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The implementation of the new Common Agricultural Policy in France will not be environmentally ambitious

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This paper assesses the environmental ambition of 2023-2027 Common Agricultural Policy in France. Since conditionality and agri-environment-climate measures are only marginally improved relative to the previous period, attention is focused on the new environmental instrument of the eco-scheme that in France targets the whole farm. Results suggest low environmental progress since almost all French farms would reach the standard level of the eco-scheme by one of the three access paths with unchanged farming practices, and 85% of them would reach the superior level. The percentage of farms at the superior level would be lower for farms specialized in annual crops than for cattle farms. We then show that the payment difference of €20 per hectare between the standard and superior level is probably insufficient for farms specialized in cereals, oilseeds and protein crops to offset the additional cost of the change in farm practices required to move from the standard to the superior level.

Keywords: CAP; France; eco-scheme; environment; FADN

1. Introduction

Agriculture in the European Union (EU) is not environmentally sustainable. The successive reforms of the Common Agricultural Policy (CAP) have so far failed to put European agriculture on the right environmental track (Navarro and López-Bao 2018; Pe'er *et al*. 2019, 2022; Dupraz and Guyomard 2019; Guyomard *et al*. 2020). It is therefore appropriate that the 2023-2027 CAP includes climate change mitigation and adaptation, environmental care, and the preservation of biodiversity and landscapes as key objectives for this new version of the policy (European Commission 2017).

To this end, the new CAP agreed in June 2021 and that applies from 1 January 2023 until the end of 2027 defines a new green architecture based on three environmental instruments of conditionality, agri-environment-climate measures (AECMs) and eco-schemes (Regulation (EU) 2021/2015). This green architecture is summarized in

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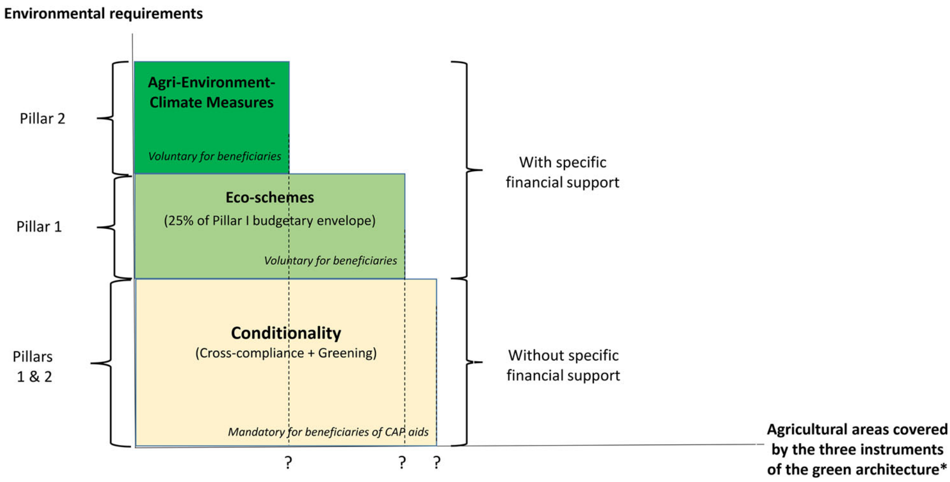

Figure 1. The green architecture of the 2023-2027 Common Agricultural Policy.
Source. Adapted from Guyomard *et al*. (2023). Pillar 1 includes income support aids and market intervention measures. It is fully funded by the European budget. Pillar 2 includes measures targeting a wide set of heterogeneous objectives such as environmental protection (through AECMs), risk management, investment support, or support for farmers in less-favored areas. Pillar 2 is co-financed by national/regional budgets. *Agricultural areas covered by AECMs and eco-schemes are necessarily lower than agricultural areas covered by conditionality. Areas covered by AECMs are expected to be lower than areas covered by eco-schemes. Areas covered by AECMs, eco-schemes and conditionality are endogenous as they depend on farmers' decisions.

Figure 1. In order to receive CAP payments, conditionality requires that farmers respect a set of statutory and management requirements (SMRs) related to health, the environment, and animal welfare, and maintain land in good agricultural and environmental condition (GAECs). Conditionality now encompasses the three conditions of the so-called green payment of the previous CAP that has been highly criticized for its very low environmental effectiveness (European Court of Auditors 2017). These three conditions aim to maintain permanent grasslands at the national or regional level (depending on the country), diversify annual crops at the farm level, and preserve ecological focus areas at the farm level. Ecological focus areas include not only non-productive elements (such as hedges or fallows) but also some productive land uses (such as nitrogen-fixing crops, catch crops, or cover crops) with, however, lower weightings. AECMs are voluntary multi-annual contracts that compensate farmers for the additional costs induced by the use of more environmentally friendly agricultural practices. AECMs suffer from drawbacks that weaken their environmental effectiveness: budgetary endowments and payments per hectare (ha) are low; farmers have adopted the simplest but least ambitious measures from an environmental point of view; good farming practices and high-diversity landscape features are spatially discontinuous because of the involvement of an insufficient number of contiguous farms (Cullen *et al*. 2018; Hasler *et al*. 2022). These drawbacks largely remain in the 2023-2027 CAP (Guyomard *et al*. 2020, 2023). Unlike conditionality and AECMs, the third instrument of the eco-scheme is novel. This voluntary instrument aims to reward farmers who are already managing land in an environmentally friendly way and incentivize other farmers to change their farming practices. Although the European legal text (Regulation (EU) 2021/2015) introduces the possibility of designing multi-annual eco-schemes, member states (MSs) have adopted annual implementation. However, in both

cases, eco-scheme payments are annual. The second novelty of the 2023-2027 CAP is its governance through a new delivery model that gives each MS considerable leeway to design instruments and allocate its budgetary envelope between the instruments (European Court of Auditors 2018).

While many research studies have made recommendations for delivering environment action through the 2023-2027 CAP or have qualitatively evaluated its environmental ambition (Lampkin *et al*. 2020; Guyomard *et al*. 2020; Hasler *et al*. 2022; Pe'er *et al*. 2022; Guyomard *et al*. 2023), there is no comprehensive quantitative assessment of the environmental performance of the CAP agreement reached in June 2021 (see, however, Barreiro-Hurle *et al*. 2021). This can be explained by the difficulties of *ex ante* assessments "given data, indicators, and integrated modeling frameworks that are currently available" (Guyomard *et al*. 2023). This can also be explained by the fact that many implementing decisions are the responsibility of MSs through their respective national strategic plans (NSPs). In addition, the final versions of NSPs were not officially approved until the very end of 2022. As a result, qualitative analyses are based on draft eco-schemes. In their analysis of 15 draft eco-schemes as of January/February 2022, Runge *et al*. (2022) highlighted that "the level of environmental ambition may be not high" and that "the majority of the eco-scheme measures mirror existing schemes". In the same way, environmental non-governmental organizations concluded that "18 out of 23 [draft] plans [as of 15 February 2022] score only poor or very poor across the different [environmental] dimensions, indicating that the overwhelming majority of NSPs will fall short of what has been promised with regards to environmental and climate objectives" (European Environmental Bureau and BirdLife International 2022).

