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Accompanying the document

REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

on the implementation of the ecological focus area obligation under the direct payment scheme

{COM(2017) 152 final}

CONTENTS

LIST OF ACRONYMS

AEC	Agri-environment-climate
CAP	Common agricultural policy
SWD	Commission staff working document
EFA	Ecological focus area(s)
EUNIS	European nature information system
JRC	Joint Research Centre
LPIS	Land Parcel Identification System
RDP	Rural Development Programme

LIST OF FIGURES

6. FIRST OBSERVATIONS ON THE POTENTIAL ENVIRONMENTAL AND CLIMATE EFFECTS OF EFA

6.1. Causal analysis on implementation choices

This chapter aims at identifying and exemplifying drivers of Member States' implementation choices and farmers' uptake. The lists presented below are not exhaustive and, in the light of present knowledge, it can neither be determined whether any of these drivers played a dominating role.

6.1.1. Drivers of Member States' choices

Member States' choices appear to have been driven by the need to find a balance between maximum flexibility for farmers and minimum administrative complexity.

More specifically, the evidence collected[1] so far suggests that Member States' implementation choices have been driven mostly by the following:

- the inclination to **offer farmers as many options as possible**, enabling them to exploit the usual practices;

- the **cost of complying** with specific inspection requirements (e.g. maximum dimensions or continuity of some landscape features) and mapping permanent EFA elements in a dedicated LPIS layer. This consideration has been repeatedly mentioned (through working groups or the public consultation) by certain administrations to justify why their national authorities did not select landscape features or catch crops/green cover as EFA types (e.g. Spain);

- **particular circumstances** and **environmental conditions –** intended to ensure the effectiveness of the scheme (e.g. presence of terraces, 'natural' heterogeneity of the allocation of stable landscape features or pollution of surface waters or ground water from agricultural sources) and the need to take into consideration both the biodiversity objective of ecological focus areas and their environmental needs;

- **the more EFA types a country selected the more landscape features types were included**. Bearing this in mind, the comparison of the maps on the number of EFA types selected by Member States (Figure 19) and on the abundance of semi-natural vegetation in EU-27 (Figure 20) shows that this feature could have driven certain

[1] From the 'Mapping and analysis of the implementation of the CAP' study (p. 279) and from feedback given by Member States in different expert groups or voiced in the public consultation on greening.

Member States' choices (e.g. France and Italy where the semi-natural vegetation is abundant, but also Finland or Sweden where it is scarce); and

Figure 19 Number of EFA types selected in 2015, by country

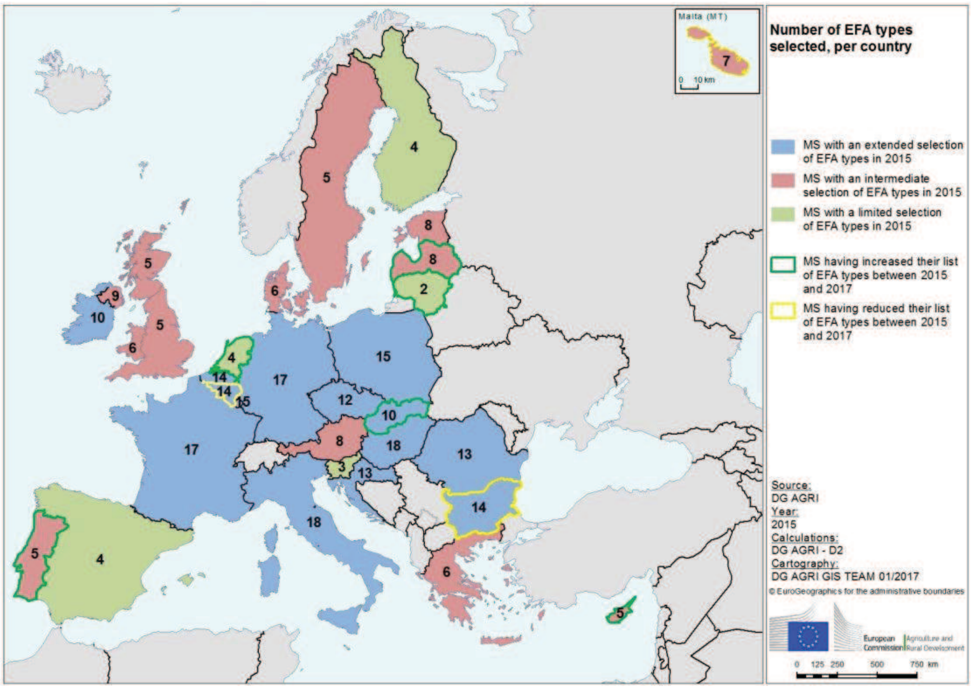
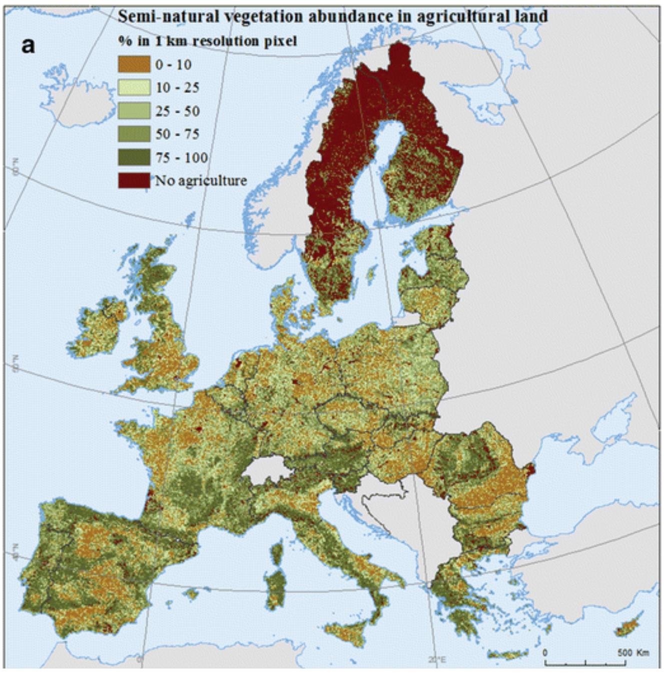


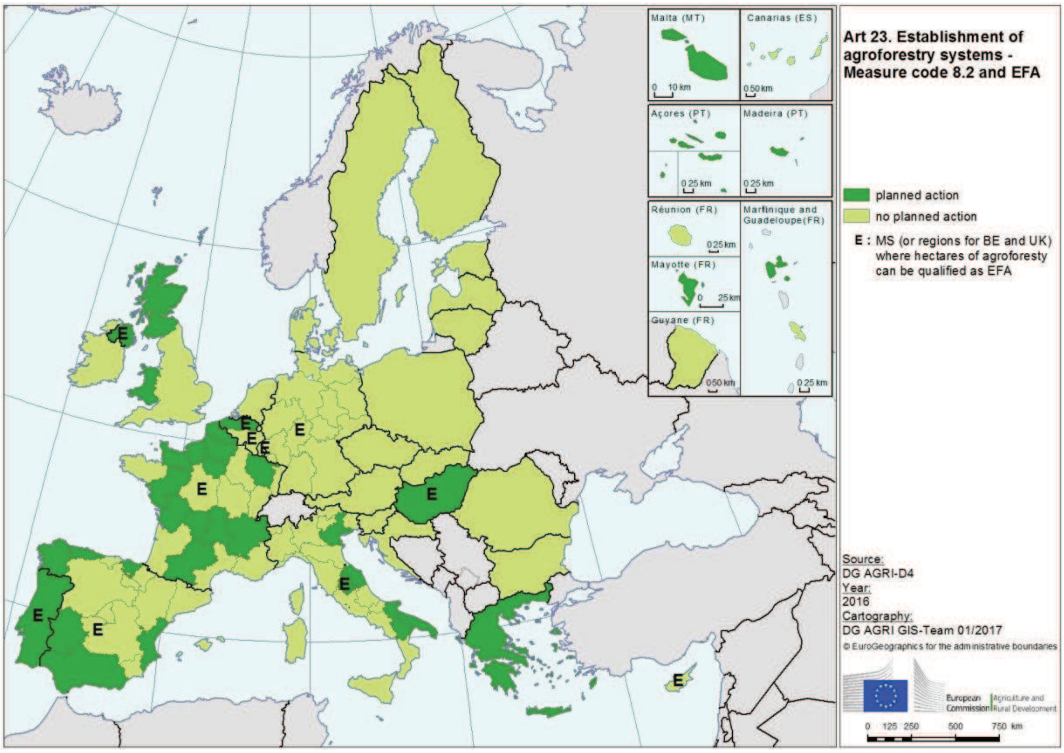
Figure 20 European Union-27 semi-natural vegetation abundance maps at 1 km resolution level



- **decisions taken under other CAP instruments or resulting from EU environmental legislation** (e.g. mandatory establishment of catch crops under nitrates action programmes). For example, afforested areas or hectares of agro-forestry can be qualified as EFA if they receive or have received support under the relevant rural development measure. Therefore, if a country or a region did not implement these measures under its rural development programme, it makes no sense to select the EFA type in question.

