}_l \end{bmatrix} \mathbf{Q}_{rl} \begin{bmatrix} \mathbf{x}_l \\ \mathbf{x}_l \end{bmatrix}$$

$$S.t. \quad \mathbf{A}_r\mathbf{x}_r + \mathbf{A}_l\mathbf{x}_l \leq \mathbf{b}$$

New problem reproducing the observed production plan by the way of the new total cost function

Simulations

Baseline 2012 Vs. ***Final CAP (1307/2013)*** → ***3 Greening requirements and sanction mechanisms***

Greening implemented into the model
Basic regulation

Measure	Greening
1. Crop diversification (arable land)	**10-30 ha: 2 crops** **> 30 ha: 3 crops**
Limits for crops	2 crops: < 75% (main crop) 3 crops: < 75% (main crop) < 95% (2 main crops)
Exception	- if entirely cultivated with crops under water - if > 75% (eligible agricultural area) is grassland or used for production of grass or other herbaceous forage or cultivated with crops under water and the remaining arable area < 30 ha - if > 75% (arable land) for production of grass or other herbaceous forage, land laying fallow and the remaining arable area < 30 ha
2. Permanent grassland	**Maintenance of permanent grassland and permanent pasture**
Maximum conversion	5%
3. EFA (arable land)	**5% Ecological Focus Area**
Mandatory	> 15 ha (arable land)
Exception	- if > 75% (eligible agricultural area) is grassland or used for production of grass or other herbaceous forage or cultivated with crops under water and the remaining arable area < 30 ha - if > 75% (arable land) for production of grass or other herbaceous forage, land laying fallow or used for cultivation of leguminous crops and the remaining arable area < 30 ha
EFA	- land left fallow - nitrogen-fixing crops (EFA weighting factor 0.7)
Entitled IPSO FACTO to the greening component	- organic farms

Greening implemented into the model
New issues

The model considers also new issues about the greening introduced after 2013 and subjected to discussions and critiques:

- Implementation criteria of types of EFA that allow production – in particular, **nitrogen-fixing crops** (delegated acts of CAP reform, March 2014)
  - increase of **weighting factor** from 0.3 to 0.7. Before 3.3 ha = 1 ha of EFA; then **just 1.4 ha = 1 ha EFA**. A request **much less demanding** for farmers. Severe critics from environmental groups.
- **Classification of leguminosae,** like clover and alfalfa (guidance document EC, July 2015)
  - If cultivated as monoculture they should be classified as a crop and **not** under the category **"grasses or other herbaceous forage"**, therefore also farms specializing in **alfalfa**, spread in the some Italian regions, are not excluded from greening but **they must diversify**.
- Complicated **System of sanction** for non-compliance with the greening requirements.
  - Matthews: "among the most **complex** that I have ever read".

Green payment reduction
Crop diversification

Non-compliance=**green payment reduction** + administrative penalties (from 2017)

Reduction of **eligible area for greening payment** (red_green_n) is the sum of the 3 reductions for the non-compliance with each of the 3 greening requirements:

$$red\_green_n = MIN\left[(red\_div_n + red\_perm_n + red\_efa_n), \left(\sum_s h_{n,s}\right)\right]$$

overall reduction shall not exceed Arable land

The «ratio of difference» (between 0 and 1) represents the level of non compliance with the greening requirements. E.g. the ratio for the threshold of main crop (75%) into the model is:

$$ratio\_div75_n = MAX\left\{\left[\left(Smax(h_{n,s}) - 0.75\sum_s h_{n,s}\right) / \left(0.25\sum_s h_{n,s}\right)\right], 0\right\}$$

area of **main crop** beyond the 75% threshold

Reduction of eligible area due to diversification: shall not exceed 50% of Arable land (100% after 3 years)

$$red\_div_n = \left\{MIN[(ratio\_div75_n + ratio\_div95_n), 1]\left(0.5\sum_s h_{n,s}\right)\right\}$$

Sum of ratios for the 75% (main crop) and 95% (2 main crops) threshold (<1)

Green payment reduction

EFA and maintenance of permanent grassland

Non-compliance=**green payment reduction** + administrative penalties (from 2017)