In France, a draft version of the NSP was submitted in December 2021. This first draft has been strongly criticized as being insufficiently ambitious from an environmental point of view (French Environmental Authority, 2021; European Commission 2022). In July 2022, France submitted a slightly revised version of its NSP that was approved without further changes by the European Commission in August 2022 (Ministry of Agriculture and Food Sovereignty – MASA 2022a). Since the two environmental instruments of conditionality and AECMs are only marginally improved relative to the previous policy (Guyomard *et al*. 2023), the environmental ambition of the French NSP can be summed up as that of the eco-scheme in a context where the annual budget allocated to the latter is substantial, that is: €1.68 billion out of a total CAP budget of €7.83 billion. By comparison, the annual budget allocated to AECMs is €260 million, which represents an increase of €10 million only with respect to the previous period (MASA 2022a).

This paper aims to examine the environmental ambition of the French eco-scheme by assessing the number of farmers who would have access to either the standard level of the scheme or the superior level without changing their farming practices. The analysis is carried out for different farming specializations (defined on the basis of their main production) based on individual data from the French Farm Accountancy Data Network (FADN), which makes it possible to evaluate to what extent the eco-scheme constraint is more restrictive for some farm types than for others. The second objective of the paper is to characterize farms according to the level of the eco-scheme they would reach without changing their practices (no access, standard level only, superior level). Finally, we analyze to what extent the €20 difference between the standard and superior level is sufficient to encourage farmers at the standard level to change their practices to achieve the superior level.

Section 2 presents the three access paths to the French eco-scheme. Section 3 describes the assessment strategy. Results are displayed in Section 4 and discussed in Section 5.

2. The French eco-scheme

Three non-cumulative paths can be used to access the French eco-scheme, namely: i) the path of agro-ecological practices; ii) the path of environmental certification; and iii) the path of biodiversity friendly elements (MASA 2022a). While both the practice and biodiversity paths are based on criteria that go beyond those of corresponding requirements of conditionality, the environmental certification path is based on two pre-existing environmental certifications; namely, the high environmental value (HEV) label and the organic farming (OF) label. For conventional farms, each access path includes two requirement levels giving entitlement to a theoretical payment of €60/ha and a superior level giving entitlement to a higher theoretical payment of 80€/ha. The scheme includes a specific payment of 110€/ha for organic farmers. It encompasses a “hedge” bonus of €7/ha that can be cumulated with the first two access paths and requires that hedges cover at least 6% of agricultural area (and 6% of arable cropland area when applicable). All these unitary amounts may be modified, either downwards or upwards, to respect the budgetary envelope of the eco-scheme. The three access paths are summarized in Table 1 and detailed in Appendix 1 (online supplementary material).

Requirements of the path of agro-ecological practices differ according to the plant cover of agricultural areas by differentiating between arable croplands, grasslands, and

Table 1. The three access paths to the French eco-scheme of the CAP.

	Agro-ecological practices				
	Diversity of arable crops	No tillage of permanent grasslands (PG)	Inter-row cover of perennial crops	Environmental certification	Biodiversity friendly elements (BFE)
Standard level (~€60 per ha)[1]	4 points	Share of PG $\geq$ 80%[2]	Cover $\geq$ 75%[3]	At least 10 points for one component of the HEV certification[4]	Share of BFE $\geq$ 7%[5]
Superior level (~€80 per ha)[1]	5 points or more	Share of PG $\geq$ 90%	Cover $\geq$ 95%	10 points or more on each component of the HEV certification	Share of BFE $\geq$ 10%
Organic level (~€110 per ha)[1]				Organic farming certification	
Hedge bonus (€7 per ha)	At least 6% of hedges on the utilized agricultural area, with 6% on arable land areas when applicable. Necessity of a “hedge” certification attesting to their sustainable management				Non-cumulative

Source: Authors’ elaboration based on the French NSP of August 31, 2022 (MASA 2022a). 1: Payment levels are indicative. 2: Share of PG is the share of non-tilled permanent grasslands in total grasslands. 3: Cover is the share of inter-rows of perennial crops that are covered by plants (grass or mulch). 4: See Table 2 for details of indicators and associated points for the three components of the environmental certification path (biodiversity, crop protection, and fertilization). 5: Share of BFE is the share of BFE in utilized agricultural area.

perennial croplands. For arable croplands, the objective is to favour crop diversity through a points system: 4 points for the standard level and at least 5 points for the superior level. For grasslands, the objective is to maintain the ratio of non-tilled permanent grasslands of total permanent grasslands to at least 80% for the standard level and 90% or more for the superior level. For perennial croplands, the objective is to develop the inter-row coverage of perennial crops to at least 75% for the standard level and 95% or more for the superior level.

The path of biodiversity friendly elements aims at rewarding the presence of these elements on the farm because of their climate and biodiversity benefits (Pe'er *et al.* 2016). Eligible elements are those that are accounted for in conditionality GAEC 8, including fallow lands but excluding nitrogen-fixing crops and catch crops that provide lower ecological benefits (MASA 2022a). Access to the standard (respectively, superior) level requires that the admissible land area of the farm includes at least 7% (respectively, 10%) of biodiversity friendly elements.

The path of environmental certification is based on the HEV French label as defined in December 2016 (Ministry in Charge of Agriculture 2016) for the year 2023 and as revised in November 2022 (MASA 2022b) from 2024. The label distinguishes four components corresponding to i) biodiversity protection, ii) fertilization, iii) phytosanitary protection, and iv) irrigation. Each component is characterized by a specific number of requirements that makes it possible to obtain a variable number of points according to the requirements met. The basic level (called environmental certification 2+ or EC2+) requires that the farmer satisfies 16 minimal environmental conditions and obtains 10 points or more for at least one of the four dimensions. The superior level requires that he/she obtains 10 points or more for each of the four dimensions.

3. Assessment strategy

3.1. The analysis in a nutshell

Figure 2 provides a graphical summary of the analysis performed. In a first step, we calculate the number of farms that have access to the standard level of the eco-scheme

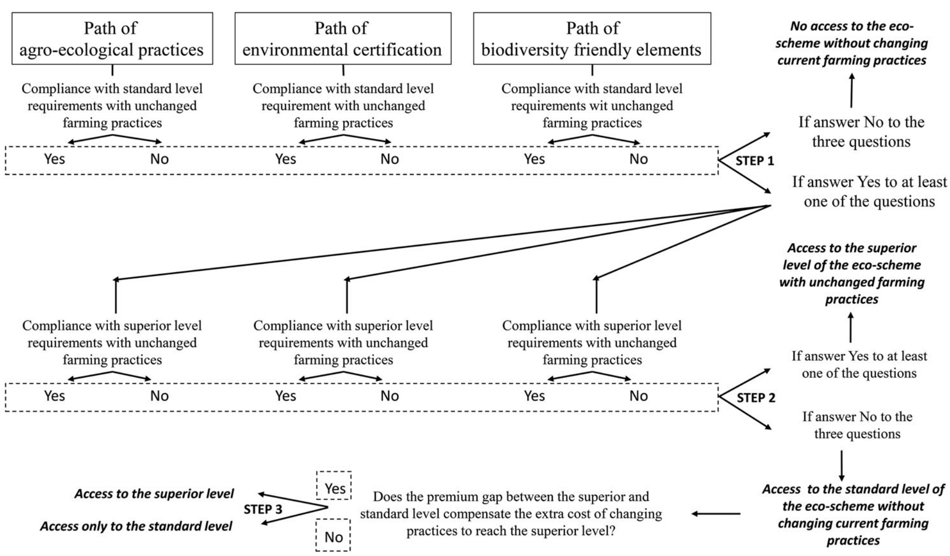

Figure 2. The three steps of the analysis.

