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Impact assessment of greening and the issue of nitrogen-fixing crops

Evidence from northern Italy

Roberto Solazzo, Michele Donati and Filippo Arfini

Abstract: *In the CAP reform 2014–2020, the ‘green’ component of direct payments remunerates environmental services and includes three greening requirements: crop diversification, maintenance of permanent grassland and establishment of an ecological focus area (EFA). This paper evaluates the effect of ‘greening’ and payment redistribution on farm incomes and land use, considering two different hypotheses of the EFA weighting factor (Ewf) for nitrogen-fixing crops. The evaluation is developed at farm level by a positive mathematical programming (PMP) model and applied to more than 2,000 farms in northern Italy. The results show that crop diversification will mainly affect the cereal area, with significant reductions in maize and wheat, while the EFA requirement, especially with the lower Ewf, will boost the spread of protein crops. Nevertheless, ‘greening’ does not seem to affect farm income, while greater economic effects are mainly due to the redistribution of direct payments.*

Keywords: *greening; positive mathematical programming; nitrogen-fixing crops; ecological focus area; farmer behaviour; CAP reform*

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On 16 December 2013, the Council of EU Agriculture Ministers formally adopted the Common Agricultural Policy (CAP) reform package that set out the new rules related to the implementation of the First Pillar for European farms in the next seven-year period (European Parliament and Council of the EU, 2013). The strategic aims of the new CAP were related to sustainable food production, a balanced territorial development to enhance the differentiation of agriculture and rural areas, and the sustainable management of resources to ensure the production of public goods and to offset the effects of climate change (Hart and Little, 2012; Matthews, 2012). The largest part of the budget of the CAP post-2013 will be allocated by direct payments, articulated in several components, the most important being the basic payment that provides direct support to farmers' income, and the green payment, equal to 30% of the total amount of

resources earmarked for direct payments, conditional on 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 and conservation of water resources, and acts as a buffering agent with respect to climate change (European Commission, 2011). The Commission's proposal was followed by the amendments of the European Parliament and the Council that ‘eased’ the greening requirements (European Parliament, 2013; Council of the EU, 2013). The final CAP agreement established three greening requirements: (i) crop diversification for farms with more than 10 ha of arable land, (ii) maintenance of permanent grassland, and (iii) allocation of 5% of arable land to an ecological focus area (EFA) for farms with more than 15 ha of arable land. Units of the holding used for organic

production are exempt from greening requirements and entitled *ipso facto* to the green payment; moreover, an exemption was established (from crop diversification and EFA) for farms with over 75% grassland, herbaceous forage or crops under water (such as rice), where the remaining arable area was not above 30 ha.

The new CAP is characterized by a high level of flexibility that allows member states to calibrate CAP measures in relation to their specific objectives. With regard to the greening choices, member states may consider as EFAs characteristic elements and areas listed in Article 46 of Regulation (EU) No 1307/2013, in addition to possible equivalent practices of Annex IX. Italy decided to consider all those EFAs listed in Regulation 1307/2013, except areas with catch crops (fast-growing crops which help to manage nutrient cycles between two crops, cover the ground and protect soil structure and which provide habitat to fauna, including beneficial insects (European Commission, 2010)).

On 11 March 2014, the European Commission adopted the first package of delegated acts of CAP reform. Those texts supplement the four basic acts adopted on 16 December 2013 by the European Parliament and the Council, in order to allow member states to draft rules at national level so that the reformed CAP could be implemented. One of the most debated issues was related to the specification of the implementation criteria of those types of EFA that allow production – in particular, nitrogen-fixing crops. A controversial question concerns the conversion/weighting factors for the various types of EFA (Ewf) defined in the delegated acts. According to the Commission's proposal on 11 March 2014, one hectare of a nitrogen-fixing crop was equivalent to 0.3 ha of EFA; therefore it was necessary for farmers to reallocate more than 3.3 ha from current land use to nitrogen-fixing crops in order to cover one ha of EFA. Later, on 2 April 2014, the Commission College meeting adopted a special declaration relating to the Delegated Acts of CAP Reform, deciding to 'adjust the coefficient in the Annex X (Reg. 1307/2013) such that 1 hectare of a nitrogen-fixing crop such as alfalfa, clover or lupins can be equivalent to 0.7 ha of EFA (rather than 0.3 ha in the original text)' (European Commission, 2014b). Therefore 1.4 ha of nitrogen-fixing crops will be considered as one ha of EFA, a request much less demanding for farmers. The justification for this change, as reported in the Commission declaration, is related to the context of the EU's strong dependence on imports of protein crops.

