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# NACHHALTIGE ERNÄHRUNGSSYSTEME UND LANDNUTZUNGSWANDEL

Mit Beiträgen von

Ackermann, A., Adu-Baffour, F., Bahrs, E., Bartkowski, B., Baum, S., Beck, A., Behle, H., Bieling, C., Bilal, M., Birner, R., Bittmann, T., Böhner, H. G. S., Bolten, A., Bornkessel, S., Bosch, C., Boysen-Urban, K., Brümmer, B., Bücheler, H., Buhk, J., Bühner, C., Codjo, E., Daum, T., Degen, A., Diekmann, M., Domptail, S. E., Dreist, D., Ehjeij, S., Feil, J., Feuerbacher, A., Flaig, D., Gafarova, G., Gebhardt, B., Geise, W., Gerster-Bentaya, M., Glauben, T., Gleue, A., Graf, S., Grotsch, H., Grunenberg, M. H., Grüner, S., Hänsch, J., Halle, O., Hanf, J. H., Harsche, J., Hartig, M., Haunert, J., Heinz, J., Hempel, C., Henning, C. H. C. A., Herrera Quinteros, G., Herrera, B., Hess, S., Höschle, L., Hüttel, S., Jahnke, B., Jamali Jaghdani, T., Janssen, M., Jordan, I., Jürkenbeck, K., Kantelhardt, J., Knierim, A., Koch, K., Krumbe, F., Kühl, S., Laggner, B., Lakner, S., Lambarraa-Lehnhardt, F., Langanke, N., Latacz-Lohmann, U., Lemken, D., Liebe, U., Loughrey, J., Loy, J., Lünenborg, C., Luo, H., Maruejols, L., Mehta, Y., Meißner, L., Mergenthaler, M., Messmann, L., Meyer-Jürshof, M., Michalke, A., Michels, M., Mörsdorf, J., Moyo, B., Munz, J., Muramatsu, Y., Mußhoff, O., Neu, C., Nieland, C., Niemann, C., Nordmeyer, E. F., O’Conner, D., Obeng, E. A., Odening, M., Oduor, F., Oeding, S., Ojo, C., Ojo, T., Osterkamp, S., Otter, V., Oyinbo, O., Pardeshi, S., Paulus, M., Perekhozhuk, O., Pfaff, S. A., Plaas, E., Pömpner, A., Rannow, W., Richter, B., Ritter, M., Röder, N., Roosen, J., Runge, T., Schaak, H., Schaller, L., Scharnhop, J., Scherfranz, V., Schmid, C., Schmidt, L., Schreiner, J. A., Schulz, F. N., Schulze, H., Schulze, M., Schulze-Ehlers, B., Schütze, B., Schwab, S., Seifert, S., Sippl, F., Speck, M., Spiller, A., Sponagel, C., Termote, C., Theilen, G., Tiedemann, T., Tröster, M. F., Uehleke, R., Uthe, P., Völker, R., von Plettenberg, L., von Steimker, F., Wang, W., Wegmann, J., Wehner, J., Wever, H., Wicklow, D., Wieck, C., Witte, F., Yu, X., Zavalloni, M., Ziesmer, J., Zühlsdorf, A.

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## COMPLYING WITH GREENING IN GERMANY: THE CASE OF ECOLOGICAL FOCUS AREAS AND CROP DIVERSIFICATION

*Sarah Baum<sup>1</sup>, Johannes Wegmann, Norbert Röder*

### Summary

With the Common Agricultural Policy reform in 2013, greening measures were introduced to establish a stronger link between payments made to farmers and environmental performance. We examine how the greening regulations for ecological focus areas (EFA) and crop diversity (CD) affected the management of arable land using data of the Integrated Administration and Control System (IACS) of five German federal states for the years 2010 to 2018. The objective of the paper is to analyse if certain observable farm and/or site characteristics can be linked to the compliance of greening rules. Moreover, we want to analyse how compliance changed over time and how farms reacted to changes in the regulation.

Around 40% of the farms were obligated to CD or EFA regulation, respectively, cultivating 90% of total arable land. With respect to CD, most farms would have fulfilled the requirements even before the implementation.

Even with low ambition level of greening, there was already a positive correlation in the number of (partial) drop-outs and management intensity. The findings confirm the limited environmental effectiveness of uniform obligations in support schemes.