without changing their current farming practices. They have access to the standard level if they meet the conditions for access to this level through at least one of the access paths. In a second step, for farms that have access to the standard level, we determine whether they also have access to the superior level for unchanged farming practices. Again, they have access to the superior level if they meet the conditions for access to this level through at least one of the access paths. In a third step, we evaluate whether the premium gap between the superior and standard level is sufficient to compensate for the extra cost of changing practices so that a farm reaching the standard level with unchanged practices will be encouraged to modify these to reach the superior level of the eco-scheme. By anticipating empirical results, almost all farms have access to the standard level with unchanged farming practices (see Section 4). Therefore, Figure 2 does not include a step to assess to what extent the aid level at the standard level will incentivize farms to change their current practices to reach the standard level of the eco-scheme: the number of farms that do not reach the standard level is too low to perform such an analysis. Section 3.2 presents the analytical framework, Section 3.3 the statistical and econometric procedure, and Section 3.4 the data and the assumptions adopted for calculating the points a farmer may claim for each access path.

3.2. Analytical framework

We assume that farmers are profit maximizers. This means that a given farmer agrees to meet the environmental requirements of the standard level of the eco-scheme when her/his profit reduced by possible additional costs generated by environmental requirements at that level but augmented by the compensation eco-scheme payment of the standard level is greater than or equal to her/his initial profit. Similarly, we assume that a farmer reaches the superior level of the eco-scheme only when her/his profit at that level is greater than or equal to her/his profit at the standard level. In addition, we assume that each farmer chooses the eco-scheme access path that leads to the higher profit. Specifically:

- A farmer will access the standard level with unchanged practices if $N_i^k \geq \text{Min}_{standard}^k$ for at least one access path k, with N_i^k the number of points reached by farmer i with the access path k $(k = 1, 2, 3)$ and $\text{Min}_{standard}^k$ the minimal number of points required to reach the standard level through the access path k. In that case: $\pi_i^f(\cdot) = \pi_i^0(\cdot) + a1$, where $\pi_i^f(\cdot)$ is the final profit of farmer i, $\pi_i^0(\cdot)$ is the initial profit of farmer i, and $a1$ is the eco-scheme aid at the standard level (step 1 of the analysis).
- A farmer will access the superior level with unchanged practices if $N_i^k \geq \text{Min}_{superior}^k$ for a least one access path k, with $\text{Min}_{superior}^k$ the minimal number of points required to reach the superior level through the access path k. In that case: $\pi_i^f(\cdot) = \pi_i^0(\cdot) + a2$, where $a2$ is the eco-scheme aid at the superior level standard level (step 2 of the analysis).
- A farmer reaching the standard level but not the superior level with unchanged farming practices will be encouraged to change her/his practices to reach the superior level if $\pi_i^m(\cdot) + a2 \geq \pi_i^0(\cdot) + a1$, where $\pi_i^m(\cdot)$ is the profit of farmer i based on modified farming practices that respect the requirements of the superior level of the eco-scheme.

In steps 1 and 2, the farmer profit reaching respectively the standard and superior level of the eco-scheme is thus higher than his/her profit in the initial situation because production costs are unchanged but he/she benefits from the eco-scheme payment (that is, in other words, from a windfall effect). This means that the number of farms at either the standard level or the superior level is underestimated because we do not include farmers who would be encouraged to change their farming practices because the cost of changing the latter is lower than the eco-scheme payment.

While a similar analytical framework has been used to analyze rates and conditions of adoption of environmentally-friendly farming practices or programmes, notably AECMs (Dessart, Barreiro-Hurlé, and van Bavel 2019), this is the first time that it is applied to the new environmental instrument of eco-schemes of the 2023-2027 CAP. Determining the rates of adoption of eco-schemes is a prerequisite for assessing their economic and environmental impacts.

Assuming that farmers are profit maximizers is very common in agricultural production economics. Yet, in the case of large Californian farms, Lin, Dean, and Moore (1974) showed that Bernoulli and lexicographic utility formulations are "more accurate predictors of farmer behavior than profit maximization". For their part, Weersink and Fulton (2020) argued that the adoption of new technologies modelled in the profit maximization framework as "a binary decision – adopt or not –" does not capture the fact that it is a more complex multistage process. They added that "while profit considerations are clearly important, particularly in the later stages of the process, they need to be supplemented with other social and cognitive considerations, particularly in the early stages". This applies to changes in farming practices and systems viewed at specific new technologies as well as to voluntary environmental measures aimed at favoring these changes (Ma *et al*. 2012). With that perspective, several studies have highlighted the importance of socio-psychological factors in farmers' decisions to adopt climate- and environment-friendly practices and measures, worldwide and in the EU, as shown by the recent meta-analysis developed by Swart *et al*. (2023) who even concluded that "attitude, intention, and perceived usefulness were most important for practice adoption, while economic outcomes and environmental awareness were of less importance". Dessart, Barreiro-Hurlé, and van Bavel (2019) are more careful by concluding that considering behavioral factors completes and enriches the economic approach based on profit maximization. Focusing on economic outcomes is thus a limit of this paper without identifying the consequences of omitting non-economic determinants of adoption. As summarized by Weersink and Fulton (2020), "the adoption rate suggested by profit maximization will be an upper bound if non-economic factors are expected to either slow down or deter adoption, while that rate will be a lower bound if non-economic factors are expected to encourage adoption". Furthermore, our analysis ignores transaction costs that have been barriers to AECM adoption and can be barriers to eco-scheme participation. According to Mettepenningen, Verspecht, and Van Huylenbroeck (2009), private transaction costs could have represented 15% of the total cost of AECMs.

3.3. Statistical and econometric procedure

Steps 1 and 2 of the empirical analysis requires calculating the numbers of points each farm can claim for each of the three access paths. The following Section 3.4 details how these points have been calculated, specifically the assumptions adopted for calculating some of them based on available information. The first set of results from steps

1 and 2 provides estimates of the numbers of farms that reach the standard and superior level of the eco-scheme with unchanged farming practices.

We then analyze in step 3 the determinants of the transition from the standard to the superior level with two complementary methods still relying on an assumption of profit maximization. The first method is based on a first econometric model in which the response variable is binary: farm reaching the superior level vs. reaching the standard level only. Specifically, the classification at the superior level ($Y = 1$) vs. the standard level ($Y = 0$) is modeled through a Probit model: $P(Y = 1/X) = \Phi(X^T\beta)$ where P is the probability, Φ is the cumulative distribution function of the standard normal distribution, β is the vector of parameters to be estimated, and X is the set of explanatory variables (farm types, farmer characteristics, farm location, partial productivities of labour and raw materials, and gross standard production defined in three classes). This first econometric model makes it possible to analyze the factors that influence whether a farm reaches the superior vs. standard level of the eco-scheme. The second method relies on the econometric estimation of agricultural income functions including among the explanatory variables a dummy variable equal to one when the farm reaches the superior level (the dummy variable can safely be assumed exogenous because the estimation is carried out with data before the eco-scheme is implemented). Specifically, we regressed agricultural income before tax on the dummy variable DX ($DX = 1$ when the farm is at the superior level and $DX = 0$ when it is at the standard level) and a set of control variables (farm characteristics, farmer characteristics, total subsidies and costs of some raw materials) for four types of farm defined according to their main production. The coefficient associated with the dummy variable is expected to be negative reflecting higher compliance costs at the superior level of the eco-scheme than at the standard level. This information is then used to assess whether the payment difference between the two levels of the eco-scheme is sufficient or not to cover the additional costs generated by the transition from the standard to the superior level.