Some environmental organizations have severely criticized this choice. The European Environmental Bureau (EEB) and Birdlife International, in a letter addressed to Commissioner Ciolos referring to the rising EFA weighting factor for nitrogen-fixing crops (European Environmental Bureau and Birdlife International, 2014), stated: 'at best, EFAs will deliver next to nothing for the natural environment, and at worst will act as a bizarre form of financial support for protein crop production. If labeling law were to be applied in this case, the word "ecological" would be deemed false advertising.' In contrast, the producer organizations expressed satisfaction with the amendments introduced in the delegated acts. Meurig Raymond, President of the National Farmers' Union of England and Wales (NFU), stated he was very

Table 1. List of nitrogen-fixing crops qualified as EFA in Italy.

Nitrogen-fixing crops	
<i>Cicer arietinum</i> L.	<i>Onobrychis viciifolia</i> Scop.
<i>Dolichos lablab</i> L.	<i>Phaseolus lunatus</i> L.
<i>Glycine max</i> L.	<i>Phaseolus vulgaris</i> L.
<i>Glycyrrhiza glabra</i> L.	<i>Pisum sativum</i> L.
<i>Hedysarum coronarium</i> L.	<i>Trifolium</i> sp.
<i>Lathyrus cicera</i> L.	<i>Trigonella foenum-graecum</i> L.
<i>Lathyrus sativus</i> L.	<i>Vicia faba</i> L.
<i>Lens culinaris</i> Medik.	<i>Vicia sativa</i> L.
<i>Lotus corniculatus</i> L.	<i>Vicia villosa</i> Roth.
<i>Lupinus</i> sp.	<i>Vigna unguiculata</i> L.
<i>Medicago</i> sp.	

Source: Italian Ministerial Decree No 6513 of 18 November 2014.

pleased that MEPs had managed to increase the Ewf for nitrogen-fixing crops from 0.3 to 0.7 (NFU, 2014).

As defined by the delegated acts, Italy has established a list of nitrogen-fixing crops qualified as EFA, including soya, alfalfa, grain legumes and herbaceous leguminous crops (Table 1). The objective of this paper is to evaluate the effect of the greening on farms in three regions of northern Italy, according to both the 0.3 Ewf for nitrogen-fixing crops proposed by the Commission in the first proposal of delegated acts, and the 0.7 Ewf as modified in the final version. Although this research focuses mainly on the effects of greening policy, it is clear that its 'depressing' effect on farm income could be amplified or compensated for by the new system of regionalization and redistribution of direct payments. Therefore the paper also analyses the effect on the sample farms of 'convergence' and the regionalization of direct payments.

Data and methodology

The analysis of the economic and productive impacts of greening measures was based on the Italian Farm Accountancy Data Network (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 include the following variables: land use, yield, output prices and specific costs per activity at farm level. In order to estimate the internal convergence of direct payments, data on CAP payments for each farm holder were extracted from the FADN database, while other descriptive variables on farm status (such as organic or conventional farming) were used to identify greening requirements and exclusion criteria. Policy assessment was carried out at farm level using the FADN weighting system in order to infer at regional level and make the simulation results more consistent with farm typologies and agricultural production systems of the area (Solazzo *et al.*, 2014; Council of the EU, 2009a).

The assessment of CAP reform post-2013 was developed by applying a quantitative model based on the positive mathematical programming (PMP) methodology (Paris, 1997; Paris and Howitt, 1998; Paris and Arûni, 2000). This methodology is able to capture the economic information taken into account by the farmer in organizing his or her production plan, so that it is possible to

Table 2. Greening constraints implemented in 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)
Exceptions	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 lying 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)
Exceptions	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 lying 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 0.3 or 0.7)
Entitled <i>ipso facto</i> to the greening component	Organic farms

estimate their responses to varying policy and market scenarios according to the farmer's preference system. The structure of the model considers both the realized and the 'latent' activities (Arfini and Donati, 2013). Latent activities are all those processes (crops) that at farm level are not activated, although they are included in the regional activity basket. For instance, in the PMP model, one farm that cultivates durum wheat and alfalfa has all the other crops cultivated in the region (at the same altitude) as latent activities. In other words, we assume that each farm decides the production plan in relation to the whole set of production possibilities given by the regional agriculture. Although not activated by the farm, these processes could be considered as components of the production possibilities overall, on the basis of latent cost information reconstructed from the analysis of the initial production data. As a consequence, during the simulation phase, modifications can be made to the initial production organization by including those new processes (that is, the latent activities) if their economic return prevails over the pre-existing processes (Donati and Arfini, 2013).

