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A two-step modelling approach for the impact assessment of greening in Italy

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Abstract

Two of the most important features of the CAP reform 2014-2020 are the system of direct payments redistribution and the establishment of the “greening” linked to the 30% of the national ceiling. Both these features may affect in a very different way even similar farms located in the same area; therefore specific tools able to estimate the effects on the individual farmers behaviour are needed.

The paper proposes a two-step modelling approach for the impact assessment of greening at farm level, able to estimate: i) the redistributive effect of the reform on the greening payment by means of CAP2020-Simulation tool, based on the Integrated Administration and Control System database (IACS); ii) the farms behaviour, in terms of land use and income effects, due to the greening implementation, taking into account the whole set of measures and the sanctions system. The latter step was carried out with a positive mathematical programming (PMP) model on more than 2,000 farms from the Farm Accountancy Data Network (FADN), located in three regions of Northern Italy.

Although the overall greening impact on the analysed area is rather modest, some specific areas and productions are affected to a greater extent: greening causes a decrease in maize and durum wheat production replaced by nitrogen-fixing crop surfaces qualified as EFA. The consequent income reduction is lower than 0.5% (-7€/ha). Almost all farms have convenience to fully apply the greening constraints. The weakening of greening measures, the relevant amount of greening payments and the effectiveness of the sanctions system represent a strong incentives for farmers to fully comply with the compulsory practices of the greening.

Keywords: CAP reform, Internal convergence, Greening, Penalties, Positive mathematical programming (PMP)

Introduction

On 16 December 2013, the Council of EU Agriculture Ministers formally adopted the Common Agriculture Policy (CAP) reform package, which sets out the new rules related to the implementation of the First Pillar for European farms in the next 5-year period.

A sensitive element of the flexibility and 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, reducing disparities and link to historical references (EC, 2010).

In the final agreement, beside the uniform payment per hectare – already implemented in some Member States and included as a political choice in the European Commission proposal in 2011¹ – a process of progressive and partial *convergence* of payments unit value to the national average was introduced. Its implementation in national legislations is one of those tasks assigned to Member States and represents an important example of that flexibility which strongly characterizes the CAP reform. A relevant share of the total amount of resources earmarked to direct payments, equal to 30%, will be allocated on the greening payment, conditioned to the production of public goods (the so-called “greening”).

Greening was one of the major areas of discussion between the Commission, the Parliament and the Council (Matthews, 2013). It was subject to intense lobbying by interest groups and to

¹ The European Commission proposal set that all payment entitlements in a Member State would have a uniform unit value as from 2015 or, at the latest, as of the claim year 2019 (Art. 22.1 and Art. 22.5 of COM(2011) 625 final).

severe ex-post critiques (Swinnen, 2015). The three greening requirements established by the final CAP agreement are: i) crop diversification; ii) maintenance of permanent grassland; iii) allocation of arable land to Ecological Focus Area (EFA). However, Regulation (EU) 640/2014 settled a complex system of reduction of greening payment for partial or full non-compliance with the greening requirements. This introduces, within the assessment of the impact of greening, the evaluation of farmers behaviour in the level of compliance with the greening requirements, in consideration of the consequent reduction of payments.

The combination of a broad margin of flexibility, on one side, and the feature of the new DPs, characterized by a farm specific implementation, on the other side, makes the overall assessment of the CAP reform particularly complex (Anania & Pupo, 2015). Moreover, also the greening measures, and the related system of sanctions, have been thought up for a specific application at farm level. The greening payment, resulting from the convergence process, and the application of greening constraints may affect in a very different way similar farm located in the same geographical area. Specific tools able to estimate and evaluate the effects of the greening measures on the individual farmer's behaviour are then needed (Louhichi et al., 2015; Solazzo et al., 2014; Waş et al. 2014).

Recently, Waş et al. (2014) proposed an optimization model expanded with a non-linear cost function from the original Howitt's PMP approach in order to show the impact of greening on Polish farms. An evaluation of the greening effect in Netherland is provided by the analysis of Boere and van Kooten (2015), where representative individual FADN farms are part of a crop allocation model calibrated using PMP.

Louhichi et al. (2015) evaluated the effects of diversification, and system of sanctions, using IFM-CAP model, a static positive mathematical programming model, which builds on the EU-FADN data, potentially complemented by other relevant EU-wide data sources such as the Eurostat, Farm Structure Survey (FSS) and CAPRI databases.

The objective of this paper is to develop a two-step modelling approach for the impact assessment of greening at farm level, able to estimate: i) the amount of greening payment per farm for 2019 and ii) the farms behaviour, in terms of land use (and consequent income effects), due to the greening application, taking into account the potential reduction of payment for full or partial non-compliance. Basic and greening payments were estimated by means of the *CAP2020-Simulation tool*, based on micro data at the farm level covering the whole Italy. While, the impact of greening measures was then assessed by a positive mathematical programming (PMP) model (Heckeley et al., 2012 and Paris and Howitt, 1998), that implements the greening constraints and the complex system of reduction of greening payments to evaluate the response of farms in terms of land use change and resulting income reduction. This methodology can provide clear and useful results to policy makers responding to a large spectrum of policy analysis needs.