ECOLOICAL FOCUS AREA

Similar mechanism of diversification

«ratio» =non-compliance with EFA

Land left fallow

EFA weighting factor

Nitrogen-fixing crops

$$ratio\_efa_n = MAX\left\{\left[\left(0.05\sum_s h_{n,s}\right) - h_{n,f} - \left(h_{n,l} + h_{n,p} + h_{n,q} + h_{n,u}\right)0.7\right] \Big/ \left(0.05\sum_s h_{n,s}\right), 0\right\}$$

EFA required

EFA in the farm

Decrease of eligible area for EFA shall not exceed 50% of Arable land (100% after 3 years)

$$red\_efa_n = ratio\_efa_n \left(0.5\sum_s h_{n,s}\right)$$

MAINTENANCE OF PERMANENT GRASSLAND

In this case the reduction of eligible area for green payment into the model concerns the permanent grassland non-compliance with the maximum drop of 5%.

$$red\_perm_n = MAX\left\{\left[\bar{h}_{n,g}(1-0.05) - h_{n,g}\right], 0\right\} \Leftarrow \{org_n \neq 1\}$$

Administrative penalties

Non-compliance=green payment reduction + **andimistrative penalties** (from 2017)

The model includes the **administrative penalties** (pen_green_n), implemented as **further reduction** of the eligible area for receiving greening payment.

In this case «Ratio» represents the degree of total non-compliance with the greening at farm level.

$$ratio\_pen_n = [red\_green_n / (elig_n - red\_green_n)]$$

Penalties area graded according to the seriousness of the non-compliance.

In the model they are divided by 4 and limited to 25 % of the greening payment (from 2018 and onwards) :

Penalties	*Administrative penalties (pen_green)*	*if (ratio_pen< 3% AND red_green<2ha):*	*[pen_green=0]* No Penalties
		if (3%<ratio_pen< 20% OR red_green>2ha):	*[pen_green=(red_green*2)/4]*
		if 20%<ratio_pen< 50%:	*[pen_green=(eligible area-red_green)/4]*
		if ratio_pen> 50%:	*[pen_green=(eligible area)/4]* 25% of green paym.
Area eligible for receiving the greening payment (elig_green)		*(eligible area - red_green - pen_green)*	New eligible area for green payment
Green payment at farm level		*[(elig_green)*(green entitlement)]*	New green payment

New eligible area for green payment

Green «entitlement» estimated in First Step

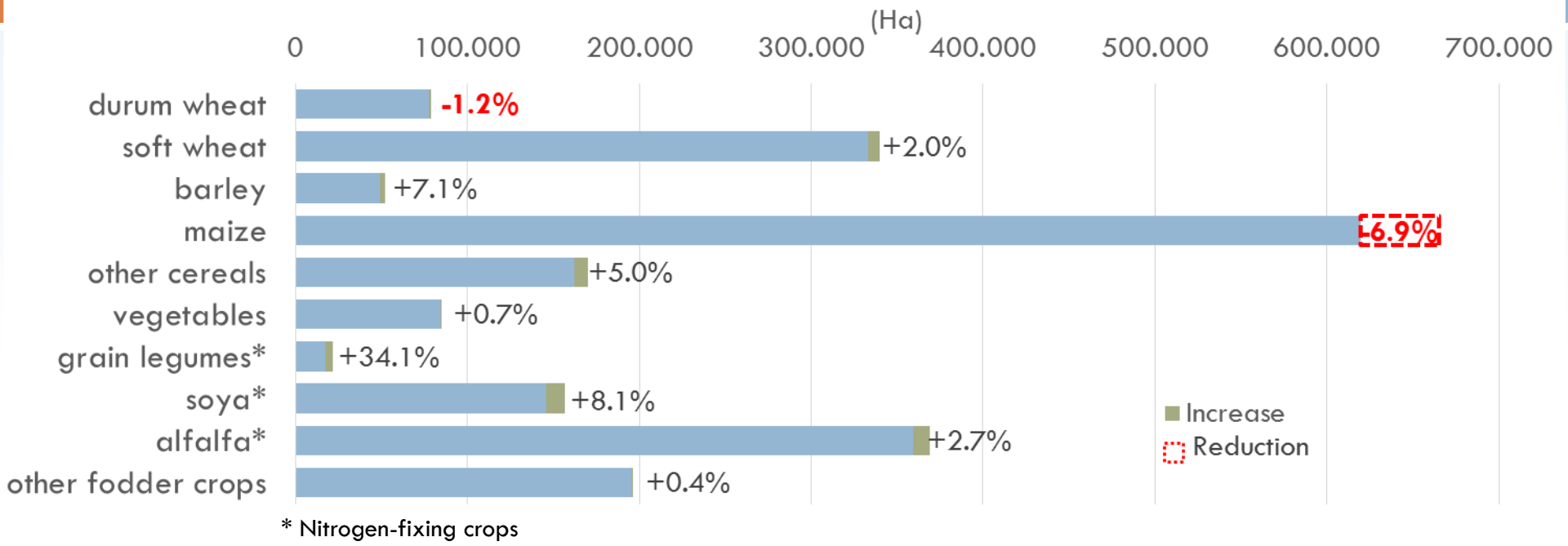
Results: effectiveness of system of sanctions

