Territorial agri-environmental measures and inequality: some insights from the French case

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Abstract: Given the challenge of prejudging whether contracting a MAEt – a territorial agri-environmental policy in France – constitutes an environmental effort on the part of the farmers, this study addresses questions of fairness raised by MAEt. Although the policy is focused on improving environment quality, there are consequences in terms of equity of access and the level of compensation obtained. The study employed statistics over the period of 2007–2013 to identify farms with access to MAEt and the associated inequalities. Contracting farmers are similar to those receiving other direct subsidies; thus, the same equity issues are addressed. However, monetary compensation does not appear to worsen income inequality between farmers.

Finally, a focus on MAEt implementation in three regions highlights the key role of contrasted but persistent logics in the definition of priority areas, a hint at a possible lack of realignment of the MAEt scheme after 2013.

Keywords: MAEt; territorial agri-environmental measures; inequality; equity; environmental effort; multifunctionality; France.

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1 Introduction

With the reform of the European Common Agricultural Policy (CAP), adopted in 2013 (EC, 2013), the distribution of the direct 'first-pillar' aid progressed towards greater equity (Lécole and Thoyer, 2015), following a shift that had already been visible in the application of EU regulations in France since 2000 (Chatellier and Guyomard, 2011). This move also affected the budget dedicated to greening the CAP, which had, since 1992, gradually oriented its aid towards the provision of environmental public goods, whether through the conditionality of 'first-pillar' aid (historically devoted to ensuring a basic income for farmers) or through agri-environmental instruments included in the 'second pillar' of the CAP (rural development). Thus, questioning the equity of distribution of these direct aids is important because, taken together, they amounted to 84% of the average income of French farms in 2013 (Kirsch et al., 2017). Moreover, there are professional eligibility challenges in defining who a farmer is (Rémy, 1987, 2014).

Further, considering the ambivalence of the policy objectives, the following question arises: Should the financial allocation of territorialised agri-environmental measures (MAEt) be considered an income support or a compensation? Over the 2007–2013 periods, the MAEt was among the nine national schemes for applying EU agri-environmental policy in the second pillar of the CAP [Article 39 of the (EC) regulation, 2005]. A MAEt is a contract voluntarily signed between a farmer and a public regulator for five years to foster environmentally friendly production practices (e.g., water quality, biodiversity, and landscape). A further provision is an annual subsidy that funds additional costs, revenue losses, and costs incurred when implementing the measures. From the EC perspective, the financial allocation of the MAEt would compensate for the environmental effort, as defined by Deldrève and Candau (2014) and Berthe and Ferrari (2015), required by this agri-environmental policy. However, such an understanding of environmental effort has been criticised given the poor ecological quality improvements and the deviation from initial objectives due to the negotiating power of the agricultural profession (Busca, 2010; Daniel and Salles, 2012). Since it is challenging to prejudge whether contracting a MAEt can be considered an environmental effort by farmers, employing a more generic term in relation to the agri-environmental policy could be justified.

Given the ambiguity of the MAEt design, the questions on equity that farmers must address are twofold:

1 Is the environmental effort provided by all farm types? That is, what is the distribution of this effort?

2 Do the subsidies received by farmers under contract decrease or increase differences in income between farms?

This study focuses on MAEt and more specifically the reduction of pesticide and nitrogen pollution, which has gained importance since the water framework directive (2000). The directive required the French state to align drinking water management policy more closely with environmental policy. Thus, distributing good-quality tap water progressed to preventing the possible diffuse pollution of water resources intended for human consumption (Roussary, 2013).

Water-dedicated MAEt is not a unique instrument that incites environmental efforts to protect water resources among farmers. It complements regulatory (e.g., the nitrates directive) and incentive (e.g., the ecophyto plan) instruments. Understanding MAEt as an incentive instrument with compensation makes it possible to assess the effect of allocation on income inequalities between farmers. Since the instrument is offered to farmers affected by zoning, regardless of their production or farm structure, it captures a sufficiently diversified population for our analysis.

The rest of the paper is organised as follows. Section 2 identifies the main consequences of the implementation of MAEt regarding equity. In Sections 3 and 4, statistical analyses at the French level for the 2007–2013 periods enables us to answer two major questions on the subject: do we observe a farm selection logic during the contractualisation process? Does the MAEt have a redistributive effect or exhibit fairness? Section 5 discusses the long-term results and examines in greater detail regional specificities in the implementation of the MAEt based on a brief study of three contrasting cases. Section 6 concludes by questioning the principles of justice regarding the implementation of MAEt.

2 MAEt and environmental effort: what place for equity?

2.1 Equity is not a central objective of the MAEt policy

The environmental efficiency of agri-environmental policies is controversial. According to Kirsch et al. (2017, p.132), ‘farms with the lowest environmental practice rankings receive, on average, more direct aid per hectare than the highest-ranked farms’, particularly in livestock production. Throughout successive CAP reforms, the environmental legitimacy of agricultural policies has been established, particularly through the objective of supporting the production of positive externalities.

Revisiting the multifunctional conception of agriculture can provide insights into the challenges of capturing the overall effects of environmental effort. The 1990s saw the emergence of the concept of multifunctionality, along with the desire to include it in agricultural policies at European and international levels in a context dominated by the liberalisation of economic policies and the emergence of the environmental issue (Garzon, 2005; Ferrari and Rambonilaza, 2008; Lewis et al., 2010). The case for multifunctionality posits that agricultural activity generates both market (food and raw materials for the industry) and non-market (environmental amenities and pollution) production. Thus, multifunctionality generates new challenges for agriculture, such as the sector's place in land-use dynamics or environmental protection. Consequently, it raises the question of whether appropriate incentives may support certain non-market functions, such as environmental protection, land-use planning, or the viability of rural areas (Ferrari et al., 2012). In this context, we can question the role of public intervention for farmers and, in particular, the redistributive effects of the MAEt.