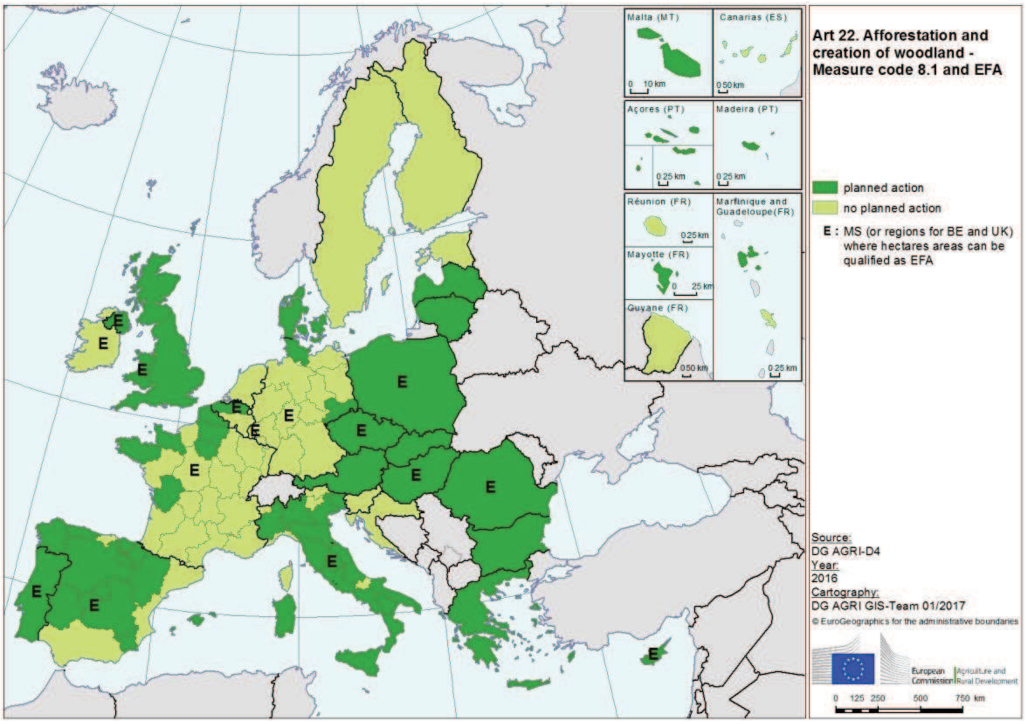
Eight Member States/regions have programmed support to create agro-forestry systems in their current RDP(s) (see Figure 21).

Figure 21 Member States having programmed support for creation of agro-forestry systems in their current RDPs



20 Member States programmed support for afforestation and creation of woodland in their current RDP(s), including in some cases only old commitments which originated in the previous programming period.

Figure 22 Member States having programmed support for afforestation and creation of woodland in their current RDPs



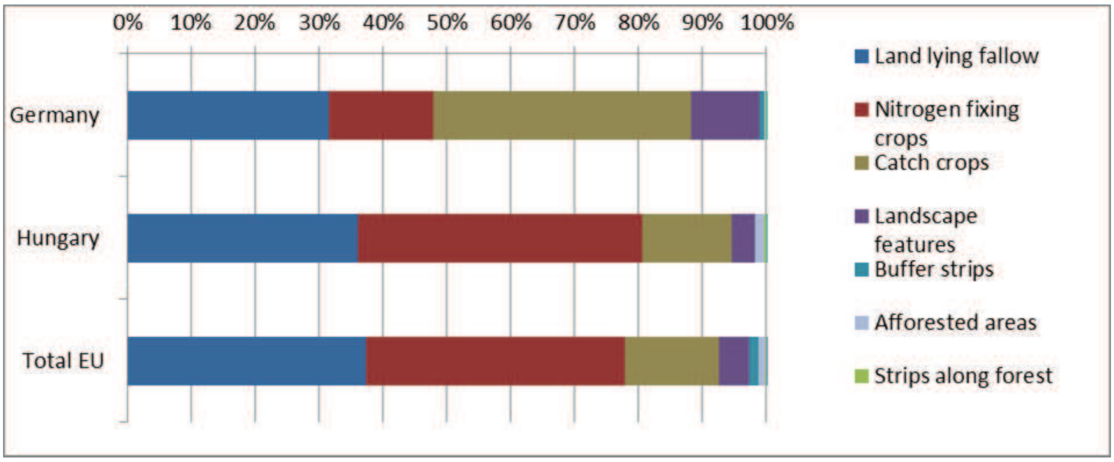
6.1.2. **Drivers of farmers' choices**

Based on the findings in the scientific literature (Pe'er et al., 2016) and the outcomes of the public consultation, the key determinants commonly used to explain farmers' decisions appear also to apply to their uptake of EFA:

- **economic determinants** leading to the choice of the least costly and the most productive EFA;
- **policy and administrative factors**:
    - limitations imposed on farmers by their national authorities, such as the decision to restrict the choice of EFA (e.g. Member States having selected three or four EFA types);
    - a high risk of inspections and non-compliance (e.g. field margins exceeding the maximum width). This could also explain why some farmers decided to use 'safe' EFA types such as land lying fallow, areas with catch crops or nitrogen-fixing crops. It could also explain farmers' applications in countries where they were able to select from all possible types of EFA to comply with the 5 % obligation. Since Germany and Hungary are the two countries that offered all possible types, their farmers can be seen as a reference group for use of areas

and features as EFAs.[2] Application data (see Figure 24) indicate that around 90 % of EFAs declared by German and Hungarian farmers in 2015 consisted of land lying fallow, areas with nitrogen-fixing crops and areas with catch crops or green cover. Of 19 possible EFA types, these three are those used most to qualify for EFAs;

Figure 24 EFAs declared by German, Hungarian and all EU farmers (2015)



- reductions in the administrative burden, for example through the use of a pre-filled single application form with all landscape features qualifying as EFAs on their farm. Conversely, the relative administrative difficulties involved in declaring each EFA, in particular landscape features, may explain the very low uptake among farmers of these EFA types.

- farmers' perceptions and knowledge of the EFA obligation (e.g. the general understanding among farmers of the benefits of certain EFA types or farmers' perception that declaring landscape features such as hedges or trees would commit themselves on the land use for several years).

[2] Despite the great number of EFA types selected in France and Italy, it was not possible to use these two Member States as a reference. This was because France did not communicate data and Italy did not select catch crops/green cover, which is a key EFA type in this context.

6.2. Potential effects on biodiversity, ecosystem services and climate change adaptation and mitigation

This chapter focuses on the potential effects different types of EFA might have on biodiversity, ecosystem services and climate change adaptation and mitigation. It analyses how different EFA features, attributes and the type of management might influence the impact. The Basic Regulation[3] stipulates that the EFA should be established, in particular*, in order to safeguard and improve* ***biodiversity on farms****.* However, this report notes that the EFAs can have **potential side effects** (co-benefits, trade-offs) on other phenomena closely connected to biodiversity, on other environmental media and the climate. Therefore, when assessing the potential impact of EFA, these other potential effects cannot be ignored. This chapter is based on the results from the EFA calculator and a review of selected specialist literature.

6.2.1 Definitions

Effectiveness

Within the meaning of this report, 'effectiveness' is the EFA measure's potential to improve or maintain the current state of biodiversity, ecosystem services and climate change adaptation and mitigation. The hypothetical question about effectiveness is:

- To what extent could the EFA measure potentially impact: (i) biodiversity and (ii) other environmental areas, such as soil and water quality, climate?

Biodiversity

This report uses the definition of 'biodiversity' given in the EU Biodiversity Strategy to 2020[4]: '*Biodiversity — the extraordinary variety of ecosystems, species and genes that surround us — is our life insurance, giving us food, fresh water and clean air, shelter and medicine, mitigating natural disasters, pests and diseases and contributes to regulating the climate. Biodiversity is also our natural capital, delivering ecosystem services that underpin our economy.*'

Ecosystem services

'*Ecosystem services' are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling. The human species, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of*

[3] Recital 44 of Regulation (EU) 1307/2013.
[4] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0 478.

ecosystem services'. (Costanza, R., 1997,[5] Millennium Ecosystem Assessment 2005[6])

'*They include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth*.' (Millennium Ecosystem Assessment 2005)

Climate change adaptation and mitigation

'Climate change adaptation and mitigation' refers to the adjustments that societies make in order to limit the negative effects of climate change and efforts to reduce or prevent the greenhouse gas emission. These adaptation and mitigation practices may vary. For agriculture, they usually encompass changing management practices.

6.2.2. Potential effects on biodiversity

6.2.2.1. EFA calculator results

The analysis focuses on **the diversity and populations of species**, with specific focus on the potential impact EFAs may have on enhancing populations. The following EUNIS species groups[7] (EEA (2015b) were used: amphibians, birds, invertebrates, mammals, reptiles and terrestrial plants.

As regards EFA type impact, the analysis was conducted depending on **the composition of the EFA area**. Nine categories of different composition were selected following the method as described in Chapter 4.5 and the NUTS 3 regions were classified accordingly. In order to explore more closely the influence of EFA type, a specific simulation was performed by isolating certain single EFA types and by identifying their individual impact (the exercise was limited to two case studies, the UK and Spain).

EFA type impact depends also on **factors** such as the physical context in which EFAs are implemented and located and other qualitative features of EFA type such as size, species compositions or management requirement. Further analysis has been done by looking more specifically at **spatial conditions and species**.

Given the limitations of the EFA calculator, as explained in previous chapters, the outcomes have to be considered as potential impacts and treated as such.

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[5] Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., van den Belt, M., 1997. The value of the world's ecosystem services and natural capital. Nature 387, 253-260.

[6] http://www.millenniumassessment.org/en/index.html.

[7] http://eunis.eea.europa.eu/species.jsp.

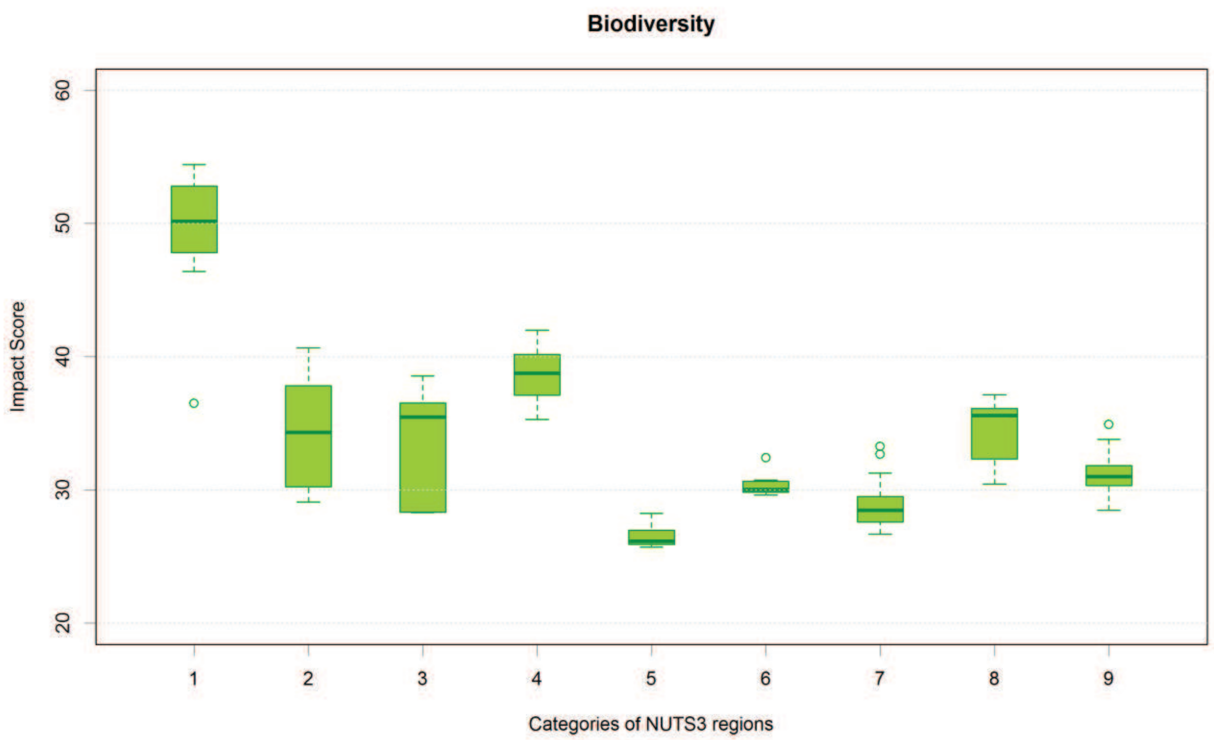
6.2.2.1.1. Overall impact on biodiversity