3.4. Calculation of points: data and assumptions

The analysis is essentially based on farm data from the French FADN for the year 2020. Farms specializing in viticulture, arboriculture, and horticulture are excluded since they benefit very little from Pillar 1 CAP support (less than 2%) and, as a consequence, are very little concerned with the eco-scheme. Our FADN sample includes 4,699 farms divided into 11 farm types. However, the focus is hereafter focused on farm types 1500 (farms specialized in cereals, oilseeds and protein crops or COP), 1600 (arable crops including COP and specialized crops such as sugar beet and potatoes), 4500 (dairy cattle), 4600 (beef cattle), 4813 (sheep and goats), and 6184 (multiple crop and/or multiple livestock farms, hereafter more simply noted mixed farms). In 2020, these 6 farming types represented 69% of French farms and 85% of agricultural utilized area (UAA). They received 88% of Pillar 1 budgetary support.

3.4.1. Agro-ecological practices access path

It was possible to estimate the number of farms that have access to both the standard and superior level through the agro-ecological practices access path for the arable crop diversity criterion on the basis of FADN data on agricultural land uses and different assumptions making it possible to retrieve the crop cover classification of the eco-scheme from the FADN database (for more details, see Section 2 of Appendix 1 [online supplementary information]). The French regulation (MASA 2022a) specifies that the criterion for non-ploughed permanent grasslands must be calculated at the scale of the farm by dividing the number of hectares of non-ploughed permanent grasslands in year $n-1$ by the number of hectares of permanent grasslands in year n. This way of calculating the criterion makes the constraint non-binding (Section 3 of Appendix 1 [online supplementary information]). Since we have systematically minimized the number of farms reaching either the standard or superior level by one of the three access paths, we assumed that all farms in our sample with more than 5% of their UAA cultivated with perennial crops (the threshold above which this indicator must be considered) do not access the eco-scheme through the agro-ecological practices access path.

3.4.2. *Environmental certification access path*

Table 2 displays the indicators that could be calculated for the three components of the environmental certification access path (biodiversity, crop protection, and fertilization) as defined by the third version of the 31 December 2016 HEV label. Given the information available, the indicators calculated make it possible to obtain a maximum score of 27 points for biodiversity (theoretical maximum score of 30 points), 20 points for crop protection (35), and 25 points for fertilization (30); for more details, see Sections 4, 5 and 6 of Appendix 1 [online supplementary information]. We attributed a score of zero to all indicators that could not be calculated. This means that our results underestimate the number of points that a farm can obtain for each of these three components and therefore underestimate the number of farms that have access to the eco-scheme through the environmental certification path. This underestimation is, however, likely to be limited because one unrecorded indicator of the crop protection component ('percentage of UAA covered by AECMs aimed at reducing the use of chemical pesticides') makes it possible to obtain a high number of points (10) but in practice concerns a very small number of farms.

The calculation of several indicators of the environmental certification access path required the use of additional databases. The national database on hedges (Ministry in Charge of the Ecological Transition and Ministry in Charge of Agriculture 2020) provides the hedge density at the scale of French '*communes*'[1] and made it possible to calculate the biodiversity indicator related to the 'share of agro-ecological infrastructures in total UAA' by taking into account the infrastructures of hedges, permanent grasslands, moor- and range-lands, and fallow lands. We associated all farms located in a given '*commune*' with the hedge density of the '*commune*'. Other infrastructures included in the criterion were not available and therefore were not considered, implying that we underestimated the percentage of agro-ecological infrastructures. The calculation of herbicide and non-herbicide total frequency indexes (TFI) of the crop protection component was possible thanks to the 2017 survey on farming practices (Agreste 2020). The farm nitrogen balance of the fertilization component was estimated on the basis of simulation results derived from the model 'CASSIS_N' for the year 2015 (Poisvert, Curie, and Moatar 2016). This model provides estimates of nitrogen surpluses at the geographical scale of the French '*canton*'.[2] We assumed that the nitrogen balance of a farm in a given '*canton*' was equal to that of the '*canton*'. We further assumed that farms with 100% of permanent grasslands or located in nitrate

Table 2. Indicators of the environmental certification access path for the three components of biodiversity, crop protection, and fertilization[1].

Indicators	Maximum possible points	Indicators that could be calculated	Data bases	Main assumptions
Biodiversity				
% of agro-ecological infrastructures in utilized agricultural area (UAA)	10	Yes	FADN Hedges	Density of hedges at the farm level equal to that of the '*commune*'
% of the dominant crop (excluding permanent grassland) in UAA	6	Yes	FADN	
Number of plant species grown	7	Yes	FADN	
Number of animal species reared	3	Yes	FADN	
Beehives on the farm	1	Yes	FADN	
Number of endangered varieties, breeds or species	3	No	–	0 point in simulations
Total of points for biodiversity	***30***	***27***		
Crop protection				
Herbicide treatment frequency index (TFI)	5	Yes	FADN PK2017*	Weighted average of regional TFIs for crops present in farm crop rotation
Non-herbicide TFI	5	Yes	FADN PK2017*	
% of untreated UAA	10	Yes	FADN	Areas in permanent grassland, fallow land, heathland, and rangeland were assumed untreated
% of UAA covered by alternatives to chemical pesticides	3	No	–	0 point in simulations
% of UAA covered by AECMs aimed at reducing the use of chemical pesticides	10	No	–	0 point in simulations
Application conditions of chemical pesticides	2	No		0 point in simulations
Total of points for crop protection	***35***	***20***		

Fertilization				
Nitrogen balance	10	Yes	FADN CASSIS-N	Nitrogen balance at the farm level equal to that of the ‘*canton*’
Use of decision support tools	3	No	–	0 point in simulations
% of non-fertilized UAA	10	Yes	FADN	Areas in fallow land, heathland, and rangeland were assumed not fertilized
% of legumes (single crop) in UAA	2	Yes	FADN	
% of crop mixes with legumes in UAA	2	No	–	0 point in simulations
Fall soil cover	3	Yes	FADN NVA**	3 points for farms with 100% of permanent grasslands and for farms located in NVA (fall cover mandatory in NVA)
Total of points for fertilization	***30***	***25***		

Source: Authors’ elaboration based on the third version of 31/12/2016 of the HEV certification label. *: PK2017: 2017 national survey on farming practices. **: NVA: Nitrate vulnerable areas. 1: Table 2 does not present the different indicators of the fourth component corresponding to irrigation requirements because we assumed that all irrigating farms reach at least 10 points on this component (for details see main text).

vulnerable areas (NVAs) obtained 3 points for the indicator related to the 'fall soil cover'. While the FADN directly provides information on permanent grasslands, the second group of farms in NVAs was determined by matching the FADN database with the database on '*communes*' in NVAs in 2015 (EauFrance 2015). Finally, the FADN database makes it possible to identify organic farms.