The MAEt function is therefore based on territorial public policies whose objectives are not always convergent, (e.g., employment, environment, and social) and whose spatial foundations are often based on ad hoc divisions. The MAEt is territorialised because, unlike the eight other MAE schemes, only areas with a prioritised environmental stake can subscribe to it. As part of the transposition of the water framework directive, France defined a MAEt on water issues (measure 214–I2), whose implementation was organised at the regional level in four main stages (Ministry of Agriculture and Fisheries, 2007), namely:

1 delimitation by the administration of 'priority action zones' regarding the water quality stake (nitrates and pesticides)

2 finding a capable local operator to conduct a MAEt project

3 definition of a MAEt project by the operator

4 validation by deconcentrated regional state offices (*préfecture de région*) following the opinion of the Regional Agro-Environmental Commission.

Thus, the territorialisation of the MAEt is constructed at the regional level for the regulatory aspects and the local level for the emergence of projects, the delimitation of the project territory, and the choice of eligible unitary commitments. As a result, farmers in priority action zones but outside MAEt project territories cannot subscribe to this system (Gassiat and Zahm, 2013).

From an economic perspective, MAEt incentives can be qualified as a voluntary economic instrument. They are based on the premises of the (normative) new public economy and, in particular, the theory of contracts and incentives, which examines the development of optimal bilateral (principal/agent) contracts in the case of informational asymmetry between the two parties (Laffont and Tirole, 1993). This theory explains how the principal can propose a cost-effective incentive contract system to encourage agents to act in the interest of societal objectives (Laffont and Martimort, 2002). In our case, it is a question of determining the best cost-effectiveness ratio between the public regulator and the farmer to ensure water quality preservation. There are two types of asymmetries here (Dupraz et al., 2007):

1 The determination of the amount of the subsidy linked to the additional cost of implementing the MAEt by the farmer (a process described as anti-selection, since the most contract-inclined farmers may incur additional costs or make lower environmental, financial efforts than the amount of the subsidy).

2 The nature of the controls to be implemented as farmers' practices during the execution of the contract may not be observable or, at least, not at a reasonable cost. The presence of information asymmetries raises the issue of the regulator of the optimal contract in terms of the right amount of subsidy to be granted.

Although not prominent in the objectives and economic functioning of MAEt, except for certain aspects of multifunctionality, (e.g., the maintenance of activity in rural areas), the equity of MAEt can be grouped into two dimensions: the fact that not all farmers may contractualise, and the way monetary compensation is allocated.

2.2 Underlying ethical stakes

Given the compensation associated with the environmental effort and territorial conditions for accessing the MAEt, it is necessary to perceive the conditions under which this effort can be considered fair, which presupposes the use of equity criteria. In general terms, Butault et al. (2002) defined equity criteria in the distribution of direct agricultural aid by considering three distinct aspects: equity in the subsidy allocation process, equity in allocation, and equity in the post-payment result. Further, the fairness of the process, which is procedural, raises questions about how the subsidy is allocated. The criterion employed is compensation (equal effort, equal achievement) or natural reward (equal talent, equal transfer), which are mutually exclusive criteria. Regarding equity of allocation, two configurations are possible: per historical principles, based on past situations (libertarian criterion), or per modalities of fair negotiation (equity of consensus). Finally, the fairness of the outcome is based on the need to correct unequal levels of individual well-being. Concerning the fairness of the result, two criteria are envisaged by Butault et al. (2002) and depend on a hypothesis of society's aversion to inequality. If the aversion is infinite, then the equity criterion leads to a correction of the differences between agents' levels of well-being to the point of equalising individual utilities (egalitarian criterion). If there is no aversion to inequality, the utilitarian criterion comes into play and maximises the sum of the utilities in society.

Thus, it is not a matter of single criterion of equity. Rather, it is a set of criteria that is likely to shed light on the distribution of the subsidies paid according to the different functions of agriculture considered. From a multifunctional perspective, public intervention regulates the production of externalities by using incentive mechanisms with uncertain redistributive effects and, potentially, a new source of inequality. Thus, to define the environmental effort that should be compensated and the fair criteria for such compensation, it is relevant to understand the relationships of complementarity between market and non-market agricultural production and to be aware of the environmental impact of agricultural activity based on such relations and land use (e.g., practices and use of inputs). This analysis can also shed light on the nature of the public policy to be implemented to regulate the production of externalities.

Specifically, the subsidy amount is defined in each region based on an estimate of the average additional costs and loss of income generated by agri-environmental practices (with a granted rate of public subsidy compensating 100% of the additional costs or loss of income). The estimate was conducted in 2006 by regional expert groups with national harmonisation to avoid possible regional disparities in the subsidy amounts for the same MAEt. However, in practice, the lump-sum nature of the subsidy raised the issue of inequality in the individual environmental effort that farmers must make to meet the objectives of the MAEt (Zahm, 2004). Not all farmers are in the same initial situation regarding their farm structure and personal dynamics (e.g., installation, modernisation, growth, early retirement and retirement). While this lump-sum and territorialised system may offer advantages regarding administrative and budgetary management (Jauneau and Roque, 1999), it has weaknesses regarding equity since it compensates farmers at the same financial level for changes that are not comparable between them concerning their production costs. A second inequality should also be highlighted. Instead of the amount received, this inequality concerns access to the MAEt policy. Not all farmers have access to the MAEt system. Even if they are in a priority zone for the water issue, MAEt can only be contracted in territories with a project leader who has expressed an interest in building and submitting a territorial MAEt project. Access to public aid depends, therefore, on the willingness of a third party to build and conduct a territorial project.

Such a complex system can lead to injustice on two levels: injustice between farmers with access to this system and the rest of society (including farmers), or among the beneficiaries of public support. We consider this dual perspective and propose a characterisation of the environmental effort; with particular reference to the equity of the result obtained (the MAEt is considered as a correction of the levels of inequality among farmers). Thus, MAEt implementation leads us to evaluate the following two aspects empirically:

1 Inequitable access to the system (Section 2): this element is subdivided into two parts:
    - inequality of access according to the collective and institutional dynamics in the priority territories (with or without a project leader)
    - inequality of access according to whether the farmer belongs to a priority territory.
2 Potential inequity in the level of monetary compensation (Section 3): this element is also subdivided into two parts:
    - inequality of compensation between contract holders
    - inequality in the population of farmers as a whole.

