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## Findings and recommendations from the project "An Evaluation of the Common Agricultural Policy from the Perspective of Environmental Protection II"

**by:**
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On behalf of the German Environment Agency

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**Kurzbeschreibung**

Mithilfe von Landnutzungsdaten wurde die Reform der Gemeinsamenagrarpolitik aus dem Jahr 2013 auf ihre Umweltwirkung analysiert. Im Fokus der Analyse stand das sogenannte Greening. Teile der Direktzahlungen (30 Prozent) wurden an die Auflagen „Bereitstellung ökologischer Vorrangfläche“, „Vielfalt beim Anbau von Ackerkulturen“ sowie „Erhalt des Dauergrünlands“ gekoppelt. Zur Beurteilung dieser Maßnahmen auf den Umwelt- und Naturschutz wurden Daten der Agrarstrukturerhebung, der Bodennutzungshaupterhebung sowie des Integrierten Verwaltungs- und Kontrollsystem der Bundesländer Hessen, Niedersachsen, Nordrhein-Westfalen und Rheinland-Pfalz ausgewertet. Mit Einführung des Greenings konnte der jahrelange Rückgang bei Brachen und Dauergrünland gestoppt werden. Zudem nahmen diese Flächen seit Einführung der Maßnahmen leicht zu, erreichten aber nicht das Niveau zu Beginn der 2000er Jahre. Bei der Vielfalt der Ackerkulturen konnte hingegen keine Verbesserung im Zuge der Reform festgestellt werden. Da die Landnutzungsänderung insgesamt gering ausfiel, blieb auch das Umweltrisiko durch den Einsatz von Pflanzenschutzmittel unverändert. Würde die Förderung anreizbasiert gestaltet werden, könnte bei gleichem Budget mehr Fläche aus der Produktion genommen werden. Allerdings würde eine solche Förderung zu einer höheren Akkumulation von Brachflächen in Gebieten mit geringerer Wertschöpfung führen, während intensiv-wirtschaftende Regionen kaum erreicht würden. Zur Umsetzung der Greening-Maßnahmen steht jährlich eine Fördersumme von 1,5 Mrd. Euro zur Verfügung, während die Gesamtkosten der Umsetzung circa 190 Mio. Euro betragen. Insgesamt lässt sich feststellen, dass mit hohen Fördersummen nur geringe Umweltwirkung erreicht wurden. Die Ergebnisse der Studie dienen als Grundlage für die nationale Umsetzung der GAP nach 2020 inklusive der Erreichung der Ziele, die in den Strategiepläne der EU Kommission (Farm-to-Fork, Biodiversitätsstratgie für 2030) festgelegt wurden.

**Abstract**

This report uses land-use data from different databases to analyse the effect of the 2013 Reform of the Common Agricultural Policy Reform (CAP) on the environment. Particularly, the analysis focuses on the effect of the direct payment’s Greening measures which were introduced to enhance the environmental performance of the CAP. Greening measures consist of three components: provision of ecological focus area, maintenance of permanent grassland, and crop diversification. For the analysis the following databases were used: the German Agricultural Census, Land Use Survey, and the Integrated Administration and Control System of the federal states Hesse, Lower Saxony, North Rhine-Westphalia, and Rhineland-Palatinate. The results show that the long-term decline of fallow land and permanent grassland was halted. The area of fallow land even increased but could not reach the level it had in 2003. Crop diversity remained at the same low level. The environmental risk of pesticide application did not change considerably as land-use change was minor. Regarding the provision of additional ecological focus area such as fallow land, the economic model indicates that more area is provided under an economic incentive scheme than under a scheme with an obligation for all farms, holding the budget constant. However, fallow land would then be clustered in less productive regions. Intensive regions and intensively producing farm holdings would not participate in such voluntary schemes. Considering the cost of Greening measures, the results indicate that annual agricultural subsidy paid to farms amounts to 1.5 billion Euros, while the cost for farms is estimated to sum up to 190 million Euros. Therefore, the study concludes that environmental improvements were archived at high costs. The results of the study provide the basis for the national realization of the 2020 Reform of the CAP as well as related EU-strategies such Farm-To-Fork or Biodiversity strategy for 2030.

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## Summary

Against the backdrop of extensive environmental pollution, for example due to the infiltration of significant quantities of nutrients and pesticides into soils and bodies of water, one of the key aims of the 2013 reform to the Common Agricultural Policy (CAP) was to establish a stronger link between the payments made to farmers and environmental performance. Substantial parts of the reform came into force in Germany in 2015.

At the heart of this reform was the concept of 'greening'. Since the reform was introduced, 30% of the direct payments have been tied in with three aspects of improving environmental performance:

- Ecological Focus Areas (EFAs), such as fallows, hedges, buffer strips or catch crops, must be allocated 5% of the available arable land.
- The main crop on large farms must not exceed 75% of the arable land in order to ensure crop diversity. The acreage of the two largest crops must not exceed 95% of the total available land.
- Permanent grassland may not be converted without being replaced.

In order to evaluate whether and how the 2013 CAP reform, and in particular the greening, has had an impact on environmental protection, data from the Germany-wide Farm Structure Survey, the Land Use Survey and data from the Integrated Administration and Control System (IACS) of the federal states of Hesse (HE), Lower Saxony (NI), North Rhine-Westphalia (NW) and Rhineland-Palatinate (RP) were evaluated. The evaluation took place as part of the German Environment Agency project 'Evaluation of the CAP reform from the point of view of environmental protection using a data analysis of IACS data from the federal states'. Municipal data from the Farm Structure Survey were available for the years 1999, 2003, 2007, 2010 and 2016. Annual data from the Land Use Survey were available in aggregated form at federal level. Detailed information from farms on the take-up of CAP support measures, which was collected via IACS in the above-mentioned federal states, has been available since 2010. These databases made it possible to evaluate land use nationwide over a longer period of time as well as to carry out detailed analyses on the type of implementation and environmental impacts of the CAP reform.

**The key findings of the report:**

1. The introduction of greening measures in 2015 halted years of continuous decline in important ecological areas such as fallow. While there were 974,000 hectares of fallow and set-aside land in 2003, this figure was only 232,000 hectares in 2014. Following the introduction of the greening measures, this area increased by approximately 50% to 345,000 hectares, rising steadily in the consecutive years to 390,000 hectares by 2019. However, it was not possible to quantify exactly how much of this increase was due to the greening and second pillar measures.
2. The IACS data show that after 2015, fallow land was mainly allocated on an annual basis, whereas the amount of multi-annual fallow land initially decreased in 2015. By the end of the data series in 2017, however, the amount of land lying fallow on a multi-annual basis was increasing again.
3. Whereas the diversity of arable crops at the local level clearly decreased from an average of 7 to 6 crops between 1999 and 2010, the number of crops has remained stable since 2010. The introduction of the greening measures had no impact on this. As a result, arable land use in many regions of Germany is dominated by a small number of crops. Winter wheat, oilseed

rape and maize in particular are sometimes grown in very short crop rotations. The limited impact on crop diversity can also be attributed to the fact that many farms would have already fulfilled the requirements of the crop diversification measure before 2015.

4. Whereas the area of permanent grassland nationwide decreased by approximately half a million hectares between 1999 and 2013, it increased by approximately 130,000 hectares between 2014 and 2019. The reversal of the trend had therefore already begun towards the end of the previous funding period in 2013 as a result of the successive tightening of cross-compliance and regulatory requirements. Consequently, the increase in grassland area cannot be credited exclusively to the greening.
5. Since there has been little change to land use as a consequence of the greening, the environmental risk associated with the use of pesticides has also hardly decreased.
6. The total costs for farms in Germany of implementing the requirements of greening are in the order of €190 million per annum. This is just less than one eighth of the annual EU payments for greening, which amount to €1.5 billion.
7. Economic model calculations show that the opportunity costs, in particular for allocating land of high ecological importance, differ considerably between regions and farms. High payments per hectare would be required to ensure a significant proportion of fallow land on intensive farms or farms in intensive regions, and therefore across Germany as a whole. A standardized nationwide payment leads to a significant deadweight effect in less productive farms and regions, even if the subsidy level is the same.