We made two additional assumptions. First, we assumed that all farms that use irrigation achieved a score of at least 10 points on that fourth component of the certification access path. This hypothesis appears realistic because corresponding farms can easily obtain 6 points for the indicator on 'the detailed recording of irrigation practices' and 4 points on the other indicators making it possible to collect 21 points in total. These other indicators are on 'the use of support decision tools for irrigation'; 'the percentage of UAA covered by the use of equipment that optimizes water use'; 'the membership of a collective management approach'; 'the percentage of UAA covered by water-saving agronomic practices'; and 'the share of water withdrawals in low water periods'. Second, we assumed that all farms that meet the requirements of the environmental certification path are labelled. In practice, the farm must make an official application for the label and obtain approval after an audit by an independent certification body. This implicit labelling rests on the assumption that the income support granted through the eco-scheme is sufficient to motivate the farm to obtain the label.

3.4.3. Biodiversity friendly elements access path

For the third access path of biodiversity friendly elements, it was possible to consider the eligible elements of hedges (again using the national database on hedges), fallows, and permanent grassland areas. The weighting coefficients of these elements differ from those of agro-ecological infrastructures of the biodiversity indicator of the environmental certification access path (Table 3). Other biodiversity friendly elements could

Table 3. Agro-ecological infrastructures of the biodiversity criterion of the environmental certification path and biodiversity friendly elements of the access path included in the analysis with respective weighting factors.

	Agro-ecological infrastructures (1)		Biodiversity friendly elements (1)	
	Included	Weighting factor	Included	Weighting factor
Hedges	Yes	1 lm* = 100 m^2 of tea**	Yes	1 lm = 20 m^2
Fallows	Yes	1 ha = 1 ha of tea***	Yes	1 lm = 1 ha***
Permanent grassland, moorland, rangeland and mountain pasture in Natura 2000 areas	No	–	Yes	1 ha = 1.5 m^2

Source: Authors' elaboration from MASA (2022a, 2023) and Ministry in Charge of Agriculture (2016). *: 1 m = linear meter. **: tea = topographical equivalent area. ***: Since it was not possible to distinguish honey, wildlife and flowering fallow areas from other fallow areas, we attributed the coefficient of 1 to all fallow areas even if coefficients of honey, wildlife and flowering fallow areas are higher in the legal texts. (1) Agro-ecological infrastructures and biodiversity friendly elements include other items that could not be counted, notably unproductive buffer strips; aligning shafts; single trees; groups of trees; ponds; unshaped walls, and traditional walls.

not be counted. The number of farms that access the eco-scheme through the access path of biodiversity friendly elements is thus underestimated.

4. Results

4.1. Assessment of the number of farms that have access to the eco-scheme without changing their current farming practices

Simulation results show that almost all farms (99.9%) reach at least the standard level of the eco-scheme without changing their current farming practices, and that 84.9% reach the superior level again without changing their practices (Table 4, panel a). While there are no access differences to the standard level between farms according to their productive specialization, livestock farms more easily reach the superior level (91.4% for dairy cattle, 98.9% for sheep and goats, and 99.1% for beef cattle) than mixed farms (79.6%) and annual crop farms (66.2% for arable crops and 69.5% for

Table 4 (panel a). Percentages of farms that have access to the French eco-scheme without changing their current farming practices.

	Percentage of farms			
		Access / No access (%)		
Agricultural specialization	Access to the eco-scheme (%)	Superior level	Standard level only	No access
1500: COP	99.66	69.45	30.20	0.34
1600: Arable crops	99.78	66.23	33.55	0.22
4500: Dairy cattle	99.88	91.38	8.50	0.12
4600: Beef cattle	100	99.06	0.94	0.00
4813: Sheep and goats	100	98.92	1.07	0.00
6184: Mixed*	99.86	79.55	20.30	0.14
Total**	99.85	84.85	15.00	0.15

Table 4 (panel b). Utilized agricultural areas of farms depending on the access to the French eco-scheme for unchanged farming practices (in percent).

	Utilized agricultural area (%)			
		Access / No access (%)		
Agricultural specialization	Access to the eco-scheme (%)	Superior level	Standard level only	No access
1500: COP	99.77	71.32	28.45	0.23
1600: Arable crops	99.87	65.45	34.42	0.13
4500: Dairy cattle	99.84	92.16	7.68	0.16
4600: Beef cattle	100	99.09	0.91	0.00
4813: Sheep and goats	100	99.56	0.44	0.00
6184: Mixed*	99.95	83.43	16.52	0.05
Total**	99.90	84.93	14.97	0.10

Source: Authors' calculation. *: Mixed farms are multiple crop and/or multiple livestock farms. **: Figures for the total sample include all farm types except farms specialized in viticulture, horticulture, and arboriculture; as a result, they also include farm types such as hog, poultry, or hog and poultry that are not detailed in the table.

COP). Agricultural areas in percentage terms of the different possible cases are almost the same, suggesting that the farm size measured in hectares is not a differentiating access factor for the eco-scheme (Table 4, panel b).

Table 5 shows that the environmental certification access path allows almost all farms to reach at least the standard level (99.5%) without significant differences between farm types (from 99.7% for COP farms to 100% for both beef cattle and sheep and goats). Reaching at least the standard level though the access path of agro-ecological practices is hardly more difficult for livestock farms (99.5% for sheep and goats, 99.2% for beef cattle, and 95.3% for dairy cattle). The agro-ecological practices

Table 5. Percentages of farms that have access to the French eco-scheme by one of the three access paths without changing their current farming practices.

	Access to at least the standard level (%)			
Agricultural specialization	One at the choice of the three access paths	Agricultural practices	Environmental certification	Biodiversity friendly elements
1500: COP	99.66	74.32	98.98	57.58
1600: Arable crops	99.78	81.51	98.71	33.98
4500: Dairy cattle	99.88	95.27	99.75	63.23
4600: Beef cattle	100	99.22	100	81.72
4813: Sheep and goats	100	99.46	100	79.78
6184: Mixed*	99.86	80.93	99.59	55.52
Total**	99.85	86.42	99.53	64.55
	Access to the superior level (%)			
	One at the choice of the three access paths	Agricultural practices	Environmental certification	Biodiversity friendly elements
1500: COP	69.45	50.57	6.45	42.99
1600: Arable crops	66.23	60.43	6.88	24.94
4500: Dairy cattle	91.38	81.31	43.33	52.55
4600: Beef cattle	99.06	95.62	66.71	72.03
4813: Sheep and goats	98.92	97.57	64.42	70.62
6184: Mixed*	79.55	63.81	19.06	41.99
Total**	84.85	71.72	31.69	52.99
	Access to the standard level only (%)			
	One at the choice of the three access paths	Agricultural practices	Environmental certification	Biodiversity friendly elements
1500: COP	30.20	23.76	92.53	14.59
1600: Arable crops	33.55	21.08	91.83	12.04
4500: Dairy cattle	8.50	13.96	56.43	10.68
4600: Beef cattle	0.94	3.59	33.28	9.69
4813: Sheep and goats	1.07	1.89	35.58	9.16
6184: Mixed*	20.30	17.13	80.52	13.54
Total**	15.00	14.71	67.84	11.56

Source: Authors' calculation. *: Mixed farms are multiple crop and/or multiple livestock farms. **: Figures for the total sample include all farm types except farms specialized in viticulture, horticulture, and arboriculture; as a result, they also include farm types such as hog, poultry, or hog and poultry that are not detailed in the table.

access path reduces in a more substantial way the percentages of arable crop farms (81.5%), mixed farms (80.9%), and COP farms (74.3%) that have access to at least the standard level. Accessing at least the standard level is more difficult through the path of biodiversity friendly elements (64.6% for the whole sample), with large discrepancies according to farm specialization (from 34.0% for arable crops to 81.7% for beef cattle).