3 Is there a selection process at work in accessing the MAEt?

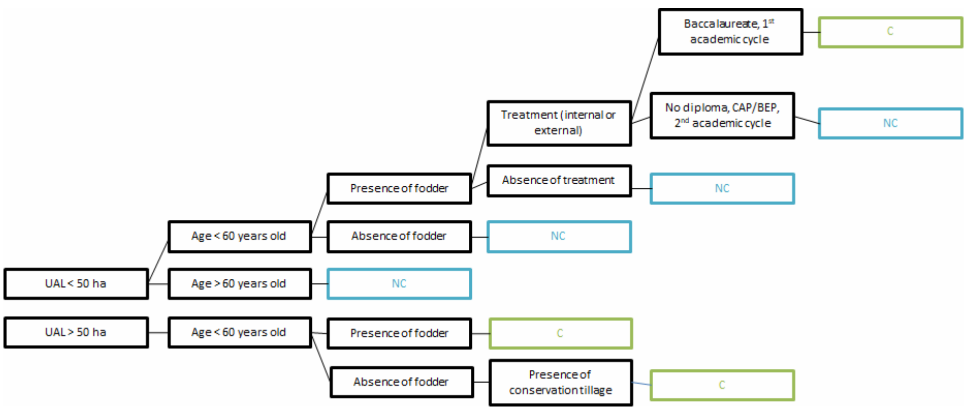
In this section, two databases are paired: the agricultural census (RA 2010), which provides socio-structural information on all farms in France, and data from the services and payment agency (ASP), which provides information on the amounts of subsidies for those that contracted a MAEt between 2007 and 2013. Among 487,050 farms identified in France (excluding Corsica and overseas territories), 6,230 contracted a water-dedicated MAEt for the 2007–2013 period. We define an eligible farm as one that belongs to the project territories and can subscribe to a MAEt. We employ the list of municipalities in the project territories for 2009. The selection of farms belonging to these territories provides a sample of 63,937 farms, among which we distinguish 4,151 contracting farms and 59,786 eligible non-contracting farms.

3.1 To contract or not: discriminating variables

This section identifies the main attributes that make it possible to distinguish between farms that have signed contracts and those that have not (but could). From a methodological perspective, a tree-based segmentation method identifies discriminating factors for understanding the split between farms with and without contracts among those eligible. More precisely, the CART method[1] successively operates a binary split among the sample of eligible farms and, after a pruning process, obtains a binary decision tree.

The main advantage of this method, beyond the fact that it is a non-parametric technique, is the clarity of the allocation rules, allowing for a direct and intuitive interpretation of the results. Figure 1 shows the list of discriminating variables in the contractual decision. The first two variables are the utilised agricultural area (UAA) and the farm manager's age, thus revealing two major trends: farms with more than 50 ha of UAL or a farm manager aged under 60 tend to contract.

Figure 1 CART regression tree on contracting (C) and non-contracting (NC) farmers (see online version for colours)



This result for the UAA shows that contracting farms are, on average, better endowed with land than non-contracting farms in eligible areas. This situation can be explained by the fact that the water-dedicated MAEt is a 'surface aid' and large farms can *de facto* dedicate fewer productive tracts to the MAEt. Moreover, even though the farmland area can indicate a sense of the economic size of the farm, it is risky to link it to income level. Reference should be made to standard gross production (SGP), which is the variable closest to turnover but does not appear as a discriminating variable. However, to provide information on this economic size, we can use the results of a univariate descriptive analysis conducted prior to the segmentation. These results reveal that farms with a high SGP (> €100,000) are over-represented (63.8% of contract holders versus 42.1% of eligible farmers) to the detriment of low SGP farms (< €25,000) (8.3% versus 31.7%), supporting the claim that contracting farms are more economically endowed.

Regarding production systems, the segmentation method does not reveal any particular discriminating variables related to a specific activity (e.g., livestock and field crops) or production method (e.g., quality products). However, technical orientation is important, since the 'presence of fodder', (i.e., having fodder crops and grassy areas on the farm) appears as a third discriminating variable. Hence, to interpret the situation, it is necessary to examine the rules constructed by the tree. The 'presence of fodder' modality is associated with the rules for characterising the contracting parties, indicating that farmers tend to enlist in MAEt activities. However, some farmers do not contractualise because they share a crop that they do not treat (absence of phytosanitary treatment). This result is in line with the conclusions of Kirsch et al. (2017) that farms with the highest environmental practices do not necessarily receive more direct CAP subsidies. Finally, farmers (no fodder) who engage in conservation tillage tend to contract.

3.2 A typology for identifying the diversity of contracting profiles

This subsection highlights the profiles of the 6,230 farms that were contractualised between 2007 and 2013. We use ward hierarchical clustering to build a typology of contracting farms. A factorial analysis via multiple correspondence analysis was first performed upstream to recode categorical variables into numeric ones using the R PCAmixdata package (Chavent et al., 2017). The agglomerative clustering algorithm was applied to the factorial coordinates of the farms, measured via the first 30 axes obtained (explaining nearly 80% of the inertia in the data). Figures 2 and 3 reveal a jump for five clusters of contractalising farms.

Figure 2 Node heights of the ward hierarchical clustering

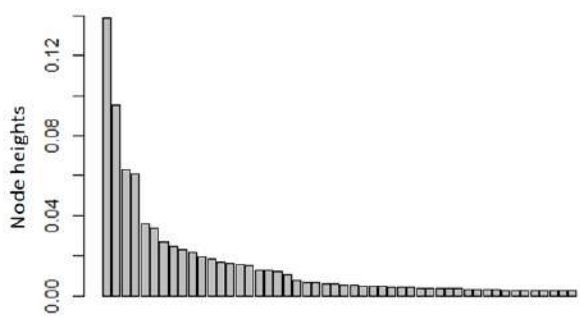
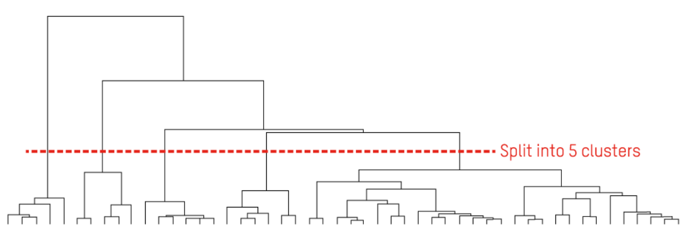


Figure 3 Top of cluster tree built with ward clustering algorithm on contractualising farms (see online version for colours)



Regarding interpretation, the five-cluster typology is relevant (see Table 1 for the characteristic modalities of the clusters). It serves to identify the fact that the typical profiles meet three main contractualisation logics, as presented below.

