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Collective Implementation of Ecological Focus Areas

Evaluation of the effects on ecosystem services, agriculture and administration

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Foreword

Working with measures to improve green infrastructure for species, habitats and ecosystem services from the landscape perspective is part of Sweden's and the EU's public policy. There are opportunities within the EU's agricultural policy to promote collaboration (collective implementation) so that farmers would collectively implement ecological focus areas (EFAs) as part of the single payment scheme. Supporting collaboration is part of the EU's investment in green infrastructure. Sweden does not currently allow for any collaboration among farmers.

This study assesses the effects on the ecosystem services pollination and biological pest control if Sweden were to introduce collective implementation of EFAs as part of the single payment scheme, including quality improvement measures such as undersowing flowering plants. The potential environmental effects are seen in relation to the impacts on the economies of farmers and their acceptance of collective implementation, as well as the administrative costs for government agencies. The study is a step towards integrating the value of ecosystem services in important decisions in society – something that is to be implemented by 2018 at the latest according to a milestone target within Sweden's national environmental objectives system. Despite the fact that ecosystem services are fundamental to our prosperity and quality of life, all too often they remain invisible when decisions are made.

This study has been carried out as part of the overarching government commission Environmental effects of the CAP (the EU's Common Agriculture Policy) to monitor the environmental effects of EU agricultural policy, given by the Swedish government to the Swedish Board of Agriculture, the Swedish National Heritage Board, the Swedish Agency for Marine and Water Management, and the Swedish Environmental Protection Agency. Sweden's county administrative boards are also participating in this task.

The Swedish Environmental Protection Agency has the primary responsibility for this report, and the contact person for the report is Karin Skantze.
The study on which this report is based was carried out by the Centre for Environmental and Climate Research at Lund University. The authors are Juliana Dänhardt, Yann Clough, Lovisa Nilsson, Jordan Hristov, Johanna Alkan Olsson, Mark Brady, Peter Olsson and Henrik G. Smith. A reference group comprised of David Ståhlberg and Emma Rybeck (Swedish Board of Agriculture), Michael Frisk (Swedish National Heritage Board) and Åsa Thorsell (Jönköping County Administrative Board) have participated in the study.

The Swedish Environmental Protection Agency would like to thank all those who participated, in particular the farmers who have contributed with their time and their experience.

Stockholm, June 2017

Björn Risinger, Director General

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1 Summary

In this study we evaluate the consequences of regional and collective implementation of ecological focus areas according to Articles 46:5 and 46:6 of the EU Direct Payments regulation. Through broader analyses, we also consider other forms of collaboration and additional management requirements. Promoting networks of areas with an ecological focus is part of the EU's investment in green infrastructure. Sweden does not currently allow for any collaboration among farmers. The study results are based on ecological-economic modelling, a workshop with farmers and interviews with administrators. Our analyses focus on the effects on pollination and biological pest control, both of which are ecosystem services benefiting agriculture, and on transaction costs for farmers and administrators.

Farmers are positive about collaboration, officials fear higher costs

Generally, the participating farmers are positive about collaboration. However, clearer and more concrete links between approved focus areas, management requirements and environmental benefits are needed to create acceptance among farmers. Administrators with experience of collaborative systems are generally positive to collective implementation, while those without experience are hesitant. There is a fear of increased transaction costs among Swedish administrators, despite the fact that well-functioning examples of collaboration in Europe exist. We recommend seeking inspiration and knowledge from these successful examples.

Small environmental effects from current focus areas

The introduction of collective implementation of ecological focus areas with the current Swedish regulations would provide small environmental effects. The environmental effects remain weak because of the possibility of still being able to choose focus areas with weak environmental effects, and because generous weighting factors reduce the actual surface allocated to focus areas providing higher environmental benefits. In addition, there are incentives to place focus areas on low productive land, where the need for focus areas supporting ecosystem services is least. Further, focus areas that are part of normal cultivation are also approved today, creating deadweight. Our models show that the possibility of collaboration does not solve these problems.

Better environmental effects with the right focus areas and quality requirements

In order to achieve substantial environmental effects, it is necessary to design rules that favour the most environmentally effective focus areas. First and foremost, the focus area menu should contain environmentally effective measures. In addition, the weighting system should be re-evaluated so that the most effective focus area is used as a benchmark. Finally, the allocation of ecological focus areas should be done from a landscape perspective to ensure their contribution to green infrastructure. At the farm level, the choice and allocation of focus areas should be guided by information and advice about where the potential for environmental benefits is the greatest, for example

near crops favoured by pollination and biological pest control. When aiming at benefiting these ecosystem services, an effective way would be to limit the menu of selectable focus areas to fallows and uncultivated field edges with a requirement to sow these with flowering plants.

2 Introduction

The EU's Common Agricultural Policy (CAP) has undergone a long process of reform, in part to bring production surpluses under control, and in part to reduce the negative environmental impacts of agriculture (Brady et al. 2009). In connection with the 2013 reform, mandatory environmental requirements were introduced for parts of the direct payments scheme. This 'greening payment' now constitutes 30% of Member States' direct payments budgets. An important part of the greening payment is the ecological focus area (EFA) requirement, whose main purpose is to promote biodiversity, and thus potentially also ecosystem services such as pollination and natural biological pest control (Hauck et al. 2014, Angileri et al. 2017). As a result of substantial derogations, for Sweden this reform is limited to farmers with more than 15 hectares of arable land, and less than 75 per cent grasslands (primarily in Sweden's southern plains and the lower parts of northern Sweden) being required to allocate five per cent of their arable land as ecological focus areas.

Article 46(2) of the Direct Payments Regulation (Regulation (EU) No 1307/2013 of the European Parliament and of the Council) regulates which types of land use Member States can choose from as ecological focus areas (EU 2013). In addition to the suggestions listed in Article 46(2), it has been up to each Member State to formulate their own rules and regional priorities. In Sweden, five land uses are approved as ecological focus areas: land lying fallow, uncultivated buffer strips, undersown green cover, short rotation coppice (willow), and nitrogen-fixing crops. However, the implementation of ecological focus areas has been subject to extensive criticism due to the lack of demonstrable environmental effects (see for example Pe'er et al. 2014). A fundamental criticism is that the EFA requirement is applied at farm level while biodiversity is dependent on much larger scale processes, that is, it is affected by how the entire landscape is laid out (McKenzie et al. 2013, Leventon et al. 2017).

Within the EU's regulatory framework, there is the option for Member States to allow groups of farmers to collectively implement ecological focus areas (collective implementation under Article 46(5) or 46(6) of the Direct Payments Regulation; EU 2013). In Sweden, this option is not currently applied. The purpose of collective implementation is in part to make it more likely that ecological focus areas will be allocated where they can be of the greatest benefit to the environment; and in part to build up adjacent ecological focus areas to guarantee added value for the environment and contribute to the enhancement of green infrastructure. Both large contiguous areas and networks of EFAs linked with more or less natural habitats can benefit biodiversity. Which of these is the most environmentally effective way depends on the type of biodiversity you intend to benefit (cf. Smith 2014).