Table 5 shows that reaching the superior level without changing current practices is easier through the path of agro-ecological practices (71.7%) than through the two other access paths (31.7% for environmental certification and 53.0% for biodiversity friendly elements). The three access paths increase by +13.3 percentage points the total number of farms that reach the superior level through at least one of the three access paths (from a minimum of +1.4 percentage points for sheep and goats and to a maximum of +18.9 percentage points for COP). The complementarity between the three access paths can also be illustrated by noting that meeting the requirements of all three access paths limit the percentages of eligible farms to 57.1% for the standard level and 17.4% for the superior level (Table 6).

4.2. Comparison of farms at the superior vs. standard level of the eco-scheme

In a first step, we compared the farms that reach the superior vs. standard level in terms of structural characteristics, economic results, technical performance, and environmental performance. We performed the exercise for the four farm types of COP, arable crops, dairy cattle, and mixed farms. The comparison is not relevant for the farm types of beef cattle and sheep and goats because of the very small number of holdings that reach the standard level only in both types. The main lessons corresponding to statistically significant median differences can be summarized as follows; for more details, see Appendix 2 (online supplementary information).

Compared to farms that reach the standard level only, farms at the superior level have more agricultural land area per unit of total labour (except for the farm type of arable crops), are more often located in disadvantaged areas, and receive more total aid per unit of UAA and more Pillar 2 aid per unit of UAA. Agricultural production (without aid) per unit of UAA and the consumption of raw materials per unit of UAA are lower at the superior level than at the standard level for the four farm types. The partial productivities of labour and land (with and without aid) are significantly lower

Table 6. Complementarity of the three access paths: percentages of farms that have access to the eco-scheme without changing their current farming practices by respecting the requirements of i) one of the access paths, ii) two paths jointly, and iii) three paths jointly.

	Access (%) through						
	One of the paths			Two paths			Three paths
	AP	EC	BFE	AP & EC	AP & BFE	EC & BFE	AP, EC & BFE
At least the standard level	86.42	99.53	64.55	86.10	57.05	64.55	57.05
The superior level	71.72	31.69	52.99	29.60	41.71	18.49	17.43

Source: Authors' calculation. AP: Access path of agro-ecological practices; EC: Access path of environmental certification; BFE: Access path of biodiversity friendly elements.

at the superior level for the four farm types. The partial productivity of raw materials without aid is also lower at the superior level, except for arable crop farms for which there is no significant difference. Agricultural income before tax for both groups of farms (superior vs. standard level) is not statistically different except for COP farms that have lower income in total, per ha of UAA and per unit of farm family labour at the superior level.

When environmental indicators are directly related to criteria used for constructing eco-scheme access indicators and scores, it is not surprising to find an improved environmental picture at the superior level. It is more interesting to note that both fertilizer and crop protection expenses per unit of UAA are significantly lower at the superior level than at the standard level. This last result suggests that there is a negative correlation between eco-scheme indicators/scores on the one hand and fertilizer and pesticide expenditure per hectare on the other. However, even if median differences are statistically different, it is not possible to assess the improvement of the environmental state at the superior level relative to the standard level from these indicators/scores, since they are all based on practices and not on environmental results/impacts.

Estimation results of the Probit model explaining the classification at the superior vs. standard level of the eco-scheme are displayed in Table 7. Estimation results can be summarized as follows. Belonging to any farm type other than the farm type of

Table 7. Probit regression results: Probability of reaching the superior level of the eco-scheme.

	Coefficient	Standard error	Average marginal effect	Standard error
Constant	0.939***	0.196		
1500: COP (reference)	–	–	–	–
1600: Arable crops	0.202**	0.081	0.066**	0.026
4500: Dairy cattle	1.043***	0.087	0.254***	0.020
4600: Beef cattle	1.646***	0.170	0.310***	0.019
4700: Beef and dairy cattle	1.286***	0.167	0.283***	0.023
4813: Sheep and goats	1.708***	0.205	0.313***	0.020
4800: Sheep, goats and other herbivores	4.584***	0.674	0.335***	0.017
5100: Hog	1.643***	0.173	0.310***	0.020
5200: Poultry	1.144***	0.137	0.267***	0.024
5300: Hog and poultry	1.789***	0.269	0.317***	0.021
6184: Mixed	0.456***	0.076	0.138***	0.022
Disadvantaged areas	0.277***	0.058	0.053***	0.011
UAA	0.002***	0.000	0.001***	0.000
Individual status	−0.071	0.058	−0.014	0.011
Higher education [1]	0.172**	0.073	0.032**	0.014
Farmer's age	−0.005**	0.003	−0.001**	0.000
Labor partial productivity	−0.000**	0.000	−0.000**	0.000
Raw material partial productivity	−0.174***	0.055	−0.033***	0.011
GSP1 (reference) [2]	–	–	–	–
GSP2	−0.397***	0.080	−0.062***	0.011
GSP3	−0.683***	0.109	−0.122***	0.018
Share of well predicted observations	85%			

Source: Authors' estimation. *, **, ***: Statistically significant at the 10, 5, and 1% level of significance, respectively. 1: Dummy variable equal to 1 when the farmer has a "baccalauréat" + 2-year level or higher (college education). 2: GSP is divided into three classes: GSP1 are 'middle' farms with GSP $\in$ [€25,000–€99,999[, GSP2 are 'big' farms with GSP $\in$ [€100,000–€249,999[, GSP3 are 'very big' farms with GSP $\in$ [€250 000–∞[.

COP farms increases the probability of reaching the superior level with an average marginal effect of approximately 6.6 percentage points for arable crop farms, 13.8 percentage point for mixed farms, and between 25 and 34 percentage points for livestock farms. The legal status of the farm (individual farm = 1) has no impact on this probability; the age of the farmer has a negative impact but with a very small average marginal effect close to 0 percentage points; and his/her education level (superior level = 1) has a positive impact with a marginal effect of 3.2 percentage points. Regression estimates indicate that location in a disadvantaged area and size (measured by the number of hectares of UAA) positively affect the likelihood of reaching the superior level with average marginal effects of 5.3 and 0.1 percentage points, respectively. In contrast, this likelihood decreases when the partial productivities of labor and raw materials are higher. In the same way, the likelihood of reaching the superior level decreases with the economic size of the farm measured by gross standard production (GSP) with a marginal effect of −6.2 percentage farms between the 'middle' and 'big' farms, and of −12.2 percentage points between the 'middle' and 'very big' farms. 'Middle' farms have GSP between €25,000 and €99,999; 'big' farms have GSP between €100,000 and €249,999; and 'very big' farms have GSP greater than €250,000.

4.3. Is the €20 difference between the two payment levels sufficient to incentivize farmers to change their practices to reach the superior level?

The empirical results presented above show that almost all farms access the standard level without changing their current practices, and that 15.0% of them have to change their practices to reach the superior level. We now analyze to what extent the €20 difference between the two payment levels (MASA 2022a) is sufficient to encourage farmers at the standard level only to change their practices to reach the superior level. This is done for the four farming types of COP, arable crops, dairy cattle and mixed farms using the approach described in Section 3.