Cap Reform post-2013 and national choices

The strategic aims of the new CAP concerned with sustainable food production, a balanced territorial development, to enhance the differentiation of agriculture and rural areas, and the sustainable management of natural resources, to ensure the production of public goods and to offset the effects of climate change (Hart and Little, 2012; Matthews, 2012).

Beyond these main objectives of the CAP, the reform aims to achieve a more balanced distribution of direct payments by means of a mechanism of internal convergence.

This DPs reform represents the end of the SPS and allows to overtake the old reference period (mainly 2000-2002) in those countries still implementing the historic model, like Italy. It became increasingly difficult to justify the existence of individual differences in the level of

support per hectare. The link to historic reference will progressively weaken over the next five years and this process will determine a sensitive redistribution of direct support from those with a unit value historically high at the benefit of those with unit value lower than the national average, so-called internal convergence.

The internal convergence is a mechanism introduced to move towards a more similar level of support per hectare, according to which Member States with historic SPS were allowed to take historical references into account when calculating the value of support for farmers in 2019, provided that:

- payment entitlements with an initial unit value lower than 90% of the national/regional average in 2019 should, for claim year 2019 at the latest, have their unit value increased by at least one third of that difference (the so called “Irish model”);
- payment entitlements in 2019 should not have a unit value lower than 60% of the national/regional average in 2019 (the so called “minimum guaranteed level”);
- Member States should finance this convergence by reducing, on the basis of objective and non-discriminative criteria, the value of payment entitlements that exceeds the average. In this context and in order to avoid unacceptably disruptive losses for certain farmers, Member States could limit this reduction to 30% of the initial value of the concerned entitlements, even if such a limitation does not allow for all payment entitlements to reach 60 % of the average value for 2019 (the so called “stop loss” or “maximum decrease”).

Italy chose to implement the payments at national level adopting the so called "Irish model" (aiming to a partial convergence in 2019) with the maximum lost of 30% and the “individual” greening payment, quantified as a share of the basic payment by single farms.

The greening payment, equal to 30% of the total amount of resources earmarked to direct payments, is conditioned to the production of public goods (so-called “greening”). Indeed the European Commission has emphasized the growing need for green agriculture, which guarantees the conservation of biodiversity, the maintenance of soil fertility, conservation of water resources and acts as a buffering agent with respect to climate change. The Commission's proposal was followed by the amendments of the European Parliament and the Council that "eased" the greening requirements (Solazzo et al., 2015; EP, 2013; Council of EU, 2013). The final CAP agreement established three greening requirements, (i) crop diversification for farms with more than 10 ha of eligible arable land, (ii) maintenance of permanent grassland, and (iii) allocation of 5% of arable land to ecological focus area (EFA) for farms with more than 15 ha of eligible arable land. Units of the holding used for organic production are exempt from greening requirements and entitled ipso facto to the greening payment; moreover, it was established that the exemption (from crop diversification and EFA) for farms with over 75% grassland, fodder or underwater crops, where the remaining arable area was not above 30 ha (European Parliament and Council of the EU, 2013).

For the crop diversification, the farmers must cultivate at least 2 crops when their arable land exceeds 10 hectares and at least 3 crops when their arable land exceeds 30 hectares. The main crop may cover at most 75% of arable land, and the two main crops at most 95% of the arable area. Maintenance of permanent grassland establishes that Member States must designate environmentally sensitive permanent grasslands that cannot be ploughed or converted. In addition, Member States must maintain the ratio of permanent grassland to total agricultural area so that it does not fall by more than 5% compared to the reference year.

The ecological focus area shall cover at least 5% of the arable area of the holding for farms with an arable land over 15 hectares. One of the most debated issues was related to the specification of the criteria implementation of those types of EFA that allow production, in particular nitrogen-fixing crops (EC, 2014a).

Commission's Delegated Regulation 640/2014 introduce a complex system of greening payment reduction and administrative penalties in the case of non-compliance with the greening requirements (table 1).

Table 1: Greening payment reduction and administrative penalties in the case of non-compliance with the greening requirements