3.2.1 Standard professional farmers engaged in nitrogen and pesticide reduction

Clusters 3 and 5 bring together most farms enlisted in water-dedicated MAEt (2,290 and 2,624, respectively, out of a total of 6,230). The farms are quite large and have a relatively high SGP (larger than the sample's average). However, they differ in terms of farmland size. Those in cluster 3 frequently have between 50 ha and 100 ha of UAL (46.1% of cluster 3 have between 50 and 100 ha of UAA relative to 34.8% in the total sample of contracting farms), and those in cluster 5 with more than 200 ha were over-represented (17.0% of cluster 5 fall under this category relative to 9.4% in the total sample and 76% of farms with more than 200 ha of UAL are in this cluster). However, their contracting logic is quite distinct:

1 Cluster 3 brings together livestock farms that are engaged in reducing fertilisation (mineral or organic) or herbicides already used in small quantities (the over-represented modality of the percentage of UAA that has not received any phytosanitary herbicide or other treatment or no herbicide is between 50% and 100%). Most also seek feed autonomy for their livestock by favouring grass (92.3% of the farms in the cluster have more than 50% of their UAA in fodder or permanent grasslands relative to 42.6% of the sample) while producing cereals. Nearly one-third of the cluster plant catch crops (between two main crops) relative to 17.7% of the sample. Thus, farms have two objectives: limit nitrogen leaching in winter and produce surplus fodder for cattle. These farms have the following family profile: they are run by a full-time farmer (94.3% of the cluster are managed by a full-time farm manager relative to 81.4% of the sample), often with no employees from outside the family (for more than 85% of the farms in the cluster).

2 Cluster 5 includes farms engaged in field crop production (50.9% of the clusters are engaged in field crop production relative to 28.9% of the sample). Regarding livestock farming, farms seek to reduce pesticide treatments (including herbicides) and fertilisers. This objective can be achieved via several techniques that are not necessarily exclusive: growing oil and protein crops (which do not require much nitrogen), leaving plant residues to enrich the soil (39% of the cluster), and sowing before winter (61.2% of the cluster) to capture soil nitrogen. Plants are then buried before planting other crops to draw soil nutrients. This contracting logic is particularly well suited to farmers with employees to help with various tasks, including treatments, on particularly large areas.

Table 1 Characteristic categories of the five-cluster typology of contracting farms from ward hierarchical clustering

Category	*Mod/Cla*	*Global*	*Cla/Mod*	*v.test*
Cluster 1: n = 538; 8.64% (Only Phyto = 2.8%; only Azote = 79.8%; Phyto and Azote = 17.5%)				
UAAnotreat = 0	97.4	8.5	99.4	58.5
UAAnoherb = 0	98.5	9.0	95.0	57.5
TreatPhyto = Abs	98.9	9.7	88.4	56.0
UAAnofertiliser = 100	64.1	7.9	70.3	37.1
UAAfodderPermanent = 100	51.1	6.8	65.0	31.2
SmallSGP	32.3	7.8	36.0	17.8
EnclosedBreeding	72.5	39.3	15.9	16.3

Notes: ‘Mod/Cla’ is the percentage of individuals in the cluster sharing the category, ‘Global’ denotes the percentage of individuals with the category in the global sample, ‘Cla/Mod’ is the percentage of individuals having this category who have been affected by this cluster, ‘v.test’ identifies the over-representative categories by testing the hypothesis that individuals composing the cluster have been randomly selected.

Table 1 Characteristic categories of the five-cluster typology of contracting farms from ward hierarchical clustering (continued)

Category	*Mod/Cla*	*Global*	*Cla/Mod*	*v.test*
Cluster 1: n = 538; 8.64% (Only Phyto = 2.8%; only Azote = 79.8%; Phyto and Azote = 17.5%)				
UAL < 50	50.7	25.6	17.1	13.1
ProfOther	17.3	8.3	18.0	7.0
F	17.5	12.5	12.0	3.4
UAAnofertiliser = 50–100	16.0	11.7	11.8	3.0
Cluster 2: n = 336; 5.4% (Only Phyto = 67.9%; only Azote = 7.7%; Phyto and Azote = 24.4%)				
UAAvines >= 50	74.7	4.2	96.2	40.4
FieldCrops	77.4	6.8	61.2	35.1
UAAnotreat = 0	57.4	3.4	91.5	33.7
UAAnoherb = 0	50.3	2.9	92.4	31.3
Labour = 0	66.1	19.3	18.5	19.4
UAA < 50	69.6	25,6	14.7	17.4
UAAnofertiliser = 0	40.2	10.0	21.6	15.2
QualProd = 1	84.2	48.1	9.4	14.1
NoTillage = 0	85.4	59.6	7.7	10.5
PermEmployee >= 2	20.8	5.4	20.7	10.1
PermEmployee = 1	22.0	14.4	8.2	3.8
SGPlarge	71.7	63.4	6.1	3.3
Cluster 3: n = 2,290; 8.64% (Only Phyto = 16.2%; only Azote = 50.5%; Phyto and Azote = 33.2%)				
UAAfodderPermanent = 50–100	92.3	42.5	79.8	64.2
UAAnotreat = 50–100	59.5	24.1	90.7	50.8
UAAnoherb = 50–100	60.3	24.7	89.9	50.7
EnclosedBreeding	78.0	39.3	73.0	48.7
UAAcereal = 0–50	91.0	56.8	58.9	44.0
CultDer = 1	32.5	17.7	67.7	23.1
FullTime	94.3	81.4	42.6	21.4
QualProd = 1	62.3	48.1	47.6	17.2
ProgAgri	98.2	91.7	39.4	15.7
UAAnofertiliser = 50–100	19.8	11.7	62.1	14.8
UAA=50-100	46.1	34.9	48.6	14.0
PermEmployee = 0	85.4	80.2	39.2	8.0

Notes: 'Mod/Cla' is the percentage of individuals in the cluster sharing the category, 'Global' denotes the percentage of individuals with the category in the global sample, 'Cla/Mod' is the percentage of individuals having this category who have been affected by this cluster, 'v.test' identifies the over-representative categories by testing the hypothesis that individuals composing the cluster have been randomly selected.