2.1 Task and Purpose

The primary purpose of this study was to evaluate the consequences of collective implementations of ecological focus areas within the CAP. Specifically, we examined what opportunities this kind of collaboration between farmers could mean for the ecosystem services pollination and natural biological pest control, and what transaction costs farmers and government agencies could expect. We have also analysed how the rules governing ecological focus areas could be designed to increase the quality of EFAs as habitats, and thus also to increase their environmental benefits. This might include amendments to the conditions for or forms of collaboration that lie outside of the options currently on the table under the rules governing collective implementation.

The evaluation was done by the Centre for Environmental and Climate Research (CEC) on behalf of the Swedish Environmental Protection Agency within the Agency's overarching government commission *Environmental effects of the CAP*. The task description given to the CEC and our interpretation of it can be found in full in Annex 1 (available in Swedish only in Report 6773. Swedish Environmental Protection Agency 2017).

2.2 Conditions and implementation

The first step in the study was to evaluate how the current regime for ecological focus areas relates to the environment, the agricultural economy, and the transaction costs of government agencies. The next step was to assess a number of alternative regimes for ecological focus areas. These alternative regimes, or scenarios, are based on the option of collective implementation (which we term in this report 'collaboration') and requires measures that are expected to have greater environmental benefits. Since pollination and biological pest control are carried out by species that can benefit from more flower resources in the landscape (Tschumi et al. 2015, Gill et al. 2016), in our scenarios we have used a requirement to undersow flowering plants in fallows and uncultivated buffer strips as a potential way to improve the quality of EFAs. Consequently, we begin by identifying weak-nesses in the current regulatory framework in order to then test the potential effects of our suggestions for improvement.

Since ecological focus areas do not have any defined objectives nor any quantified budget, it is difficult to assess the cost-effectiveness of these payments. To get an idea of the environmental effects of different scenarios in relation to their social cost, the aim in this report was to identify the option that generates the greatest possible environmental effect with a 'budget' corresponding to the 5 per cent of arable land allocated as ecological focus area. Each scenario is evaluated in relation to a number of criteria, which are then related to each other in order to be able to draw conclusions about which scenario can be deemed the most effective and feasible. These evaluation criteria are environmental benefits, the agricultural economy, transaction costs, and perceived opportunities and constraints.

Environmental benefit in this report is defined as the potential for promoting the ecosystem services pollination and natural biological pest control. To evaluate the effects on *agricultural economy and structural change*, we have used a number of indicators including income per hectare and proportion of surviving farms. The change in the average income per hectare is not a perfect measure of the cost for the agricultural sector, but does constitute a good indicator of changes in the financial incentives. If more farms close down because of increased environmental requirements, this could counteract the political will to introduce more demanding requirements. *Transaction costs* refer to the additional costs that would arise for the authorities in the event of a change in the payments regime for ecological focus areas, for example, the costs of adapting the administrative system and of increased inspections and controls and follow-ups as a result of new rules. Assuming that political deci-sion-makers need to weigh up the potential costs against the potential bene-fits, in this report we use these transaction costs as an indicator of a potential social cost. Policy instruments not only have a purely monetary impact on the actors involved, but often also have other effects. These can be difficult to capture, but nonetheless play a significant role in decision-making processes (Fleury et al. 2015). Therefore, we have used perceived *opportunities and constraints* as one of the criteria for assessing the different scenarios. The most important Swedish stakeholders in this study were identified as farmers and the various authorities (primarily the Swedish Board of Agriculture and the county administrative boards).

2.3 Methodological approach

The alternative regimes (scenarios) for the establishment of ecological focus areas that we developed in this project are primarily intended to reflect the two aspects highlighted in our task. These are the possibility of collaboration, and the promotion of the ecosystem services pollination and biological pest control. In our scenarios, we have combined these aspects in a number of different ways and formulated a number of conditions to enable an evaluation of the methods available to us. Consequently, the scenarios should be seen primarily as a way of clarifying the aspects investigated and as something on which to base debate. Conversely, they are not necessarily intended to reflect realistic situations or actual regulatory frameworks.

To evaluate all these aspects of the various alternative regimes, we use a combination of ecological and economic modelling (ecological-economic modelling) and social science methods. Economic modelling was done with the aid of the agent-based model AgriPoliS.

The results from this modelling provide answers to how the agricultural economy and structural change is likely to be affected under each scenario. This model also calculated how land use and the distribution of crops would change under different scenarios. These results were then used in spatially explicit ecological models to evaluate the consequences for the ecosystem services pollination and biological pest control.

Interviews were conducted with a number of Swedish and foreign government agencies to investigate how farmers and officials view the different scenarios and their attitudes to them, and a workshop was conducted with farmers. This was how we identified relevant factors that we then took into account in our recommendations for how to design regulatory regime for ecological focus areas in the future. The interviews with officials were also intended to provide a more quantitative estimate of the changes in transaction costs for different authorities if the processing of these payments were to be adapted to the new regimes proposed in our scenarios (Chapter 4). Information about farmers' choices of crops and EFAs from a landscape perspective was gathered at the workshop, along with why they made these choices, and the farmers' scenario preferences (Chapter 5.3). The latter were gathered via a short questionnaire and used as a semi-quantitative dimension in the overall comparison of the alternative regimes.

There are comprehensive derogations from the requirement for ecological focus areas (cf. Chapter 3). The consequence of these derogations in Sweden is that primarily larger farms operating conventional cultivation in Sweden's southern plains and the lower parts of northern Sweden are affected by the requirement to allocate five per cent of their arable land as ecological focus areas. But it is also in these regions that crops which could benefit greatly from the ecosystem services pollination and natural biological pest control are cultivated. Therefore, we have chosen to use Götaland's southern plains (Gss) as the study area, but in our view our results would also be relevant for other plains regions in Sweden.

2.4 Disposition of the report

This report contains a main part that briefly describes the background, analyses, discussions and conclusions, and an Annexes part with more detailed information. This disposition and how it relates to the questions and evaluation criteria is shown in Figure 1.

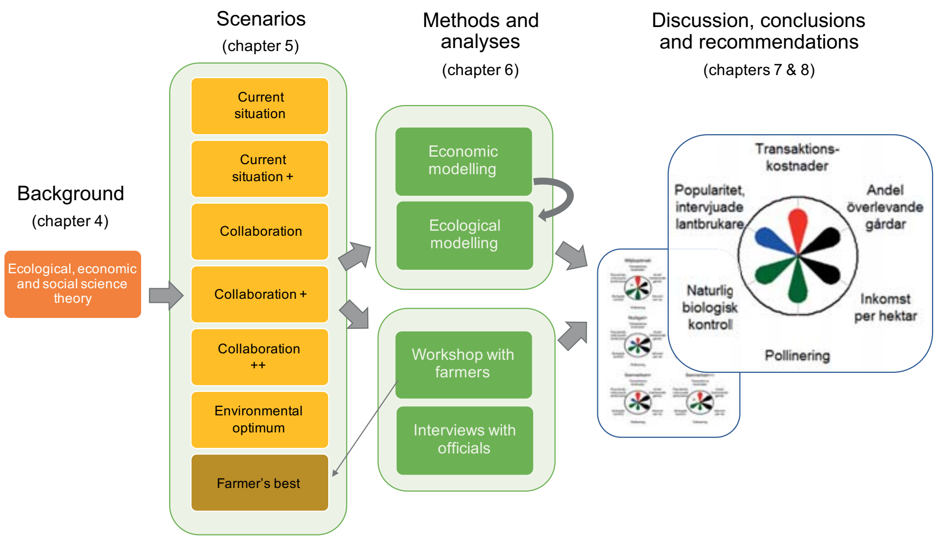


Figure 1. Schematic of the disposition of the report. Chapter 3 contains background information about ecological focus areas and about ecological, economic, and social science theories relevant to the study. The next chapter 4 describes the scenarios we designed. Chapter 5 describes the evaluation methods used and reports the results. Finally, we summarise and discuss the results and set out our conclusions and recommendations in Chapters 6 and 7.