- ✓ **Strong incentives for farms to the greening compliance.**
  - ✓ i)The weakening of greening measures (much less demanding than the original Commission proposal),
  - ✓ ii) the relevant amount of green payments and
  - ✓ iii) the effective sanctions system

- ✓ Almost all farms affected by the greening requirements have convenience to fully apply these measures.
  - ✓ **In the observed baseline, about 17%** of the analysed farms **non-comply** with the greening requirements.
  - ✓ In the **assessment scenario more than 80% of these farms** decide to **fully respect the greening requirements,** while less than 20% (lass than 3% of analysed farms) has convenience to adopt a partial non-compliance with a consequent reduction of the payments.

The green payments decrease, and the additional penalties have been designed so that even small non-compliance with the requirements could produces a significant drop in the green payment, and in some cases also in the basic payment.

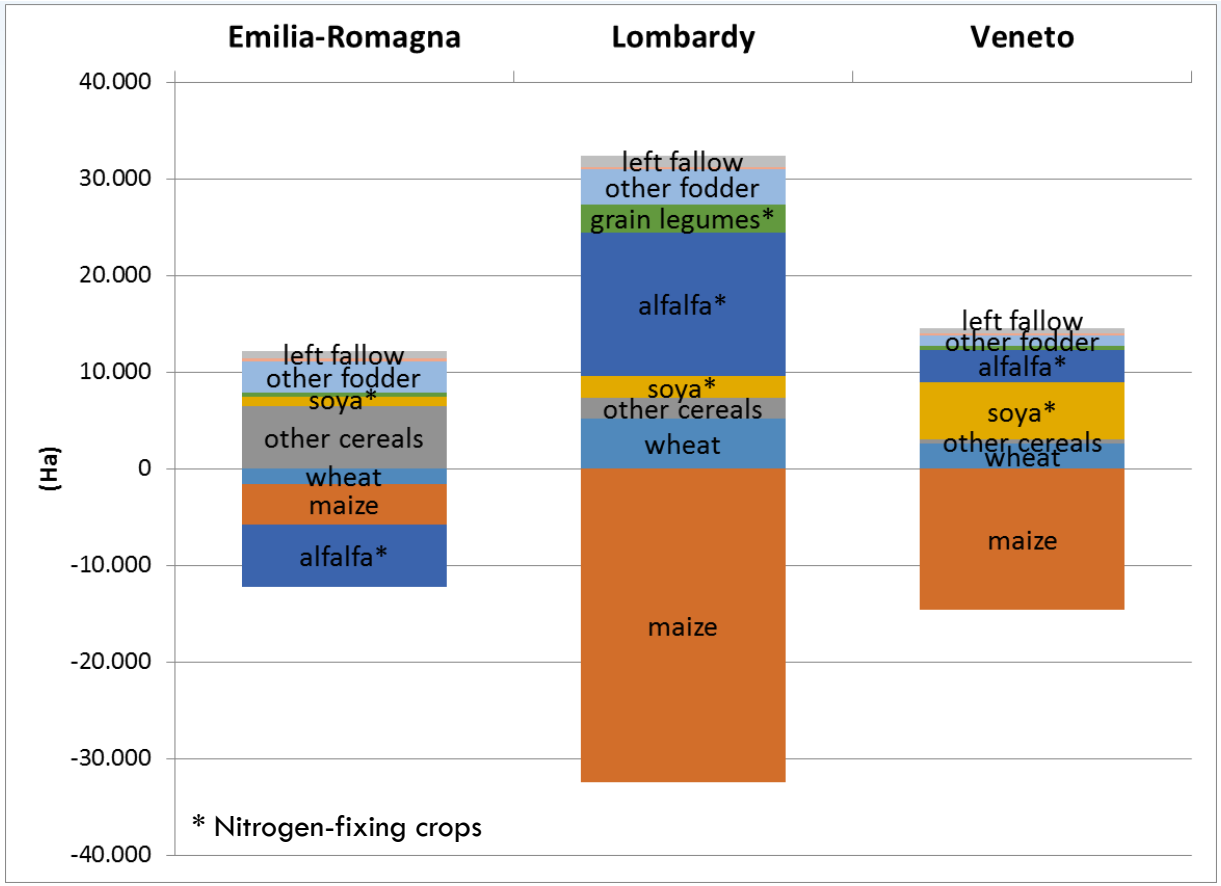
Impact of greening on land use



* Nitrogen-fixing crops

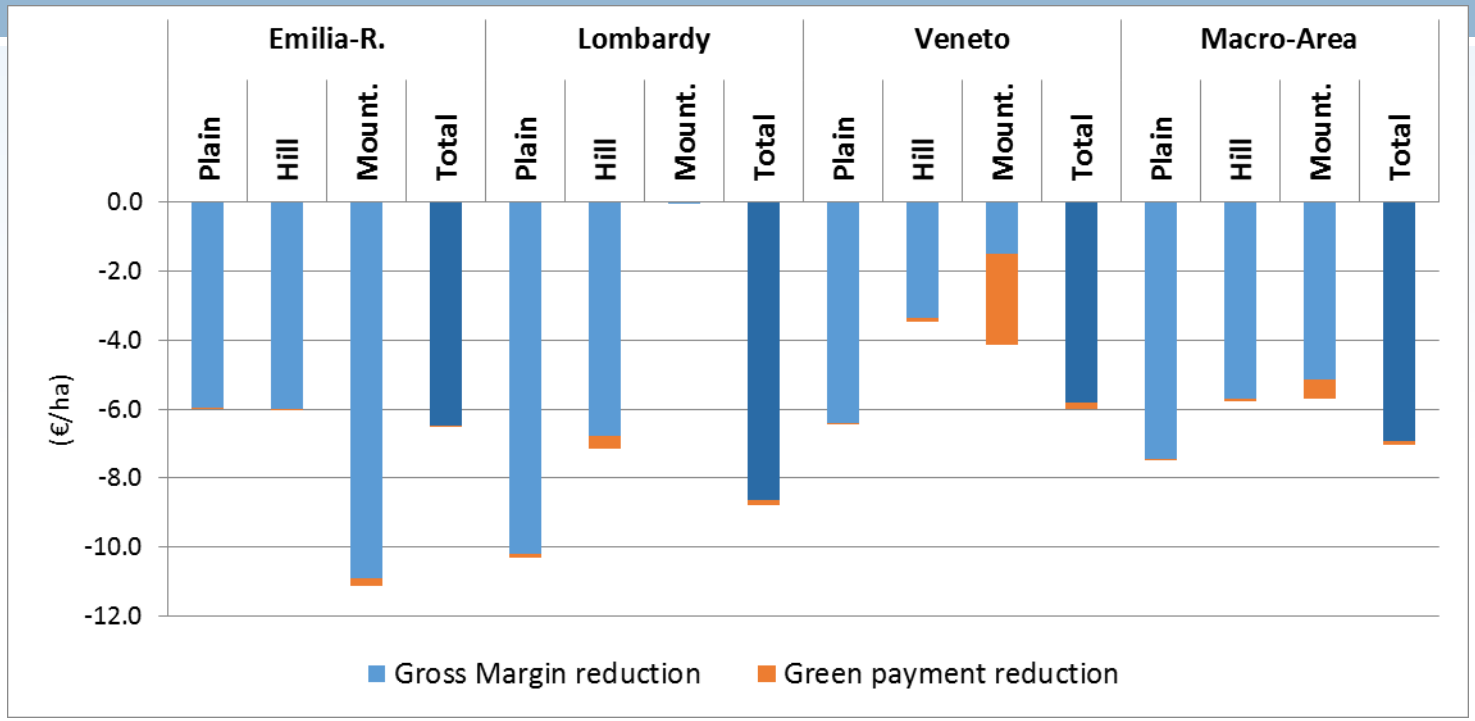
- ✓ Greening causes a decrease in maize and durum wheat production with an increase in nitrogen-fixing crop surface qualified as EFA (mainly soya an alfalfa)
- ✓ Two 'greening' effects on cereals:
  - ✓ The diversification obliges specialised farms to increase (or activate) the area of other crops.
  - ✓ Farms affected by the EFA requirement choose to reallocate cereal crops to ecological focus area in order to maintain more profitable crops.