### Keywords

Agri-environmental policy, compliance, CAP, greening

### 1 Introduction

The drastic loss of biodiversity in the European agricultural landscape, high emissions of methane and nitrous oxide from livestock and soils as well as nutrient surpluses which endanger the quality of water have urged policy-makers in the EU to reform its agricultural policy (cf. PLIENINGER et al., 2012). The so-called greening, aiming at a more environmental- and climate-friendly agriculture (EUROPEAN PARLIAMENT (EP), COUNCIL OF THE EUROPEAN UNION, 2013) was implemented as a result of the Common Agricultural Policy (CAP) reform in 2013. All farmers receiving direct payments were obligated to meet its standards. A total of 30% of EU direct payments, that was 12 billion Euro per year (EUROPEAN COURT OF AUDITORS, 2017), were explicitly dedicated to three measures: provision of ecological focus areas (EFA), crop diversification (CD) and preservation of permanent grassland. To fulfill EFA requirements, an agricultural holding had to designate at least 5% to fallows, catch crops, buffer strips and landscapes. CD was fulfilled when more than three crops were sown (depending on the farm size).

The environmental effectiveness of CAP greening, like all agri-environmental measures, depended on the area for which the regulation triggers changes in the land use compared to a baseline, the compliance of the farmers to the rules and the environmental quality of the management. Farms had to provide greening measures on arable land if passing respective thresholds. Organic farms and small farmers were exempted from greening. Prior to the introduction of greening, PE'ER et al. (2014) assessed the expected effect of its introduction. They assumed for the EU28 that at least 88% of the farms, managing 48% of the utilized agricultural area

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<sup>1</sup> Thünen-Institut für Lebensverhältnisse in ländlichen Räumen, Bundesallee 64, 38116 Braunschweig, sarah.baum@thuenen.de

(UAA) would have been exempted from providing EFA; for CD they assumed 81% of the farms managing 13 % of the arable land. Furthermore, the authors showed large regional differences for different parts of Europe. For western Europe, they stated that around 61% of the farms would be exempted from EFA as well as half of the UAA. For CD, 40% of the farms managing 4% of the arable area would not have been obligated in western Europe.

Before and after the implementation of 2013 CAP reform many ex-ante modelling studies evaluated the likely impact of the greening, mostly focusing on certain farms, farm-types and regions but also EU-wide (for an overview see e.g. GOCHT et al., 2017). The overall result of these studies was that the likely effect of greening on agricultural land use and consequently on the environment would be fairly marginal as in most cases the farms already fulfilled the obligations prior to their implementation. These ex-ante assessments were largely confirmed by a so-far very limited number of ex-post studies looking at the implementation of the 2013 CAP and its consequences for land use. The studies using farm level data focus mainly the use of arable land and cover parts of Germany (NITSCH et al., 2017; RÖDER et al., 2019; RÖDER et al., 2021b; LAKES et al., 2020), Italy (BERTONI et al., 2021) and Sweden (SCHAAK et al., 2023), in addition for Spain used regionally aggregated data only (DÍAZ-POBLETE et al., 2021).

However, none of these studies focused so far on the decision-making units and whether there is some link between farm characteristics and the likelihood to comply with the obligations, or more correctly, to fully participate in the CAP's support program. There is a widespread plea, also within the scientific community to waive, to raise the CAP's environmental ambition level (e.g. PE'ER et al., 2020). To assess the environmental impact of flat-rate instruments such as greening or the 'enhanced conditionality' it is not only important to know, which farms are going to comply (because they did anyway), or adapt but also who is going to fully or partially leave the system. While in the first case windfall profits are generated, in last case the environmental performance might decline as these farms fall back to ordinance law.

Of the factors determining the environmental effectiveness of agri-environmental measures we focus in particular on the farmers' compliance with the obligations. Filling this gap would enable policy makers creating more powerful regulations which have positive environmental effects in the future. In particular our main research questions are:

- Can compliance to greening be linked to certain farm or site characteristics?
- And did the behavior to comply with greening regulation change over time?

In the paper we focus on the greening obligations relevant for the management of arable land. The paper is classically structured. Chapter 2 to presents the material and methods, followed by the results, discussion and conclusion.

## **2 Material and Methods**

In our study we use highly resolved data of the Integrated Administration and Control System (IACS) of five federal states in Germany for the years 2010 to 2018. A great advantage of these data is that it is almost a full sample as each farm that claiming direct payments is recorded in the IACS. The data provides geo-referenced land use information of each agricultural holding's plot - linking farm id and plot to each other. The five regarded federal states show very marked differences in farm sizes and land-use intensity (e.g. stocking rates), predominant sectors and bio-physical factors ( c.f. ROBBERG et al., 2007, Table 1). The study area covers 41% of the German arable land (4.8 mil. ha) managed by 40% of the German farming population (107.600 farms, (STATISTISCHES BUNDESAMT, 2018).