**The following conclusions can be drawn from the findings:**

1. The 2013 CAP reform halted successive years of loss of fallow and permanent grassland and initiated a slight recovery in these areas.
2. Overall the increase in fallow land and permanent grassland that has been achieved is not sufficient to yield significant improvements in environmental protection and nature conservation.
3. Most farms have had to make only minor changes, if any, to their production methods as a result of the introduction of the greening.
4. In order to mitigate the environmental risk posed by the use of pesticides a significant shift in land use towards low-risk types of land use or production methods would be required.
5. Higher subsidies would have to be granted in intensive regions and on intensively managed farms than in the 2014-2020 funding period in order to reduce substantially the negative environmental impacts of agriculture in these regions and farms, and therefore nationwide.
6. Flat-rate area subsidies are clearly less efficient than location-specific subsidies.

Important conclusions can be drawn from the findings on the 2013 CAP reform with regard to the 2020 CAP reform, which is expected to come into force in Germany in 2023. The findings of this report should therefore serve as a basis for developing our own national positioning regarding environmental protection. With regard to implementing the farm-to-fork strategy and the goal of 'halving the use and risk of chemical pesticides', consideration should be given both to the amount of active ingredient and the hazard potential, and this should be broken down based on land use. Land use also plays a crucial role in the Biodiversity Strategy 2030. The aim is to increase the proportion of non-productive land to 10% of all agricultural land. The analysis shows that the costs and consequently the feasibility of this goal depend on the way in which non-productive land is distributed geographically. However, consideration should be given not only to the quantity, but also to the quality of environmental protection - as can be seen in the example of the fluctuating duration of individual areas of fallow land.

# 1 Introduction

## 1.1 Background and objective of the research project

Despite numerous attempts to reform, large quantities of nutrients and pesticides are being introduced into soils and bodies of water, and agriculture is putting pressure on soil, water and air. The research project ‘An Evaluation of the Common Agricultural Policy from the Perspective of Environmental Protection’ therefore aimed to analyse the environmental impact of the 2013 CAP reform in Germany. The study focused in particular on the concept of the 'greening'. Data from the Germany-wide Farm Structure Survey and Land Use Survey as well as from the IACS databases of six federal states were used to conduct a detailed analysis of land use and land use change. This made it possible to study the environmental impacts of the CAP reform in different regions. Furthermore, the costs of the greening and possible alternative approaches to funding were assessed in monetary terms using an opportunity cost approach. Risk indicators were used to investigate the environmental risk of pesticide strategies for specific soils and climates.

## 1.2 Data set

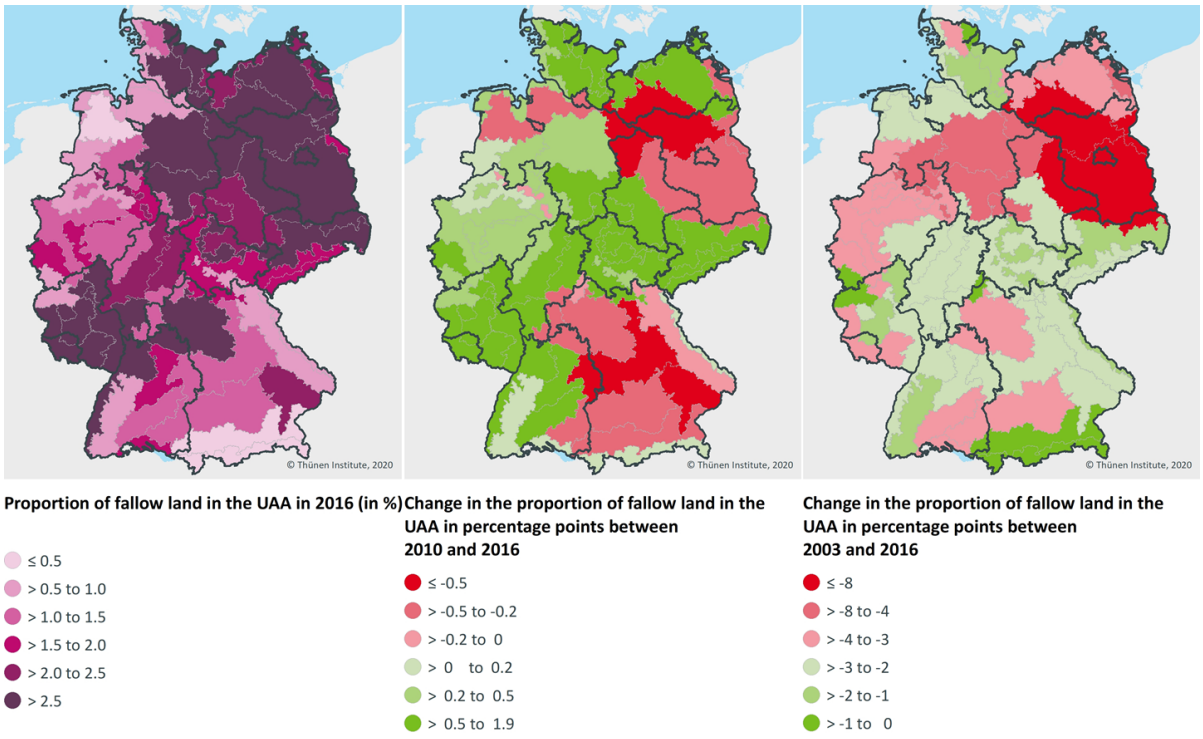
Germany-wide farm structure data from all the federal states were available at municipal level for the years 1999, 2003, 2007, 2010 and 2016. Data from the main Land Use Survey conducted by the Federal Statistical Office of Germany were used for annual agricultural use data, but aggregated at the federal level. IACS data at farm level were evaluated for the states of Lower Saxony, Rhineland-Palatinate, Hesse and partly for North Rhine-Westphalia for the period between 2010 and 2017. Data from the federal states of Lower Saxony and Brandenburg (BB) were used to assess the impacts of the environmental risks entailed in the use of pesticides.

# 2 Findings

## 2.1 The proportion of important ecological areas such as fallow land has increased since greening was introduced, but has not reached the same level as at the turn of the millennium

In order to receive the full amount of the greening payment, farms are obliged to set aside 5% of their arable land as an Ecological Focus Area (EFA). The individual EFA measures are weighted differently for the purpose of comparing the ecological value of different types of use. Fallow fields are classified as extremely important ecologically-speaking, as are landscape elements such as hedges and lines of trees (highest weighting) and buffer strips (second highest weighting). The data from the Farm Structure Survey show that between 2010 and 2016 - after the introduction of greening - there was a moderate increase in the amount of fallow land as a proportion of all agricultural land from 1.8 per cent to 2.1 per cent, which corresponds to an area of 352,000 hectares in 2016. Compared with the early 2000s, however, there was a significant loss of fallow land. In 2003, the area of fallow land in Germany amounted to 974,000 hectares or 5.7% of the land used for agriculture (Figure 1).