Estimation results are displayed in Table 8, panel (a) where the endogenous variable is measured per unit of family labor and in Table 8, panel (b) where the endogenous variable is measured per ha. Estimation results show that COP farms that only reach the standard level need an eco-scheme premium per ha of around €90 (panel a) or €96 (panel b)[3] to compensate for their income loss between the standard and superior level and therefore move from one level to the other. The premium difference per ha is of the same order of magnitude for dairy cattle (around €100 for the panel (a) model and €92 for the panel (b) model) but the estimated parameter associated with the dummy variable *DX* is statistically significant at the 10% level only. The estimated parameter associated with this dummy variable *DXY* is not statistically significant for either arable crop farms or mixed farms.

5. Discussion

The eco-scheme is the main innovative measure of the 2023-2027 CAP. Targeting climate and environment issues with a much larger budget than Pillar 2 AECMs, the eco-scheme has been expected to be the main instrument to align the CAP with the strategies of the European Green Deal focused on the agricultural sector; that is, essentially, the Farm to Fork Strategy (European Commission 2020a) and the European

Table 8 (panel a). Estimation results of the equation of agricultural income before tax per unit of farm family labor.

Variables	Coefficients (standard errors)			
	COP	Arable crops	Dairy cattle	Mixed farms
Constant	5,826.77 (12,951.81)	66,316.00* (29,371.58)	15,679.38* (7,548.86)	12,344.32 (10,747.00)
Disadvantaged area (dummy)	−6,652.40** (2,997.26)	−1,168.99 (13,286.36)	−1,449.94*** (2,507.41)	−5,963.97* (3,050.03)
UAA (ha)	178.21*** (19.16)	201.62*** (57.93)	89.46* (25.21)	67.99*** (19.88)
Subsidies per UAA (€)	83.16*** (23.73)	−23.82 (23.55)	19.24 (10.73)	21.31 (14.39)
Individual status (dummy)	−6,111.33* (3,181.44)	−2,040.45 (10,105.04)	−2,929.83 (2,373.67)	956.61 (3,253.68)
Higher education (dummy)[1]	3,590.77 (3,835.10)	13,126.85 (11,078.16)	−2,660.90 (2,469.48)	6,991.07* (3,707.26)
Farmer's age (years)	−20.94 (135.68)	−678.51 (420.84)	0.36 (97.44)	−172.49 (135.28)
Family labor (unit)	−15,421.93*** (2,926.79)	−18,807.89*** (7,142.57)	−3,259.52* (1,671.48)	−3,174.22 (2,175.75)
Employed labor (unit)	7.41 (29.23)	49.21*** (16.05)	−1.09 (13.24)	50.72*** (10.59)
Crop protection expenditure (€ per ha)	−23.92 (27.63)	129.91*** (43.10)	8.02 (35.27)	69.94*** (22.15)
Fertilizer expenditure (€ per ha)	35.56 (22.84)	−74.38* (44.38)	2.78 (20.02)	1.42 (22.90)
Livestock units (LU)	−1.02* (0.600)	−1.24 (1.21)	0.34* (0.19)	0.36* (0.15)
Superior level of the eco-scheme (dummy)	−12,108.02*** (3,084.79)	1,471.30 (9,471.137)	−5,208.94* (3,295.48)	−5,086.48 (3,360.86)
R^2	0.13	0.10	0.06	0.13

Source: Authors' calculation. *, **, ***: Statistically significant at the 10, 5, and 1% level of significance, respectively. 1: See endnote of Table 7.

Table 8 (panel b). Estimation results of the equation of agricultural income before tax per unit of ha.

Variables	Coefficients (standard errors)			
	COP	Arable crops	Dairy cattle	Mixed farms
Constant	26.20 (89.71)	909.70** (367.34)	223.64* (114.68)	87.08 (146.31)
Disadvantaged area (dummy)	−55.49*** (20.76)	418.18** (166.17)	−18.43 (38.09)	−68.86* (41.52)
UAA (ha)	−0.01 (0.13)	−4.94*** (0.72)	−2.20*** (0.38)	−1.28*** (0.27)
Subsidies per UAA (€)	0.64*** (0.16)	−0.26 (0.29)	0.30* (0.16)	0.52*** (0.20)
Individual status (dummy)	10.57 (22.04)	−264.13* (126.38)	−56.88 (36.06)	−9.81 (44.29)
Higher education (dummy) [1]	47.44* (26.56)	145.42 (138.55)	−25.55 (37.52)	54.91 (50.47)
Farmer's age (years)	−0.20 (0.94)	−11.64* (5.26)	0.86 (1.48)	−2.16 (1.84)
Family labor (unit)	57.95*** (20.27)	314.35*** (89.33)	175.16*** (25.39)	165.03*** (29.62)
Employed labor (unit)	1.43*** (0.20)	0.73*** (0.20)	0.25 (0.20)	0.72*** (0.14)
Crop protection expenditure (€ per ha)	−0.32* (0.19)	3.03*** (0.54)	0.35 (0.54)	1.05*** (0.30)
Fertilizer expenditure (€ per ha)	0.14 (0.16)	−0.75 (0.56)	−0.12 (0.30)	−0.17 (0.31)
Livestock unit (unit)	−0.01 (0.00)	−0.03* (0.02)	0.01** (0.00)	0.00 (0.00)
Superior level of the eco-scheme (dummy)	−95.76*** (21.37)	119.11 (118.45)	−91.90* (50.06)	−34.91 (45.75)
R^2	0.12	0.24	0.13	0.17

Source: Authors' calculation. *, **, ***: Statistically significant at the 10, 5, and 1% level of significance, respectively. 1: See endnote of Table 7.

Biodiversity Strategy for 2030 (European Commission 2020b). The eco-scheme budget must be equal to at least 25% of the Pillar 1 budgetary envelope in each MS, which represents in France €1,684 million per year (MASA 2022a). Farmers who do not have access to the eco-scheme are thus implicitly taxed. They are thus encouraged to change their farming practices provided that the cost of change is lower than the eco-scheme payment.

Our results show that the French eco-scheme does not encourage farmers to adopt more environmental friendly practices. Almost all farms reach the standard level of the eco-scheme by using one of the three access paths without changing their current practices. Furthermore, many farms reach the superior level again with unchanged practices. This applies more to cattle farms (91.4% for dairy cattle, 98.9% for sheep and goats, and 99.1% for beef cattle) than to COP (69.5%) and arable crop (79.6%) farms.

This means that the French eco-scheme should not induce cattle farmers to change their livestock management practices. In particular, they should not reduce their net greenhouse gas emissions (by reducing their gross emissions and/or by increasing carbon storage) despite the reduction of greenhouse gas emissions being the central objective of the European Green Deal. It is worth remembering that agriculture ranks second in France in terms of gross greenhouse gas emissions, with approximately 21% of the country total, and that approximately 70% of agricultural gross emissions come from livestock, mainly in the form of methane emissions by ruminants. At the same time, grasslands absorb approximately 13% of French gross agricultural greenhouse gas emissions annually (Ministry in Charge of Agriculture 2018). Yet numerous studies have shown that there is significant room for improvement at low cost in that domain with, however, large heterogeneities among cattle holdings (Samson *et al.* 2012; Veysset *et al.* 2015; Dakpo, Jeanneaux, and Latruffe 2017).