**Table 1: Mean farm size and stocking rates in the year 2015**

Federal state	Agricultural area: mean area per farm (ha) <sup>1</sup>	Arable land: mean area per farm (ha) <sup>1</sup>	Total number of cattle <sup>2</sup>	Average cattle stock per farm <sup>2</sup>
BB	229.0	221.0	561.859	127
HE	36.8	31.1	458.981	52
NI	54.7	53.1	2.652.139	122
NW	35.3	35.0	1.458.481	81
RP	37.7	41.0	359.555	67

Quelle:<sup>1</sup>Own calculations by using IACS data and <sup>2</sup>(STATISTISCHES BUNDESAMT, 2016)

Between 2015 and 2022, farms with more than 15ha arable land had to provide 5% (weighted) of their arable land as EFA. There were different types of EFA that had different weight factors reflecting their ecological value (for details and exceptions see EUROPEAN COMMISSION, 2014); EUROPEAN PARLIAMENT (EP), COUNCIL OF THE EUROPEAN UNION, 2017, 2013; EU 2017/2393, EU 1307/2013). CD affected all farms with at least 10ha arable land (Art. 44 EU 1307/2013). For exceptions see Art. 44 (EFA) and 46 (CD) EU 1307/2013 and EU 2017/2393.

To examine if the type of farming had an influence on the obligated farms to fulfil or not fulfil the greening obligations in terms of EFA and CD, types of farming in terms of the regulation (EC) 1242/2008 (EUROPEAN COMMISSION, 2008) were used. These types of farming describe a farm's productive orientation; decisive for classification are the respective shares of the different production branches on the farm's overall standard output. The standard output describes the average monetary value (in euros) of the gross agricultural output of an agricultural holding using average yields and prices calculated for a reference period of five marketing years (RÖDER et al., 2022). Data was provided by KURATORIUM FÜR TECHNIK UND BAUWESEN IN DER LANDWIRTSCHAFT E.V. (2020).

Analyses on CD were made on basis of crop groups in terms of the greening regulations (RÖDER et al., 2022).

As decisions from farmers are made annually, but also depend on location, we apply a generalized additive mixed model. As decisions to fulfil requirements can be modelled as a binary outcome and link it to the regression model via a logit model. The binominal response variable was "EFA requirements fulfilled (no: 0/yes: 1)". Formally the model is as follows:

$$g(\mu_{it}) = x'_{it}\beta + \sum_{j=1}^m f_j(x_{it}) + z'_{it}b_i$$

where  $g$  is the inverse link logit function,  $\beta$  are linear predictors,  $f_j(x_{it})$  is a non-parametric function which can be estimated using splines and  $b_i$  are the random effects. The subscripts indicate that observations are made at farm level,  $i$ , and at different point in time,  $t$ . So far, the relationship between the outcome variable (fulfilment of EFA requirements) and farm type, land use intensity (utilized agricultural area per animal) and the standard output (EUR) as well as the location on soil-climate area of the farm's plots enters linearly in the regression. The relationship between the outcome and area of (arable) land (hectare) is estimated using penalized splines. Random effects in the model are at the individual farm level (random intercept) varying between the years as well as between soil-climate-areas (SCA).

SCA represent regions with more or less homogeneous site conditions concerning agricultural production in Germany taking especially the influence of soil quality and climate into account

(ROßBERG et al., 2007). Therefore, we include this information as random effect. As the numbering of the SCA follows a hierarchical system, it was possible to form aggregates by deleting the last digit of the SCA codes. This was mainly done for enhancing the clarity of the visualisation of the results that did not change when the SCAs were not aggregated.

We analysed the EFA implementation using data of all five federal states, while we excluded NW for the CD analysis as in NW the land use codes became much more differentiated after 2015.

### **3 Results**

#### **3.1 Farms and arable land obligate to EFA and CD**

Most of the farms receiving direct payments were neither obligated to implement EFA nor CD: This share of farms increased from 56% in 2015 to 58% in 2018 but affected only 7% to 8% of the arable land. The share of farms obligated to EFA as well as CD regulations declined from 40% (2015) to 38% (2018), managing 90% (2018) to 91% (2015) of the arable land. In total, 42% (2018) to 44% (2015) of the farms and 92% (2018) to 93% (2015) of the arable land were affected at least by one of the two greening measures.