Table 1 Characteristic categories of the five-cluster typology of contracting farms from ward hierarchical clustering (continued)

Category	*Mod/Cla*	*Global*	*Cla/Mod*	*v.test*
Cluster 3: n = 2,290; 8.64% (Only Phyto = 16.2%; only Azote = 50.5%; Phyto and Azote = 33.2%)				
SGPlarge	67.7	63.4	39.3	5.4
UAAnofertiliser = 0	12.1	10.0	44.6	4.2
Cluster 4: n = 442; 7.1% (Only Phyto = 24.4%; only Azote = 20.4%; Phyto and Azote = 55.2%)				
LowerPartTime	89.1	9.9	64.2	42.8
ProfOther	71.9	8.3	61.5	36.1
SGPsmall	46.8	7.8	42.8	23.8
FieldCrops	74.0	28.9	18.2	20.4
UAL < 50	69.7	25.6	19.3	20.2
UALcereal >= 50	59..7	30.8	13.8	13.0
UAAfodderPermanent = 0–50	56.6	35.2	11.4	9.5
UAAnoherb = 0–50	73.1	63.4	8.2	4.4
UAAnotreat = 0–50	73.5	64.0	8.1	4.3
Fallow=1	51.4	41.4	8.8	4.3
Cluster 5: n = 2,624; 42.1% (Only Phyto = 27.1%; only Azote = 21.9%; Phyto and Azote = 51.0%)				
UAAnoherb = 0–50	99.1	63.4	65.8	56.1
UAAnotreat = 0–50	99.3	64.0	65.3	55.8
UAAfodderPermanent = 0–50	68.2	35.2	81.6	47.6
UAAcereal >= 50	59.6	30.8	81.5	42.8
FieldCrops	50.9	28.9	74..1	32.8
UAAnofertiliser = 0–50	91.4	70.4	54.7	32.7
UAAOleagProt > 25	28.0	13.7	86.0	28.6
UAAOleagProt = 0–25	51.0	31.7	67.8	28.0
PlantResidues = 1	39.0	26.8	61.4	18.5
UAA > =200	17.0	9.4	76.0	17.5
intermediateCropsNitrate = 1	61.2	48.6	53.1	17.1
PBSGde	75.0	63.4	49.8	16.4
UAA = 100–200	39.5	30.1	55.3	13.8
PolyCultBreeding	23.0	15.6	62.0	13.5
PermEmployee = 1	19.3	14.4	56.3	9.2
Enclosedbreeding	13.1	9.3	59.1	8.6

Notes: 'Mod/Cla' is the percentage of individuals in the cluster sharing the category, 'Global' denotes the percentage of individuals with the category in the global sample, 'Cla/Mod' is the percentage of individuals having this category who have been affected by this cluster, 'v.test' identifies the over-representative categories by testing the hypothesis that individuals composing the cluster have been randomly selected.

3.2.2 Small farms run by multiple jobholders engaged in nitrogen and pesticide reduction

We identify the specific contracting logic for small farms (farms with less than 50 ha UAA are over-represented; one-third of farms with less than 50 ha UAA are in one of the two clusters) and with a modest SGP. These clusters are much smaller (538 and 442, respectively, of 6,230). The pluriactivity of the farm manager is common among them; particularly for cluster 4 (nearly 72% of the farms in the cluster conduct other activities relative to 8% for the overall sample). However, they form two (instead of just one) clusters because of their technical orientation, with livestock farming and field crops, resulting in to a distinct type of contractualisation:

1. Breeders (cluster 1), almost 80% of the sample, have signed MAEt to reduce nitrogen fertilisers, some of them even going as far as not applying fertilisers. Thus, their production is based on an extensive grassland system (a large share of UAA in permanent grasslands).
2. Cereal farmers (cluster 4) have contracted measures to reduce the use of fertilisers and herbicides. Although their UAA is reduced, they nevertheless implement a grass cover on certain plots (56.5% of the cluster uses fodder and permanent grasslands relative to 35.2% in the sample of contracting farms).

3.2.3 Winegrowers engaged in herbicide reduction

With an even smaller number of cases (336), we group together winegrowing farms (3/4 of the farms in cluster 2 have more than 50% UAA in vines and permanent crops; they amount to only 4% of the sample of contractual holdings). As in many vineyards in France, they also sell a product with a quality sign (84.2% of the cluster has products with quality signs relative to only 48.1% of the overall sample). The MAEt reduces the use of herbicides (more than 2/3 of the farms in this cluster have subscribed to a phytosanitary dedicated MAEt), with an unusual specification: to avoid inter-row weeding by favoring grass. The reduction is, therefore, limited since the underside of the rows is weeded, whereas weeds could be controlled through tillage.

3.3 A selection of farms through MAEt contracting?

Based on the results, it is necessary to identify which farm profiles do not appear or appear only rarely and the corresponding reasons. We note the absence of market gardening and horticulture as well as off-ground livestock farming. However, this is because these technical orientations are not prominent among French farms.

In addition, perennial crops (e.g., vines and fruits) have low contractualisation rates (4.2% compared to 9.5% for eligible farmers). Even though they constitute a specific cluster with its own contracting logic (Cluster 2), they only amount to 5% of the contracting farms. However, some MAEts are adapted to this type of crop. Thus, we can hypothesise that these farms, particularly winegrowing farms, whose income level is the highest among all farms, would not need financial subsidies even when experimenting with new practices, and are ‘independent’ from the agricultural extension networks implementing most MAEts. Moreover, ‘small’ farms, whether in terms of income, land area, or turnover, are not very visible. Though these criteria are not necessarily linked, they are under-represented among the contracting farms. Similarly, farm managers without a diploma are under-represented among contract holders (8.2% of contract holders relative to 21.8% among eligible farms). The same is true for multi-activity farm managers (8.9% relative to 28.9%).