All the specific crops in the Italian FADN were reclassified into 48 items in the model. In particular, four items were classified as nitrogen-fixing crops (soya, alfalfa, grain legumes and herbaceous leguminous crops) and used, with the land left fallow, in order to calculate both the EFA already present on the farms and as a possible choice for the achievement of the EFA requirement at the farm level. Therefore, 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.

Greening requirements in the PMP model

As described above, the focus of this analysis was to evaluate the effects of 'greening' requirements on land use at farm level. These consider three measures (crop diversi-

fication, maintenance of permanent grassland and ecological focus area) and different options according to the farm characteristics. Table 2 provides a detailed description of the complex architecture of the green policy as implemented in the PMP model. The assessment of farmer behaviour is carried out by considering a specific set of 'green' constraints in the model, to determine the impact of each greening measure.

Crop diversification

Crop diversification is expressed as:

$$h_{n,s} \leq 0.75 \sum_s h_{n,s} \Leftrightarrow \{ \sum_s h_{n,s} > 10 \vee org_n \neq 1 \vee fid1_n \neq 1 \vee fid2_n \neq 1 \} \quad (1)$$

$$h_{n,s} + h_{n,r} \leq 0.95 \sum_{s,r} h_{n,s} \Leftrightarrow \{ \sum_s h_{n,s} > 30 \vee org_n \neq 1 \vee fid1_n \neq 1 \vee fid2_n \neq 1 \} \forall s \neq r \quad (2)$$

where:

- n = farm index;
- s, r = arable crop indexes, which are sub-indexes of the index j related to the whole set of activities;
- $h_{n,s}$ = arable crop area at farm level;
- org_n = farm parameter, 1 for organic farms and 0 otherwise;
- $fid1_n$ = farm parameter, 1 if more than 75% of the arable land is used for the production of grasses or other herbaceous forage, is land lying fallow, or is subject to a combination of these uses, and the remaining arable area < 30 hectares;
- $fid2_n$ = farm parameter, 1 if more than 75% of the eligible agricultural area is permanent grassland, is used for the production of grasses or other herbaceous forage or for the cultivation of crops under water, and the remaining arable area < 30 hectares.

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.

Maintenance of permanent grassland

The maintenance of permanent grassland is expressed as follows:

$$h_{n,g} \geq \bar{h}_{n,g} (1 - 0.05) \Leftrightarrow \{org_n \neq 1\} \quad (3)$$

where:

- g = permanent grassland index, a sub-index of the index j related to the whole set of activities;
 $\bar{h}_{n,g}$ = permanent grassland area at farm level in reference scenario.

The other symbols are as defined above.

Ecological focus area (EFA)

To model the share of total farm area allocated to EFA, the land constraint was defined as follows:

$$\sum_j h_{n,j} + green_n \leq b_n \quad (4)$$

The total area of the farm (b_n) is equal to the sum of utilized agricultural area (UAA) in the farm production system ($\sum_j h_{n,j}$) and the EFA as required by the greening actions ($green_n$).

The EFA requirement was represented in the model as follows:

$$green_n \geq \{[0.05(\sum_s h_{n,s})] - [\sum_f h_{n,f} + (\sum_l h_{n,l} + \sum_p h_{n,p} + \sum_q h_{n,q} + \sum_u h_{n,u})Ewf]\} \Leftrightarrow \{\sum_s h_{n,s} > 15Vorg_n \neq 1Vfid1_n \neq 1Vfid2_n \neq 1\} \quad (5)$$

where:

- f = land left fallow index, which is a sub-index of the index j related to the whole set of activities;
 l, p, q, u = respectively, alfalfa, grain legumes, soya and herbaceous leguminous indexes, which are sub-indexes of the index j related to the whole set of activities;
 Ewf = EFA weighting factor, equal to 0.3 or 0.7 in the two policy scenarios.

The other symbols are as defined above.

Convergence of direct payments in the PMP model

In addition to the impact of greening, the model was used to evaluate possible impacts of the variation in the direct payments received by the farms. The calculation of new payments takes into account the reduction of the direct payment ceiling for Italy, the regionalization and the process of 'internal convergence'. The definition of regionalization considered in this paper regards Italy as a unique region, and the model also considers the hypothesis of a 10.3% cut in the ceiling for Italy, which will decrease the national budget from 4.1 billion euros in 2013 (Council of the EU, 2009b) to 3.7 billion in 2019 (European Parliament and Council of the EU, 2013). In the model, for simplification, the ceiling was divided into two components (basic payment scheme of 70% and green payment 30%). In the scenarios analysed, methods of calculation of direct payments were applied with reference to the mechanism of convergence:

- the average national unit value of direct payments per hectare in Italy in 2019 (292.7 €/ha) was estimated using the 10.3% cut in the ceiling to the entire national FADN database (more than 11,000 farms) and applying the FADN weighting system;
- the historical Single Farm Payment at farm level, based on the Italian FADN database (2012), updated to 2015 based on the estimated ceiling reduction for this year (European Parliament and Council of the EU, 2013);
- at the basic payment component (70%), a system of recovery for payments under the national average was applied based on the so-called 'Irish model': farmers with payments below 90% of the national average payment per hectare will have their payments raised by at least one-third of the difference between their current payment and 90% of the national average by 2019, with a minimum payment of 60% of the national average per hectare by 2019; moreover, a maximum decrease (30%) of the initial unit value was fixed; and
- the green payment was calculated as a share of the total value of the farm's basic payment entitlements (Reg (EU) No 1307/2013).

Policy scenario

The PMP simulation phase consisted of two scenarios to assess possible effects of new CAP reforms on Italian agriculture considering different EFA weighting factors for the conversion of nitrogen-fixing crops in EFA. The new CAP scenarios are compared with a reference scenario that reflects the market and policy situation in 2012:

- Reference scenario (baseline): this represents the situation in 2012.
- Scenario Sim_03: this implements the greening constraints as described in Table 2; the unit value of payment entitlements is differentiated by farms applying the convergence mechanism described above; the EFA weighting factor for nitrogen-fixing crops is equal to 0.3, according to the European Commission proposal on 11 March 2014 (European Commission, 2014a).
- Scenario Sim_07: this implements the greening constraints and the convergence mechanism as described in the previous scenario, except for the EFA weighting factor equal to 0.7, according to the European Commission declaration on 2 April 2014 (European Commission, 2014b).

Results

Impact of CAP reform on land allocation

The results for production on all farms shows a major impact of the greening requirements on cereal crops for both scenarios (Table 3). With the exception of barley and other minor cereals, there is a significant decrease for the most common cereals in the area analysed, mainly for maize and wheat. The greatest reduction is in maize production, especially in the Lombardy region, due to the large number of farms highly specialized in maize production, which will have to change their production plans, introducing new crops and moving cropped areas to EFA.

Overall, the reduction in cereal area is due to two 'greening' effects. On the one hand, this is attributable to

Table 3. Impact of greening measures on land use.

Crops	(Ha)			Variation (%) compared to baseline	
	Baseline	Sim_03	Sim_07	Sim_03	Sim_07
Durum wheat	78,635	76,077	76,850	-3.3	-2.3
Soft wheat	326,947	315,846	324,215	-3.4	-0.8
Barley	45,681	45,342	46,374	-0.7	1.5
Maize	665,225	613,199	623,878	-7.8	-6.2
Other cereals	154,601	155,771	156,202	0.8	1.0
Processing tomato	31,252	31,632	31,610	1.2	1.1
Other horticulture	53,095	52,995	53,012	-0.2	-0.2
Permanent crops	280,422	280,422	280,422	0.0	0.0
Sugarbeet	55,440	55,440	55,440	0.0	0.0
Grain legumes ^a	12,981	16,271	16,086	25.3	23.9
Herbaceous legumes ^a	223	296	271	32.7	21.5
Soya ^a	134,746	149,957	143,410	11.3	6.4
Alfalfa ^a	349,757	378,215	373,884	8.1	6.9
Other fodder crops	194,870	197,858	199,673	1.5	2.5
Other crops	44,289	44,537	44,589	0.6	0.7
Grassland	335,724	335,713	335,713	0.0	0.0
Left fallow	14,771	29,087	17,030	96.9	15.3
				(% of UAA)	
EFA required	–	28,186	24,383	1.0	0.9
Total UAA	2,778,659	2,778,659	2,778,659		

Note: ^aNitrogen-fixing crops.

the requirement of diversification, which obliges specialized farms to increase (or activate) the area of other crops (in particular, other cereals). On the other hand, the obligation to allocate a quota of arable land to EFA affects cereal crops: in many cases, the farms choose cereal crops as EFA in order to maintain more profitable crops. In the Sim_07 scenario, the impact, as one would expect, is more limited; this result relates to the increase in EFA weighting factor and to the resulting increase in the number of farms that already meet the EFA requirement. In the final scenario, the new EFA, net of the existing EFA in the reference scenario, is about 24,400 ha (0.9% of the total regional UAA), while in scenario Sim_03, it would exceed 28,000 ha. More than 14,000 ha of the new ecological area would be left fallow in scenario Sim_03: the low EFA weighting factor drives farms to prefer this choice rather than replacing over three ha of current crops with nitrogen-fixing crops in order to achieve one ha of EFA. The share of new EFA left fallow is much lower in Sim_07, because the higher Ewf, as amended by the Commission, is much more beneficial for farms that decide to activate or enhance their nitrogen-fixing crop area. However, because of the different ratio between the area of nitrogen-fixing crops and EFA, the overall increase in these crops is higher in Sim_03 (+9.4%) compared to Sim_07 (+7.4%).