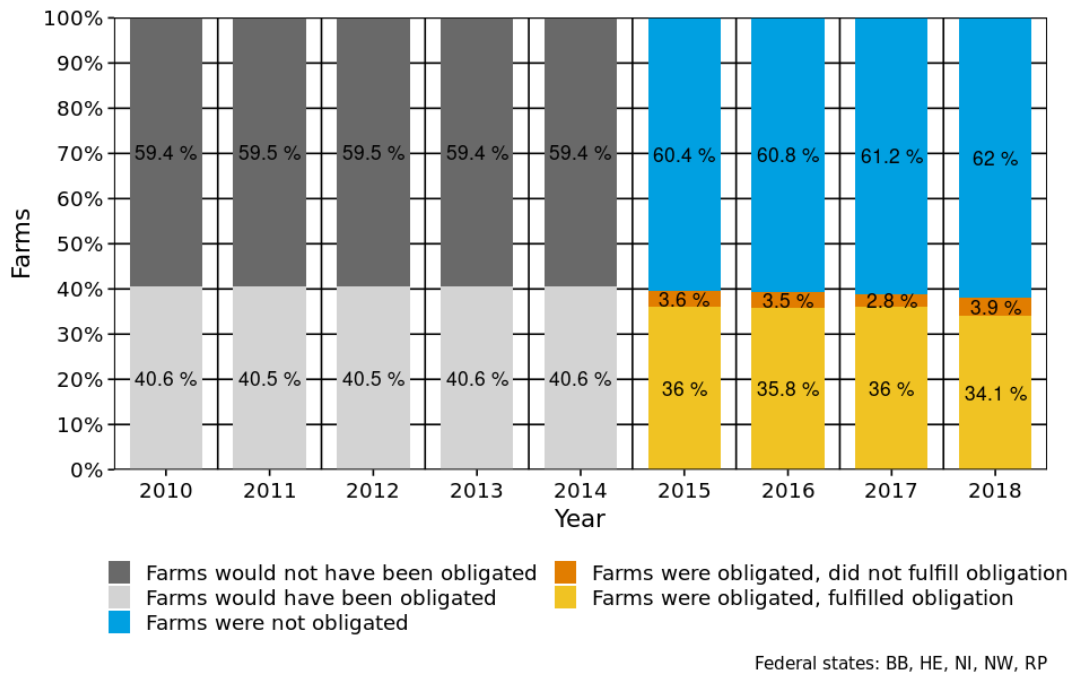
#### **3.2 Ecological focus areas (EFA)**

Only 39.6% of the farms had to comply EFA regulations in 2015. This percentage declined constantly and reached 38.0% in 2018 (Figure 1). However, the share on arable land was hardly affected prior to 2018. Looking at the years before greening was implemented, we see that between 2010 and 2014 40.6% of the farms would have been obligated, if the regulation would have been in force, slightly exceeding the respective figures after 2014. Using only IACS data it is not possible to say how many of them would have been able to fulfil the obligations as catch crops are only reported if they were supported as EFA or agri-environmental and climate measures (AECM). The evolution of the figures indicate that we have some stronger adjustment in farm structure coinciding with the implementation of greening in 2015 and the ban of pesticides on EFAs in 2018.

The overwhelming majority of the obliged farms fulfilled the requirement to manage at least 5% (weighted area) of their arable land as EFA Only 3.6% of all farms (or 9.1% of the obligated) did not fulfil the requirements in 2015. This number dropped till 2017 to 2.8% but increased in 2018 to 3.9% of all farms (7.2% (2017) or 10.3% of the obligated farms, respectively). If these farms would have reported 5% of their arable land as EFA (note: they did not necessarily report nothing, but less than 5%), the EFA area of all farms would have been in 2015 and 2018 2.2% or 3.8%, respectively, higher.



**Figure 1: Affectedness and implementation of the greening's EFA regulations. 2010-2014: theoretically (not) obligated farms; 2015-2018: (not) obligated farms**



Source: Own depiction

In the data we see a marked and increasing gap, when comparing the area covered by land uses potential eligible as EFA (= potential EFA area), irrespective of funding, with the area actually reported by the farms (reported EFA). We excluded catch crops and green cover and landscape elements from this analysis as catch crops and green cover are only reported when they are financially supported via EFA or AECM and data for landscape elements were not available for all years.

Prior to 2015 the potential maximum share of EFA on the arable land decreased slightly but increased with the introduction of the greening till 2017. While low productive sites were taken into production prior to 2015 greening rules made it comparatively attractive to leaving fallow these sites. The difference between potential EFA share and reported EFA share doubled from 1.1 to 2.0% points between 2015 and 2018. Here the increasing promotion of different fallows and flower strips via AECM is also an important driver but the increase is mainly due to EFA fallows (BAUM et al., 2021). With banning the application of plant protection products on EFA, the share of nitrogen fixing crops reported as EFA decreased markedly from 2017 and 2018.