**Figure 1: Proportion of fallow land in the utilised agricultural area (UAA) per soil and climate area in 2016, and how this has changed compared to 2010 and 2003.**




UAA = Utilised agricultural area

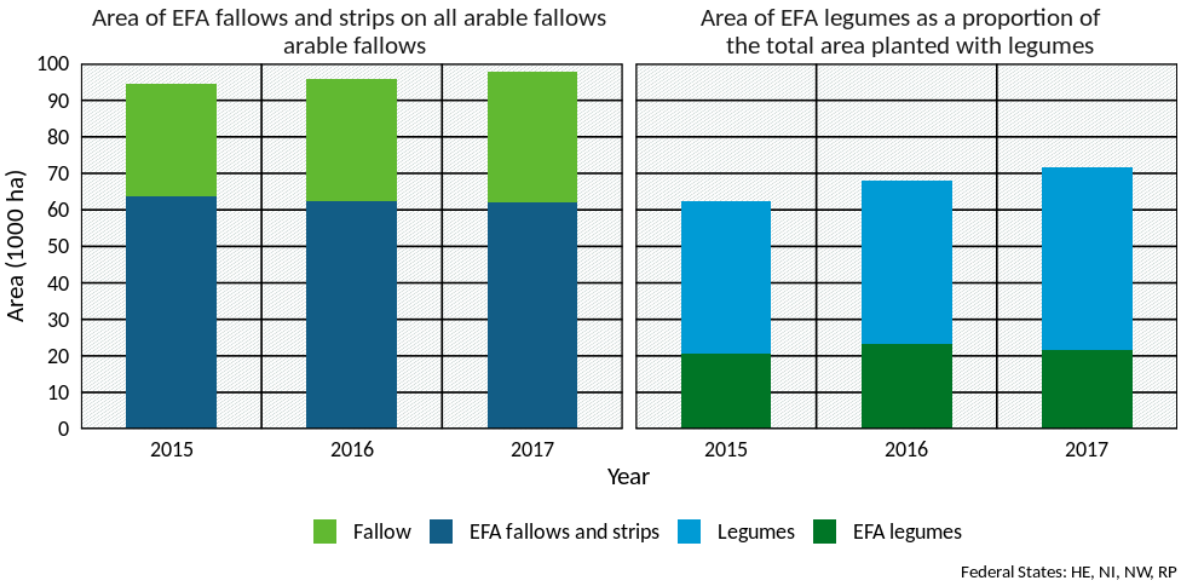
Source: Own Source, Thünen-Institute

It is not possible to quantify exactly how much of the increase in fallow land is due to the greening and second pillar support measures. Following the implementation of the CAP reform in 2015, the area of fallow land increased by 113,000 hectares across Germany compared to 2014. Fallows that were subsidised through the new greening scheme accounted for a sizeable 69% of all fallows in 2015. This figure had fallen to just under 60% by 2019. However, this

relative decrease can be attributed to the 45,000 hectare increase in the total area of fallow land by 2019, while the area of fallow land subsidised through greening remained almost constant. The Greening can therefore only partly account for the increase in fallow land after 2014. The remaining increase is due in part to increased support through agri-environment-climate measures (second pillar) enacted by the federal states. This means that additional fallow land was increasingly allocated as a result of agri-environment-climate measures and less so as a consequence of greening.

An analysis of the detailed IACS data for the federal states of Hesse, Lower Saxony, North Rhine-Westphalia and Rhineland-Palatinate completes the picture provided by the data for the whole of Germany. The data show that the amount of fallow land increased by 3% between 2015 and 2019, while the amount of fallow land reported as EFA remained constant during this period (Figure 2). As far as the duration of individual fallows is concerned, the transition to a new funding period in 2014 was followed by a decline in the number of multi-annual fallows. Multi-annual fallows have many ecological advantages over annual fallows. After 2015 the duration for which fallows are maintained has since increased again (Figure 3). Both developments are attributable to effects of the second pillar funding provided by the federal states. For one thing, a large number of contracts for second pillar measures expired in 2014 and 2015 and could not be renewed in time due to a lack of financial resources; for another, the subsidies available for fallow-like measures were increased substantially from 2015 onwards.

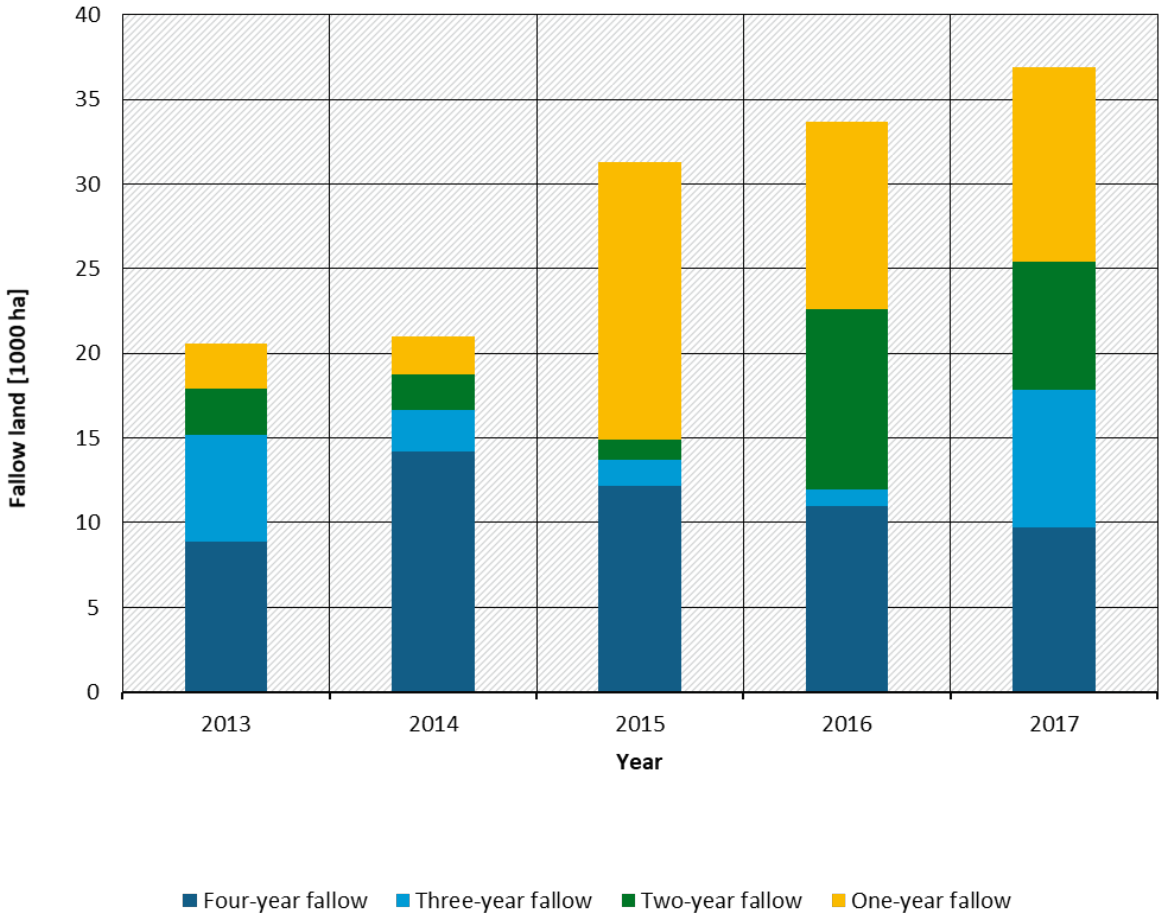
**Figure 2: Arable fallow land (including set-aside land) and land planted with legumes, subdivided into EFA and non-EFA in Hesse, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate.**