Finally, farmers that match the model and are deemed by professional agricultural organisations to be 'professional' mainly subscribe to MAEt (Rémy, 1987, 2014), while farms oriented towards 'luxury agriculture' do not subscribe. Although MAEt does not have a productive objective (wealth creation), it is 'addressed' or adapted to classical target audiences. The statistics obtained at the national level show that they also participate in the dominant selection logic. From this observation, based on socio-structural characteristics, we complete our analysis from an economic perspective on the consequences of the implementation of MAEt in terms of existing inequalities.

4 A compensated environmental effort: limited inequalities but selective subsidies

This section connects previously used data to a third database from the Farm Accounting Information Network (RICA in French), comprising economic data on farms. As this information is only available for a sample of farms, this section is based on a smaller sample (7,159 farmers in total, including 145 contractors).

4.1 How to measure economic inequalities between farmers

To study the inequalities associated with the payment of monetary compensation for MAEt, we propose to use inequality indicators, which identify the levels of inequality between farmers on a single MAEt or gross operating profit (GOP) variable, and concentration indicators, which assess whether the farmers with the highest incomes obtain compensation. We use the most common indicator of inequality: the Gini index. This coefficient varies between 0 and 1. The higher its value, the greater the inequality. The value of 0 denotes perfect equality among all individuals, and 1 denotes perfect inequality, that is, a situation in which the same person owns all resources. Unlike inequality indexes, concentration indexes identify a resource (MAEt) concentration as a function of another variable (GOP). This indicator therefore makes it possible to assess the greater or lesser concentration of aid among farmers with the highest GOP.

The statistics obtained were calculated from a previously employed database. The variables used are the GOP and the total amount of MAEt payments dedicated to water issues. Tables 2 and 3 show the inequalities for the whole population and that for contracting farmers only, respectively. Each table includes four items of information (one per line):

1 G_{GOP}: inequalities in GOP, including MAEt received measured by the Gini index.

2 G_{MAEt}: MAEt subsidy inequalities between farmers measured by a Gini index.

3 $G_{GOP\text{-}MAEt}$: inequalities in GOP, excluding MAEt subsidy (Gini index).

4 C_{MAEt}: concentration of MAEt received in the GOP function (concentration index).

The results are generated by calculating averages of GOP and MAEt subsidies devoted to water issues from 2007 to 2013. Further, for comparison purposes, Table 3 reports the results obtained in the only other study on the subject employing similar methods (Lewis et al., 2010).

Table 2 Inequality measurements on the whole farmer population

Inequalities	*Results on 2007–2013 mean*
G_{GOP}	0.4099
	(0.0037)
G_{MAEt}	0.9903
	(0.0010)
$G_{GOP\text{-}MAEt}$	0.4099
	(0.0037)
C_{MAEt}	0.3369
	(0.0655)
Number of farmers	7,159
Number of contracting farmers	145

Note: Standard deviations are indicated in parentheses.

Source: Authors, based on the data from ASP

Table 3 Inequality measurements for the contracting farmers

Inequalities	*Results on 2007–2013 mean*	*Results from Lewis et al. (2010)*
G_{GOP}	0.3467	0.28
	(0.0191)	
G_{MAEt}	0.5193	0.40
	(0.0284)	
$G_{GOP\text{-}MAEt}$	0.3530	0.36
	(0.0199)	
C_{MAEt}	0.2323	
	(0.0553)	
Number of farmers	7,159	
Number of contracting farmers	145	657

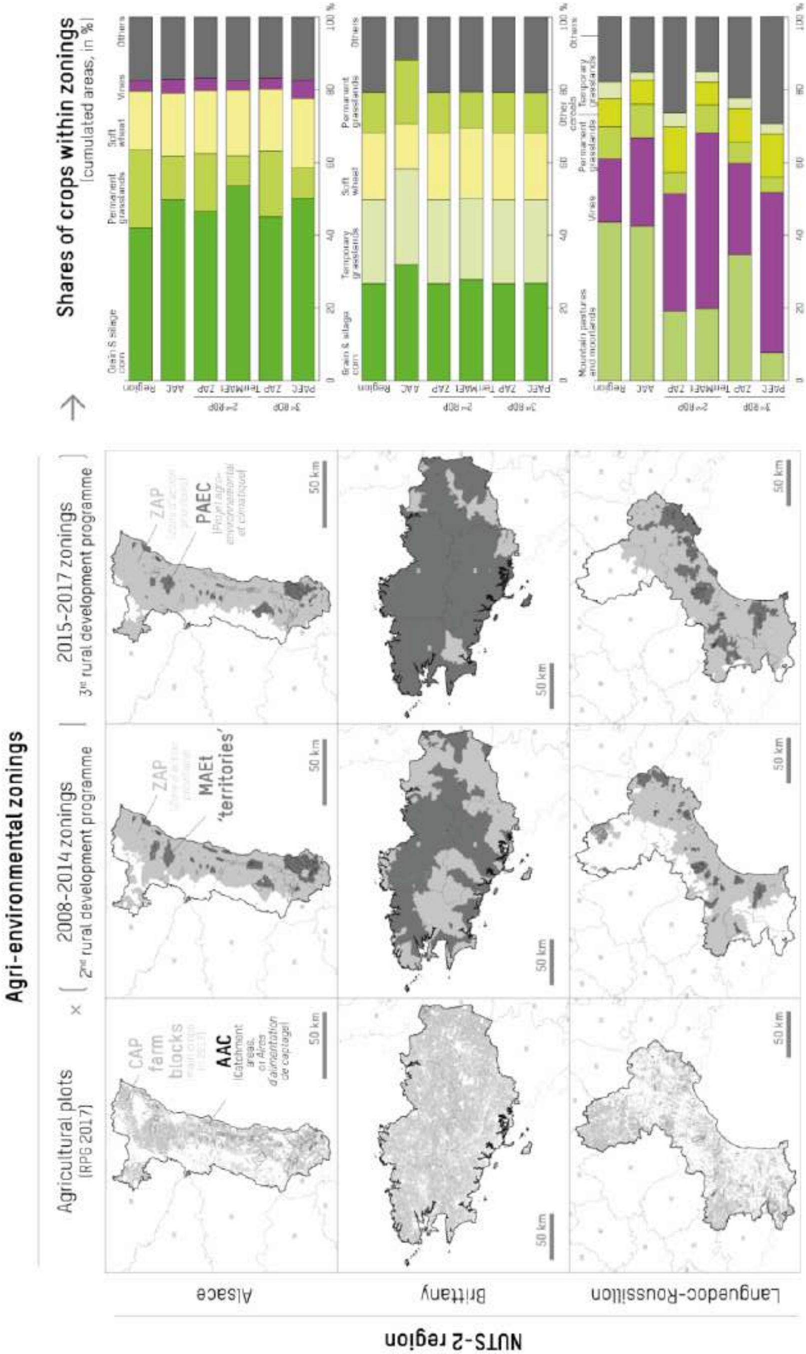
Note: Standard deviations are indicated in parentheses.