### Type of farming

As 7.2% (2017) to 10.3% (2018, see above) of the obligated farms did not (fully) follow the EFA regulations, we scrutinize potential factors that influence the decision to fully comply with greening rules or to waive (at least a part of) the payment. Most obliged but non-compliant farms (EFA<sub>On</sub>) are 'specialist field crop', 'specialist grazing livestock', 'mixed crops and livestock farms' and 'specialist granivores'. These four types of farming accounted for roughly 90% of all farms that were obligated to EFA but did not fulfil the requirements. The relatively high share of compliant livestock farms can be explained by the implementation of catch crops as EFA: Specialist granivores, specialist grazing livestock, mixed crops and livestock as well as specialist field crop farms reported 92%, 87%, 75% and 68%, respectively, of their reported EFA area as catch crops.

**Figure 2: Influence of type of farming on not-fulfilment of EFA regulations: changes with respect to reference year 2015**

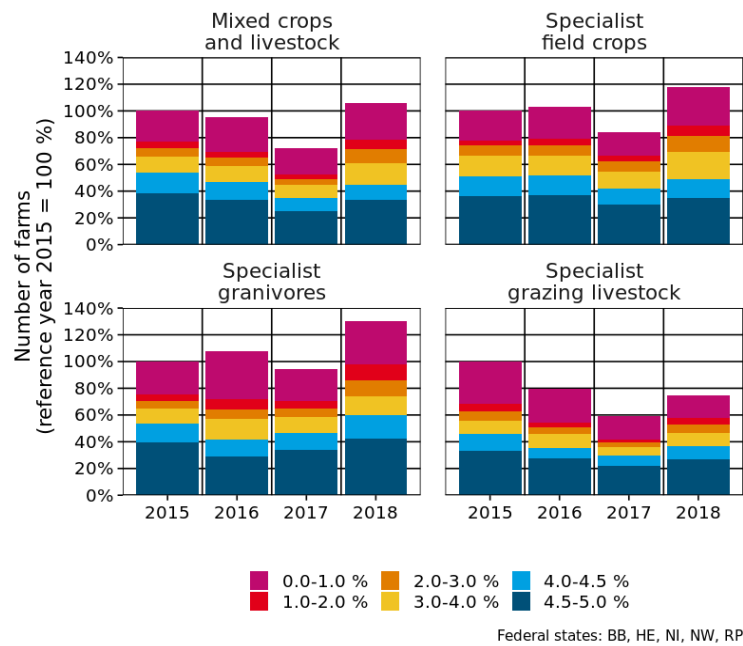


Figure 2 shows that within the group of EFA<sub>On</sub> farms the typology of an agricultural holding had no influence on the share of reported EFA: Most farms reported either no or barely any EFA (0-1%) or missed the target slightly (4.5-5%). For the four regarded types of farming showed clear differences in the development in the respective number of farms that did not fulfil the requirements over time. This number declined especially for specialist grazing livestock but declined also for mixed crops and livestock farms as well as for specialist field crops until 2017 (see also Figure 3). However, in 2018 the number of EFA<sub>On</sub> farms increased substantially and exceeded even the levels of 2015 for specialist granivores (+30%), specialist field crops (+20%) and mixed crops and livestock farms (+6%) (Figure 5). This pattern partially deviates from our expectations: due to economic reasons specialist field crops should adapt the most and not specialist grazing livestock (-23%) as with increasing livestock farming the influence of restrictions like feed ration or adhere nutritional balances as well as short-term opportunity costs increase. The little adaption of mixed crops and livestock farms is in line with this expectation.

Selection of the four most common types of farming that accounted for 90 to 91% of all farms that were obligated but did not fulfil the requirements. Bar segments: weighted share of arable land reported as EFA.

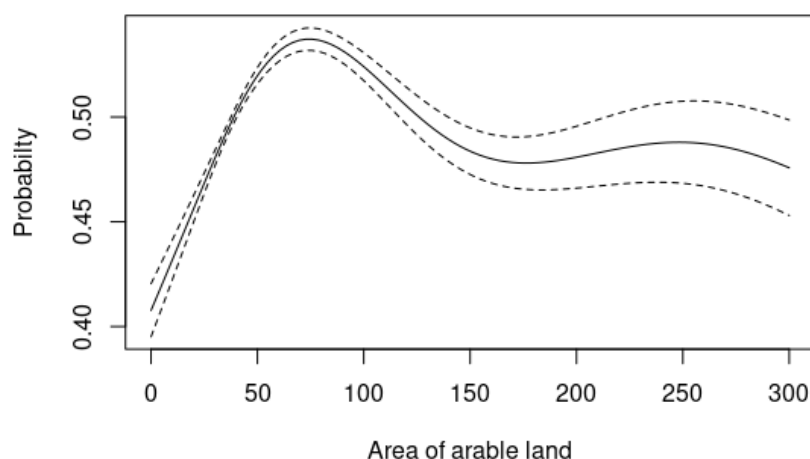
### Endowment with arable land

While on the one side some obliged farms did not fulfil their respective obligation, on the other side some farms reported much more land than required (e.g. between 24.1% (2015) and 26.5% (2018) of EFA<sub>O</sub> reported at least 7% of their arable land as EFA). In any given year for farms with more than 50ha of arable land the distribution of reported EFA shares was fairly independent of the area endowment. Thus, the ‘safety margin’ of in excess reported EFA seems more to be given share than an acreage.