Changes in land use, particularly with respect to increasing land with nitrogen-fixing crops, are clearly differentiated at the regional level (Table 4). In Lombardy and Veneto, scenario Sim_03 produces a greater increase in these crops compared to scenario Sim_07, while in Emilia-Romagna, the trend is the opposite, with a greater increase in nitrogen-fixing in the latter scenario. This has important implications for local production structures, where half the region (Emilia) devotes milk production to the Parmigiano Reggiano and Grana Padano Protected Designation of Origin (PDO) systems. For the first one,

the code of practice established by the Parmigiano Reggiano Consortia, requires that half the grass should be originated by the farm, and it is clear that scenario Sim_07 is much more in the interests of this PDO cheese supply chain.

The different effects of Ewf at territorial level can be explained by the different productive structure and specialization of farms in the regions analysed. In Emilia-Romagna, many of the arable farms already adopt crop diversification, so they must meet only the EFA constraint. Therefore, in Sim_03, they often decide to reallocate only 5% of arable area to fallow, with a minimal change in the production structure; while in Sim_07, with the increase in Ewf, for these farms to become more profitable, they must activate nitrogen-fixing crops. In the other regions (Lombardy and Veneto), farms affected by the greening measures are often highly specialized (with monoculture) in maize production; therefore they cannot move only 5% from the current production to fallow, but, in order to meet the diversification constraint, they must reallocate up to 25% of their arable area to other crops (or fallow). For these farms in both scenarios, it is more profitable to keep this area in production, reallocating it to nitrogen-fixing crops rather than leaving it unproductive.

Impact of CAP reform on farm income

The analysis of economic variables shows the potential impact of both the greening requirements (GM I level) and CAP reform, also considering the new direct payments redistribution (GM II level; see Table 5). Based on the results of the model, the greening applied according to the new CAP reform would result in a contraction in gross margins (GM I level) of less than 0.5% in both scenarios. The results are strongly related to the 'easing' of greening measures during the co-decision process of the Trilogue. The average value of GM I level, net of direct payments, is

Table 4. Impact of greening measures on land use at regional level.

Crops	Baseline (ha)			Var Sim_03 compared to baseline (ha)			Var Sim_07 compared to baseline (ha)		
	Emilia-Romagna	Lombardy	Veneto	Emilia-Romagna	Lombardy	Veneto	Emilia-Romagna	Lombardy	Veneto
Durum wheat	62,448	8,599	7,587	-2,658	44	56	-2,207	331	90
Soft wheat	176,530	57,288	93,129	-8,132	203	-3,173	-6,707	3,417	557
Barley	22,713	17,106	5,862	-327	-110	98	-273	828	139
Maize	132,806	268,474	263,945	-6,867	-29,962	-15,196	-6,713	-25,240	-9,394
Other cereals	37,854	107,820	8,927	731	404	35	938	613	51
Processing tomato	24,324	4,104	2,823	231	116	33	216	107	36
Other horticulture	24,042	12,497	16,556	-20	25	-105	-21	50	-112
Permanent crops	147,111	24,589	108,723	0	0	0	0	0	0
Grain legumes ^a	9,765	3,065	151	67	2,796	428	544	2,305	256
Soya ^a	14,630	17,501	102,615	761	3,445	11,005	2,547	2,226	3,891
Alfalfa ^a	259,759	75,096	14,901	6,465	17,804	4,189	10,496	11,375	2,255
Herbaceous legumes ^a	0	223	0	0	73	0	0	48	0
Other fodder crops	43,495	86,969	64,406	372	1,535	1,081	379	2,847	1,577
Other crops	59,951	13,193	26,584	69	69	110	84	93	123
Grassland	92,835	148,791	94,098	-20	4	6	-20	4	6
Left fallow	7,148	2,809	4,814	9,327	3,554	1,434	737	997	526
					(% of UAA)		(% of UAA)		
EFA required	-	-	-	1.0	1.2	0.8	0.9	1.0	0.7
Total UAA	1,115,413	848,126	815,121	1,115,413	848,126	815,121	1,115,413	848,126	815,121

Note: ^aNitrogen-fixing crops.

Table 5. Impact of greening (I level gross margin) and payment redistribution (II level gross margin) on main economic variables.