The impact score for biodiversity is the result of aggregating and normalising the impacts for the different EUNIS species groups (EEA, 2015b) using the scoring system of the EFA calculator (see Chapter 4.6.3). Positive and negative impact scores are averaged and aggregated separately to avoid hiding possible bad effects. Only total impact scores (resulting from adding together positive and negative scores) have been presented for overall biodiversity. This was to take account of cases where there was no or very low negative impact.

The score for biodiversity of the 121 NUTS 3 regions was analysed using different compositions of EFA type (see the nine categories defined above). As described in the paragraph on methodology, these scores should not be considered as absolute values of the actual impact of EFA implementation on biodiversity, but instead as the potential impact on biodiversity of the EFA-type composition declared in the NUTS 3 region. They can be used to compare how different compositions of the EFA type declared can potentially affect biodiversity.

Figure 25 shows results of the total score for biodiversity according to the EFA calculator for the nine categories of NUTS 3 regions. **Category 1 (landscape feature more than 50 % of EFA declared) appears to perform much better than the others.** Category 4 (more than 70 % of EFA as land laying fallow) also achieved good scores. The lowest scores were obtained for category 5 (more than 70 % of EFA declared as catch crop).

Figure 25 Potential impact on biodiversity of categories of NUTS 3 regions



6.2.2.1.2. Biodiversity at species group level

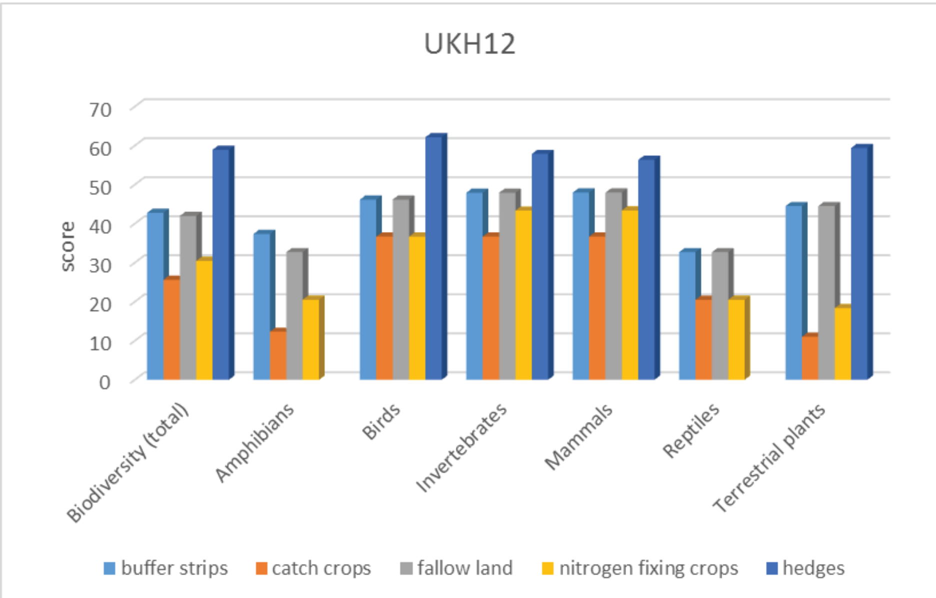
When considering the score at species group level, some similar trends are observed and they confirm the ranking for overall biodiversity impacts, as indicated by the graph above. This analysis underlines the **positive impact of the landscape features** on invertebrates, birds and terrestrial plants. For reptiles and amphibians, a higher presence of **buffer strips and fallow land** in the category class gives higher positive impact scores. Nevertheless, it is not possible to draw any concrete conclusions on the real impacts since they are dependent on very localised factors and features (which are not described in the region files, where an average value is used).

6.2.2.1.3. Analysis per EFA type

From the analysis of scores of different categories of NUTS 3 regions, the percentage of each EFA types greatly affects the impact scores. So to explore the impact of each EFA type, a simulation has been carried out to generate impact scores for each EFA type and compare them.

The results obtained clarify the impacts of different EFA types on biodiversity. Hedges represent the EFA type with highest positive effects on biodiversity, as shown in Figure 26.

Figure 26 Impact scores of different EFA types calculated for biodiversity (total) and some EUNIS species groups in the UK



6.2.2.1.4. Additional analysis

The impact of EFA measures also depends on some other features that are characteristic of the measure. Therefore the impact of EFA should be analysed in a broader perspective, taking account of other factors such as specific local issues and other qualitative aspects of EFA.

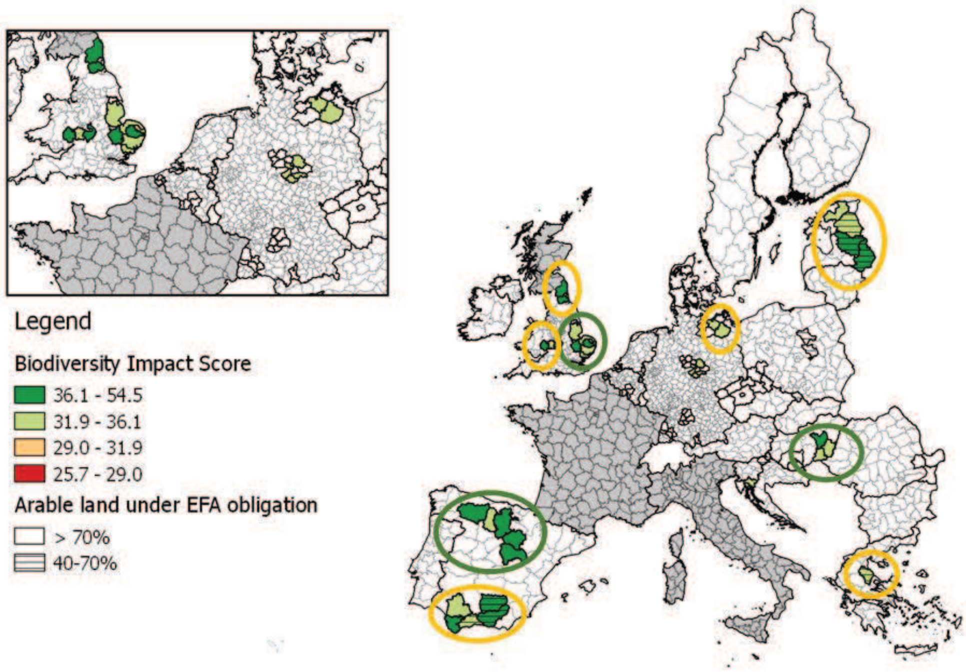
EFA type and regional context

The results of the analysis of the potential impacts of different EFA-type composition could be supplemented by **a spatial analysis** where potential impacts are overlaid with specific environmental issues. This allows understanding whether the declared EFA composition could address specific local issues. Biodiversity scarcity has been considered as one of these local issues. For this purpose a map was used showing the distribution of semi-natural vegetation in agricultural land (Garcia-Feced et al., 2015[8]) aggregated at NUTS 3 level.

By overlaying these two kinds of information (NUTS 3 regions with scarce semi-natural vegetation and NUTS 3 regions with good or low scores for biodiversity), it is possible to highlight areas where greening policy implementation could have an impact on biodiversity, as well as different potential effects of the EFA-type composition on biodiversity as shown by figure 25.

In Figure 27, areas highlighted with green and yellow circles are those where EFA-type composition declared seems to have: a very positive effect (good scores for biodiversity in areas where the current level of semi-natural vegetation is very low); and a positive effect (good scores for biodiversity in areas where the current level of semi-natural vegetation is low or the area under EFA obligation is between 40 and 70 %).