Source: Authors, based on the data from ASP

4.2 What is the role of MAEt on income inequalities between farmers?

Different results can be highlighted from the tables. First, contracting farmers are a more uniform sub-population than the entire population. The GGOP index for the population is approximately 0.41, whereas it is 0.35 for the contracting sub-population.

Figure 4 Crosstabulated areas of majority crops in the CAP farm blocks within the zonings of water-dedicated agri-environmental schemes (MAEt and PAEC) in the NUTS-2 regions of Alsace, Brittany, and Languedoc-Roussillon (see online version for colours)



Source: Graphique R.P., 2017, DRAAF Alsace, Bretagne and Occitanie, sandre, IGN

Second, the level of inequality regarding the MAEt subsidy is very high (0.99) due to the tiny proportion of contracting farms (145 out of 7,159). Even if we look only at the 145 contracting farmers, the MAEt is distributed in a differentiated manner, with a Gini index of 0.52. Recent work has shown that, in the unequal distribution of subsidies at the European level, inequalities are greatest among the beneficiaries of subsidies (Lécole and Thoyer, 2015). The system's logic can explain such a situation based on the principle of subsidies that is mainly determined by farmland area, which favours large farms (regarding UAA).

These subsidies are concentrated among farmers with the highest GOP, as shown in the fourth column of both tables (positive concentration index). Nevertheless, in the third column of Table 2, the level of inequality for the GOP minus the MAEt is slightly higher than the level of inequality for the GOP plus the MAEt. However, this difference was not significant. In all cases, therefore, subsidies do not seem to increase inequalities between farmers. This is because even though subsidies are more concentrated among farmers with high GOP, they do not increase inequality because they are probably less unequal than other incomes. The reduction of inequalities by the introduction of MAEt was higher in Lewis et al. (2010). In that case, however, all the subsidies were included on a particular and experimental ground (Territorial Farming Contract in the Dordogne NUTS-3 region, e.g., the third level of the European 'nomenclature of territorial units for statistics'). The double cap on subsidy could explain the fact that inequalities do not increase with the introduction of the MAEt subsidy: a cap on subsidy per hectare according to crops and a cap on maximum annual subsidy per farm at 7,600 €/farm/year.

Using data from the period of the 2nd Rural Development Regulation, our statistical analyses benefit from a complete coverage of metropolitan France. This inventory can nevertheless maintain a fixed and homogeneous vision, even though the 2013 turnaround could rebalance the management of MAEt towards a more egalitarian system.

5 The MAEt: an evolving system with different local appropriations

As mentioned above, great complexity and robust inter-regional disparities may have characterised the territorialisation of the water-dedicated MAEt policy from 2007 onwards. Among contingency sources, we can cite the following:

1. The regionally dominant types of agriculture and their organisational settings [regarding union representation and agricultural extension (cf. Brun and Chabé-Ferret, 2014)].
2. The sharing of competences at regional level (NUTS-2 and NUTS-3) between the regional, decentralised executive body and deconcentrated state services (each possibly under more or less pressure, linked to the visibility of water quality issues).
3. The prioritisation policy of water agencies via the water development and management master plans (SDAGE in French) of the selection of priority catchments.

By focusing on regions with contrasting agricultural characteristics and where the genealogy of zonings is available, it is possible to investigate the diversity of spatiotemporal dynamics in the deployment of the MAEt offer, thereby assessing the continuity of prioritisation and localisation logics for the zonings and the representation of agriculture types. Based on spatial data from the land parcel identification system (*Registre Parcellaire Graphique* or *RPG* in French) as a proxy for agricultural activity, the areas of the 28 crop groups in the RPG 2017 were intersected with spatial zones within the (former) regions of Brittany, Alsace, and Languedoc-Roussillon, thus allowing for a calculation of cross-tabulated areas. In addition to the boundaries of the region and its drinking water catchment areas, overlapped envelopes associated with the implementation of water-dedicated MAEt were also considered: the overarching 'priority action zones' (*zones d'action prioritaire* – ZAP) and the smaller MAEt 'territories' defined for the second rural development program (2007–2014), followed by new 'priority action zones' and 'agro-environmental and climate projects' (*Projets agro-environnementaux et climatiques* – PAEC) at the beginning of the third rural development program (2015–2017).

A clear pattern can be identified in the case of the Alsace region, which displays significant continuity in the selection logic of MAEt zonings over the two periods. Out of the 322,734 ha of crops considered in the region, the divisions preserve the proportions of the main crop groups: field crops dominate, followed by permanent grasslands and vineyards. For example, the proportions are close to the regional averages for drinking water catchment areas, even though the agricultural areas included amount to only 11% of the regional total. Similar representativeness is also observable for the MAEt and PAEC areas. The prior identification of priority action areas had been very inclusive (covering the Alsatian plain – east of the region) and continuous (88% to 93% of the areas, which are largely overlapping). Thus, the inflections were made on the side of the location of the MAEt territories and the PAEC: covering, respectively, 17% and 11% of the regional crops, these two generations of zoning overlap rather weakly.