Crop diversification	Ratio of difference for crop diversif.: main crop (ratio_div75)	Share of the main crop beyond 75% of arable land/ area required for the other crop groups (25%)	
	Ratio of difference for crop diversif.: 2 main crops (ratio_div95)	Share of the two main crops beyond 95% of arable land/ area required for the other crop groups (5%)	
	Non-compliant area for crop diversif. (red_div)	$\text{MIN}[(\text{ratio_div75} + \text{ratio_div95}), 1]^1 * (50\% \text{ of arable land})$	
Permanent grassland	Non-compliant area for perm. grassland (red_perm)	Non-compliance area with the third subparagraph of Article 45(1) of Regulation (EU) No 1307/2013 (conversion or ploughing of permanent grasslands which are environmentally sensitive); Non-compliance area with the obligations as referred to in Article 44 of Delegated Regulation (EU) No 639/2014 (maintenance of the ratio of permanent grassland).	
	Ratio of difference for EFA (ratio_efa)	Share of the (missing EFA/EFA required)	
Efa	Non-compliant area for EFA (red_efa)	$\text{ratio_efa} * (50\% \text{ of arable land})$	
Total non-compliant area (red_green)		$(\text{red_div} + \text{red_perm} + \text{red_efa})^2$	
Reduction of the greening payment		$[\text{red_green} * \text{green_ent}^3]$	
	Proportion of non-compliant area (ratio_pen)	Difference between red_green and [eligible area - red_green]	
Penalties	Administrative penalties (pen_green)	if (ratio_pen < 3% AND red_green < 2ha):	pen_green = 0
		if (3% < ratio_pen < 20% OR red_green > 2ha):	pen_green = $[(\text{red_green} * 2) * (\text{green_ent})] / 4$
		if 20% < ratio_pen < 50%:	pen_green = $[(\text{eligible area} - \text{red_green}) * (\text{green_ent})] / 4$
		if ratio_pen > 50%:	pen_green = $[(\text{eligible area}) * (\text{green_ent})] / 4$
Total sanction for non-compliance with the greening requirements		Reduction of the greening payment + Administrative penalties	

¹ The sum of the ratios of difference shall not exceed 1.

² The sum of the reductions expressed in hectares shall not exceed the total number of hectares of arable land.

³ green_ent = unit value of the greening payment (€/ha).

⁴ Table represents administrative penalties for 2018 and onwards: divided by 4 and limited to a maximum of 25% of the amount of the farmer's greening payment. No administrative penalties would apply in 2015 or 2016; in 2017 the penalties shall be divided by 5 and limited to 20% of greening payment.

Source: compiled based on Commission's Delegated Regulation 640/2014.

The payment reduction affect the area eligible for receiving the greening payment and it is the sum of the three reductions, based on the non-compliant area with each of the three greening requirements. This sum cannot exceeds the total arable land of the farm. For the maintenance of permanent grassland the reduction of the area to be used for the calculation of the greening payment concerns the land non-compliant with the third subparagraph of Article 45(1) of Regulation (EU) No 1307/2013 or with Article 44 of Delegated Regulation (EU) No

639/2014. More complex is the reduction mechanism linked to crop diversification and EFA requirements. In these cases it is necessary to calculate the so-called “ratio of difference” (between 0 and 1), that represents the share of non-compliant area with the requirements.

Both in the case of diversification and EFA requirement, the area to be used for the calculation of the greening payment shall be reduced by 50 % of the total area of arable land determined multiplied by the ratio of difference. Therefore each of the two greening requirements account, for the first three years of non-compliance², for 50% on the total reduction of greening payment.

A farm not fully satisfying the requirements for the ‘green’ payment, starting from 2017 not only will be affected by reduction of the area eligible for greening payment, but will incur an administrative penalty that will be gradually implemented. The penalties are graded according to the seriousness of non-compliance with the greening. If the level of non-compliance is lower than 3% (or 2 ha) no penalties will be applied while if the level is greater than 50%, the penalty will be equal to 20% of greening payment in 2017 and 25% in 2018 and onward (EC, 2014b).