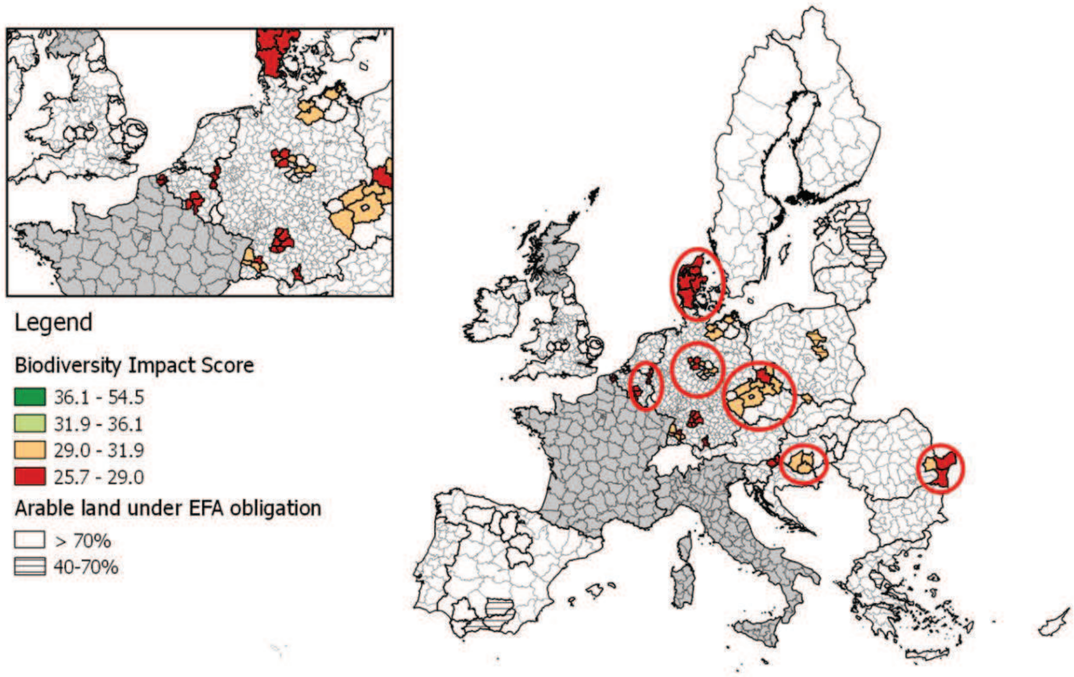
Figure 27 Biodiversity impact scores in NUTS 3 region with more than 40 % of arable land under an EFA obligation



[8] http://link.springer.com/article/10.1007/s13593-014-0238-1.

In Figure 28, areas highlighted with red circles are those where the EFA-type composition declared seems not to provide benefits on biodiversity (i.e. low scores for biodiversity in areas where the current level of semi-natural vegetation is very low or low).

Figure 28 Biodiversity impact scores in NUTS 3 region with more than 40 % of arable land under an EFA obligation



In some regions of eastern England, northern Spain and south-eastern Hungary where semi-natural vegetation is scarce, biodiversity scores are good. The great amount of landscape features and fallow land declared as EFA determines these results. Nevertheless, it is still not possible to determine the real impact of landscape features since already existing landscape features such as hedges are declared in significant quantities by farmers.

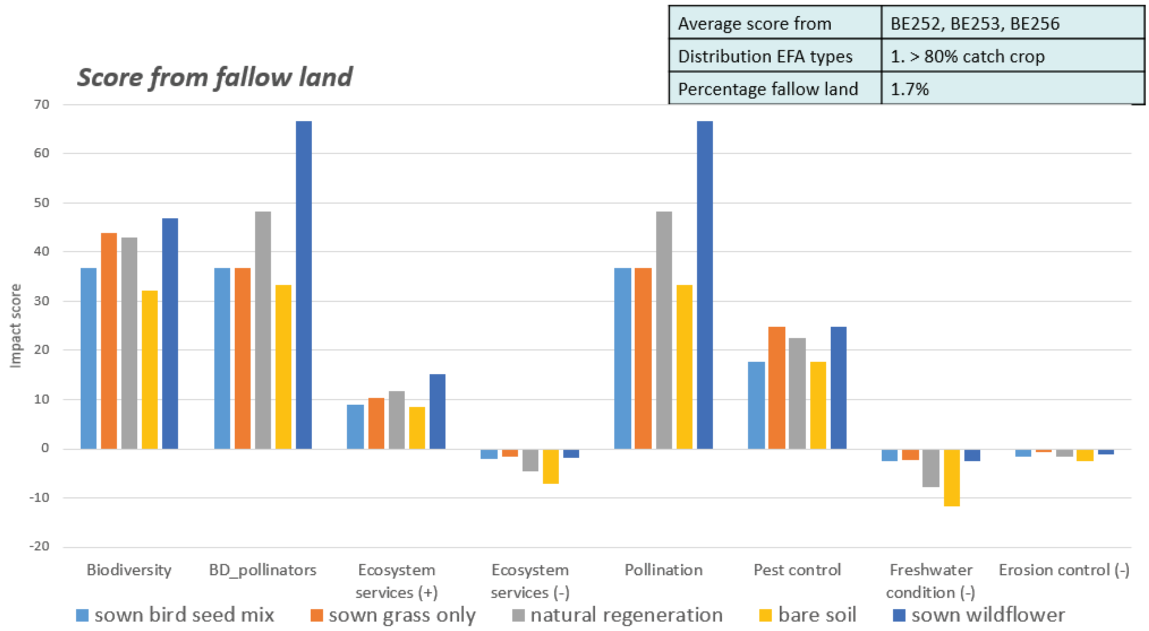
On the contrary, in some regions with scarce semi-natural vegetation (e.g. Denmark, some regions in the Netherlands and Belgium, south-western Hungary and Romania) but with lower scores for biodiversity, it is possible to highlight areas where the EFA-type composition declared does not seem to be able to provide benefits for biodiversity. In this case EFA features declared are represented by EFA types with low impacts on biodiversity (mainly catch crops) in areas where the presence of semi-natural vegetation is also scarce.

EFA feature and species

The impact of **additional features and the choice of species** sown have been explored using the EFA calculator. Simulations have been carried out to assess how scores for biodiversity and ecosystem services can vary according to some specific characteristics for land laying fallow, catch crops or green cover and nitrogen-fixing crops.

Impact scores for **land laying fallow** were calculated specifying different types of **vegetation cover** (sown bird seed mix, sown grass only, natural regeneration, bare soil, sown wildflower). The results (Figure 29) show that for pollinators, sown wildflower produces the highest scores and bare soil the worst. Natural regeneration is also a good option to foster biodiversity and pollination. Natural regeneration may offer potential for the growth of arable flora that also favours pollinating invertebrates.

Figure 29 The effects on biodiversity and ecosystem services of different types of land lying fallow in selected Belgian NUTS 3 regions



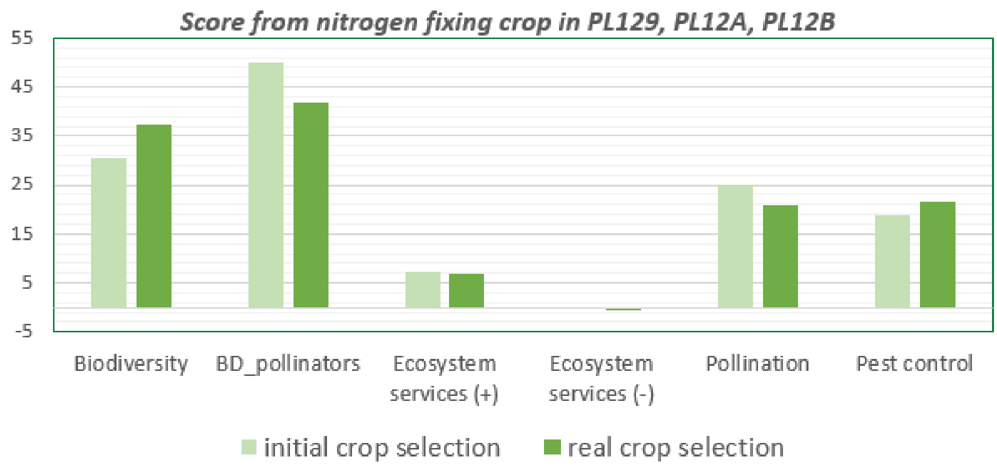
For catch crops and nitrogen-fixing crops, simulations involved changing some **species compositions.**

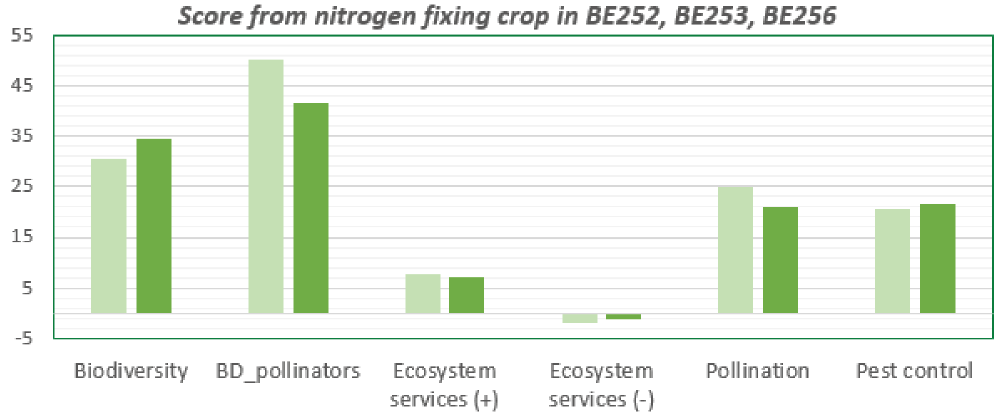
In the case of **catch crops,** the standard mixture used by EFA calculator was composed of *Sinapis alba* and *Lotus spp*. For the simulation, other compositions were introduced based on a possible mixture used in Flanders that also includes *Sinapis alba* and *Lolium* and *Raphanus*. The scores for biodiversity are similar even if the species composition varies. It is difficult to obtain a significant differentiation for catch crops in terms of biodiversity. Indeed, all species may provide some shelter during the winter to active predatory beetles compared to bare soil. When present as winter cover crops all species have a limited effect on amphibians, birds of prey, insectivorous birds, seed-eating birds, small mammals, reptiles and flowering plants.

For **nitrogen-fixing crops,** the standard species used by EFA calculator was *Vicia faba*. For the simulation, other species were introduced, based on the species most used in Belgium and Poland, respectively *Medicago sativa* and *Ornithopus spp.* (Bird's foot).

This simulation exercise shows (Figure 30) that scores vary for nitrogen-fixing crops, especially for biodiversity (in fact, for pollinators *Vicia faba* gave better scores than the species that are actually cultivated). The differences can be reflected in the impact scores for the whole 'NUTS 3 farm', where nitrogen-fixing crops represent a significant percentage of the EFA types.

Figure 30 Comparing impact scores for nitrogen-fixing crops between crops species used in the NUTS 3 analysis (initial crop selection — *Vicia faba*) and those actually mostly used by the farmers in the specific NUTS 3 (real crop selection) for selected NUTS 3 regions in Poland and Belgium





6.2.2.2. *Findings from other studies*

As the analysis was done by the EFA calculator, the results might be regarded as too narrow. Therefore, the findings were supplemented by other research studies done for different EFA types.