Impact of greening on land use
Regional level



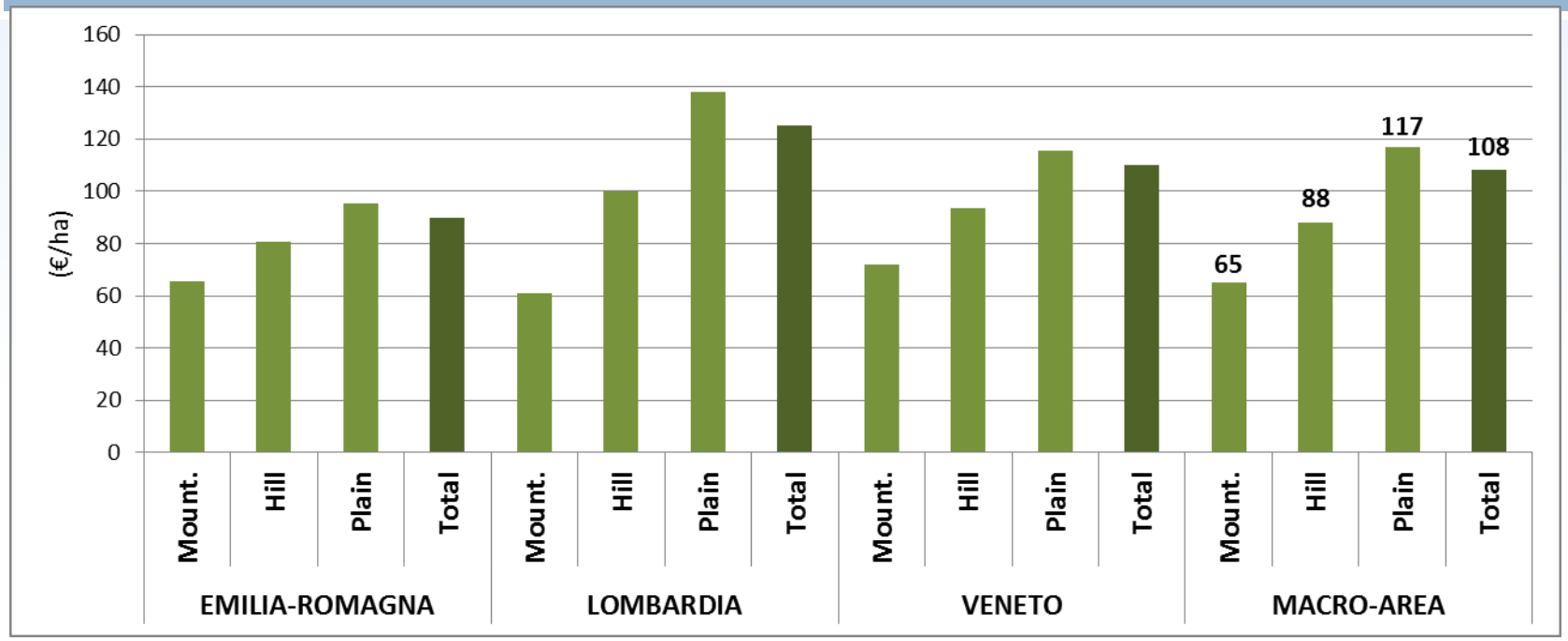
- ✓ At regional level in Lombardy and Veneto, maize is the only crop to drop but…the impact of greening concerns also farms specialized in other cereal productions (hidden by reallocation on maize)
- ✓ An exception to the increase in nitrogen-fixing crops concerns the alfalfa in Emilia-Romagna, due to the large number of highly specialized farms in this crop.
  - ✓ Direct consequent of the Commission clarification about leguminosae not "grasses or other herbaceous forage".

Impact on incomes



- ✓ In terms of gross margin the model estimates an overall income reduction lower than 0.5% in the analysed area, equal to -7 €/ha.
- ✓ The greatest economic impact concerns Lombardy (greater concentration of big farms highly specialized in maize growing, and therefore affected by the greening constraints).
- ✓ Mountain of Emilia-Romagna most affected by greening. This result, rather surprising, is related to the relevant share of farms specialized in alfalfa (often monoculture) in this area.