EFA = Ecological Focus Area

Source: Own Source, Thünen-Institute

**Figure 3: Development of the total area of fallow land differentiated according to their individual duration.**

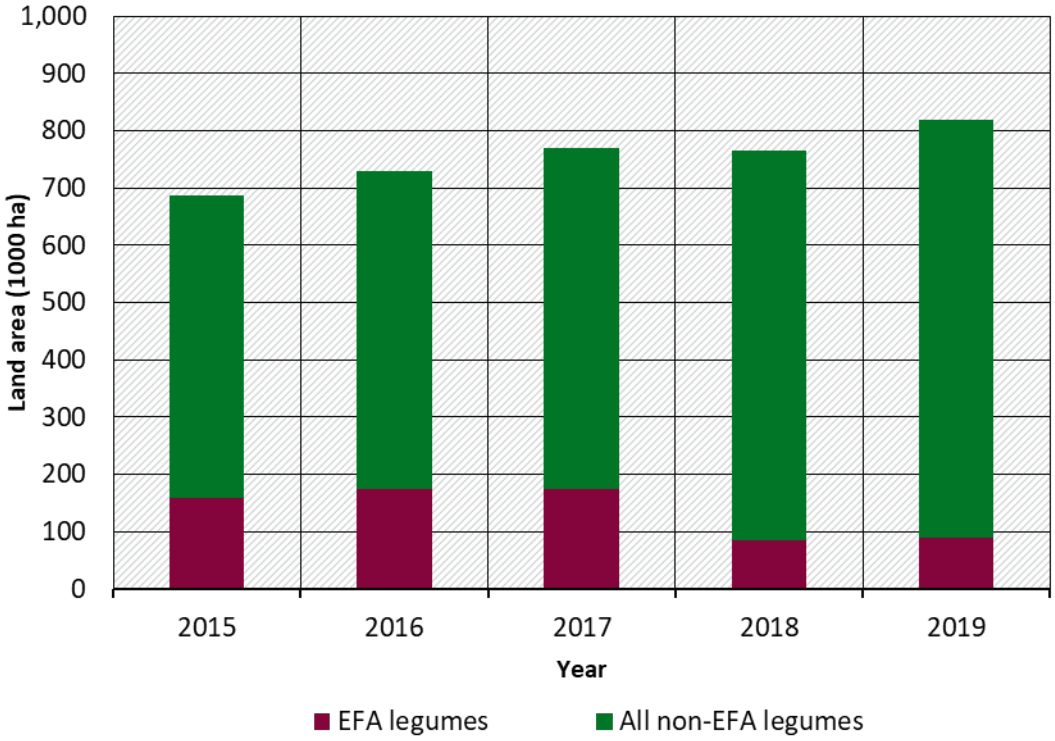



Average of the time intervals between 2010-2013 and 2014-2017. Durations subdivided into one-, two-, three- and four-year fallows.

Source: Own Source, Thünen-Institute

Whether fallow land or other EFAs are the preferred option to implement the EFA obligation depends largely on the net provision costs of allocation and the weighting factor of the EFAs (= premium per hectare). The changes in response to the ban on the use of pesticides on EFAs introduced in 2018 are a prime example for the importance of this economic weighting. Despite the simultaneous increase in the weighting factor, after 2018 farms increasingly preferred other options (for example catch crops) to cultivating EFA legumes without pesticides. However, farmers continued to cultivate legumes but refrained from obligatory employing mechanical weed control only. As a result, the total area under legumes reported as EFAs fell by 52% across Germany. At the same time, the total amount of legume cultivation remained constant (Figures 2 and 4). The increase in the weighting factor was consequently not sufficient to compensate for the additional effort and expense incurred by using methods that did not involve pesticides.

**Figure 4: Development of the cultivation area devoted to EFA legumes and non-EFA legumes in Germany in the period 2015-2019.**

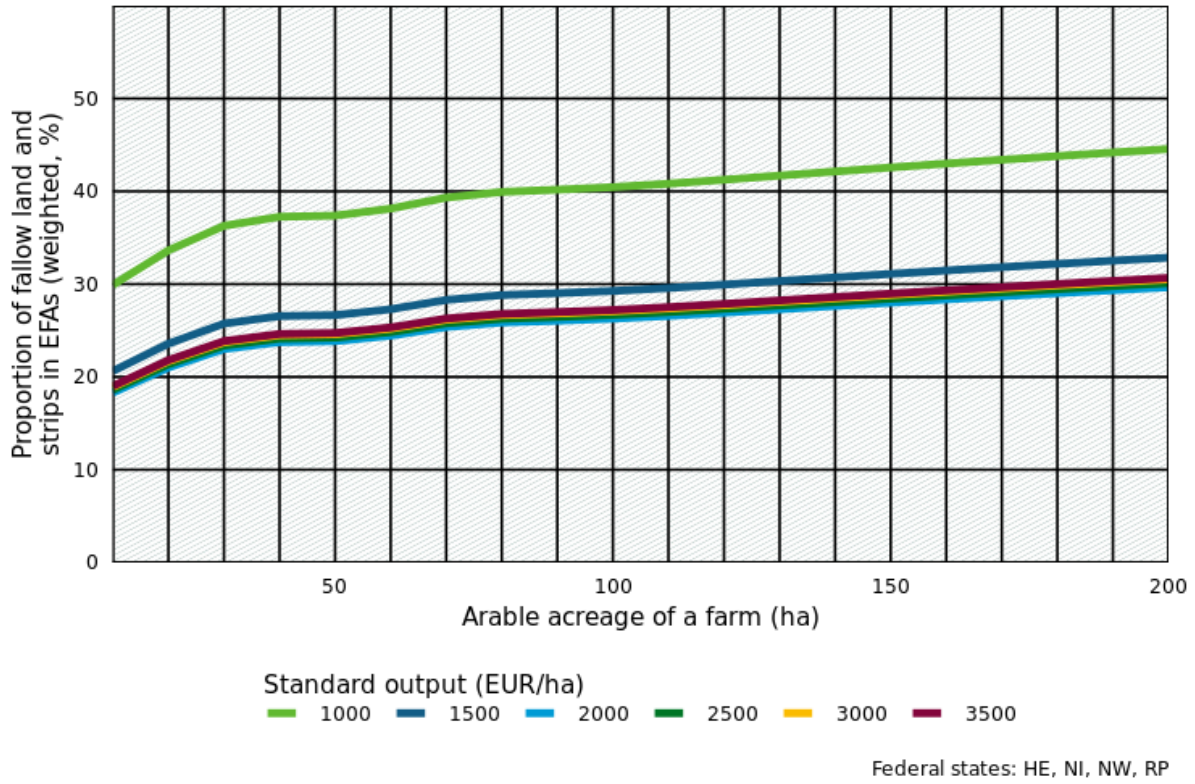



EFA = Ecological Focus Area

Source: Own Source, Thünen-Institute

The example of fallow land and strips clearly demonstrates the importance of opportunity costs - that is, the benefit/profit that would have been generated by using land in an alternative way - in making decisions on whether to allocate land as EFA or not. In particular, farms with lower value added per hectare and larger acreages over proportionally opt for the most ecologically important EFAs, i.e. fallows and strips (Figure 5). The conclusion to be drawn from this is that, as a rule, these farms derive greater economic benefit from the subsidy than from cultivating the land (yield minus costs). In contrast, farms with higher value added per hectare are more likely to use alternative approaches, such as catch crops, to meet their EFA obligations, as this option allows to maintain high yield crops.

**Figure 5: Proportion of fallow land and strips in the total EFA of a farm in relation to land area and profitability (standard output per hectare)1 for the year 2017.**