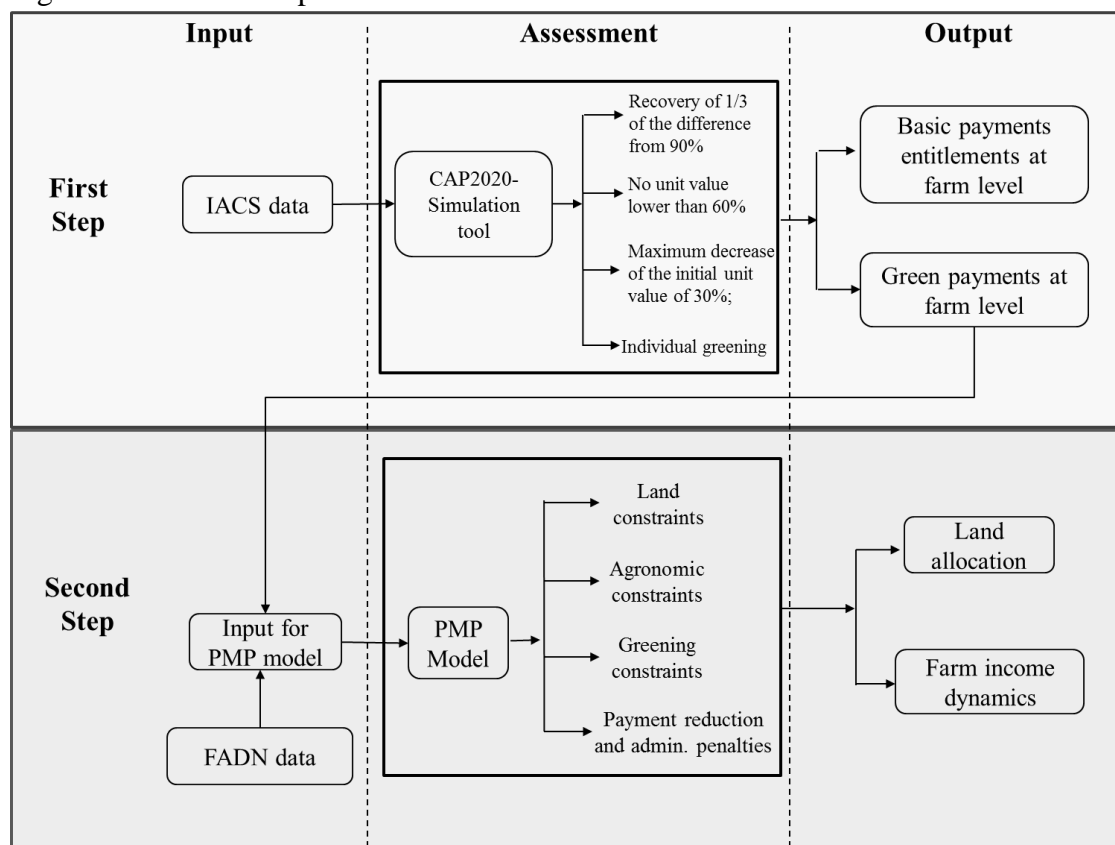
Data and Methodology: the Two-step model structure

The two-step model proposed in this contribution is based on the Italian national choices and European legislation on the internal convergence of direct payments and the greening application (figure 1).

The first step estimates the amount of basic and greening payment per farm for 2019, while the second step assesses the farmers behaviour due to the greening application, with the possibility to fully or partially non-comply with mandatory requirements, facing a consequent payment reduction. Indeed, even though the greening practices are mandatory by regulation, the model leaves the farmers the possibility to opt the level of compliance with them on the basis of economic advantage, with a trade-off between income reduction for a full compliance with practices versus green direct payment reduction as a consequence of a non-full compliance. This approach allows to assess the effectiveness of the measures and of the sanction system as a whole.

² For the subsequent years shall be the total area of arable land multiplied by the applicable ratio of difference.

Figure 1: The Two-step model structure



The first step: payment entitlements estimation

The first step concerns the estimation of the entitlements under the basic payment scheme and green direct payments. For this part, a Simulation tool was developed (CAP2020-Simulation tool), based on micro data at the farm level covering the whole Italy.

The tool was developed, in accordance with the Italian authority decisions, in order to assess the effects of internal convergence of direct support distribution at farm, territorial and sector level. To this aim, a complete national dataset at farm level, from the Integrated Administration and Control System (IACS³), storing information on payments received by farmers for 2012 under SPS and specific support of article 68 (regulation (EC) n. 73/2009) was exploited together with data at farm level from the Farm Register gathering information on land use and on potential eligible agricultural area (2014).

The use of IACS data, with about 1,196,000 Italian farms, and its match with the Farm Register, with more than 2 million of farms, is necessary for the proper implementation of convergence process. Indeed, as already stressed above, if the implementation and impact of this reform is “farm specific”, the convergence mechanism adds another element of complexity: it does not allow to deal with payment entitlements (PEs) quantification separately as each of them affects the value of all the others. Thus they should be determined altogether simultaneously (Pierangeli et al., 2015).

The tool allows to estimate, for the whole Italy, the Basic Payment entitlements and the Green direct payment that each farm will receive as from 2015 to 2019, moving from the eligible

³ Source: National and Regional Payment Agencies.

payments received in 2012 (SPS and art. 68 for quality of tobacco and *danae racemosa* flowers). Indeed the tool, based on the Italian authority decisions, implements the internal partial convergence of entitlements and the calculation for the Green direct payment as a proportion of the BPS total value, reported in the Table 2.

The tool is structured into three steps, in order to implement the internal partial convergence above described:

- i) implementation of the so called "Irish model" of partial convergence;
- ii) implementation of the "minimum guaranteed level" of 60%;
- iii) "maximum loss", with a maximum decrease of -30% of the initial unit value.

The convergence of the payment entitlements with a value above the average should also take account of the estimated resources available for payment entitlements.