The literature indicates that among EFA options, **buffer strips, land laying fallow and landscape features** are considered to have **positive impact** on biodiversity. Of the landscape features, hedges, field margins and traditional stone walls were considered the most favourable for biodiversity (Pe'er, 2016[9]) as they provide habitats for beneficial insects and arthropods, birds and plants (EIP AGRI 2016).

The EFA non-productive options in general (land lying fallow, landscape features and field margins) have the potential to be even more valuable for biodiversity under **non-intensive type of management** (e.g. no use of pesticides) (Underwood, E. and Tucker, G.,20 16[10]).

By contrast, **nitrogen-fixing crops and catch crops** are **unlikely to produce a positive effect** on biodiversity (Pe'er 2016). Nitrogen-fixing crops rarely produce a positive effect since they are mostly grown intensively, are frequently cut and grazed and pesticides and fertilisers are used. Catch crops can only bring about a positive impact if they are comprised of plant mixes designed to benefit pollinators and birds and those plants are allowed to flower and set seed (Underwood, E. and Tucker, G., 2016). The positive impact of nitrogen-fixing crops and catch crops then depends mostly on **the type of management** introduced on the field.

Land laying fallow is regarded as a 'win-win option' in terms of farmers' uptake and their view on different EFA elements. This is because it is both attractive to farmers and also provides services to farmland biodiversity. In contrast, buffer strips and landscape features, even though they are pro-biodiversity, are not **perceived by farmers** as an attractive option. This can be explained in part by the assumption that farmers tend to choose EFA options which are less costly, are easy to implement and which offer production potential (Pe'er, 2016) (see also Chapter 6.1.2).

As regards the management of EFAs, in the public consultation on greening, farmers voiced the opinion that out of the different management types of EFAs indicated, they regarded rotation and sowing mixtures of species as the production methods most beneficial for the environment.

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[9] http://onlinelibrary.wiley.com/doi/10.1111/conl.12333/abstract.

[10] http://www.ieep.eu/work-areas/agriculture-and-land-management/policy-evaluation/2016/12/ecological-focus-areas-what-impacts-on-biodiversity.

6.2.3. Other potential effects: Potential effects on ecosystem services

6.2.3.1. EFA calculator results

A similar analysis as the one for biodiversity was performed for **ecosystem services**, using the classification of ecosystem services as presented by the Common International Classification of Ecosystem Services (CICES[11]):

Provisioning services — provision of water as a material and water for nutrition;

Regulation services — global climate regulation, pollination and seed dispersal, pest control, chemical condition of freshwater, flood protection, mass stabilisation and control of soil erosion, filtration/sequestration by flora and fauna, mediation of smell/noise/visual impacts;

Cultural services — aesthetic services, heritage and cultural services.

The analysis then focused on the **ecosystem services to which EFA measures are more relevant:**

- pollination and seed dispersal;
- pest and disease control;
- chemical condition of fresh water (considering nitrate leaching to surface and groundwater);
- mass stabilisation and control of erosion rates

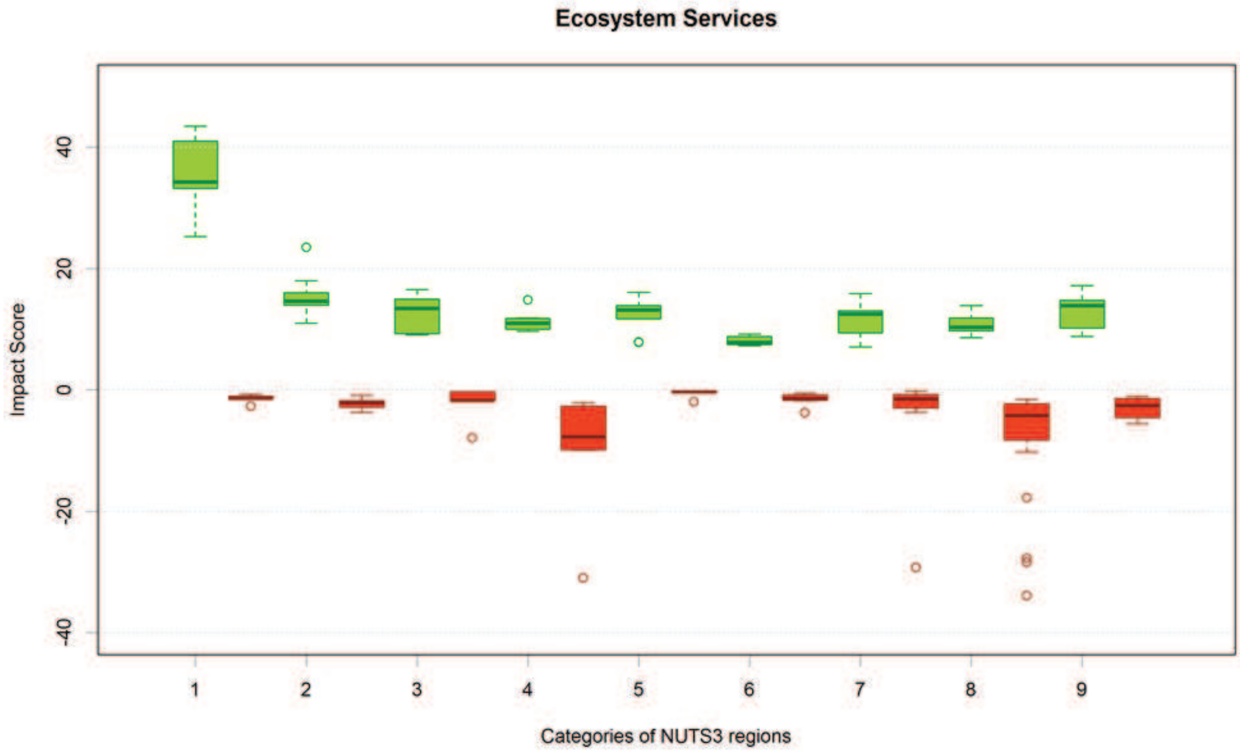
Total impact is the result of aggregating scores for all ecosystem services analysed. Positive and negative impact scores are averaged and aggregated separately. For ecosystem services, each impact score (both positive and negative) has been also presented separately.

[11] http://cices.eu/.

6.2.3.1.1. Overall impact of EFA on ecosystem services

Based on the analysis done, it appears that the **category where landscape features account for more than 50 % of declared EFA** has the **most positive effect** on ecosystem services in general. It can therefore be assumed that landscape features are most beneficial for ecosystem services. On the other hand, since the negative impacts in all the categories are fairly low, it can be assumed that no EFA type has a completely negative effect on the ecosystem services analysed.

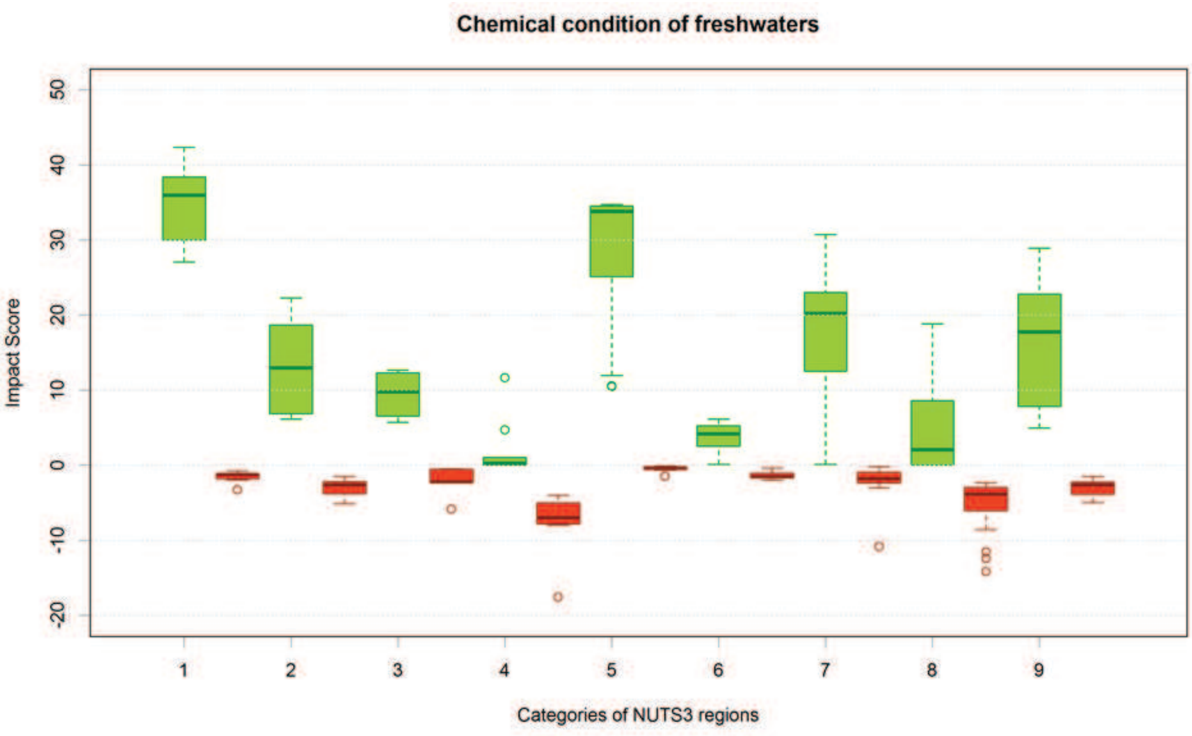
Figure 31 Potential impact on ecosystem services by categories of NUTS 3 regions. Scores for positive impacts are in green, scores for negative impacts in red



6.2.3.1.2. Chemical condition of freshwater

As with the overall impact, category 1, **with landscape features** comprising more than 50 % of EFA, was shown to be most beneficial for the chemical condition of freshwater. When **catch crops** are the most prominent EFA (more than 70 %) (i.e. category 5) they also give good positive results. This means that while catch crops might not have a positive impact on biodiversity, they might still prove favourable for some ecosystem services. Category 4 (**land lying fallow more than 70 %)** shows slightly negative results under some management practices, specifically when the land lying fallow is left with bare soil.