EFA = Ecological Focus Area

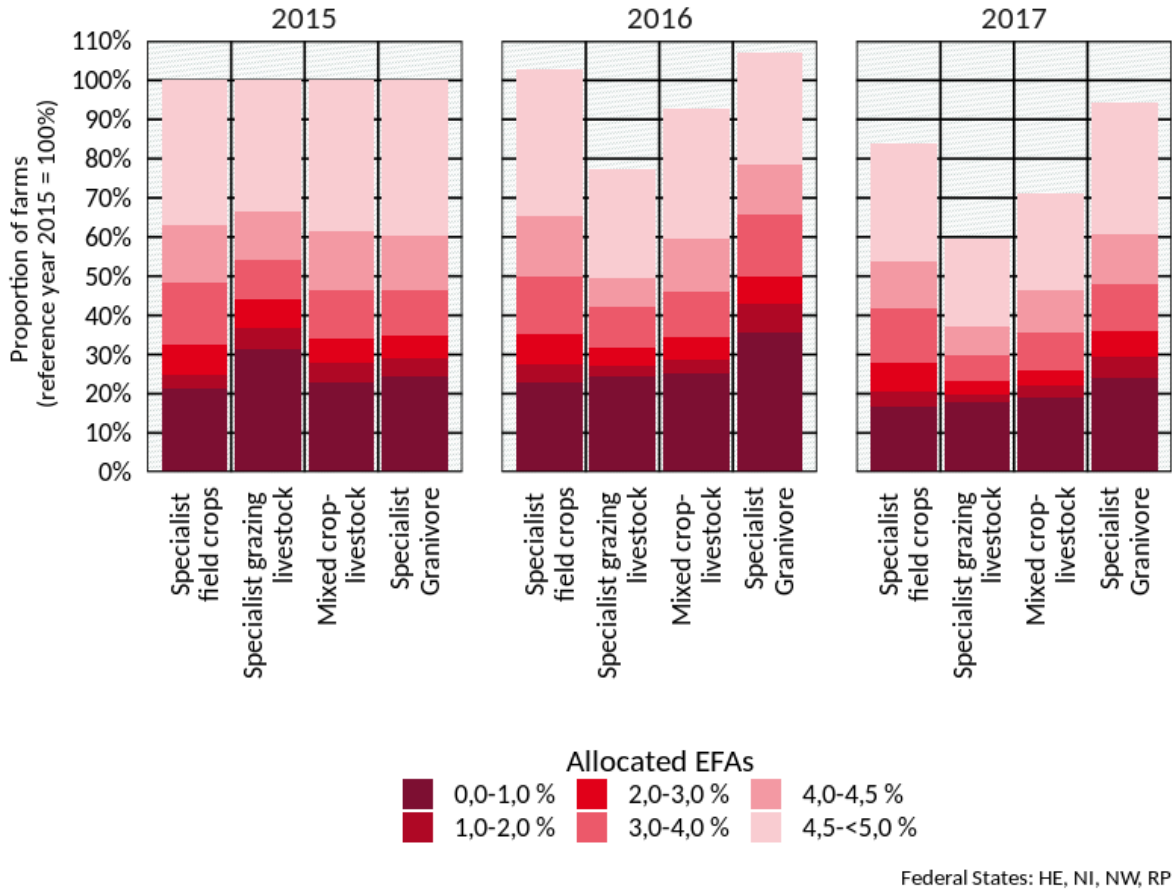
Source: Own Source, Thünen-Institute

The analysis of farms reporting less than the required 5% or no EFA at all showed that the percentage of such farms decreased from 8% in 2015 to 6% in 2017. This implies that farms were increasingly adapting to the EFA requirements. A breakdown by type of farming shows that specialized field crop farms, specialized grazing livestock farms and specialized granivore farms were most likely to violate the EFA requirements. These are types of farming with a comparatively high value added per hectare of arable land. In absolute numbers, specialised field crop farms were most likely to fail to comply with the requirements. However, this type of farm is the one most frequently obliged to comply with EFA requirements, with the result that the percentage of infringements was comparable to that of specialized grazing livestock farms and specialized granivore farms. Examining adjustments to the EFA regulations over a period of time reveals that specialized granivore farms recorded the fewest adaptations. Just 10% of the farms that violated the EFA regulations in 2015 adapted how they cultivated their land in order to comply with requirements by 2017. Specialised grazing livestock farms, on the other hand, were most likely to adapt how they managed their land in order to comply with the requirements. 40% of these farms were still in breach of the requirements in 2015 (Figure 6). One reason for the comparatively strong adjustment on grazing livestock farms might be that on these farms direct payments relatively often account for a high share of income and thus the economic pressure to comply with the requirements is relatively high. In addition, it is precisely

[1] Standard output per hectare is a measure of the economic size of a farm. The standard output is based on the yields and prices of the different activities averaged over a reference period of five marketing years.

on this type of farming that catch crops are often a very cost-effective option for meeting the EFA requirements.

**Figure 6: Breaches of EFA requirements subdivided according to allocation of EFAs and type of farm.**




Changes compared to the reference year 2015. Selection of the four types of farm that most frequently violate EFA requirements. Farms with no infringements were not considered (EFA ≥ 5%).

EFA = Ecological Focus Area

Source: Own Source, Thünen-Institute

## 2.2 Crop diversity remains unchanged despite greening

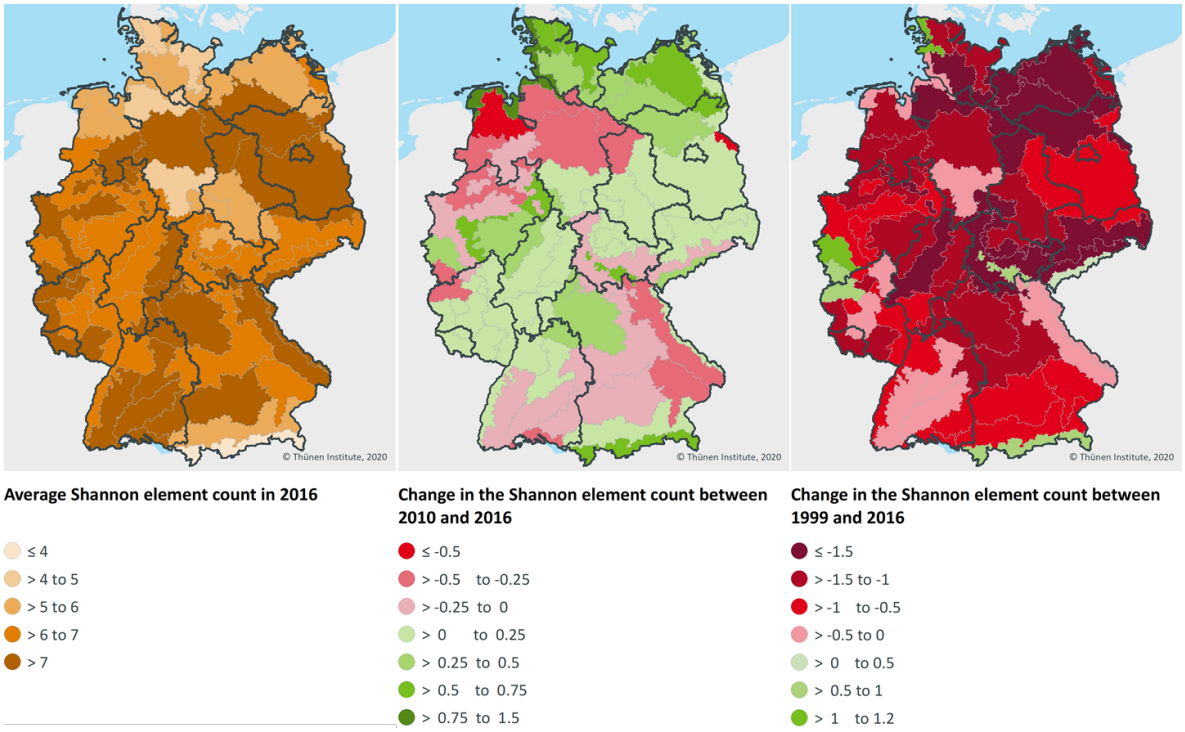
In recent decades, there has been a marked decrease in the diversity of arable crops. In 2010, for example, one less arable crop was cultivated on average per municipality than in 1999 (with the exception of the Cologne Lowland) (Figure 7). This development should be counteracted by the greening requirement for crop diversity. Between 2010 and 2016, however - in other words both before and after the introduction of greening measures - the municipal average of arable crops across all soil and climate types increased only marginally from 6.03 to 6.13 (Figure 7 middle panel).

This finding is supported by the analysis of the IACS data for the federal states of Hesse, Lower Saxony and Rhineland-Palatinate. The number of crops per high nature value (HNV) sample area (measuring 100 hectares) remained relatively constant on average between 2010 and 2017. There was, however, a slight increase in the number of crops being grown following the

introduction of greening in 2015 compared to 2014. However, the extent of this effect is within the fluctuation range of previous years.

This inconclusive effect is related to the finding that approximately 80% of obligated farms would have already complied with crop diversity requirements prior to 2015. Just 16% of farms have adapted the way they manage their arable land since 2015. Only 4% of farms did not comply with the requirements on crop diversity (Figure 8). Similar to the EFA requirements, farms that had to make only moderate changes to their cropping system in order to comply with the crop diversity requirements were the most likely to adapt. Accordingly, specialized granivore farms were the most likely of all the types of farm to adapt their cropping system to comply with the requirements. For these farms, the income from arable farming is often only of secondary economic importance and they are therefore much more flexible in terms of their cropping system than, for example, specialized grazing livestock farms, which can only use certain crops as fodder on the farm.