Chapter 3 contains background information on the regulatory framework for ecological focus areas and describes the ecological, economic, and social science theories on which the study is based.

Chapter 4 provides an overall description of our support scenarios and why we have chosen them. For each evaluation method, we had to set up specific rules and conditions to which the models, interview subjects, and workshop participants related. These conditions are described instead in the Methods section for each of the methods used.

Chapter 5 describes separately for each method how we analysed our scenarios and reports the results for the evaluation criteria that we used. The chapter is divided into two parts, where Chapter 6.1 deals with ecological-economic modelling, and Chapter 6.2 sets out the results from the social science methods used (interviews and workshop).

Chapter 6 reports and discusses the combined results for all methods, including the common semi-quantitative comparison of the evaluation criteria for each scenario.

Chapter 7 sets out our conclusions and recommendations. In this chapter, we take up the factors that we were able to show with this study to be of great importance for the development of effective policy instruments that provide incentives for farmers as well as greater environmental benefit.

3 Ecological focus areas – background from different perspectives

Below, we set out the fundamentals of ecological focus areas and collaboration from different perspectives: legal, ecological, and economic. The economic perspective includes both the strictly business economics perspective (individual level), and the decision theory and collaboration (individual and group levels) perspectives.

3.1 Regulatory framework and purpose

One of the biggest changes to come out of the EU's Common Agricultural Policy (CAP) reform in 2013 was what is termed 'greening'. It meant that mandatory environmental conditions were introduced for parts of the direct payments scheme with the aim of generating positive impacts on the climate, the environment, and biodiversity. The greening part of direct payments now represents 30 per cent of each Member State's direct payments budgets, and is a mandatory part of the single payment scheme. The greening payment has three components: crop diversification (at least two or three crops must be grown on the farm), conservation of permanent grasslands (regulated in Sweden at the national level), and ecological focus areas. The ecological focus areas component applies to farmers with more than 15 hectares of arable land and means that five per cent of their arable land must be allocated as ecological focus areas. Because of comprehensive derogations[1] the requirement to allocate land as ecological focus areas applies mainly to regions in southern Sweden dominated by agriculture.

The purpose of ecological focus areas is to directly or indirectly conserve and improve biodiversity in agricultural holdings. Article 46(2) of the Direct Payments Regulation (EU 2013) regulates the types of areas that Member States may choose to count as ecological focus areas. These comprise ten different types of areas including land lying fallow, buffer strips, landscape features such as hedges and forests, protection zones, short rotation coppice (willow), catch crops, and nitrogen-fixing crops. Based on this list, it has then been up to each Member State to draw up rules and regional priorities for their own countries (see Chapter 3.1.2 below).

1. Derogations from the greening payment requirements apply for areas dominated by forest and areas with natural limitations (termed ecological compensation areas). Even farms operating certified organic farming are exempt from these requirements. Farmers with less than 15 hectares of arable land (excluding natural grazing areas) are also exempt. The rules also vary slightly for different areas of production in Sweden.

3.1.1 Collective implementation of ecological focus areas

Under Article 46(5) and 46(6) of the Direct Payments Regulation (EU2013), Member States may choose to allow farmers to meet half of their obligations in respect of ecological focus areas collectively, provided that such collectively implemented ecological focus areas are adjacent to each other.

The purpose of collective implementation is to build up adjacent ecological focus areas to guarantee added value for the environment and contribute to the enhancement of green infrastructure. Article 46(5) gives Member States the option of allowing the authorities to designate specific areas where ecological focus areas can be implemented collectively. This creates better scope for regional adaptations to the rules and for influencing the location and types of ecological focus areas, and this is expected to lead to greater biodiversity in the agricultural landscape. Article 46(6) instead gives farmers whose holdings lie close to each other the option of taking the initiative themselves to collectively implement ecological focus areas.

Commission Delegated Regulation (EU) No 639/2014 contains more detailed rules governing collective implementation. It states for example that farmers participating in a collective implementation must conclude a written agreement that includes details on the internal arrangements of financial compensation and on the administrative penalties in case of non-compliance on their common ecological focus area. The number of farmers participating in a collective implementation must not exceed ten. So far, only two Member States have chosen to implement the option of collective implementation: the Netherlands and Poland, In the Netherlands, these collective implementations have been called “Ten-farmer collectives”. In this kind of collective, the farmers can choose to locate all collectively implemented ecological focus areas on a neighbour’s land. The total surface area of ecological focus areas is then the same as without collective implementation, but the farmers have greater freedom of choice regarding the location of EFAs.

3.1.2 Ecological focus areas in Sweden

Currently in Sweden, five different types of ecological focus areas can be approved: fallows, short rotation coppice (willow), nitrogen-fixing crops, uncultivated buffer strips on arable land, and undersown green cover (Table 1). A weighting factor has been determined for each type of ecological focus area. The weighting factor is determined at the EU level and is used to calculate the actual area that must be allocated in order to fulfil the five per cent ecological focus area requirement. Measures deemed to have relatively little environmental benefit have been given a lower weighting while types that are assessed as being the most environmentally effective have been given a higher weighting (Table 1). This means in reality that you must allocate a larger land area as ecological focus area if you choose to implement measures deemed to generate fewer environmental benefits.

Land lying fallow is used as the benchmark – one hectare of land lying fallow corresponds to one hectare of ecological focus area. The actual area of land allocated as ecological focus areas on a farm thus varies depending on the types of EFAs the farmer chooses.

Table 1. Approved ecological focus areas in Sweden and their weighting factors.

Ecological focus area	Weighting factor
Land lying fallow	1.0
Short rotation coppice (willow)	0.3
Undersown green cover (catch crop)	0.3
Nitrogen-fixing crops	0.7
Uncultivated buffer strips	9.0

Because of the many derogations in force, these payments in Sweden apply mainly to the southern plains. Figure 2 shows the distribution of the different types of ecological focus areas in Sweden's three plains regions: The Svealand plains, and Götaland's northern and southern plains. The relative distribution of different types of ecological focal areas is slightly different in each of these regions. Land lying fallow, undersown green cover, and nitrogen-fixing crops account for the largest area, while short rotation coppice (willow) is less important, regardless of the region (Figure 2). The relative importance of fallows as ecological focus areas increases as you move from the south to the north, while the relative importance of nitrogen-fixing crops and undersown green cover decreases. The figures make clear that farmers choose primarily existing crops as ecological focus areas (Swedish Board of Agriculture 2016).