	Baseline (euro/ha)	Sim_03 (euro/ha)	Sim_07 (euro/ha)	Sim_03 Variation (%) compared to baseline	Sim_07 Variation (%) compared to baseline
Gross saleable production	4,118	4,100	4,108	-0.4%	-0.2%
Variable costs	1,552	1,546	1,549	-0.4%	-0.2%
GM I level (greening)	2,565	2,554	2,559	-0.4%	-0.2%
				(-11 €/ha)	(-6 €/ha)
Payments	439.8	347.7	347.7	-20.9%	-20.9%
GM II level (greening + payments)	3,005	2,901	2,907	-3.4%	-3.3%
				(-103 E/ha)	(-98 E/ha)

equal to 2,565 €/ha in the farms analysed; therefore, the loss of profitability linked to the greening, considering all farms in the area analysed, would be equal to 11 €/ha in the '0.3' scenario. In the final scenario, this reduction is further limited (-6 €/ha) due to the increase of the Ewf.

The reduction of direct payments leads to a higher decrease in the farms' profitability compared to the greening measures. In the scenarios, the contraction of payments is around 21%, equal to an average decrease of 92 €/ha. The average GM (II level), including direct payments, is equal to just over 3,000 €/ha; the introduction of the greening measures and, above all, the convergence of direct payments would lead to a reduction of about 3.3% of the GM (II level) and the loss in euros would be equal to about 100 €/ha. At regional level, the greatest economic impact of CAP reform concerns Lombardy, for both the greening requirement (GM I level) and the redistribution of direct payments (GM II level). In this region, there is a greater concentration of big farms highly specialized in maize growing, and therefore affected by

the greening constraints. Furthermore the importance of the livestock sector, whose farms have historically received higher payments than other sectors, justifies the net contraction of direct payments in the evaluation scenario. The impact of the reform is much more limited on farms in Emilia-Romagna, which in the baseline scenario received a payment close to the reference value for the convergence in 2020.

Figure 1 shows the economic impact of CAP reform according to the production specialization of the farms analysed. In this respect, the negative economic impact of greening is greater for farms specializing in field crops and granivores. This is because some such farms are subject to the diversification constraint and the obligation to provide EFA, partly due to a low number of production processes (with cases of monoculture practice) and large areas of arable crops. Regarding direct payments redistribution, farms specializing in livestock and field crops would see a significant reduction in GM II level gross margins (110–150 €/ha). In the first case, the reduction in

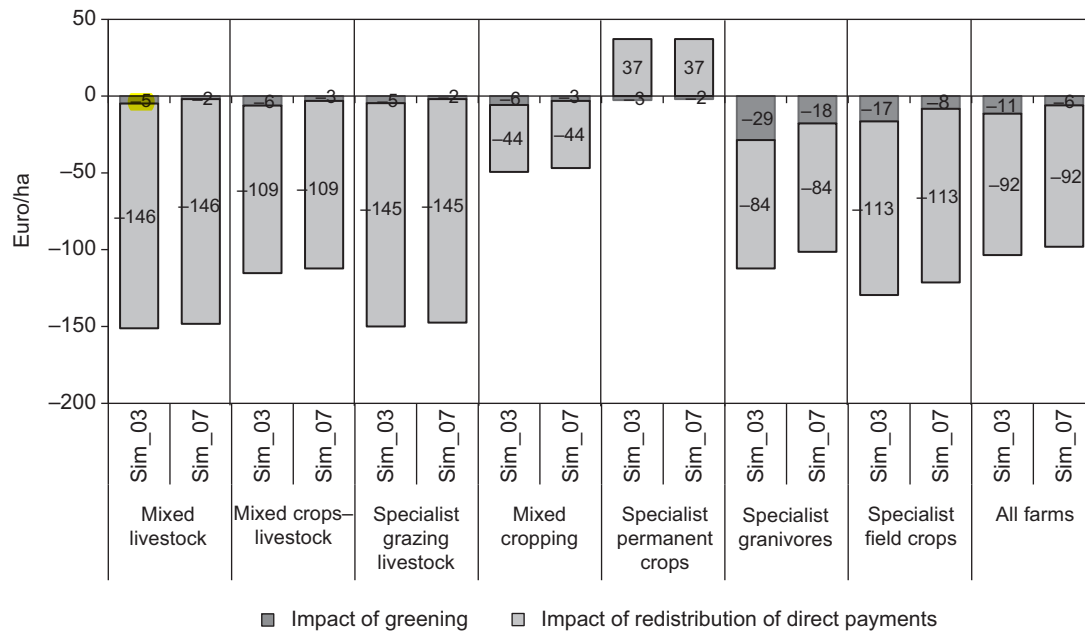


Figure 1. Breakdown of reform impacts (greening and direct payment redistribution) on farms' gross margins by type of farming.

gross margin is due exclusively to the effect of the convergence of payments, while there is a combined effect of the greening and, mainly, convergence for farms specialized in field crops. On the other hand, farms specializing in permanent crops would see an overall increase in gross margins. Clearly, these are farms which at the baseline received low levels of, or in many cases zero, direct payments, and which can now benefit from new payments distribution.