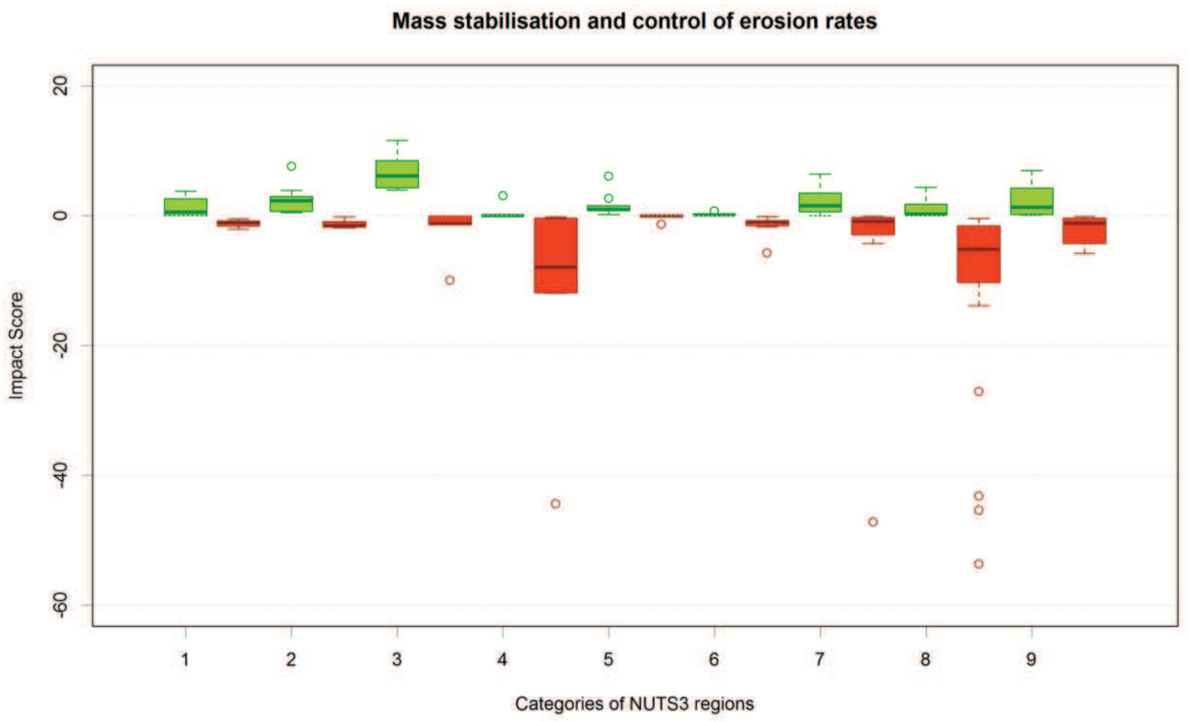
Figure 32 Potential impact on the ecosystem service 'chemical condition of freshwaters' by categories of NUTS 3 regions. Scores for positive impacts are in green, scores for negative impacts in red



6.2.3.1.3. Mass stabilisation and control of erosion rates

The impact of different categories of EFA-type compositions has been proven to be so low that **no general conclusion** can be drawn from these results. The impact probably results more from specific **local conditions** like slope or ground cover. However, these are not taken into account in this analysis.

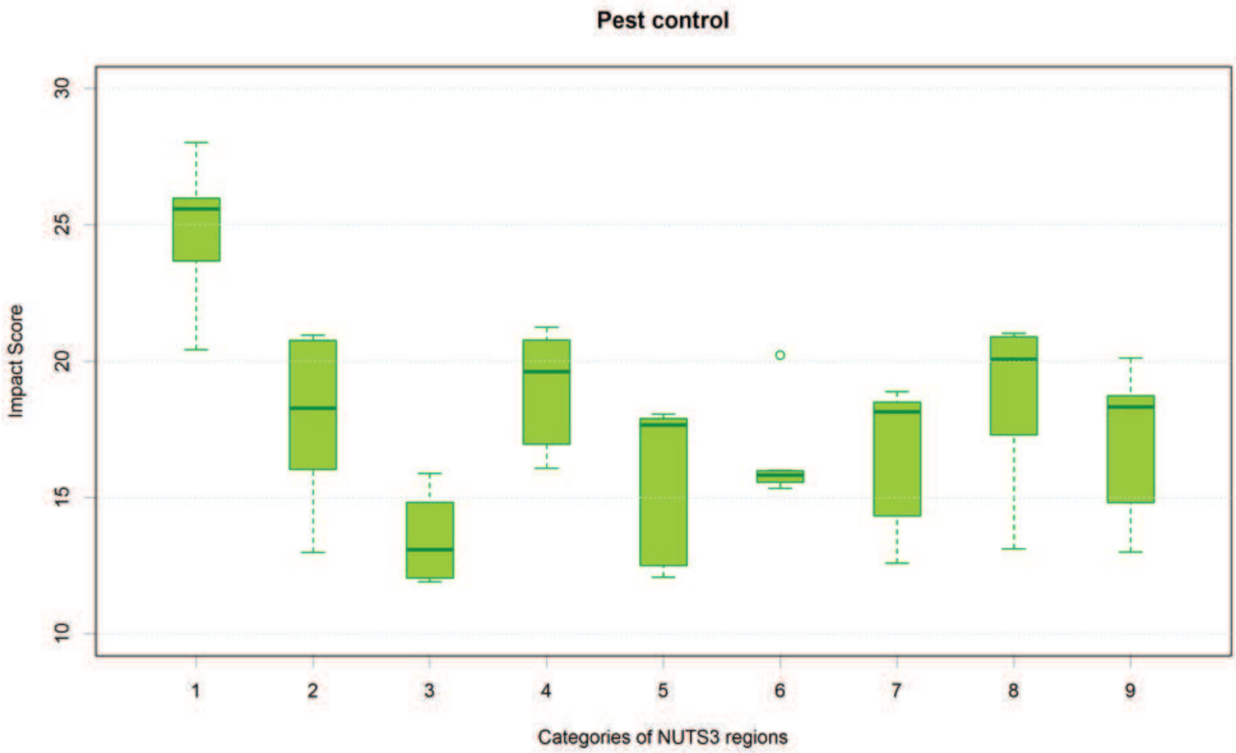
Figure 33 Potential impact on the ecosystem service 'mass stabilisation and control of erosion rates'. Scores for positive impacts are in green, scores for negative impacts in red



6.2.3.1.4. Pest control

As with previous types, the category where **landscape categories** were prevalent proved to be most beneficial for pest control. Other categories showed no significant impact. Natural enemies that control agricultural pests and provide a service by regulating pest populations need to have habitats such as landscape features.

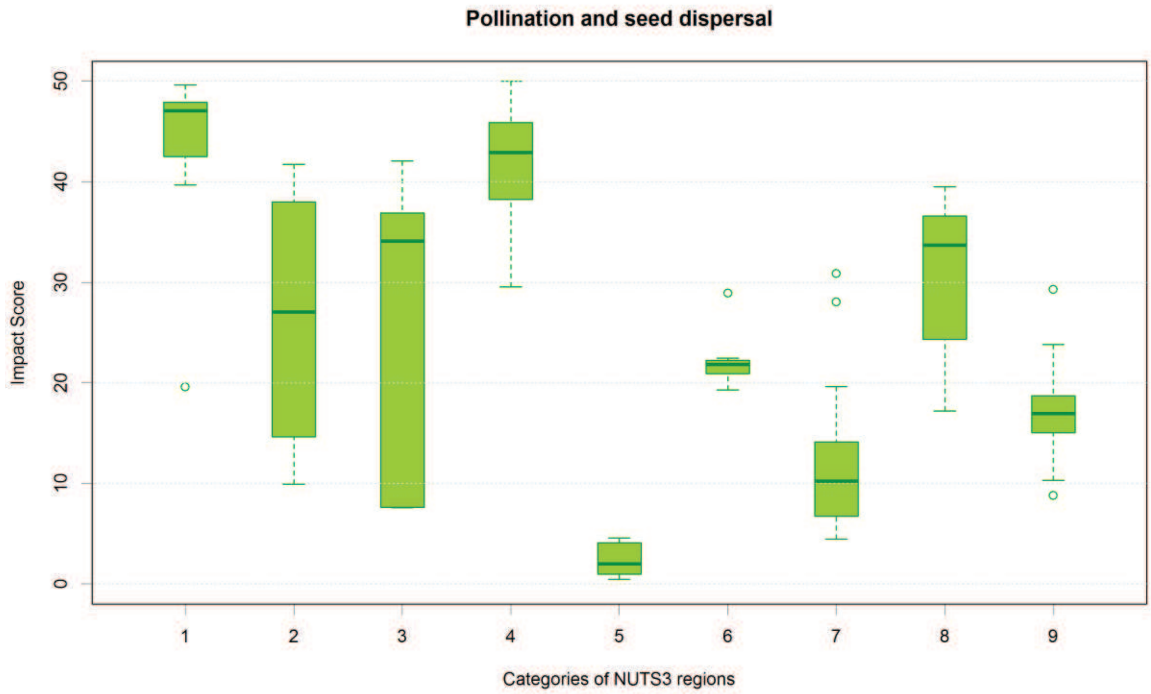
Figure 34 Potential impact on the ecosystem service 'pest control' by categories of NUTS 3 regions



6.2.3.1.5. Pollination and seed dispersal

Pollination and seed dispersal are closely linked to biodiversity. The most positive impact on this ecosystem service can be generated through the **presence of landscape features** and land lying fallow. By contrast, catch crops generate no such result.

Figure 35 Potential impact on the ecosystem service 'pollination and seed dispersal' by categories of NUTS 3 regions



6.2.3.1.6. Estimated impact of each EFA type on ecosystem services

As was done for biodiversity, the impact of a single EFA measure on ecosystem services has been considered. The EFA types which were overall most favourable to ecosystem services were **hedges and buffer strips**. Together with land laying fallow, these are also most beneficial for pollination, while control of erosion generated a positive impact only with buffer strips. As highlighted before, catch crops are beneficial for the chemical condition of freshwater.

A very low negative effect has been documented from land laying fallow (but depending on the ground cover) and from nitrogen-fixing crops.

6.2.3.1.7. Additional analysis

As with biodiversity, impact of EFAs should be analysed in a broader perspective, taking account of other factors such as specific local conditions and other qualitative aspects of EFAs.