In the same way, few conventional farms should choose the environmental certification access path to reach the superior level, although this is the only path that includes requirements in terms of pesticide and fertilizer uses in line with the quantitative reduction targets of the European Green Deal (−50% for pesticide use and −20% for fertilizer use by 2030). Most farms should use one of the other two access paths and, thus, should not have to bother with explicit requirements in terms of fertilizer and pesticide use through the eco-scheme. The diversification access path requires that farms grow more categories of crops. In a context where there is no binding target in terms of reducing pesticide and fertilizer uses, a stronger requirement for crop diversification appears as a necessary condition for this reduction. However, this is not a sufficient condition, since the reduction also depends on crop rotation from one year to the next with greater environmental benefits than crop diversification (Guyomard *et al.* 2023). Since most farms already comply with the crop diversification requirement of the current eco-scheme, at least at the standard level, very little improvement is expected for the remaining ones.

The payment gap of €20 per ha between the superior and standard level appears to be too low to encourage those COP farmers who reach the standard level with current farming practices to change them to reach the superior level. Econometric results do not support any strong conclusion on the ability of the payment gap to encourage (or otherwise) farmers to move from the standard to the superior level for arable crops, dairy cattle and mixed farms because the estimated coefficient associated with the dummy variable capturing belonging to the superior level is not statistically significant (or only at the 10% level of significance for dairy cattle). This question of the 'optimal' level of the payment difference between the standard and superior level to encourage farmers to change their practices to reach the superior level requires further research. On this point, it would be interesting to compare the eco-scheme requirements with those of the system AECMs for field arable crop, herbaceous and pastoralist systems (in the 2023-2027 CAP as well as in the previous versions of the policy). Field crop system AECMs applied in the past have been characterized by very low adoption (Védrine and Larmet 2021) despite higher payments per ha than those of the eco-scheme at the superior level. In return, their environmental requirements are higher than those of the eco-scheme. The eco-scheme payment levels are also lower than estimates of tax levels required to substantially reduce pesticide use (Féménia and Letort, 2016). Furthermore, grain prices are today higher than prices in the decade 2010-2020, which implies that a higher tax is required to trigger the reduction in pesticide use simulated by Féménia and Letort (2016). More generally, the higher the agricultural income, the lower the incentives to modify farming practices using eco-scheme payments to compensate change costs (for given eco-scheme payment levels). If agricultural product prices remain high in the years to come, farms might not only not be incentivized to use eco-scheme payments to change their farming practices but, worse, might be encouraged to increase their use of chemical inputs in simplified agricultural systems in order to maximize their market profits. Of course, such a prediction also depends on input price evolutions.

There are, of course, many other areas for further research. It would be interesting to complete our statistical study based on publicly available data with an analysis based on farm survey data and farmers' interviews. This complementary analysis would make it possible to analyze the robustness of our results. It would also make it possible to analyze the relative weight of non-economic factors in adopting eco-schemes in a context where numerous papers have highlighted this importance for AECMs (Canessa *et al*. 2024) and more generally environmentally-friendly farming practices (Dessart, Barreiro-Hurlé, and van Bavel 2019). Furthermore, data for the first year (2023) of policy implementation should be readily available. They could usefully be compared with our empirical results. On this point, it will be noted with interest that the first estimates of the Ministry in charge of agriculture expects an important take-up of eco-scheme measures for 2023. This led it to reduce the eco-scheme advance payments from €60 to €46.69 per ha for the standard level, from €80 to €63.7205 per ha for the superior level, and from €110 to €93.72 per ha for OF (MASA 2023). Finally, it would be interesting to analyze to what extent the new eco-scheme instrument affects the adoption of AECMs.

This design of the French eco-scheme will certainly succeed in making it accessible to most farmers. The French Government explicitly stated this objective of access to the greatest number in its NSP (MASA 2022a). However, this comes at the cost of making it less effective in reducing the climate and environment footprint of French agriculture. The new delivery model of the 2023-2027 CAP gives each MS the responsibility for designing the CAP tools targeting global public goods such as climate and biodiversity, while its farms will still have to compete within the European single market. This game structure naturally leads to a race to the bottom regarding climate and environmental issues, since no MS will organize competitive distortions against its national farms (Dupraz and Guyomard 2019). Furthermore, the output and result indicators of NSPs do not reflect climate and environmental impacts but rather expenditure and areas covered by the different CAP instruments and associated farming practices. Future bonuses and penalties that could affect the CAP budget of each MS depend on these indicators and not on an improvement or a deterioration in climate and environmental impacts. Rooting the eco-scheme in largely spread practices is a way for each country to secure its national envelope of the CAP budget.

Eco-scheme payments do not come without public and private transaction costs. Based on a comparison of draft eco-schemes for 15 MSs, Runge *et al*. (2022) concluded that this policy innovation would not simplify the CAP, although that was an explicitly stated objective of the policy (European Commission 2017). Even if these 15 draft eco-schemes are very diverse, transaction costs are expected to increase everywhere for both the administration and the farmers. Furthermore, several studies have shown that transaction costs at the farm level associated with AECMs are mostly fixed costs, which contribute to make participation unattractive for small farms (Ducos, Dupraz, and Bonnieux 2009; Espinosa-Goded, Barreiro-Hurlé, and Dupraz 2013).

A review of the 2023-2027 CAP and of the different NSPs is legally possible as early as 2025, hence before the next CAP that should theoretically apply from January 2027. In a given MS, this revision is all the more likely to be substantial if the uptake of eco-scheme measures is low (in that first case, the MS will seek to increase the number of beneficiaries by reducing environmental requirements) or, conversely, if eco-schemes in the different MS are as environmentally unfriendly as the French eco-scheme (in that second case, the MS will seek to increase the environmental ambition of the eco-scheme at the cost of negative impacts on agricultural incomes). The work in progress in Brussels on the definition and/or the revision of directives and regulations in line with the objectives of the agricultural component of the European Green Deal increases the relevance of such a review. Further, penalizing pollution and rewarding environmental benefits appears necessary. This requires reducing the governance flaws mentioned above, strengthening the EU trade policy for agricultural and food commodities to avoid pollution leakages from the EU to non-EU countries through trade (Matthews 2022), and explicitly addressing the trade-off (at least in the short term) between economy and ecology. The ecological transition of French and European agriculture increases production costs. It requires targeted aid for farms who bear these additional costs. Part of this aid may be financed by transferring resources from the CAP budget, possibly through a "new land management and transition fund which would be directed at investments, training and advice for transition, along with payments for environmental services and leveraging of additional private finance". This new fund would be placed under the authority of directorate-general (DG) Environment and DG Climate Action in order to balance the power of agriculture ministers and lobbies (Baldock and Bradley 2023). However, new and additional sources of funding are required, for example by developing private markets for environmental services or by using public saving linked to lower environmental and health damage (Guyomard *et al*. 2023).

Notes

1. '*Communes*' are the smallest local administrative units in France. There were about 35,000 '*communes*' in 2021.
2. '*Cantons*' are French local administrative units that lie between '*communes*' and NUTS3 regions. There are around 2,000 '*cantons*'.
3. When income per ha is considered (panel a), the eco-scheme premium per ha between the standard and superior level required to compensate for the income loss per ha is equal to the estimated coefficient of the dummy variable DX ($DX = 1$ when the farm is at the

superior level and $DX = 0$ when the farm is at the standard level). When income per unit of family labour is considered (panel b), the required premium par ha is calculated by using the estimated coefficient of the dummy variable DX multiplied by the ratio of the mean of units of family labor to the mean of UAA.

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Supplemental data

Supplemental data for this article can be accessed here.

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