Conclusions

The new CAP reform introduces two important measures that could significantly affect the profitability of farms: greening and the convergence of direct payments. The evaluation proposed in this study adopts a model based on the PMP methodology that implements the latest decisions on CAP reform assumed in December 2013, with two options for the application of the EFA measure: the EFA weighting factor for the conversion of nitrogen-fixing crops equal to 0.3, as proposed by the European Commission, and 0.7, as subsequently amended.

The analysis was carried out on an FADN sample of more than 2,000 farms in northern Italy and adopting the FADN weighting system. The results obtained relate to the modification of land use, the variation in farms' production and the effects on the main farm economic variables (total gross production, total variable costs, subsidies and gross margins). The most evident result of the greening introduction at sector level is the decrease in cereals and the contemporaneous increase in land cultivated with protein crops. Soya, alfalfa, grain and herbaceous leguminous crops are considered in the model as nitrogen-fixing crops that can be adopted in response to the EFA requirement. This is the reason why the greening induces a relevant increase in these crops, mainly soya and alfalfa. The results also show how the

change to the Ewf for the nitrogen-fixing crops qualified as EFA (from 0.3 to 0.7) produces a much higher convenience in allocating EFA to these crops rather than to land lying fallow. However, because of the different Ewf, the overall increase in the area of nitrogen-fixing crops is higher in the scenario with the lowest weighting factor. On the contrary, at territorial level some areas in the Emilia-Romagna region, where milk production is based on alfalfa, will experience more benefits with the Ewf at a ratio of 0.7 than 0.3, with greater benefits for both farmers and consumers. This different effect at the territorial level can be explained by the different degree of farm specialization in the regions analysed. In Emilia-Romagna, many of the arable farms already adopt crop diversification and must meet only the EFA constraint, while in the other regions there is a high concentration of farms specializing in maize, for which there is a joint effect of EFA and diversification requirements.

Nevertheless, both diversification and, above all, the establishment of an EFA do not really seem to affect farm income in either scenario. According to the model results, the 'cost of the greening' would not exceed 15 €/ha at the regional level. The relatively small impact of the greening measures on farm income should, however, be analysed at farm type and territorial levels to identify the differentiated effect of greening on the farm economic variables. The negative economic impact of greening is greater in the Lombardy region and for farms specializing in field crops and granivores. This is because some such farms are subject to the diversification constraint and the obligation to provide EFA, partly due to a low number of production processes (with cases of monoculture practice) and large areas of arable crops.

The deep revision of the original European Commission text of the CAP reform has also involved direct payments, which in the final document are rather conservative. On one hand, the choice of Italy as a unique

region results in a greater redistribution of payments at sectoral and territorial levels compared to other regionalization criteria; on the other hand, the convergence process and its application criteria are intended to reduce current payments as little as possible, imposing a series of conditions to prevent reduction below certain thresholds. This policy decision will contribute to a lessening of the solidarity effect that the reform had at the beginning of the entire CAP reform process. The regionalization and convergence of direct payments would reduce farm income in the area analysed by 3% compared to the reference scenario. Also, for these outcomes, it is necessary to consider the effects at farm type level. Farms specializing in grazing livestock and field crops would see a higher reduction in direct payments (110–150 €/ha), while those specializing in permanent crops, which at the baseline received low levels of, or in many cases zero, direct payments, would see an overall increase in gross margins.