Table 2: Italian national choices for direct payments implemented into the CAP2020 – Simulation tool

Measure	Description	Reg.
Minimum size per holding	5.000 sqm	art. 24.9
Agricultural area	Eligible hectares	art. 32.5
Regionalisation	Italy as a unique region	art. 23
BPS ceiling	58% of Annex II annual ceilings (incl. National reserve 2015 and Small farmer payment)	art. 22.1
Increase BPS ceiling	3%	art. 22.2
National reserve	3% of BPS	art. 30.3
Convergence method	1° step "Irish model"	art. 25.4 (1)
	2° step minimum guaranteed level: 60% of national average in 2019	art. 25.4 (3)
	3° step "stop loss": -30% of initial unit value	art. 25.7
Green direct payment	30% of Annex II annual ceilings	art. 47
	Payment calculated as a proportion of the total value of the payment entitlements that the farmer received under the BPS for each relevant year	art. 43.9 (3)

Source: Pierangeli and Ruscio (2015)

The second step: the impact assessment of the greening

The values of the greening payments estimated at farm level in the first step were used, in the *second step*, as exogenous information within a Positive Mathematical Programming (PMP) model (Paris and Howitt, 1998) for the assessment of the economic and productive impacts of greening measures on farmers behaviour. To this aim data on the green direct payments per farm were matched with data from FADN database by physical code or VAT number.

This analysis was based on the Italian FADN Database for the 2012 accounting year, using a sample of 2,038 farms located in three regions of northern Italy: Emilia Romagna (711 farms), Lombardy (624) and Veneto (703). The FADN data includes the following variables: land use, yield, output prices and specific costs per activity at farm level. Moreover other descriptive variables on farm status (e.g. organic or conventional farming) were used to identify greening requirements and exclusion criteria. As stressed before, the CAP reform

have been thought up for a specific application at single farm level, therefore also the greening assessment was carried out at farm level in the model. In order to make the simulation results more consistent with farm typologies and agricultural production systems of the analysed area, the FADN weighting system was used inferring the results at regional level (Solazzo et al., 2014; Council of EU, 2009).

The model implements the complex architecture of the green policy, as described in Table 3.

Table 3: Greening constraints included into the model

MEASURES	CONSTRAINTS
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% (at farm level)
3. EFA (arable land)	5%
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 (<i>EFA weighting factor 0.7</i>)
Entitled IPSO FACTO to the greening component	- organic farms

Source: own elaboration based on regulation (EU) n. 1307/2013 and regulation (EU) n. 639/2014

Organic farms were excluded *ipso facto* from the greening requirements and also other exemption criteria, as farm specialisation in production of grasses, other herbaceous forage or crops under water, were implemented into the model. The definition of ‘crop’ used in the model is in line with the provisions of Regulation 1307/2013 (Article 44, paragraph 4) for crop diversification thresholds. Regarding to the maintenance of permanent grassland, the threshold of 5% has been introduced at the farm level in the modelling. This is because, although Italy has chosen the application at national level, as established by Regulation (EU)

1307/2013 (Article 45, paragraph 3) if this threshold is breached, the obligations to reconvert land to permanent grassland will be imposed by Member State at holding level. While, in order to meet the EFA constraint, the farms may reallocate land to the fallow area, with a cost of land management of 100 €/ha, or allocate the land to one or more of the nitrogen-fixing crops, applying the weighting factor (0.7).

The PMP model implements also the complex system of reduction of greening payments and administrative penalties. It is able to evaluate the farms response and adaptation in terms of change in land use and resulting income reduction. Every single farm have the possibility in the model to fully, partially or not respect the greening constraints with endless possibilities of partial application of the requirements. This was possible taking into account in the objective function the resulting reduction (and penalty) in the payment, related to the degree of non-compliance with the greening requirements chosen by the farmers.

In particular, every single farm into the model, if affected by the greening, can decide full compliance or the (partial or full) non-compliance taking into account the resulting greening payment reduction and administrative penalties (for 2018 and onwards), as reported in table 1⁴.