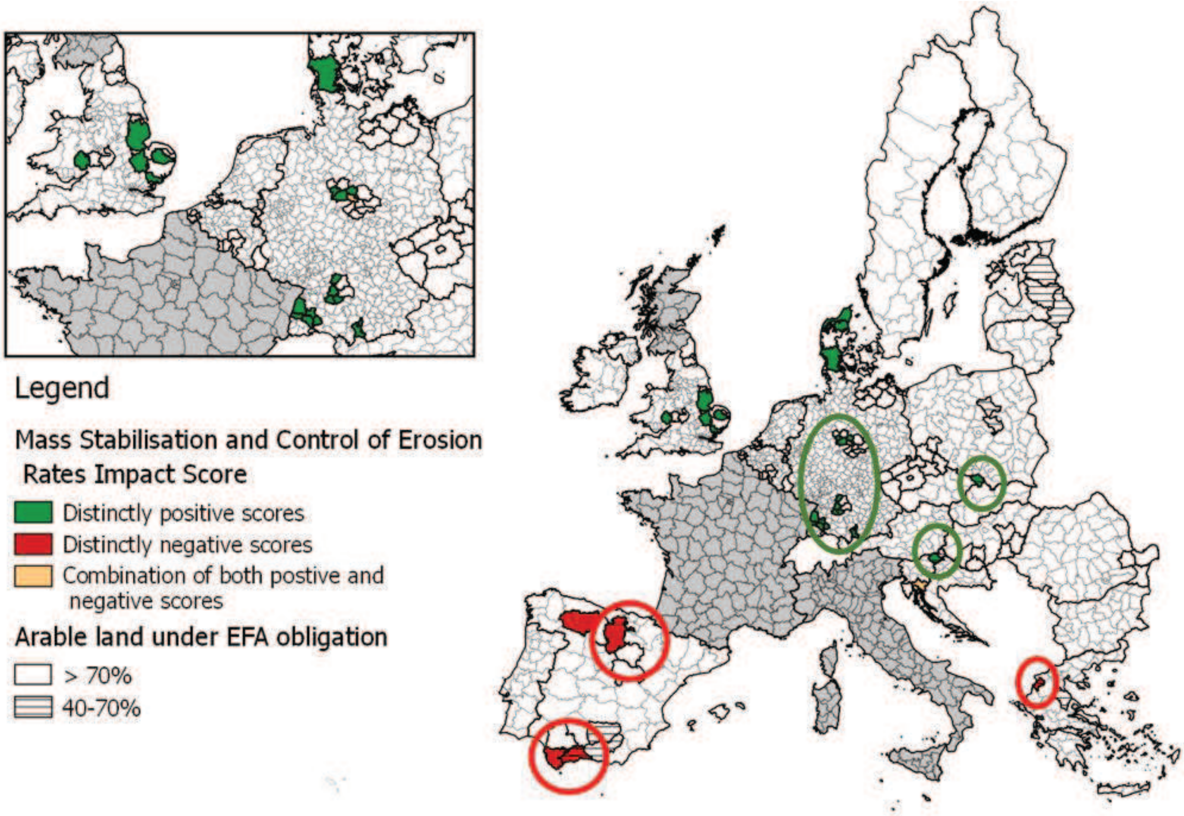
EFA type and regional context

Relevancy of EFA type can depend on certain specific **local conditions**. To understand whether specific environmental issues can be addressed according to the EFA types declared, a possible approach would be to run a spatial examination of results coming from the analysis of the potential impacts of the different EFA-type composition on ecosystem services. One of these environmental issues is **soil erosion** by water. A map of water erosion of soil in the European Union produced by JRC's Soil Bureau (Panagos et al., 2015) has been used for this purpose.

By overlaying the two kinds of information (NUTS 3 regions with high and moderate risk of water erosion and NUTS 3 regions with good or low scores for the ecosystem service 'mass stabilisation and control of erosion rate'), it is possible to highlight areas with erosion risk where the EFA-type composition declared could have an impact (or not) on mitigating erosion, as shown in Figure 36. The areas highlighted with **green circles** are those where the **actual EFA-type composition** could be **effective** for erosion control (good scores were recorded in areas with moderate soil erosion). In areas highlighted with **a red circle**, it seems that issues related to erosion by water **could not be addressed** by the **composition of the EFA types declared** (low scores were recorded in areas with a moderate or high level of erosion).

In some countries or regions such as Germany, Slovenia and southern Poland, the analysis underlines the potential positive contribution of the EFA types declared in a context of moderate and high risk of erosion. Conversely, for Spain and Greece the analysis points to a negative impact.

Figure 36 Erosion control rates impact scores in NUTS 3 region with more than 40 % of arable land under EFA obligation


Legend
Mass Stabilisation and Control of Erosion Rates Impact Score
Distinctly positive scores
Distinctly negative scores
Combination of both postive and negative scores
Arable land under EFA obligation
> 70%
40-70%

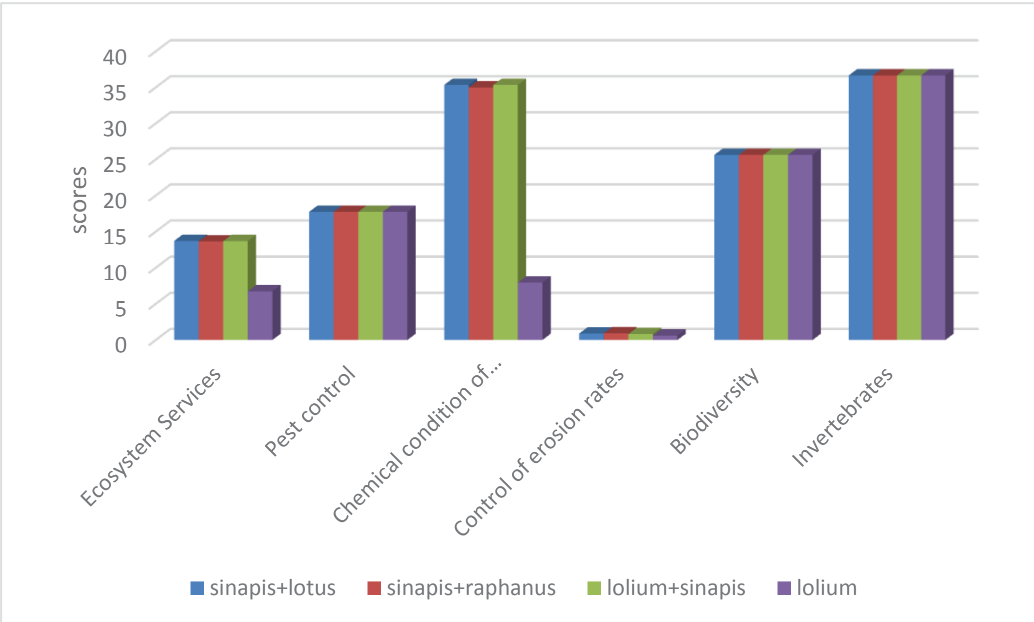
EFA features and species

Using the EFA calculator, the impact of **additional features and the choice of species sown** in different EFA elements has been explored for ecosystem services. This was done by using the same simulation carried out for biodiversity for land laying fallow, catch crops or green cover and nitrogen-fixing crops.

As already identified for biodiversity, for land lying fallow the impact of some **coverage** such as sown wildflower is very significant for the ecosystem service 'pollination' when compared with other coverage. Bare soil performs more poorly in terms of the ecosystem services it supplies.

For catch crops, the scores obtained are similar even if the **species composition** varies. The exception is the ecosystem service 'chemical condition of freshwater', where the same of a single plant family (*Lolium*) used as a mixture produces lower scores.

Figure 37 Impacts of different catch crops mixture on some ecosystem services and biodiversity



The literature confirmed that two species groups with different nutrient requirements and rooting systems are likely to utilise more soil nitrogen in autumn and winter due to differences in plant functional type and nutrient resource exploitation (Finn *et al*., 2013[12]). For this purpose, mixtures including *Poacea* such as *Lolium* (rye grass) and *Brassicacea* can be more effective than having a single composition of *Brassicaceae* or grass species.

[12] http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12041/pdf.

6.2.3.2. Findings from other studies

As for biodiversity, the results from the EFA calculator on ecosystem services are supported by findings from other studies. In terms of benefits for ecosystem services, landscape features, especially **hedgerows and flower strips together with field margins**, are proven to have a positive effect. The ecosystem service functions provided by these landscape features include microclimate regulation, erosion control and nutrient retention, biological pest control and pollination (EIP AGRI 2016[13]). Even though **nitrogen-fixing** crops do not have any significant impact on biodiversity and ecosystem services in general, they are beneficial for biological nitrogen fixation and therefore for the mitigation effect with regard to climate change (RICARDO AEA, 2016[14]).

6.2.4. **Other potential effects: Potential effects on climate change adaptation and mitigation**

Although the EFA calculator has not been used to analyse the potential impact of EFA measures on climate change adaptation and mitigation, EFAs have some positive potential contributions to global climate regulation.

These potential positive impacts can include:

- increased provision of landscape features, which would be expected to increase the climate resilience of farms (improved climate adaptation, protection against, wind, sun etc.);

- conservation of existing stable elements, which can have an effect on carbon sequestration;

- an increase in the area of nitrogen-fixing crops (vs conventional crops), which is expected to decrease nitrogen use (direct mitigation impact). The displacement of artificial nitrogen with nitrogen fixation is another positive mitigation action leading to reduced greenhouse gas emissions;

- afforestation actions, which help increase carbon sequestration;
- land lying fallow, which generally leads to less overall N fertiliser use and can also have a potential positive impact on climate change mitigation

[13] https://ec.europa.eu/eip/agriculture/node/2094.
[14] https://ec.europa.eu/clima/sites/clima/files/forests/lulucf/docs/cap_mainstreaming_en.pdf.

6.2.5. Additional attributes and management types of EFA elements and their impact on biodiversity and ecosystem services

As already explored by the EFA calculator, qualitative aspects are important for EFA impact. Additional attributes and management types of different EFA types may add up to a positive impact on biodiversity and ecosystem services and thus promote the positive effect of the greening measure. The findings of the EFA calculator on this subject are supported by and developed in other studies.