In all years, we see in the group of farms with less than 25ha arable land an over proportionally high share of farms reporting less than 5% EFA and especially farms falling short of the requirement by more than 1%-point. While the share of non-complying small farms declined over time until 2017, we see the opposite for farms managing larger areas (>100ha): in 2018, their

share of farms reporting less than 5% EFA was higher than that of smaller farms. Apparently, larger farms increasingly waived their EFA greening bonus. The increasing share of larger farms not complying with the EFA regulation in 2018 might have been driven by changes in regulations (e.g., ban of plant protection products on EFA).

**Figure 3: Marginal effect of a farm’s endowment with arable land (in ha), the likelihood to comply with the EFA obligations over all years**



Source: Own depiction

**Table 2: Factors influencing factors the farms' likelihood to comply with EFA regulation**

Variable	Odds Ratio	Confidence Interval	
		2.5%	97.5%
Intercept	3.77	3.58	3.97
Intensity	1.02	1.00	1.04
SCA (reference SCA 14)			
SCA 10	1.62	1.47	1.78
SCA 11	0.74	0.59	0.93
SCA 12	0.47	0.44	0.51
SCA 13	0.84	0.79	0.89
SCA 15	1.07	1.01	1.14
SCA 19	0.64	0.55	0.75
Year (reference 2015)			
2016	1.02	0.98	1.07
2017	1.28	1.22	1.34
2018	0.85	0.81	0.89
Type of farming (reference Specialist field crops)			
Specialist horticulture	0.74	0.63	0.87
Specialist permanent crops	0.63	0.55	0.73
Specialist grazing livestock	1.63	1.54	1.72
Specialist granivores	1.78	1.66	1.92
Mixed cropping	1.02	0.90	1.15
Mixed livestock holdings	1.97	1.78	2.17
Mixed crops — livestock	1.44	1.38	1.51
Non-classified holdings	0.12	0.00	1.99
Standard output	0.99	0.99	1.00