**Figure 7: Average number of arable crops per soil and climate area in 2016 and how this had changed by 2010 relative to 1999.**

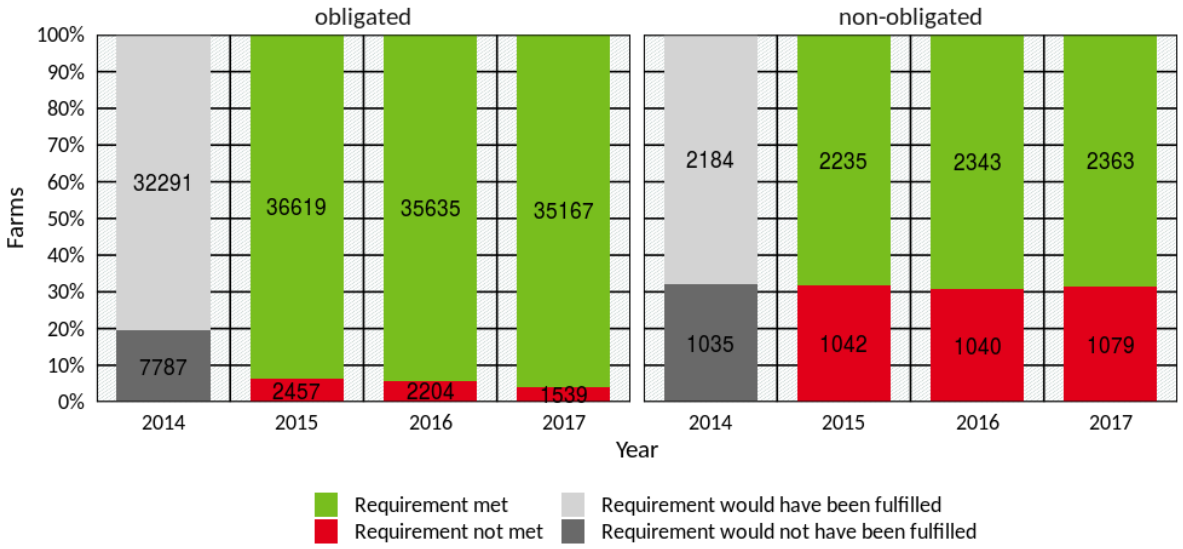



Average values per soil and climate area calculated using the Shannon element count[2] for each municipality.

Source: Own Source, Thünen-Institute

[2] The Shannon element count is used to interpret the Shannon index. This in turn is a measure of diversity, which considers both the number of different cultures and their respective prevalence. The element count indicates the minimum number of crops that must be present in a region in order to reach the defined Shannon index value.

**Figure 8: Development of compliance with crop diversity requirements before and after the introduction of greening measures, broken down by obligated and non-obligated farms.[3]**




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

Source: Own Source, Thünen-Institute

## 2.3 The area under permanent grassland has been increasing slightly since 2013

The greening measure of maintaining permanent grassland was intended to reverse the reduction in the area of permanent grassland in the EU. European legislation stipulates that no more than 5% of permanent grassland may be converted into arable land at a regional level relative to 2012. Since 2015, as a rule the conversion of grassland to arable land in Germany is linked to reduced payments and administrative penalties unless arable land is converted to grassland elsewhere. However, cross-compliance rules had already been tightened before the introduction of the greening, and grassland conversion was prohibited by ordinance law in many federal states.

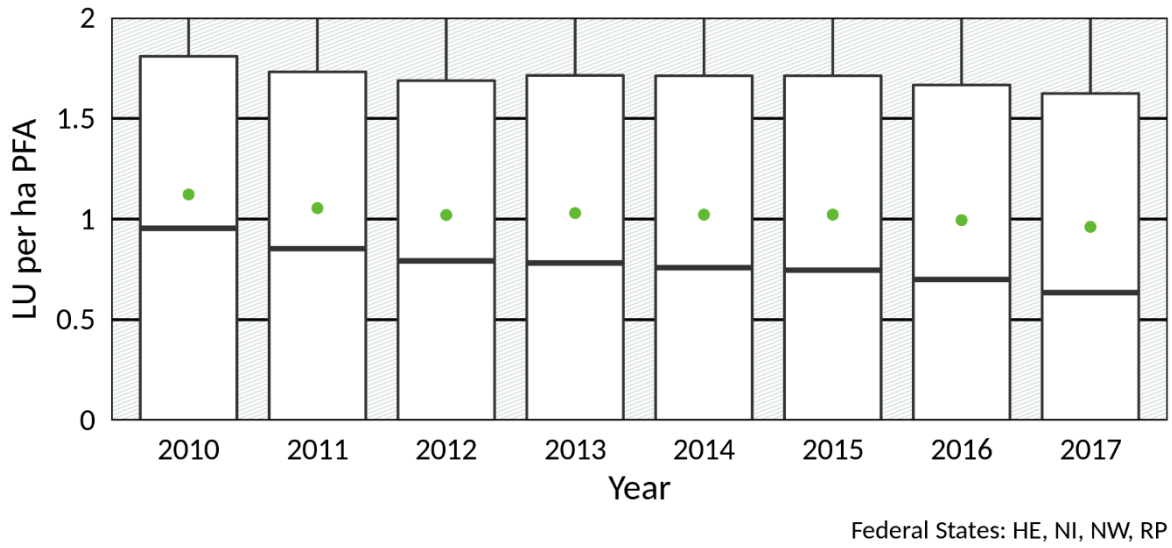
After the total area of permanent grassland fell by approximately 600,000 hectares between 1999 and 2013, the amount of permanent grassland increased by 0.6% compared to 2014 with the introduction of the greening in 2015, corresponding to an area of 27,000 hectares. The area under grassland actually increased by 56,000 hectares compared to 2013. This effectively halted the trend of grassland loss. However, this reversal of the trend cannot be attributed to the greening alone.

The IACS data made it possible to analyse the intensity of use of grassland. The intensity of use is an important criterion for nature conservation on grassland. It must fall within a certain range, in order to meet certain conservation quality standards, in other words it must be neither too high nor too low. The analyses showed that the intensity of use declined steadily in both the short and medium term. The number of grazing livestock units (LUs) per hectare of main forage area (MFA) is used to measure the intensity of use. This density particularly decreased on land

[3] Farms not bound by crop diversity requirements include small-scale producers, organic farms (excluded from all greening measures), farms with less than 10 hectares of arable land, farms where more than 75% of the land is devoted to grass or herbaceous forage, permanent grassland or fallow and the remaining arable land does not exceed 30 hectares, and farms where more than 50% of the land has been declared by another farm growing a different crop on the entire arable land in the previous year.

that already had a low stocking rate (Figure 9). Furthermore, the proportion of grassland increased on farms with a very low intensity of use or without any opportunities for making use of grassland. However, a certain minimum intensity is necessary in order to reach nature conservation objectives in grassland protection. Many farms failed to reach this minimum intensity.

**Figure 9: Distribution of the intensity of use of grassland based on the measure of grazing livestock units per hectare of main forage area between 2010 and 2017.**