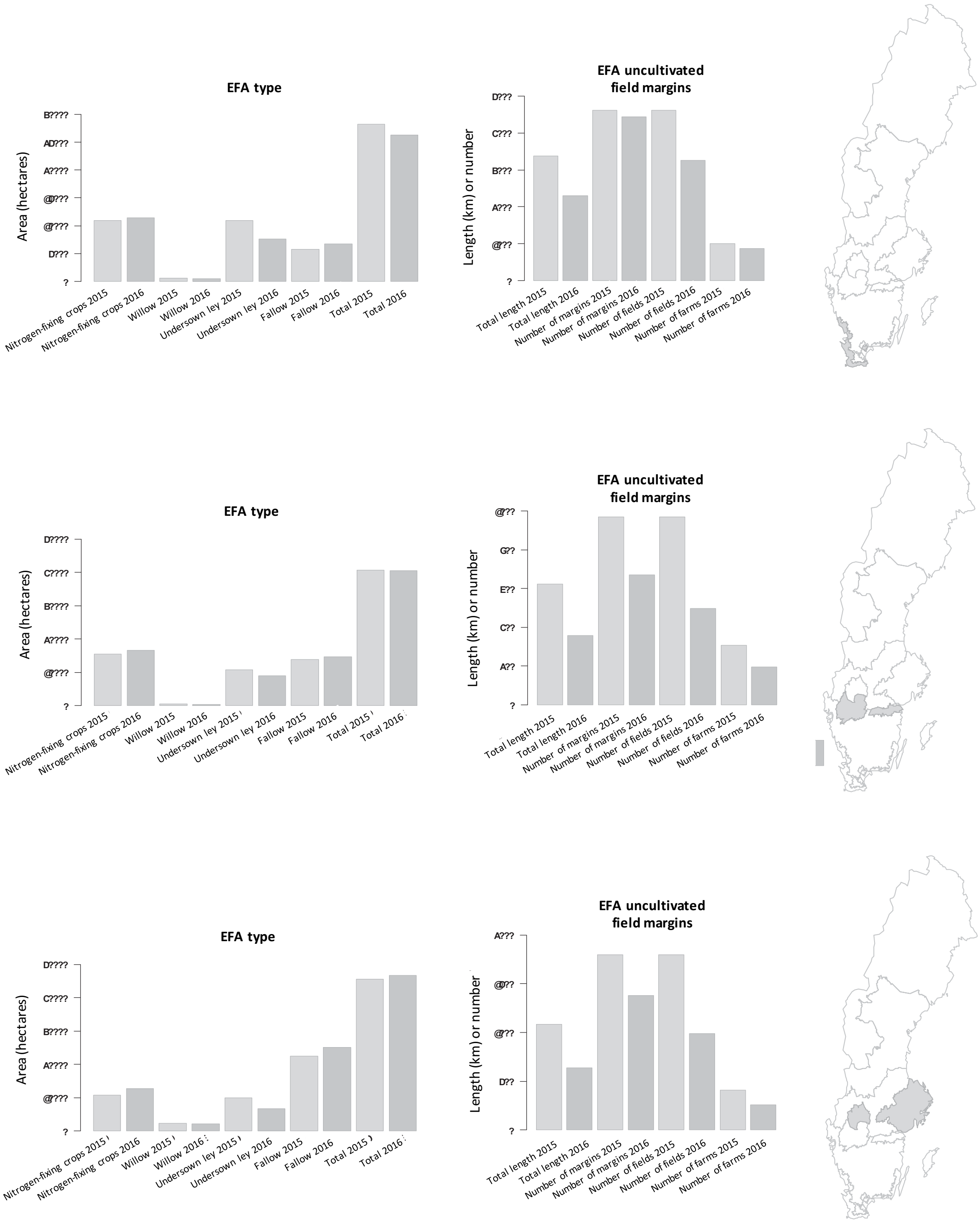


Figure 2. The distribution of different types of ecological focus areas (EFA) in (A) Svealand's plains, (B) Götaland's northern plains and (C) Götaland's southern plains in 2015 and 2016 based on information in the Swedish Board of Agriculture's SAM Internet applications. The left side lists areas of fallows, short rotation coppice (willow), undersown green cover, and nitrogen-fixing crops, in hectares. The right side shows the total length of uncultivated buffer strips as well as the number of buffer strips and the number of parcels of land with buffer strips. There is no information about the width and management of uncultivated buffer strips. Data from 2016 is burdened by greater uncertainty than the data for 2015 because the 2016 data has not yet been verified by field inspections. Source: Swedish Board of Agriculture.

3.2 Factors influencing the effect of ecological focus areas and collaboration on the ecosystem services

The intensification of agriculture is considered to be the main cause of the loss of biodiversity in agricultural landscapes in Europe (Krebs et al. 1999, Donald et al. 2001, Robinson and Sutherland 2002). Although there are signs that the loss of biodiversity among certain species groups has slowed down (Carvalheiro et al. 2013), this does not mean that biodiversity in agricultural landscapes has recovered, and for other taxonomies, the losses continue (Inger et al. 2015). This means that ecosystem services that are important for agriculture, such as pollination and natural biological pest control, are under threat (Matson et al. 1997, Tscharntke et al. 2005, Potts et al. 2016). The purpose of ecological focus areas is to conserve and enhance biodiversity in the agricultural landscape. Below we go into more detail about the ecosystem services pollination and natural biological pest control and how they can benefit from ecological focus areas.

3.2.1 The impact of ecological focus areas on pollination

Globally, crops that are wholly or partially pollinated by insects constitute a large proportion of agricultural production (Klein et al. 2007). In Sweden, important insect-pollinated crops include oilseed rape, fruit and berries, broad and field beans, and clover seed (Rahbek-Pedersen 2012). The honey bee is an important pollinator for several of these crops, but wild pollinators, in particular wild bees, can be the dominant pollinators of certain crops (Garratt et al. 2014). Wild pollinators often supplement pollination by the honey bee (Garibaldi et al. 2013) and constitute an important backup if numbers of honey bees were to fall (Potts et al. 2016). Historical data shows that wild bees have reduced in number (Dupont et al. 2011) and diversity (Bommarco et al. 2012), while comparative data shows that this has mainly affected the plains, which have also undergone the greatest intensification of agriculture (Rundlöf et al. 2008). The main reason for this is that the intensification of agriculture has resulted in fewer nesting sites, and a lack of food resources in particular (Goulson et al. 2008). Although periodically there may be high availability of resources in the form of mass-flowering crops, the lack of continuity of food resources has led to wild bees such as bumble bees not being able to take advantage of this (Westphal et al. 2009). Various measures contributing nesting sites and food resources can prevent the loss of wild bees, in particular in the plains. Natural grasslands, small biotopes such as uncultivated buffer strips and flowering waysides, organic farming and flowering buffer strips are the kinds of measures that could benefit wild pollinators and contribute nesting sites and food resources (Holzschuh et al. 2008, Pywell et al. 2011, Kennedy et al. 2013, Scheper et al. 2013).