Number of farms: 61 837

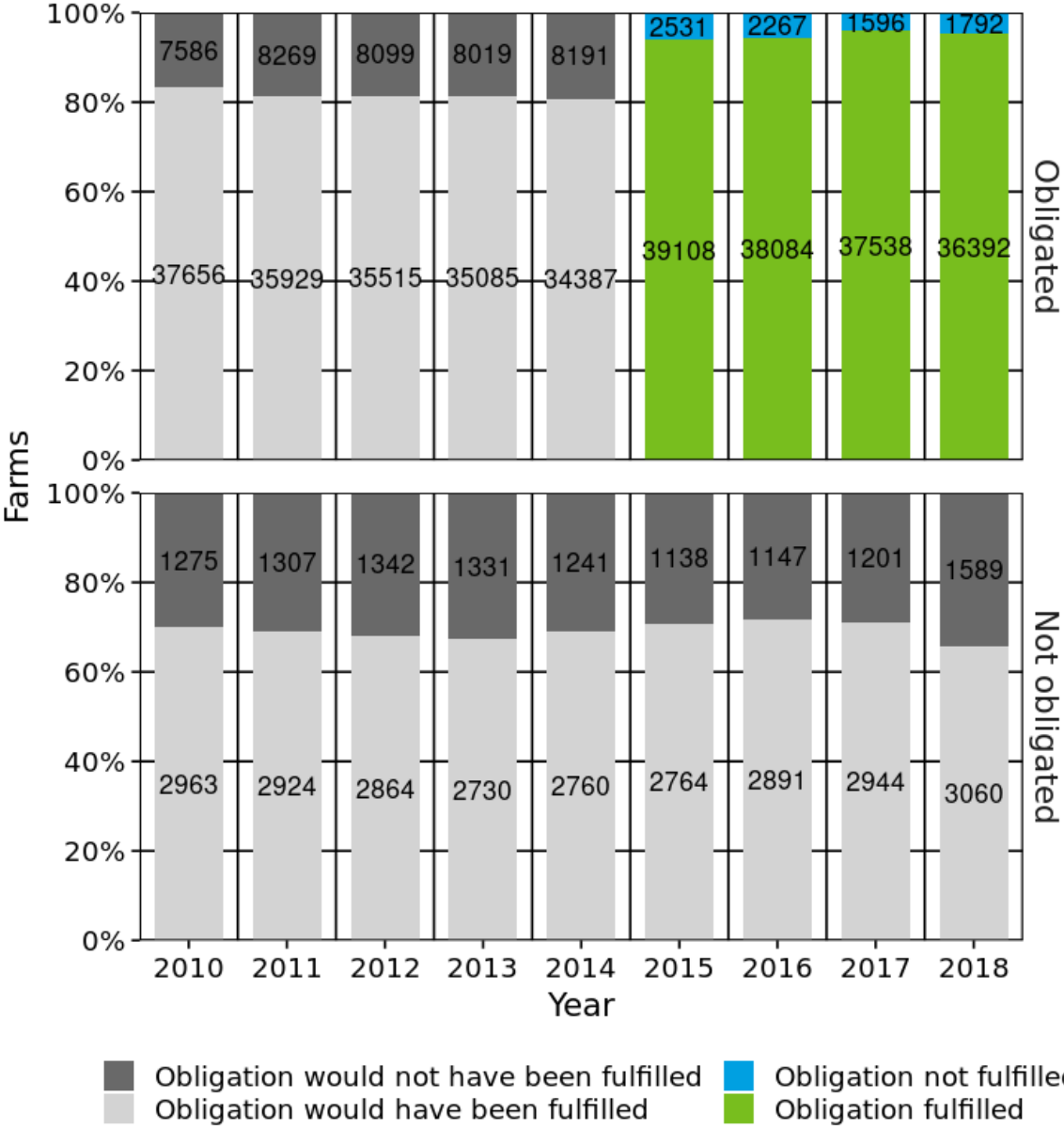
The regression model output (Table 2) reveals a relative high intercept indicating that the probability of EFA compliance was high without controlling for any factor (probability at the intercept: 79%). We also see that in the year 2018, the odds ratio was much lower to comply with EFA regulation than in 2015. On the one hand, we have not expected that even if we control for other factors that livestock-oriented farms (specialist granivores, specialist grazing livestock and mixed livestock) were more likely to fulfil EFA requirements in comparison to specialist field crop farms. However, grazing livestock farms were also more likely to fulfil greening requirements which we did not expect (see above). On the other hand, the relatively low compliance for farms specialised in horticulture and permanent crops is in line with our expectations. In general, all livestock orientated farms were more likely to fulfil greening requirements. With respect to soil-climate regions, farms in mountainous regions as well as in the south-west were less likely to follow the EFA rules, while farms in the north-east are more likely to comply.

### **3.3 Crop diversification (CD)**

In the years 2010 to 2014, between 45% to 46% of all farms would belong to the group of farms theoretically been obligated to comply with the crop diversification obligation (CD<sub>O</sub>). Regarding only farms with at least 10 ha arable land, 91% of all farms belong to CD<sub>O</sub>. After the implementation of the greening in 2015 in this group the share of CD<sub>O</sub>-farms marginally but steadily declined to 89% of the respective farms in 2018. For all farms this steady decline with in a similar relative magnitude. This means increasingly less farms were obliged to comply with the crop diversification obligation despite a constantly declining number of farms. This might indicate the realization of some adjustment in the growth strategies of the farms in order to circumvent additional burdens related to crop diversification.

Figure 4 shows that only few farms had to change something in cultivation for getting the full direct payment funding as of 2015. Of the CD<sub>O</sub> more than 80% would have fulfilled the conditions even before the greening was introduced. With the implementation in 2015, depending on the year, 94 to 96% of the CDO fulfilled the regulations so that there was a small effect of the greening. However, even if the farms were exempted (around 70%) would have met the regulation concerning CD, anyway.

**Figure 4: Affectedness and implementation of greening's CD regulations**



Farms with at least 10ha arable land. Federal states: BB, HE, NI, RP

All of these four types of farming showed a decrease in the number of farms that did not fulfil the CD obligations after the year 2015. This decline was strongest for the specialist grazing livestock farms with almost -50% in 2017 and 2018 (compared to 2015) and weakest for specialist field crop farms. From 2017 to 2018, for all four regarded farm types the number of farms that did not follow CD rules increased which might also be a side effect of pesticide ban on EFA legumes.