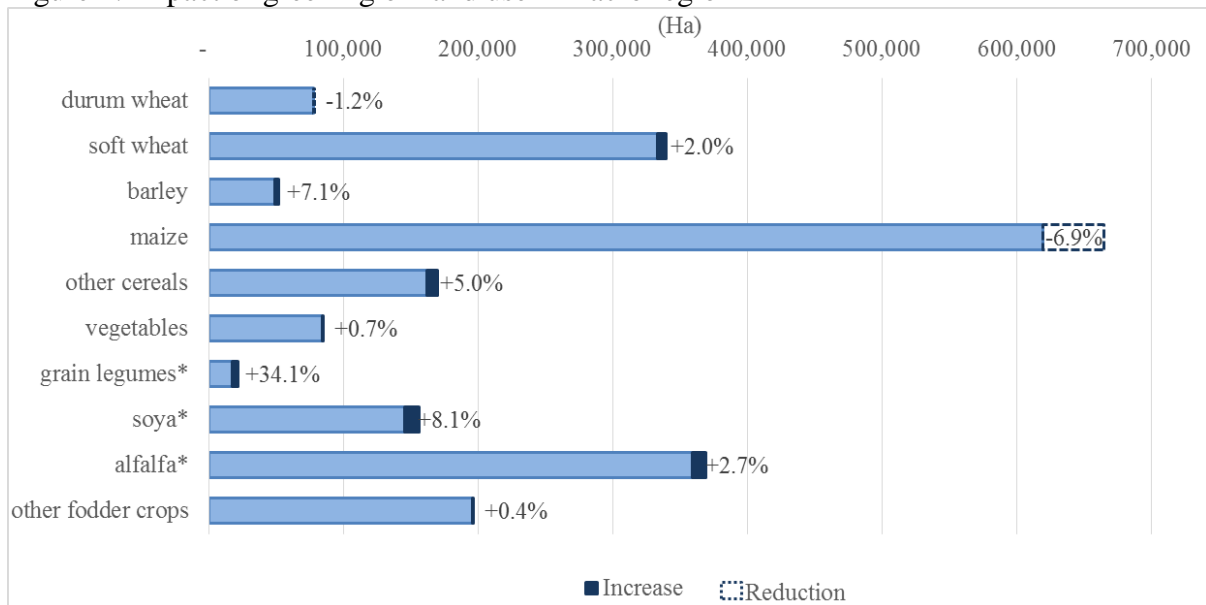
Results

The main findings on the three Northern Italy regions (Lombardy, Emilia-Romagna and Veneto) show that the weakening of greening measures much less demanding than the original Commission proposal, along with the relevant amount of greening payments and with the payment reduction system are strong incentives to the compliance with the greening requirements. Almost all farms affected by those agricultural practices have convenience to fully apply the greening constraints. The greening payments reduction, and the additional penalties have been designed so that even small non-compliance with the requirements could cause significant cuts in the payment. About 17% of the analysed farms does not comply with the greening requirements in the baseline (observed scenario 2012). Most of these farms decided to meet fully the greening requirements, while less than 20% (less than 3% of analysed farms) has convenience to adopt a partial non-compliance with a consequent reduction of the payments.

In terms of changes in the land use, greening causes a decrease in maize and durum wheat production with an increase in nitrogen-fixing crop surface, mainly soya and alfalfa, qualified as EFA (figure 2).

⁴ For the permanent grassland requirement, the greening payment reduction into the model concerns the permanent grassland area non-compliant with a maximum drop of 5%. For the other greening requirement, the system of sanction was implemented exactly as described in the table 1.

Figure 2: Impact of greening on land use – Macro region



* Nitrogen-fixing crops

Source: own elaboration

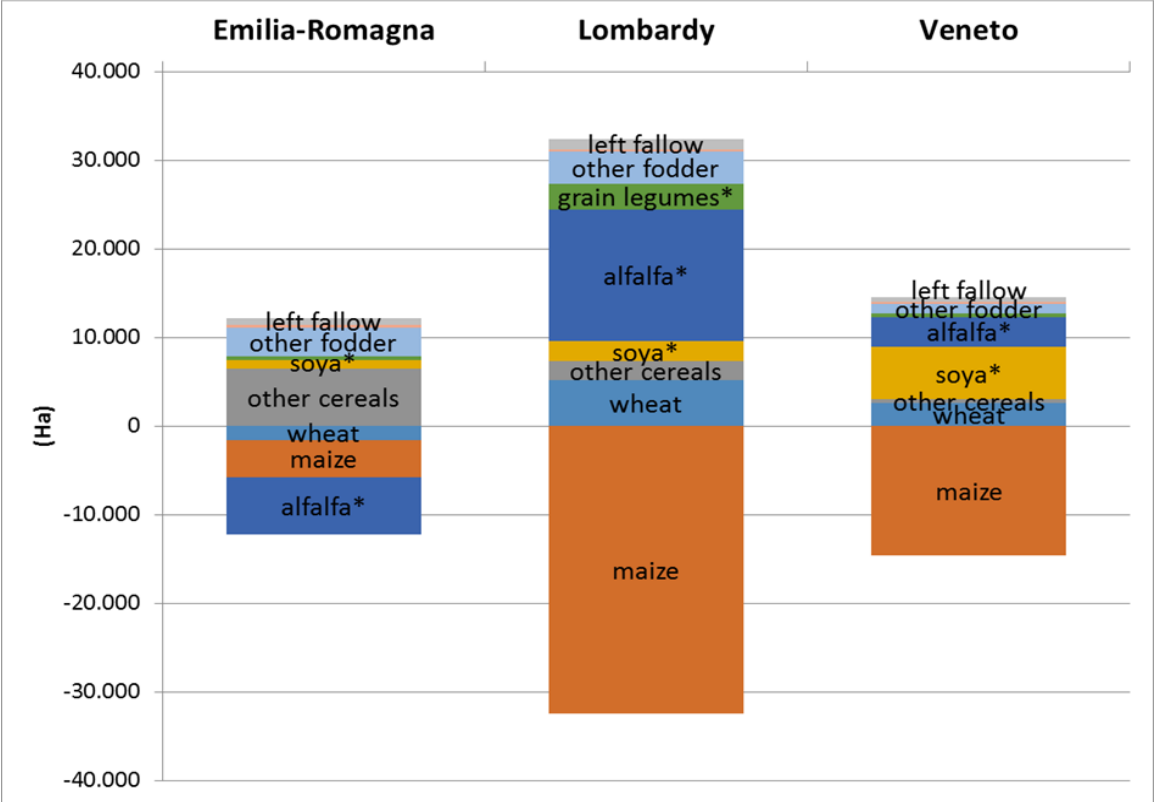
At regional level it should be noted that although in Lombardy and Veneto, the area with maize is the only one to drop, the impact of greening concerns also farms specialized in other cereal productions (figure 3). The latter, in fact, in many cases reduce the area for the main crop, but this effect is hidden at the regional level by the relevant reallocation of maize surface to other cereal crops by large and specialised farms.