With the right design and management, ecological focus areas can provide yet another opportunity to encourage wild pollinators by giving them greater access to food resources. The types of ecological focus areas permitted in Sweden today include fallows (Kuussaari et al. 2011) and uncultivated buffer strips (Kells et al. 2001), both of which have great potential to benefit wild bees. Sowing fallows or buffer strips with flowering plants, as an ecological focus area for example, aids continuity in the availability of nectar and pollen in the landscape (Haaland and Gyllin 2010). Buffer strips of flowering annuals such as *Phacelia tanacetifolia* (purple tansy) and *Trifolium resupinatum* (Persian clover) are visited frequently by wild bumble bees and domesticated honey bees, but with good management, even perennial buffer strips can offer an abundance of flowering plants (Wood et al. 2015).

3.2.2 Impact of ecological focus areas on natural biological pest control

Natural biological pest control is an ecosystem service based on the interplay between pests in crops (e.g. aphids and pollen beetles) and their natural enemies (such as spiders, ground beetles and parasitoid wasps). In conventional agriculture today, this natural interplay is often replaced by synthetic plant protection products; however, these can have a number of negative consequences (Ekbom 2002, Rundlöf et al. 2012, Bourguet and Guillemaud 2016). It has been proposed instead that, to reduce the use of plant protection products, you can encourage the natural enemies of pests by providing more undisturbed habitats in the cultivated landscape (Bianchi et al. 2006, Rusch et al. 2010, Veres et al. 2013). This can be done by choosing a higher proportion of perennial crops and by conserving or creating other permanent habitats.

Several of the types of ecological focus areas permitted in Sweden can benefit the natural enemies of pests. A greater variety in crops at the farm level, more permanent crops such as grasslands, or the use of catch crops can benefit the natural enemies of pests (Östman et al. 2001), and so too can greater access to natural grasslands (Rusch et al. 2013). There is strong empirical evidence for the effect of flowering buffer strips (Scheid 2010, Pywell et al. 2015, Tschumi.et al. 2015, Tschumi et al. 2016), which serve as alternative food sources for flying predators such as ladybirds and also for parasitoid wasps and hoverflies (Jönsson et al. 2015); and for buffer strips with grass (Griffiths et al. 2008, Holland et al. 2008, Holland et al. 2012), which act as overwintering sites and recolonization sources for generalist predators. Both of these measures have been shown to reduce the number of pests and in some cases, a positive effect on the harvest has also been found (Tschumi et al. 2016).

3.2.3 Management requirements for ecological focus areas influence their environmental benefits

How effectively ecological focus areas can promote biodiversity in general, or the ecosystem services pollination and biological pest control in particular, depends to a large extent on their design and management. In Sweden, the management requirements for ecological focus areas are slight. For example, fallows and uncultivated buffer strips may be left bare and may be treated with pesticides. Consequently, in practice it is common to see buffer strips and fallows with bare soil and without any vegetation, (Figure 3A and C), but there can be great variation in ways to manage these EFAs (Figure 3). This applies in particular to uncultivated buffer strips, which some farmers sow in with flowering plants even though there is no requirement for them to do this. As a result of these low demands on management, the anticipated effects of ecological focus areas for insects that contribute to the ecosystem services pollination and biological pest control may be assumed to vary between non-existent or negative (Figure 3A and C) to positive (Figure 3B, E and D).

Uncultivated buffer strips may be between 1 and 20 metres wide. In practice, however, the majority of uncultivated buffer strips are not much wider than 1 metre. This is because only the length of the buffer strip counts, while the width plays no role at all in the weighting. If you calculate the area of uncultivated buffer strips on the basis of 1 metre wide strips without taking into account the generous weighting factor for these, the area that is *de facto* allocated corresponds to only 1.2 per cent of the ecological focus area in Götaland’s southern plains, and 0.1-0.2 per cent in the other two plains regions (Figure 2). Consequently, the area actually covered by uncultivated buffer strips is relatively small.

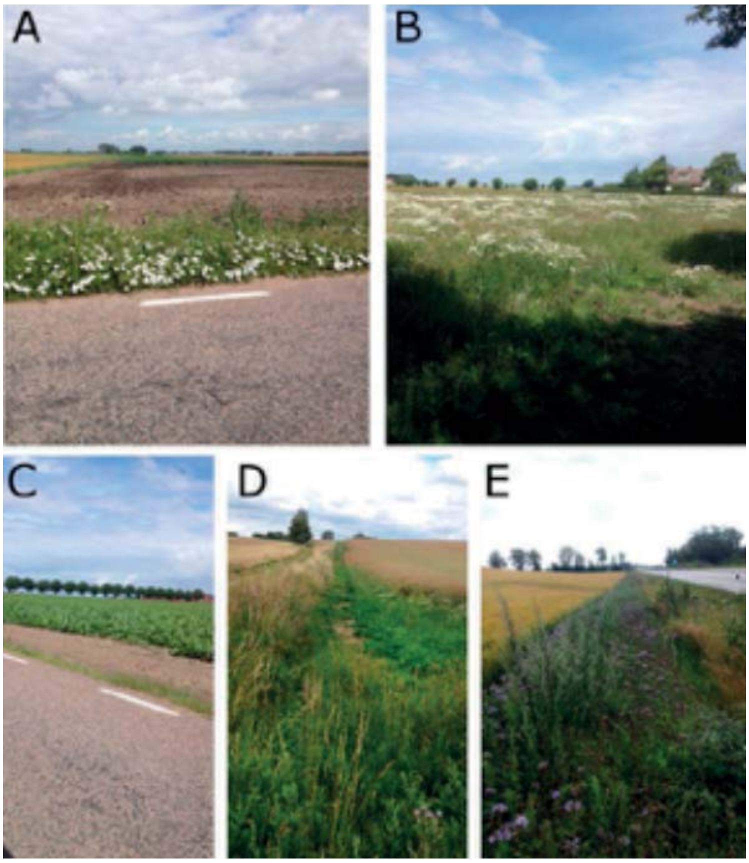


Figure 3. Different forms of fallows and uncultivated buffer strips in Scania, summer 2016: (A) bare fallow, (B) fallow with spontaneous natural vegetation, (C) bare uncultivated buffer strip, (D) uncultivated buffer strip with spontaneous natural vegetation and (E) uncultivated buffer strip sown in with purple tansy and other plants. Low demands on management for ecological focus areas mean that the effects on insects can be assumed to be either negative (A, C) or positive (B, E, D) in comparison with crops on fields. Photo: Peter Olsson)

3.2.4 How can collective implementation of ecological focus areas benefit ecosystem services?

The effectiveness of measures intended to promote biodiversity and ecosystem services linked to ecological focus areas can be strongly impacted by the way in which the EFAs are located in relation to each other, that is, if they are concentrated or spread out in the landscape. The loss of biodiversity is largely due to valuable habitats having been reduced in size or quality. The effect of the fragmentation of habitats has been investigated in the field of conservation biology (Andrén 1994, Hanski 1999). For a number of reasons, fragmentation of the landscape leads to the loss of species that are strongly linked to specific habitats. For example, in modern agricultural landscapes, this can affect the chances of survival of populations linked to natural grasslands (Öckinger and Smith 2006, Cousins et al. 2007). This means that the value of measures aimed at the conservation of species with restricted habitat requirements may be greater if such measures are concentrated spatially (Smith et al. 2014). However, the effect of measures being concentrated spatially can vary greatly for organisms that utilise both the habitats and resources arising as a result of the measures, and the surrounding landscape (Smith et al. 2014). Some organisms utilise several different habitats, such as utilising some habitats as nesting sites and other habitats for foraging; or by utilising different habitats for reproduction and for overwintering. Examples are wild bees that, from a central nesting site in a suitable habitat, can utilise flower resources including flowering crops at various distances from the nest; or ground beetles that can overwinter in permanent grassland habitats but spread to newly sown fields and contribute to the natural biological control of aphids. If a measure (re)creates a habitat type which has suffered a reduction in the agricultural landscape, such as offering flowering plant resources late in the season or overwintering sites, it is important that these (re)created habitats lie close to other habitats that are utilised as nesting sites or for reproduction. By focusing on the needs of organisms from a landscape perspective, by utilising measures that increase the pluriformity of the landscape, one can offer resources for organisms throughout their life cycles (Schellhorn et al. 2015, Landis 2017).