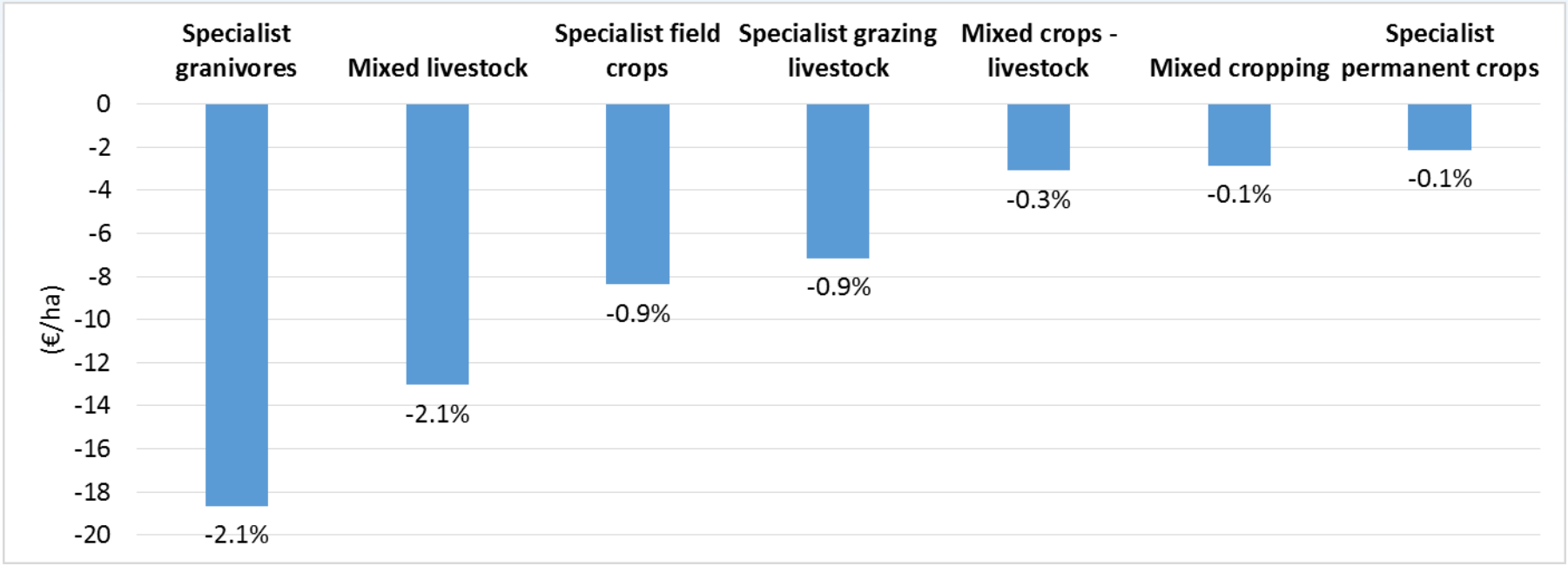
Amount of green payment



- ✓ In the macro-area, average green payment of 108 €/ha
- ✓ Lombardy is the region with the greatest impact of greening but also with highest green payment
- ✓ Overall green payment compensates the income reduction for the implementation of the greening requirements

Impact on incomes

Types of farm



- ✓ The negative economic impact of greening is greater for farms specializing in livestock (granivores) and field crops. This is because some of such farms are subject to the diversification constraint and the obligation to implement EFA, partly due to a low number of production processes and large areas of arable crops
- ✓ Not relevant effect on mixed cropping farms, already diversified and often with a lower surface.
- ✓ Permanent crops excluded by greening.

Conclusions

- **Two-step modeling approach** assesses **at farm level** the response of farmers to the **Greening requirements,** taking into account the complex **mechanism of sanctions**
- The overall **greening impact** on farms for the 3 regions of Northern Italy is rather **modest,** but some specific areas/crops significantly affected.
- Greening **affects mainly cereal crops** (maize and durum wheat production) with an **increase in nitrogen-fixing crop** surface (mainly soya an alfalfa) qualified as EFA, but….
- In Emilia-Romagna relevant impact on alfalfa production
- Overall income reduction lower than 0.5% in the analysed area, equal to -7 €/ha
- **Strong incentives to the greening compliance:** weakening of greening measures, relevant amount of green payments, effectiveness of sanctions system.

Thank you for your attention

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