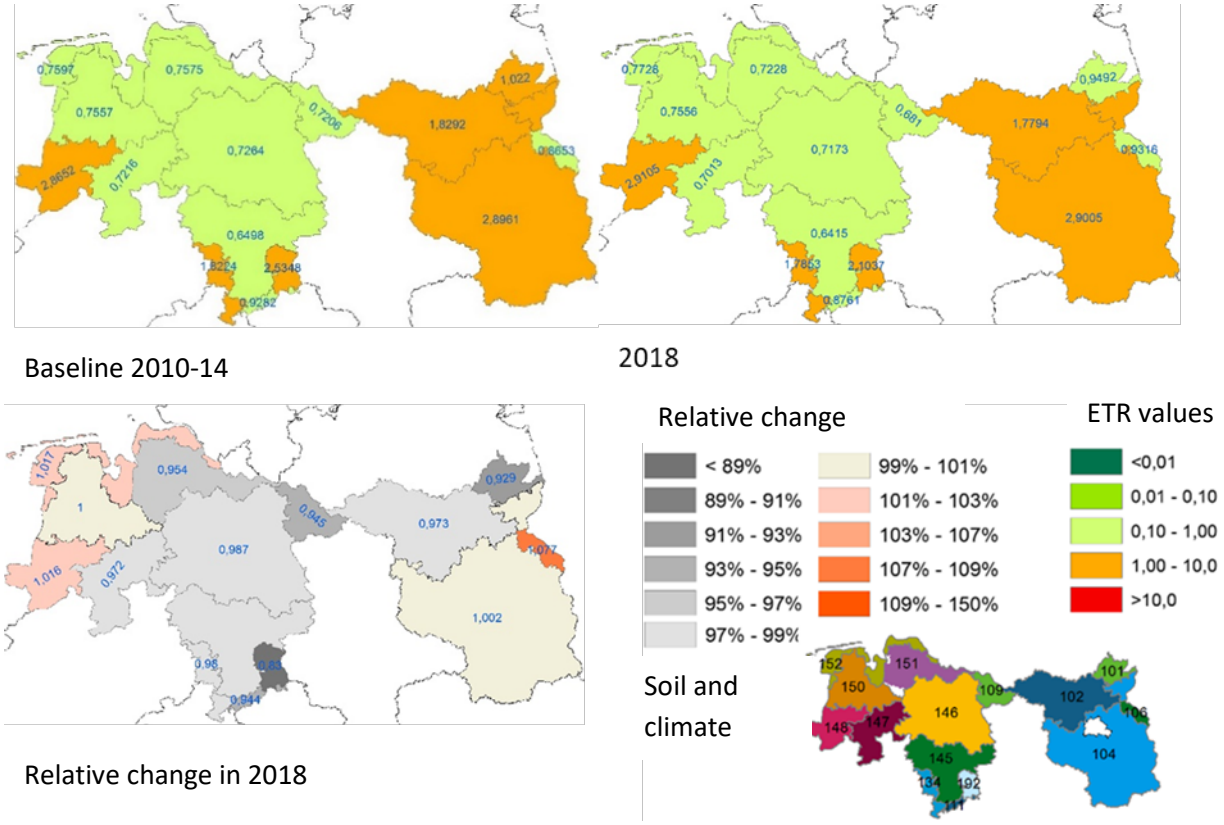

Green dot = average value. Figure considers only farms with at least 1 hectare of agricultural land
LU = livestock unit; PFA = principal forage area
Source: Own Source, Thünen-Institute

## 2.4 CAP-induced changes in use have no impact on the environmental risks posed by using pesticides

Changes in land use and cropping patterns go hand in hand with changes in the environmental risks associated with pesticides. In order to be able to assess the influence of the 2013 CAP reform on environmental risks, various scenarios were designed that only account for changes in cropping patterns. The same generic spraying sequences were used for crop protection in each year and the year 2017 was chosen as the weather scenario in order to exclude weather or pesticide-induced changes. Any changes in the environmental risk were therefore exclusively due to changes in land use. In order to assess the risk, the acute and chronic aquatic risk and the risk to non-target arthropods and soil organisms were calculated on a site-specific basis. The average environmental risk was calculated as a regional risk index (90th percentile) for each soil and climate area in Brandenburg and Lower Saxony.

The results show that changes in the proportions of land used for the different crops had an impact on the environmental risk. There was a slight decrease in environmental risk for the vast majority of soil and climate areas. The relative change in environmental risk in the individual soil and climate areas was slightly higher in Lower Saxony, with a range of 0.01-17%, compared to 0.01-8.1% in Brandenburg (Figure 10).

**Figure 10: Average environmental risk of pesticide use in soil and climate areas for the baseline period 2010-2014 and for 2018.**




90th percentile of the exposure toxicity ratio. The relative change in 2018 is compared with the base period.
ETR = Exposure Toxicity Ratio
Source: Own Source, Julius-Kühn-Institute

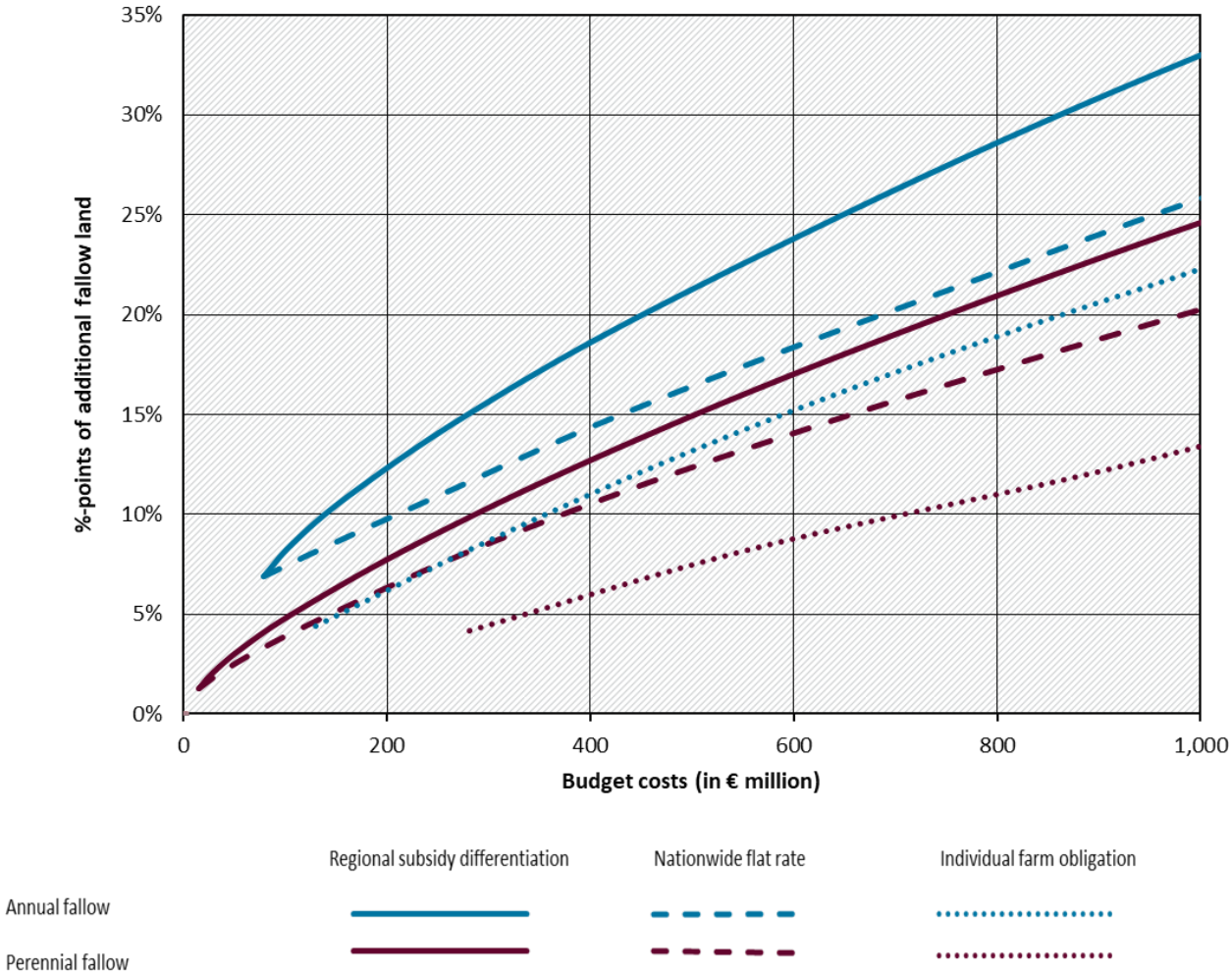
However, these changes in use, some of which were specific to a particular area, were not induced by CAP measures. The areas of land on which no pesticides were applied, such as fallows and strips, increased by 23% in Brandenburg and by 33% in Lower Saxony in relation to the base period (2010-2014), but this corresponds to only 4.4% and 2.5% respectively of the arable land included in the analysis. It therefore follows that the changes in land use induced by the CAP only have a minor impact on the average environmental risk. There would have to be a considerably greater change in land use towards low-risk land use types in order to have an impact on the risk potential in any given area (90th percentile).

## 2.5 General environmental requirements have higher budget costs than incentive-based measures

A commitment to increasing the amount of fallow land is enshrined in the European Commission's draft EU Biodiversity Strategy. The aim of this commitment is “to restore at least 10% of agricultural land to high diversity landscape features” (European Commission (COM) 2020). Three scenarios were modelled in order to examine which instrument could be used to achieve this goal for Germany in a cost-effective manner. In each case, it is assumed that land will be set aside if the payments are larger than the revenues from using the land in an alternative way (opportunity costs). As a general rule, it is the crops with the lowest yield that make way and are reimbursed.