Species that perform the majority of important ecosystem services such as pollination and biological pest control are often relatively common habitat generalists (Kleijn et al. 2015), although this does not mean that rare species are unimportant (Lyons et al. 2005). Populations of common species have also decreased in the agricultural landscape as a result of increasingly intensive farming, such as the reduced availability of flowering plant resources for pollinators, and overwintering habitats for the natural enemies of pests. This means that they can benefit from measures that contribute supplementary resources such as buffer strips of flowering plants (Feltham et al. 2015, Jönsson et al. 2015, Tschumi et al. 2015) and beetle banks/buffer strips of grass (MacLeod et al. 2004, Rusch et al. 2010). It is assumed that the measures have a more positive impact on the organisms and the ecosystem services they perform if they are spread out in the landscape.

According to Commission Delegated Regulation (EU) No 639/2014 (60), the purpose of enabling collective implementation is to "*build up adjacent ecological focus areas to guarantee added value for the environment and contribute to the enhancement of green infrastructure*". Introducing mandatory environmental conditions into the direct payments scheme and additionally permitting collective implementation in order to further support adjacent ecological focus areas is part of the EU's investment in green infrastructure. Only the Netherlands and Poland have taken advantage of the possibilities of collective implementation. Currently, because of the ways in which the rules governing ecological focus areas have been implemented in Sweden and most of the other Member States, it is doubtful that EFAs contribute to achieving the biodiversity objectives that have been set. The main criticism of ecological focus areas is that the requirements on the ecological quality of EFAs have been set too low, and that the implementation of EFAs lacks the landscape perspective (see for example Pe'er et al. 2014, Pe'er et al. 2016).

3.3 Factors affecting farmers' decision-making

Farmers' decisions concerning collaboration and the implementation of environmental measures (such as ecological focus areas) are dependent on various factors: the holding's potentials, the farmer's knowledge and interests, and communications from the authorities, but in particular, financial aspects (Lastra-Bravo et al. 2015). Since business economics factors generally drive these decisions, and can go far in explaining changes in behaviour resulting from policy changes, we have chosen to begin this report by reviewing economic theory and how considerations of a strictly business economics nature could impact the effectiveness of any future regimes for ecological focus areas.

3.3.1 The farmer's economic situation

Agriculture is a complex production process because it usually produces a variety of different products and by-products as a result of many different actions. Productivity is largely driven by natural potentials (such as the quality of the soil and the spatial distribution of fields), but also by the farmer's skills. Because the effects of policy changes on income are important for the vast majority of farmers, it is also reasonable to assume that economic considerations play a major role in the decisions that farmers make in relation to ecological focus areas. According to a survey, the main reason why farmers choose a certain type of EFA is that it already exists or is being cultivated on the farm (Swedish Board of Agriculture 2016). Consequently, as long as profit maximisation is the primary factor for the farmer, the type, layout and location of EFAs would be selected based on which options are least costly for the farm (Solazzo and Pierangeli 2016). Farmers' choices are naturally also influenced by the specific terms and management requirements that apply to ecological focus areas. A significant factor is the weighting factor determined for each type of EFA (Table 1), which affects how much land must in fact be allocated. But management requirements are also expected to be significant. In practice, there are few management requirements beyond the actual definition of the land use. For example, there is no requirement regarding vegetation on uncultivated buffer strips. Furthermore, normal management of fallow land and nitrogen-fixing crops is permitted. This includes the use of plant protection products, which can have negative consequences for the environment.

The costs of different types of ecological focus areas and their location in the landscape are probably influenced to a large extent by spatial factors such as the productivity of the soil in a similar way as for other environmental measures (Drechsler and Wätzold 2001, Wätzold and Drechsler 2005). Land allocated as fallows or uncultivated buffer strips cannot be used for crops and thus entail an (opportunity) cost or loss of income for the farmer. This potential reduction in harvest is probably the single biggest cost of ecological focus areas for the farmer. In plains country, where the normal harvest for winter wheat is around 8 tonnes per hectare (Statistics Sweden 2016), the harvest foregone can be counted in the thousands of SEK per hectare, compared with the management cost of fallows for example, which runs to around SEK 650 per hectare (Hushållningssällskapet 2012). Consequently, low-productivity land, or land that is difficult to cultivate such as small fields located at a distance from the core of the holding, tend to be the most attractive for ecological focus areas since the loss of income from taking this land out of production is relatively low. This in turn can affect demand for low-productivity land, which can be anticipated to increase if the requirement to allocate ecological focus areas is set at the farm level. This kind of trend was observed in the 1990s, when the fallows requirement was introduced for what was then termed the area payment (Mahé 2012, Westhoek et al. 2012).

Management costs, such as the farmer's own labour, machinery, and seed for sowing must of course also be taken into account, but these costs probably mainly influence the type of EFA chosen. In addition, there are a number of costs that are difficult to measure such as the risk of increased weed pressure or the impact on the appearance of the farm (which can probably be seen as positive or negative).

3.3.2 Economic incentives for collaboration

From an economic perspective, collaboration provides a variety of ways in which farmers can reduce their (individual) costs, among other things because collaboration can increase flexibility (Emery and Franks 2012). Combining their ecological focus areas into larger adjacent areas provides some economies of scale; for example, larger machinery can used more efficiently. Joint purchasing of seed for undersowing of flowering plants in uncultivated buffer strips for example will generally be cheaper. One way of minimising the total cost for all of the collaborating farmers is to find the least productive land among the group's farms. This provides individual incentives if the profit from this kind of collective implementation is distributed among the farmers. However, the same effect can be achieved even without collaboration via the leasehold market.

3.3.3 Factors affecting opportunities for co-management of natural resources and ecosystem services

Co-management of natural resources is often seen as an important but not entirely unproblematic way of providing for more sustainable management of different types of natural resources, including ecosystem services (Pretty 1995, Grimble 1999). Co-management is promoted as a means of:

- establishing a common perspective and thus reducing conflicts between the parties involved;
- building social capital and enabling social learning;
- promoting the exchange of information and the dissemination of knowledge;

- facilitating sustainable management of the resource;
- generating synergies; and
- improving the legitimacy and quality, and extending the life, of administrative decisions.