Overall, the reduction in cereal area is due to two ‘greening’ effects. The diversification obliges specialised farms to increase (or activate) the area of other crops (in particular, other cereals). On the other hand, farms affected by the EFA requirement choose to reallocate cereal crops to ecological focus area in order to maintain more profitable crops. As said above, the greatest reduction is in maize production, especially in the Lombardy region, due to the large number of farms highly specialized in this production, which will have to change their production plans, introducing new crops and moving cropped areas to EFA.

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. On July 2015, in a guidance document on the implementation of greening by member states, the Commission has clarified that species belonging to the botanical family of leguminosae like clover and alfalfa, cultivated as monoculture should be classified as a crop and not under the category “grasses or other herbaceous forage”. Only when these species are sown in mixture with grasses or herbaceous forage, should be classified as “grasses or other herbaceous forage”. This implies that farms specializing in alfalfa are not excluded from greening. Therefore, farms with more than 10 hectares and monoculture of alfalfa, spread in the Emilia Romagna region, will have to reallocate 25% of the area for other crops. This interpretation will be implemented as from 2016⁵.

⁵ Where for the 2015 claim year farmers, acting in good faith, considered pure leguminous crop such as alfalfa as "grasses" further to letter (d) of Article 44(4) of the Regulation (EU) 1307/2013 in respect of fulfilling the crop diversification requirement, those farmers, exceptionally in the claim year 2015, should not face negative consequences (DSCG/2014/39 FINAL- REV 1).

Figure 3: Impact of greening on land use – at regional level

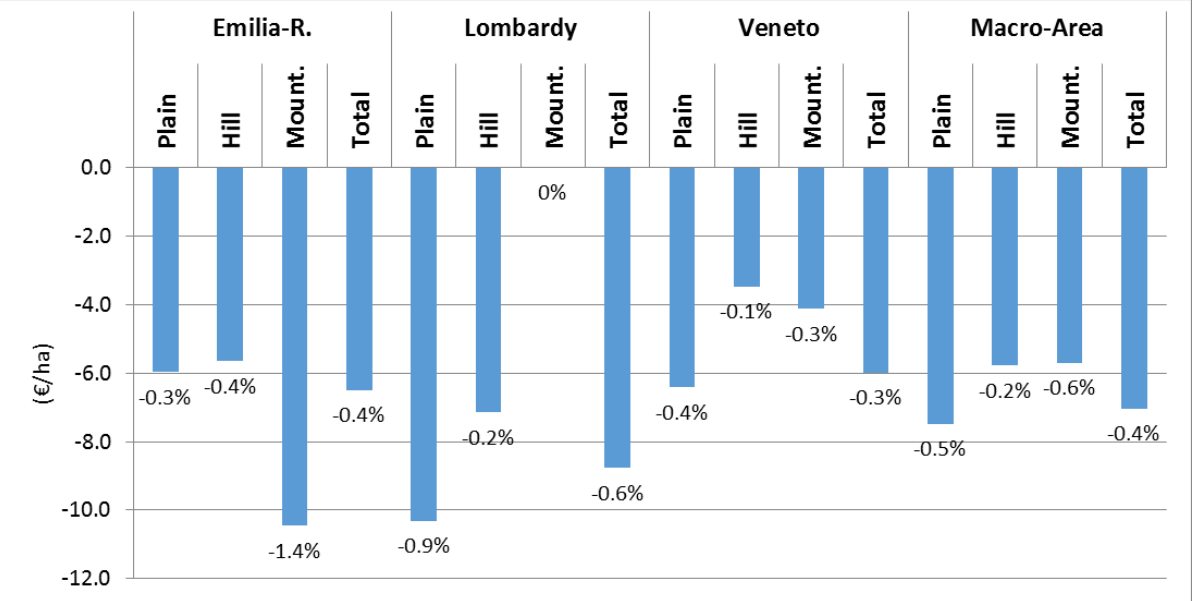


* Nitrogen-fixing crops

Source: own elaboration

In terms of lower gross margin incurred by farmers for fulfilling the greening requirements, the model estimates an overall income reduction lower than 0.5% in the analysed area, equal to -7 €/ha. At regional level, the greatest economic impact of greening concerns Lombardy, where there is a greater concentration of big farms highly specialized in maize growing, and therefore affected by the greening constraints (figure 4).