References

- Arfini, F., and Donati, M. (2013), 'Organic production and the capacity to respond to market signals and policies: an empirical analysis of a sample of FADN farms', *Agroecology and Sustainable Food Systems*, Vol 37, No 2, pp 149–171.
- Council of the EU (1991), *Council Directive 91/676/EEC of 12 December 1991 Concerning the Protection of Waters against Pollution Caused by Nitrates from Agricultural Sources as Amended by Regulations 1882/2003/EC and 1137/2008/EC*, EU, Brussels.
- Council of the EU (2009a), *Regulation (EC) No 1217/2009 of 30 November 2009 Setting up a Network for the Collection of Accountancy Data on the Incomes and Business Operation of Agricultural Holdings in the European Community*, EU, Brussels.
- Council of the EU (2009b), *Regulation (EC) No 73/2009 of 19 January 2009 Establishing Common Rules for Direct Support Schemes for Farmers under the Common Agricultural Policy and Establishing Certain Support Schemes for Farmers, Amending Regulations (EC) No 1290/2005, (EC) No 247/2006, (EC) No 378/2007 and Repealing Regulation (EC) No 1782/2003*, consolidated version, EU, Brussels.
- Council of the EU (2013), 'Amendments on proposal for a regulation of the European Parliament and of the Council establishing rules for direct payments to farmers under support schemes within the framework of the Common Agricultural Policy (CAP Reform) – Presidency consolidated draft Regulation (7183/13)', EU, Brussels.
- Donati, M., and Arfini, F. (2013), 'Application of the PMP model to estimate specific cost in Italy', in Cesaro, L., and Marongiu, S., eds, *The Use of RICA to Estimate the Cost of Production in Agriculture Application of Econometric and Mathematical Programming Methodologies*, INEA, Rome.
- European Commission (2010), *Environmental Impact of Crop Rotations in the EU*, Final Report, 6 September 2010, EC, Brussels.
- European Commission (2011), *Proposal for a Regulation of the European Parliament and of the Council Establishing Rules for Direct Payments to Farmers under Support Schemes within the Framework of the Common Agricultural Policy*, COM(2011) 625 final/2 2011/0280 (COD), 19 October, EC, Brussels.
- European Commission (2014a), 'Delegated acts on the CAP Reform – an explanation of the main elements', MEMO/14/180, 11 March, EC, Brussels.
- European Commission (2014b), *Commission Declaration on Delegated Acts on CAP Reform*, website: http://ec.europa.eu/agriculture/newsroom/161_en.htm (last updated 2 April 2014).
- European Commission (2014c), *Commission Delegated Regulation (EU) and Annexes, Supplementing Regulation (EU) No 1307/2013 of the European Parliament and of the Council Establishing Rules for Direct Payments to Farmers under Support Schemes within the Framework of the Common Agricultural Policy and Amending Annex X to that Regulation*, EC, Brussels.
- European Environmental Bureau and Birdlife International (2014), 'Letter of EEB's Secretary General, Jeremy Wates, and Birdlife International Head of Policy, Ariel Brunner, to Commissioner Ciolos on the Delegated Act', website: <http://www.birdlife.org/sites/default/files/attachments/Open%20letter%20Ciolos%20Delegated%20Acts%20final%20pdf%20version.pdf>.
- European Parliament (2013), *Proposal for Negotiating Mandate on the Proposal for a Regulation of the European Parliament and of the Council Establishing Rules for Direct Payments to Farmers under Support Schemes within the Framework of the Common Agricultural Policy (COM(2011)0625 – C7-0336/2011 – COM(2012)0552 – C7-0311/2012 – 2011/0280(COD) – 2013/2528(RSP))*, European Parliament, Brussels.
- European Parliament and Council of the EU (2000), *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 Establishing a Framework for Community Action in the Field of Water Policy*, European Parliament and Council of the EU, Brussels.
- European Parliament and Council of the EU (2013), *Regulation (EU) No 1307/2013 Establishing Rules for Direct Payments to Farmers under Support Schemes within the Framework of the Common Agricultural Policy and Repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009*, European Parliament and Council of the EU, Brussels.
- Hart, K., and Little, J. (2012), 'Environmental approach of the CAP legislative proposal', *International Agricultural Policy*, Vol 1, pp 19–30.
- Matthews, A. (2012), *Environmental Public Goods in the New CAP: Impact of Greening Proposals and Possible Alternatives*, Directorate General for Internal Policies Policy Department B: Structural and Cohesion Policies, Agriculture and Rural Development, European Parliament, Brussels.
- National Farmers' Union of England and Wales (2014), 'EU vote paves way for Government decision on CAP', website: <http://www.nfuonline.com/news/press-centre/eu-vote-paves-way-for-government-decision-on-cap/> (last updated 8 April 2014).
- Paris, Q. (1997), 'A PMP update and extension', paper presented at the *Capri Workshop, Reggio Emilia, Italy*.
- Paris, Q., and Arfini, F. (2000), 'Funzioni di costo di frontiera, auto-selezione, rischio di prezzo, Pmp e Agenda 2000', *Rivista di Economia Agraria*, Vol 55, No 2, pp 211–242.
- Paris, Q., and Howitt, R.E. (1998), 'An analysis of ill-posed production problems using maximum entropy', *American Journal of Agricultural Economics*, Vol 80, pp 124–138.
- Solazzo, R., Donati, M., Arfini, F., and Petriccione, G. (2014), 'A PMP model for the impact assessment of the Common Agricultural Policy reform 2014–2020 on the Italian tomato sector', *New Medit Journal*, Vol 13, No 2, pp 9–19.