(Weber 2000, Ljung 2001, Olsson et al. 2011, Prager et al. 2012, Prager 2015). Co-management is about using cooperation and communications to build trust and empowerment. In turn, this can foster collective learning, where new ideas and strategies and different options for achieving positive environmental effects while lowering individual costs are tested and implemented (Ljung 2001, Pahl-Wostl 2009). The more problematic side of cooperation principally has to do with how the process is organised, the stakeholders involved and their relationships, how to select the participants and what mandates they should have, and how conflicts are dealt with (Kenney 2000).

In order to identify the most appropriate way to encourage cooperation, one needs to understand the ecological, geographical, socio-economic, and cultural contexts within which administrative decisions are made (Austin et al. 2014). These contexts include both formal factors such as legislation, market prices, taxes, charges, and subsidies; and informal structures such as standards, formal and informal institutions, values, and knowledge. All these factors can influence how a collaboration functions and are defined as the decision-maker's external and internal contexts (Ostrom 1990, pp.192-206). It is customary to categorise factors influencing the ability to implement or comply with a policy as technical, economic, organisational, legal, knowledge, or social constraints (Rycroft-Malone and Bucknall 2010, Weible et al. 2010). The boundaries between these constraints are often not clear, and when studying decision chains in which different levels of government are involved, the situation rapidly grows complex. A constraint at one level can be seen as an opportunity at another level. This complexity is usually termed the web of constraints. In other words, the relationships between constraints are complex and ought to be seen as a *fabric* of constraints that can influence each other, rather than as individual constraints that can be dealt with separately. This complex web of constraints will affect farmers' decisions in relation to potential new support schemes for ecological focus areas in various ways. In the context of an evaluation of alternative regimes for these payments, it is therefore important to investigate and better understand these constraints as a complement to economic modelling, which for the most part focuses on the financial aspects.

4 Scenarios

In order to evaluate and compare the current regulatory framework for ecological focus areas with different alternative designs, we need to define specific rules and conditions that we can then assume and react to in both the ecological-economic modelling, and the social science methods. We have called these theoretical alternative regimes 'scenarios'. It is important to emphasise that these scenarios should not be seen as realistic proposals for the future design of the regulatory framework governing ecological focus areas, but as a way to enable the evaluation of the two main aspects included in the study: collective implementation (collaboration) and greater environmental benefit. For this reason, we based the scenarios on the option of collective implementation and a requirement for quality enhancing measures for EFAs (undersowing with flowering plants – see Chapter 4).

This chapter sets out the different scenarios at a general level. The rules outlined here apply to evaluation with all of our methods. On the other hand, for technical reasons we have needed to interpret these rules to be able to recreate or relate to the overarching rules in each of the individual methods. These interpretations are reported in the more detailed descriptions for each of the methods used.

4.1 Environmental optimum

To create a clear benchmark for our analysis, we have created an extreme scenario, *Environmental optimum*. This scenario corresponds to the best imaginable environmental situation, under the condition that five per cent of arable land is allocated as ecological focus areas. In this 'optimum' scenario, ten farmers collectively allocate five per cent of their land as flowering buffer strips. In addition, these flowering buffer strips have the optimum location to benefit pollination and natural biological pest control. The results of the evaluations of the scenarios are then used for an overall comparison of the economic, ecological, and social aspects in the study.

4.2 Current situation

The scenario *Current situation* is based on the current regime for ecological focus areas (Chapter 3). This means that agricultural holdings in the regions studied must allocate five per cent of their arable land as ecological focus areas. They may choose freely from among the five types of ecological focus areas approved in Sweden.

The current weighting factors are applied, and there is no possibility of collaboration nor a requirement to sow in flowering plants.

4.3 Current situation plus undersowing (Current situation+)

For the scenario *Current situation+*, the same basic rules apply regarding the area, type and weighting of EFAs as for the scenario *Current situation*. In addition to these rules, a requirement to sow in fallows and uncultivated buffer strips with flowering plants has been added to increase the ecological value of the EFAs. The weighting factor for these EFAs remains the same as without the requirement to sow in flowering plants, and there is no option to collaborate.

4.4 Collaboration

For the scenario *Collaboration* too, the same basic rules apply as for *Current situation*, but there is the option of collective implementation of ecological focus areas. As an added incentive, this scenario offers an EFA discount for farmers who choose to collaborate. The requirements are formulated in such a way that at least half (2.5 per cent) of each farmer's ecological focus area must be located on the farmer's own holding. The remainder may be allocated collectively by the group, provided that the allocated EFAs are contiguous. This means that all farmers in the collective may credit this collectively allocated area as ecological focus area, which leads to a reduction in the total area of land allocated to EFAs in the landscape. Under the EU rules, only fallows and uncultivated buffer strips are permitted as EFAs in collectively allocated areas of land. The scenario *Collaboration* most closely resembles the collective implementation option described in Article 46(6) in the Direct Payments Regulation (EU 2013), where the initiative for collective implementation of EFAs comes from the farmers themselves. On the other hand, the current EU rules do not permit the EFA discount that we have introduced here.

4.5 Collaboration plus flower sowing (Collaboration+)

Collaboration+ is a combination of the scenarios *Current situation+* and *Collaboration*. The basic rules are similar to those for *Current situation+*, but with the option of collective implementation. An EFA discount is given to collaborating farmers in the same manner as in the scenario *Collaboration*. In addition to these requirements, this scenario introduces the obligation that the collectively allocated area must consist of fallows or uncultivated buffer strips sown in with flowering plants, and that these must be located optimally from the environmental perspective. Since the environmental obligation requires coordination at a landscape scale, this scenario is seen as equivalent to Article 46(5) of the Direct Payments Regulation (EU 2013), according to which the authorities may designate suitable areas and set conditions for collective implementation. However, this Article does not permit an EFA discount.

4.6 Collaboration plus flower sowing without EFA discount (Collaboration++)

For *Collaboration++,* the same rules apply as for the previous scenario *Collaboration+*, with the exception that in this scenario no EFA discount is given for the participating farmers. However, this scenario also corresponds to a collective implementation like that suggested in Article 46(5). This scenario was only evaluated using the ecological-economic modelling.

5 Analysis

This chapter describes the ecological-economic modelling that was used to analyse the effects of the various scenarios (Chapter 4) on the farm's economy, structural change, land use, and environmental benefit. The economic model AgriPoliS was used to simulate optimum decisions on land use and choice of EFAs by the farmers under the different scenarios. The modelling results also show what impact optimum choices by the farmers have on the farms' income and survival rate, as well as structural changes. The ecological modelling then used the land use simulated in AgriPoliS for each scenario to calculate the resulting effects on pollination and natural biological pest control.

5.1 Economic modelling

One of the objectives of this study was to assess how farmers' land use and costs might be affected if the regulatory framework for ecological focus areas was amended in accordance with our scenarios. Since in fact only the *Current situation* scenario has been implemented in practice, there are no actual observations of how land use for example might change as an effect of alternative regimes. That is why economic modelling is needed to simulate the consequences of the decisions made by the farmers under different circumstances. In this case, economic modelling has primarily two purposes: (1) To simulate the most optimum production decision and choice of ecological focus area for farmers under the various scenarios (*Current situation+*, *Collaboration*, *Collaboration+* and *Collaboration++*). This information on the effects on land use in the landscape is then used in the ecological modelling to calculate the environmental benefit (see Chapter 6.2); (2) To calculate the effects on the structure and economy of the farm, which indicates the potential costs for both farmers and society under the different scenarios.