The first two scenarios work on the assumption that an incentive-based instrument is used. In both scenarios, farms can choose to allocate fallow land in return for a subsidy. This is similar to how second pillar measures work. The first scenario (regional subsidy differentiation) supposes an almost perfect subsidy differentiation. This means that only the opportunity costs that are incurred by setting aside an area of land are reimbursed in each municipality. This scenario acts as a reference to estimate the financial potential of differentiating subsidies by region. In this scenario, a different subsidy is paid depending on the region. The second scenario proposes a uniform subsidy (flat rate) to recompense farmers for setting aside arable land throughout Germany. In contrast to regional subsidy differentiation, the land is not subsidised based on the opportunity costs per region, but with a uniform nationwide subsidy. In the third scenario, each farm must comply with the requirements as a whole and would receive a subsidy corresponding to the opportunity costs of the farm (individual farm obligation).

**Figure 11: Proportion of additional fallow land relative to arable land dependent on the available budget and the chosen means of implementation.**




Instruments: only opportunity costs accounted; variable machine costs and variable regional factors considered, but labour costs excluded

Source: own calculations based on Neuenfeldt et al. (2020); Bayerische Landesanstalt für Landwirtschaft (LfL) (2020); Kuratorium für Technik und Bauwesen in der Landwirtschaft e.V. (KTBL) (2020); Federal Statistical Office (Destatis) (various years).

As a rule, an incentive-based implementation involving nationwide subsidies results in considerably lower budget costs than an individual farm obligation. This applies to both annual and perennial fallows. Budget costs would be even lower if subsidies were differentiated by region (Figure 11). However, with incentive-based implementation, the target areas would be heavily concentrated in regions with lower value added. In regions dominated by intensive livestock farming, for example, incentive-based support would be unlikely to lead to additional set-aside. The larger the area of land that is taken out of production, the greater the savings effect of regional subsidy differentiation tends to be.

## 2.6 Costs of greening amount to €193 million per year and are offset by €1.5 billion in subsidies

Farms receive around €85 per hectare if they comply with all greening requirements. The total amount of funding for greening for all farms amounts to approximately €1.5 billion per annum.

Three aspects were considered when calculating the costs for farms of implementing greening: a) additional management costs directly related to the requirements, b) the costs incurred by alternative and more economically viable uses being prevented by greening, and c) the loss of second pillar payments due to the increase in the baseline. In total, the estimated costs for greening amount to approximately €193 million per annum (Table 1). It is clear that implementing the EFA measures is the largest cost factor for farms. It amounts for approximately €120 million. This sum derives primarily from the allocation of additional fallow land. On average, substituting an annual fallow for the weakest crop in a crop rotation system will result in €280 per hectare in lost yields. Perennial fallow land costs an average of €600 per hectare, as it displaces entire crop rotations. However, as shown above, it was predominantly fallow land of short duration that was used to implement greening measures. Implementing EFAs using catch crops costs €75 per hectare for managing the crop minus the reduced fertilizer costs. Given that catch crops were used as an EFA measure on an area of just under 540,000 hectares, the costs amount to nearly €41 million. Grassland protection costs approximately €45 million. This figure is based on the average loss of grassland per year between 2005 and 2014. This potential area, which cannot be converted into arable land, averages 155,000 hectares per year. The difference in tenure between grassland and arable land was used to assess the potential loss in value resulting from non-conversion. This amounts to an average of €270 per hectare. Given that many farms had already fulfilled the requirements for crop diversity before greening was introduced, €19 million represents the lowest costs of any greening measure. We assumed that there was only a local or regional shift in the cultivation of silage maize, as (a) mainly farms had to adapt to the requirement producing large quantities of silage maize, while (b) at the same time the amount of silage maize cultivation remained relatively constant. Based on estimates from the IACS data, this affected 75,000 hectares of arable land across Germany. The costs of this shift in cultivation were estimated at €250 per hectare covering for transport and transaction costs.

It was not possible to differentiate between all the potential land types when calculating the costs. It is therefore likely that not all grassland sites are suitable for arable farming. Furthermore, there is the potential for price increases due to a reduced supply of agricultural market goods as a result of the greening. Research by Gocht et al. (2017) shows that greening has the potential to increase farm incomes modestly in Germany. The extent of a price increase induced by the greening and consequently the effect on farm incomes depends largely on the degree to which reduced production of agricultural goods in the EU is offset by increased supply from third countries.

**Table 1: Estimation of the economic costs of greening for the agricultural sector in Germany.**

| Greening measures | Impact pathway | Costs (in millions of euros per annum) |
|---|---|---|
| Ecological Focus Area | additional fallow land | |
| | perennial | 15 |
| | annual | 52 |
| | Fallow land with reduced support in agri-environment and climate measures (for example flowering meadows) | 8 |
| | Cultivation of additional catch crops | 41 |
| | Cessation of agri-environment-climate measures for catch crops | 9 |
| | Cultivation of additional legumes | 5 |
| | *Subtotal* | *119* |
| Crop diversity | Higher transport costs due to local shift in maize cultivation | 19 |
| Grassland conservation | Lower potential added value on grassland areas that cannot be converted into arable land | 45 |
| **Total** | | **193** |

Source: Own Source, Thünen-Institute

# 3 Conclusion

The results of the project show that the 2013 CAP reform led to minor improvements in environmental protection and nature conservation. According to most experts, however, these fall short of the requirements for environmental protection and nature conservation. While the number of important ecological areas has increased slightly compared to 2010, it has not yet returned to the level of the early 2000s. There was also very little change in the diversity of arable crops compared to the period before the introduction of greening. The national average of permanent grassland also increased modestly. However, this increase cannot be attributed exclusively to the greening. The use of pesticides, on the other hand, did not significantly reduce the environmental risk because there was also virtually no change in land use. One reason for such minor changes is that farms were not required to adjust their production methods significantly in order to receive the full subsidy. It can therefore be concluded that the way in which the greening measures were designed was insufficiently ambitious to bring about significant positive effects for the environment.

The project also demonstrated that significant reductions in the environmental impacts of agriculture can be achieved if the subsidies are structured differently. An incentive-based subsidy, for example, could significantly increase the total area of fallow land at no extra cost to farms. The more specifically that a farm's costs are compensated and the smaller the income effect of the subsidy for environmental services, the higher the efficiency of the subsidy will be in relation to environmental services. However, incentive-based support subsidies would not reach farms with high value added on the land and fallow land would accumulate in less productive regions. Even with blanket requirements in subsidy law, there may be a lack of fallow land in regions with high added value. This would occur if the economic benefits from farming without a subsidy were greater than those generated by the payment of a subsidy for meeting the requirements. In such cases, farms choose to waive the subsidy.

Comparing the costs incurred by the farms in implementing greening with the subsidies paid out to the farms reveals that the farm management costs are significantly lower than the subsidies paid. In summary, it can be concluded that the minor ecological improvements brought about by greening have been paid for with a considerable input of public funds (cf. the qualitative assessment of the European Court of Auditors (ECA) 2017, p. 47).

The results of the study provide the foundation for designing a national version of the CAP from the perspective of environmental protection against the backdrop of the EU's various strategic plans. The aim of the ‘farm-to-fork strategy’ to ‘halve the use and risk of chemical pesticides’ should be considered not only in terms of the quantity applied and its toxicity, but also in terms of the potential risk differentiated by land use, as is illustrated by the analysis on the environmental risk of pesticides. This gives rise to synergy effects in relation to the "Biodiversity Strategy for 2030", which also aims to reduce the harmful effects of pesticides. Another of its aims is to increase the proportion of non-productive land to 10% of agricultural land. It should be noted that the cost and therefore the feasibility of this approach depends largely on the geographical distribution of the non-productive land. However, it is important to take both the quantity and the quality of any environmental protection into account. Indeed, the study reveals that although the number of fallows has increased, the duration of each fallow is relatively short.

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