Regarding only the CD<sub>O</sub>-farms reveals that the complying farms (CD<sub>Oy</sub>) had more arable land than the non-complying (CD<sub>On</sub>). And for CD<sub>Oy</sub>, we see between 2010 and 2018 a marked increase in the mean (83 ha to 93 ha) and median (46ha to 51ha) farm's endowment with arable land. For CD<sub>On</sub>-farms we reveal in the respective period a smaller increase in the mean (54ha to 58ha) and a decline in the median (38ha to 33ha) endowment. This decline can be largely attributed to changes between 2014 and 2015; a decline in the median from 38ha to 34ha. Thus, in terms of the cultivated area of arable land, smaller farms abstained the greening funding more often than greater farms and we see some adjustment reactions to greening. Smaller farms might

have waived the greening subsidies intentionally as the bonus was irrelevant compared to market revenues and they did not want to invest much (time) in the compliance of the obligations. The greening bonus might have been too little to offset the decline in added value (see also BAUM et al., 2022).

#### 4 Discussion

In our study area around 43% of the farms receiving direct payments were obligated at least to one of the regulations EFA or CD managing more than 91% of the arable land. Given the relation between the number of obliged farms, a key factor determining total administrative burden both for farmers and the administration, to the covered area, a key factor for the potential environmental impact, the exemption clauses were quite efficient for our study area.

We see that after the introduction of greening, the overwhelming majority complied instantly with the rules. Of the farms obligated, 90 to 93% complied with the EFA and 94 to 96% the CD regulations between 2015 and 2018. However, our results demonstrate that even before greening rules were even established in 2015, e.g., 80% of the potentially obligated farms fulfilled the CD requirements. These results confirm the literature and the *ex-ante* studies (see introduction) with respect to the general limited impact the greening had on arable land use. EUROPEAN COURT OF AUDITORS (2017) showed that EFA and CD together led only to changes on approximately 2% of the total EU farmland or 1.2% of the EU arable land, respectively; together with grassland regulations the greening led to changes in farming practices on estimated 5% of all EU farmland.

While CD obligations were over-proportionally violated by smaller farms the picture was more divers for EFA. As for CD, especially smaller farms did not fulfil the requirements in 2015 and 2016. Since 2018, larger farms have waived EFA greening payments increasingly. Interestingly, the share of non-compliant farms and the relative importance of certain farm characteristics is rather time-invariant. We would have expected a more marked effect esp. from 2015 to 2016, as the details of the regulation became transparent to the farmers as late as the first month of 2015. This low response might indicate a low importance of learning, to correct non-intentional violations of the obligations. Another explanation for non-compliance is that it is rational choice. Smaller and more intensive farms (horticulture, permanent crops, granivores and diary) might have waived the greening payments intentionally as the payment is of low relevance compared to market revenues and they did not want to invest much (time) in complying to obligations. The greening payments might also have been too little to offset the decline in added value (BAUM et al., 2022). The increasing share of larger farms not complying with EFA regulation in 2018 might be driven by changes in regulations (e.g., the application of plant protection products has been banned).

Also, with respect to other land use aspects, generally only very limited adjustments could be observed after 2015. show that, e.g., the selection of EFA barely changed over time. Therefore, we conclude that the adjustment pressure was low.

WITTE AND LATACZ-LOHMANN (2014) calculated the implementation costs for different farms in different regions of Germany and showed that these costs were in general clearly below the received greening payments. Regarding an analysis of (RÖDER et al., 2021a) reveals that the additional costs for farmers to fulfil the greening regulations amounted to 193 million Euro per year but were offset by 1.5 billion Euro in subsidies that is almost eightfold. Thus, there was an effective monetary incentive, but, from another point of view, the greening payments were much too high as most farms fulfilled the regulations even before the introduction of the greening as the requirements were too low.

## 5 Conclusion

The ex-post analysis largely confirms what ex-ante evaluation has predicted. Even though greening in terms of EFA and CD affected more than 90% of the arable land in the regarded federal states of Germany, only slight adjustments in land use management was triggered by greening. Consequently, greening has had only a small effect on the environment.

Looking at compliance of farmers to greening regulations, there is a considerable drop-out rate when environmental regulations became slightly stricter like in 2018. We also see that rule compliance is greater when it is easily integrated into farm management plans (EFA regulation and livestock management) while drop out increases when it doesn't align with the farms' main activity. The results underpin the results as compliance varies between farm types and land endowment. This highlights the problem of uniform obligations and payments as well as un-specific targeting of payments that are meant to improve environmental conditions. For the future European agricultural policy, we recommend higher requirements for measures such that farmers need to change their production system/land use management. The same includes that it compensates for farmers' effort to provide additional environmental services. At the same time the difference between CAP requirements and ordinance law needs be aligned; otherwise, farms' drop out of CAP payments would have a large negative impact on the environment.

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