Figure 4: Income reduction due to the greening requirements – by altitude

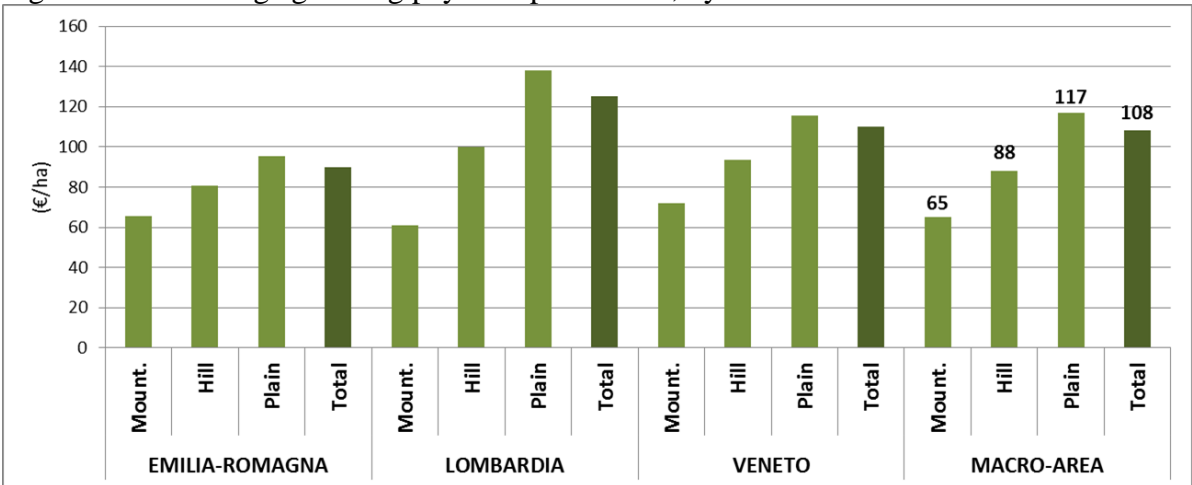


Source: own elaboration

Breaking down the result by altitude, the farms most affected by greening are located in the mountain of Emilia-Romagna (-1.4%). This result, rather surprising, is related to the interpretation of alfalfa as a crop to be diversified. Several farms in the mountain of this region cultivate only alfalfa, and will be therefore affected by the greening. Moreover the limited possibilities of alternative productions available to reallocate the surface at this altitude represent an additional burden. The Veneto shows instead the lowest impact of greening in the analysed area, with an average reduction of 0.3% of incomes at regional level, almost entirely on farms in the plain area.

In the analysed macro-area, the average greening payment per hectare, estimated in the first step by the CAP2020-simulation tool is equal to 108 €/ha (figure 5). Lombardy is the region with the greatest impact of greening but also with highest greening payment per hectare, linked to the high historical payments in this region. Overall greening payment compensates the income reduction for the implementation of the greening requirements.

Figure 5: The average greening payment per hectare, by altitude



Source: own elaboration

Conclusions

In this paper we used a Two-step modelling approach to asses at farm level the response of farmers to the greening requirements, taking into account the complex mechanism of sanctions. The greening payments per hectare estimated by the CAP2020-Simulation tool (in average circa 108 €/ha for 2019) is significantly higher in the plain area and in Lombardy region, with important differences among regions and altitudes.

The main findings show that almost all farms affected by those agricultural practices have convenience to fully apply the greening constraints. The greening payments reduction, and the additional penalties have been designed so that even small non-compliance with the requirements could cause significant cuts in the payment.

The overall greening impact on farms, estimated by a positive mathematical programming (PMP) model, is rather modest for the analysed area of Northern Italy, however some specific areas and production are affected to a greater extent.

In terms of changes in the land use, greening causes a decrease in maize and durum wheat production with an increase in nitrogen-fixing crop surface, mainly soya an alfalfa, qualified as EFA. 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. According to Commission guidance document, alfalfa cultivated as monoculture should be classified as a crop and a certain number of specialized farms in Emilia Romagna must diversified.

Overall the income reduction due to the greening application in the analysed area is lower than 0.5%, about -7 €/ha. At regional level, the greatest economic impact of greening concerns Lombardy, where there is a greater concentration of big farms highly specialized in maize growing, and therefore affected by the greening constraints. But Lombardy is also the region with the highest greening payment per hectare, linked to the high historical payments in this region. Breaking down the result by altitude, the farms most affected by greening are located in the mountain of Emilia-Romagna. This result, rather surprising, is related to the recent interpretation of alfalfa as a crop to be diversified. Several farms in the mountain of this region cultivate alfalfa as monoculture, and will be therefore affected by the greening. Overall, greening payment compensates the income reduction for the implementation of the greening requirements in the analysed area. Therefore, the weakening of greening measures, much less demanding than the original Commission proposal, along with the relevant amount of greening payments and effectiveness of sanctions system are strong incentives to the compliance with the greening requirements.

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