The case of Brittany was significantly different. There, European litigation on nitrate contamination led to the commitment of specific resources. Thus, the region was considered a single priority action area starting from the second rural development program. Under this first layer, MAEt territories and the PAEC were proposed over substantial parts of the region, with 54% and 89% regional crops (in 2017). These zonings are therefore very representative of the regional crop groups (1.6 Mha), dominated by maize, soft wheat, and grasslands (temporary and permanent). Thus, it would seem that the implementation of MAEt in Brittany would hardly be 'territorialised' because of weakly selective zoning, which would be justified by the scale of the issues at stake and the presence of additional resources. A mechanism for spatial sorting remained at work in the yearly deployment of the 2nd RDP, with a rotation in the territories eligible for the water-dedicated MAEt. From a farmer's perspective, contractualisation was only possible over restricted time windows, especially as opportunities in this region decreased by the end of the program. From 2008 to 2013, the surface areas of crop groups in MAEt territories decreased from 54% to 29% of the regional total.

An opposite dynamic can be observed in the Languedoc-Roussillon region. Here, the implementation of MAEt territories was late but cumulative: covering only 6% of regional crops in 2012, the eligible areas then increased slightly until the end of the program (7% and 8% in 2013 and 2014). The selectivity of these zones was coherent with the priority action zone for the second RDP (53%). The following period saw a shift along these lines, with an increase in areas for both ZAP and PAEC zones (16% and 69%). The changes were most evident in the proportions between the major crop types. Even though they amount to only 17% of the RPG crop area, vines are very present in the water-dedicated zones, reaching 48% of the total in the MAET territories and 44% in the PAEC. As this over-representation of vines is at the expense of the ‘mountain pastures and moors’ entry of the RPG, it is understandable that it may be partly due to the logic of efficiency of measures and the existence of levers for collective action in a wine sector dominated by cooperatives (Kuhfuss et al., 2014). However, the proportions of crop groups included in the region’s drinking water catchments areas are much closer to the average. Meanwhile, summer pastures and moors represent 44% and 8%, respectively, of the dominant crop groups in the region and PAEC territories; they account for 42% of the drinking water catchments areas.

Thus, the current regional implementation of the PAEC zonings provides few clues to the *a priori* and more equitable nature of the new arrangements. High selectivity may be associated with highly volatile zonings and be representative of regional agriculture (the case of the Alsace region). Low selectivity does not prevent the over-representation of one type of agriculture, thus generating possible inequities (the case of the Languedoc-Roussillon region). However, a more inclusive system can also involve numerous spatial sortings of farms, possibly worsening preexisting inequities via the implementation of programs (the case of the Brittany region).

6 Conclusions

The present work identifies the issues of equality and equity associated with the implementation of water-dedicated MAEt. The first part demonstrates that the issue of equality is not central to this policy, as its primary aim is environmental. Nevertheless, the existence of a set of conditions for accessing the system (regarding the eligibility of joining the MAEt program) and a monetary compensation justify an examination of the consequences of this system from the perspective of distributive justice in its broadest sense.

First, our socio-structural analysis reveals that subscribing farmers are not identical to the rest of the French farming population. Direct subsidies have mainly been criticised as an injustice because of their indexation of farmland areas and the calculation of payments based on past subsidies (Lécole and Thoyer, 2015). Although the MAEt is not calculated on historical bases, we show that they largely maintain the importance of farm size for receiving aid.

Second, an economic analysis of the inequality level shows that the population of farmers receiving the MAEt compensation is more homogeneous than that of non-contracting farmers. Although the MAEt is mainly subscribed to by farmers with high GOP, this economic analysis shows that the existence of financial compensation does not increase existing inequalities in the population. The *ex-post* evaluation of inequalities raises the issue of the equity criterion, which merits an examination. The principle of compensation is based on an economic principle associated with the theory of contracts. However, it does not explicitly raise the question of justice. Fairness is therefore assessed based on the integration of farmers into the MAEt scheme rather than a study of the scheme itself. From this standpoint, the relevance of the compensation-access to the system duality is probably artificial (but necessary for the interdisciplinary analysis of equity). The weak redistributive effects of the system can be explained, in part, by the selection logic inherent to the contracting modalities.

Third, the identification of post-2013 developments in the last section allows us to observe the challenges related to the study of the equity of these schemes nationally. Their decentralisation makes it necessary to open up a third space for equity evaluation, following those of the European Union and the member state (Lécole and Thoyer, 2015) and the local territory, particularly at the regional level. This question of scale (EU, member state, territory) overlaps with other nested equity issues associated with the MAEt. Our analysis remained restricted to equity within the agricultural profession. However, a complete assessment would require a study of the broader population, including individuals who suffer from environmental degradation caused by agriculture. Consequently, the relevance of the MAEt system in terms of justice could also be based on the increase in well-being produced by the implementation of this system, given the production of non-market goods that it would enable. Moreover, arguing for a specific assessment of MAEt should not lead to their exclusion from direct subsidies. It is relevant to assess the equity consequences of the MAEt scheme. However, it is important to consider whether it is possible to address multiple aspects of multifunctionality with a single instrument.

Generally, the arguments presented here should contribute to the understanding of farm complexity, considering the new opportunities and constraints offered by multifunctionality and the range of new efforts it implies. Diversification of practices should extend the issues of inequalities between farms to an issue of social cohesion within a profession producing increasingly different goods. Moreover, the production of non-market and diversified goods complicates the assessment of equity. In our case, some dimensions of the equity of distribution between farmers may remain unaddressed due to the elusiveness of certain parameters, such as the unknown administrative costs of MAEt management or the challenge of accessing result indicators on water quality at the farmer level (Kuhfuss et al., 2012).

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Notes

1 CART means classification and regression trees. It was introduced by Breiman et al. (1984). See Genuer and Poggi (2017) for a recent reference. The analysis was conducted with the R rpart package (Therneau et al., 2018).