6.2.5.1. Land lying fallow

The impact on biodiversity and on ecosystem services of land laying fallow can be influenced by the **nature of the coverage** (as already highlighted by the EFA calculator) and also by the **land management**, especially the **cultivation intensity**.

The results for positive impacts vary depending on the nature of plant used: **wild seed mixes and bare fallow with winter stubbles** and **naturally regenerated vegetation** perform better than grass or grass-clover ley. By contrast, and as already mentioned, keeping the land lying fallow with bare soil has a detrimental effect.

Mixtures with flowering plants provide:

- favourable habitats and hibernation sites for insects, insectivorous birds and small mammals (a potential food source for birds of prey);
- a source of food for grass eating and insectivorous species such as birds (Tzilivakis, J., et al. 2015[15]).

Young fallow areas with cereal stubble provide a valuable foraging habitat for farmland birds and can be suitable breeding habitats for some species. (Underwood, E. and Tucker, G.,20 16)

The results also depend on the type of management and on the amount of time the land is actually left lying fallow.

Limited cultivation and re-establishment frequency favours predator populations. Mixtures that require more frequent tillage or areas where bare ground persists are not as favourable to predators. (Tzilivakis, J., et al. 2015)

Fallow can be expected to increase soil macro fauna abundance, primarily because of the lack of disturbance from tillage and pesticides as compared to arable soils. The wild native plants tend to reach maximum plant species richness in the second year and long-term fallow land provides an attractive nesting habitat for solitary bees. By contrast, destruction of EFA fallow land after half a year will destroy bee nests and does not therefore offer a nesting habitat for solitary bees (Underwood, E. and Tucker, G., 2016)

[15] https://ec.europa.eu/jrc/sites/default/files/ReqNo_JRC 99673_final_report.pdf.

Land laying fallow is also beneficial for erosion prevention — sown wild seed mixes are expected to reduce soil erosion and run-off to farmland ecosystems in significant levels compared to bare soil.

6.2.5.2. Catch crops

The **choice of seed mixtures and choice of species** greatly affect the purpose of the catch crops and their effect on biodiversity and ecosystem services.

As shown by the EFA calculator, **species that utilise more nitrogen during the autumn** are effective at removing nitrogen from the soil and reducing the risk of leaching during winter, especially on soils with a high percentage of sand content. Examples of such species include winter oilseed or forage rape (*Brassica napus*), or species which rapidly establish extensive roots, such as winter cereals, of which winter rye (*Secale cereale*) is a good example. (Tzilivakis, J., et al. 2015).

In terms of biodiversity, compared with bare soil all species may provide some shelter during winter to soil surface active predatory beetles. However, the impact is likely to be small. (Tzilivakis, J., et al. 2015)

Nevertheless, the benefit will depend on the **sowing date and on the duration** of the catch crops. Catch crops have a benefit for biodiversity when they are sown very early in summer, giving them time to flower. This can provide some prey/host and/or nectar/pollen resources to carry over predators into the next crop or into hibernation, unlike in bare soil. The presence of catch crops in the field can sometimes have also negative effects: for example, the lower weed diversity and abundance in summer catch crops compared to fallow land is considered negative. When winter cover crops replace winter cereal stubbles, seed-eating farmland birds are negatively affected. (Underwood, E. and Tucker, G., 2016)

When catch crops are incorporated into soil they **increase soil organic matter**. However, this benefit is **counteracted by tillage and herbicide application**. Catch crops also help to reduce **soil erosion and nitrate leaching** from the cropping surface into field margins, depending on vegetation structure and duration. A good environmental practice is to immediately follow a nitrogen-fixing crop with a catch crop or a winter arable crop. (Underwood, E. and Tucker, G., 2016)

The positive effect of catch crops on biodiversity and ecosystem services is marginal, but can substantially improve depending on **the farming management**.

6.2.5.3. Nitrogen-fixing crops

The impact of the nitrogen-fixing crops on biodiversity and ecosystem services is also influenced by the **choice of species and the intensity of the management** by farmers.

As shown by the EFA calculator, the **seed mixtures and choice of species** can greatly influence nitrogen-fixing crops.

Vicia faba (Broad bean), *Lotus spp.* (Birds foot-trefoil) and *Trifolium spp.* (Clover species) are of value to pollinating insects, for example bees. They are favoured by solitary bees, short and long tongued bumblebees and honeybees. Species such as *Cicer spp* (Chickpea) and *Glycine spp.* (Soybean) may act as a potential food source for seed-eating birds. Species with a long corolla and light flower colour are potentially favourable to moths, and moths provide a source of food to bats that feed at night. A single species sown crop will be of low floral diversity. (Tzilivakis, J., et al. 2015)

The management of nitrogen-fixing crops also influences its impact. A decrease in **cultivation frequency** reduces the quantity of nitrogen returned to the soil within plant residues via mineralisation, and reduces the risk of soil erosion and phosphate loss in surface run-off, while a greater frequency of tillage decreases habitat favourability to many soil surface active invertebrates, including predatory beetles.

This means that benefit is provided by species that may only require re-establishment and tillage every few years, for example *Lotus spp.* (Birds foot-trefoil), *Anthyllis* (Kidney vetch) and *Trifolium spp.* (Clover species) (Tzilivakis, J., et al. 2015)). This corresponds to nitrogen fixing used as multiannual forage instead of annual crop used such as dry pulses.

Nitrogen-fixing crops can also benefit from **extensive management** (low input and cutting regime). This is the case of alfalfa, where weed diversity is significantly higher without management inputs between May and August.

Delayed mowing of parts of an alfalfa crop benefits spiders, seed-eating carabid beetles and butterflies. Populations of bumblebee species can benefit from late season red clover and also generally if the nitrogen-fixing crop is allowed to flower for several months in spring and in late summer.

Finally, legumes used as a green manure can increase soil organic matter and fertility and prevent soil erosion and nitrate losses, while the increased soil nitrogen content can also reduce need for nitrogen fertiliser in subsequent crops. Broad bean and field pea specifically do not require nitrogen fertiliser and so can lower fertiliser use and associated energy use in the crop rotation if the farmer follows recommendations. (Underwood, E. and Tucker, G.,2016)

6.2.5.4. Landscape features — hedges

As presented through the EFA calculator, landscape features have great potential for biodiversity and ecosystem services. Additional attributes of hedges and their management, such as the following, can increase this potential positive impact:

- floral diversity;
- hedge height;
- hedge density and porosity;
- presence of deadwood;
- cutting of the hedge. (Tzilivakis, J., et al. 2015)

Hedgerows rich in **floral diversity** can attract a greater diversity of pollinators and promote pollination. Flora richness in the hedgerow, in terms of both total richness and insect-pollinated plant richness, is important for birds, insects and mammals. Also the presence of deadwood affects the diversity of life in hedges as it is beneficial for pollinators and provides nest holes, foraging and perches for many different species, for example invertebrates such as spiders, ground beetles and hoverflies. Deadwood also provides nesting opportunities for bees and can enhance the habitat for mosses and liverworts. (Tzilivakis, J., et al. 2015)

Hedge height also affects potential impacts both for ecosystem services and biodiversity. Tall hedgerows offer the greatest benefit for trapping pests, and are most effective in reducing pesticide drift and protecting non-target areas, including water bodies. They also offer the greatest benefit for mediating smell, noise and visual impacts and attract a large number of birds. (Tzilivakis, J., et al. 2015)

The density and porosity of hedges influence the presence of birds and other species. Also the presence of trees in hedges can play a role since it has a large positive impact on the abundance and diversity of moths. Having a large number of species (including butterflies) visiting the hedge is dependent on the tree layer. The incidence of bats is significantly affected by tree density — the more trees present, the greater the population and diversity of bats visiting. Porosity is also a key factor. Hedgerows with low porosity offer the greatest benefit for trapping pests and mediating smell, noise and visual impacts while moderate porosity is most effective in reducing pesticide drift and protecting non-target areas, including water bodies. (Tzilivakis, J., et al. 2015)

The **management of the hedge** can also be a factor in the positive effect on biodiversity. **Uncut hedges** provide more flowers and berries than cut hedges and can support twice as many species of birds. Hedgerow cutting reduces the number of flowers and the biomass of berries available over winter. Therefore cutting should be done in the winter and avoided during spring and summer. (Tzilivakis, J., et al. 2015)

Other studies confirm the positive impact hedges also have on biodiversity and ecosystem services. Hedges contain greater herbaceous plant species richness than crop areas, as well as the presence of woody species. Soil macro-organisms are likely to be much more abundant in undisturbed (i.e. untilled) soils below hedges. Hedges are also key foraging and dispersal habitats for butterflies, moths, solitary bees and bumblebee queens. In addition, wide hedge bases can provide larval food plants. Hedges also provide important breeding habitats and food resources for many species of farmland birds. Also, as mentioned before, hedges reduce soil erosion and buffer arable field run-off, filtering out nutrients and pesticides. (Underwood, E. and Tucker, G.,2016)

6.2.5.5. Landscape features — buffer strips

The important attributes of buffer strips are the following:

- the dimensions and location of the buffer strip;
- the density and structure of vegetation;
- diversity of vegetation. (Tzilivakis, J., et al. 2015)

Buffer width has an impact on pesticide drift and surface run-off: the impact increases with buffer width due to greater opportunity for infiltration (surface run-off) and filtration by vegetation (pesticide drift). (Tzilivakis, J., et al. 2015)

The **management of the adjacent field** also affects the buffer strip, especially if the field is prone to erosion. Buffer strips may become overwhelmed if there is excessive sediment delivery, so there is a risk that they may become less effective in **locations** where soil erosion is high. (Tzilivakis, J., et al. 2015)

The **density and diversity of vegetation** is also an important factor as dense vegetation provides a greater barrier to overland flow (and the pollutants it carries) than more sparsely populated buffer strips, thus reducing flow velocity and increasing time for infiltration. Structurally diverse habitats such as rough grassland, scrub, hedgerow or woodland in close proximity provide a favourable habitat. This habitat declines in suitability with a decrease in structure, for example frequently cut vegetation maintained at a low uniform height or where large areas of bare or frequently disturbed ground are present. (Tzilivakis, J., et al. 2015)

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