5.1.1 Brief introduction to AgriPoliS

Farmers' land use choices are influenced by many factors. One of these is changes in the regulatory framework for the implementation of ecological focus areas. The farms in a region are heterogeneous in terms of size, type of production, and the characteristics of the arable land such as productivity, field size, distance to the headquarters of the holding, etc. But the farmers themselves also differ in various ways such as age, skills, the family's capacity and willingness to contribute their labour, alternative employment opportunities, etc. A simulation model is needed to take into account the complexity of agriculture and the impact of all of these factors on land use.

Economic simulations of farmers' adaptations to new sets of conditions were done using the dynamic agent-based model AgriPoliS (Balmann 1997, Happe et al. 2006). The model is described in more detail in Annex 3, but fundamentally, it describes the heterogeneity among agricultural holdings, the geographical distribution of agriculture, and competition for agricultural land in the leasehold market. In AgriPoliS, the region studied (Götaland's southern plains) is based on regional statistics and data from actual farms so that the model imitates the structure of agriculture in the region, conditions of production, and the structure of the landscape (Hristov et al. 2016). To represent the structure of agriculture, 27 typical farms were identified. The typical farms are farms with a specific production focus and size that are typical of the region. The percentages of the different typical farms used in the model are based on actual distributions in the region.

A virtual landscape is used to capture the variation in the quality of the agricultural land (productivity) and field characteristics, primarily the range in size of the fields and their distance from the headquarters of the holding (Brady et al. 2012). The simulation agents in AgriPoliS – the model farmers – seek to maximise their income. They do so by altering the composition of their production (area covered by crops, and livestock numbers), investing in machinery and farm buildings, borrowing money, making changes in their labour force, leasing more or less land, or closing down the farm if the operation is not sufficiently profitable. Family members may also work full-time or part-time and invest outside the farm, if pay on the labour market or interest on savings outside the farm exceeds returns from the farm.

AgriPoliS works well to simulate farmers' choices of ecological focus areas and the costs that can arise due to the requirement to allocate land as EFAs. Decisions are modelled at the farm level and take into account spatial factors that can impact the profitability of growing different crops and choosing different types of EFAs. Using the different scenarios, the model can optimise the farmers' choices and the location of ecological focus areas in the landscape. Farmers react to the different scenarios and their decisions have impacts on the structure of agriculture in the region, such as the number of farms, their size, and land use. By comparing the outcomes of different scenarios with an environmental optimum benchmark scenario, we gain a picture of how effective a specific regime for EFAs is, based on the selected evaluation criteria.

5.1.2 What we can expect from the economic model

The model farmers are assumed to be profit-maximising, that is their choices strive to minimise the costs incurred by the holding as a result of EFAs. Under these circumstances, the expected outcome in AgriPoliS is that the farmers choose EFAs in the following ways in the different scenarios:

1. In the first instance, the farmers choose to utilise the crops already being grown on the farm which can be counted as ecological focus areas, because these do not entail any additional expenses. According to agricultural statistics for 2014, this means fallows, short rotation coppice (willow), nitrogen fixing crops, and undersown green cover (Statistics Sweden 2015).

2. If these existing crops do not add up to the requirement of five per cent EFAs, they need to allocate additional land. Since uncultivated buffer strips attract a generous conversion factor (9 times the actual area), at least in the short term, the farmers in the model will probably choose primarily uncultivated buffer strips for the remainder of their EFAs.
3. However, the model farmers will also adapt their choices of EFA to any changes at the holding level in the longer term. For example, it may be unprofitable to invest in new machinery when it is time to replace old machinery. In practice, there is also the option to lease land in order to locate EFAs in low-productivity areas. This raises the expectation that the extent of fallows as ecological focus areas could rise over time.

The purpose of the AgriPoliS simulations is to quantify these potential effects for our various scenarios with the aim of being able to compare changes relative to the benchmark scenario *Environmental optimum*.

5.1.3 Simulation of scenarios in AgriPoliS

The assumptions made for simulating the different scenarios in AgriPoliS are summarised in Table 2. In the benchmark scenario *Environmental optimum,* only uncultivated buffer strips sown in with flowering plants are permitted as ecological focus areas. Since no conversion factors are used, the actual area of uncultivated buffer strips is five per cent of the arable land. In this scenario, AgriPoliS is used to calculate the costs incurred by the farmers and the effects on structural change if they are forced to allocate ecological focus areas in ways that maximise the environmental benefit.

In the scenario *Current situation,* AgriPoliS was calibrated to match the farmers' choices of types and areas for ecological focus areas with statistics from the Swedish Board of Agriculture. The model agents' optimum choices of ecological focus areas in the scenario *Current situation* thus reflect the farmers' actual choices in Götaland's southern plains in 2015 and 2016.

The other scenarios were simulated as described in Chapter 4. For the scenar-ios *Collaboration+* and *Collaboration++,* we introduced an additional factor that forced the model agents to implement EFAs separately on both high- productivity and low-productivity land, to mimic a requirement to locate EFAs in a more optimum way. This means that the model farmers must allocate five per cent of their highly productive land and five percent of their low productivity land as EFAs.

The model farmers' optimum EFA choices and the resulting land use is then used in the ecological model to model the environmental effects (see Chapter 6.2).

Table 2. Schematic overview of how the rules in the different scenarios are implemented in AgriPoliS. The symbol 🌻 means that fallows and uncultivated buffer strips (UBS) must be sown with flowering plants at a cost of SEK 760 per hectare (source: www.skanefro.se). It is anticipated that this cost would be reduced by 30 per cent to SEK 530 per hectare if farmers collaborate.

	Approved ecological focus areas						Collaboration		Spatial distribution	
	Fallow	UBS	Short rotation coppice (willow)	Nitrogen-fixing crops	Undersown green cover	Weighting	With discount	Without discount	High/low productivity land*	Environmental optimum location
Environmental optimum		✔🌻								✔
Current situation	✔	✔	✔	✔	✔	✔				
Current situation+	✔🌻	✔🌻	✔	✔	✔	✔				
Collaboration	✔	✔	✔	✔	✔	✔	✔			
Collaboration+	✔🌻	✔🌻	✔	✔	✔	✔	✔		✔	
Collabora-tion++	✔🌻	✔🌻	✔	✔	✔	✔		✔	✔	

* The EFA requirement applies separately to high-productivity and low-productivity land, respectively.

5.1.4 AgriPoliS – Results

This section describes how the choices made by the model farmers under the different scenarios impacted land use and a number of economic and structural factors in the fictional landscape in AgriPoliS. These choices were made in relation to the benchmark scenario *Environmental optimum*, which is deemed here to be the most environmentally effective situation. *Environmental optimum* entails more stringent requirements on ecological focus areas and higher costs for the model farmers (profit per hectare decreases). This leads to a lot more agricultural holdings being closed down by 2020 compared to scenarios that do not have these tough requirements on EFAs. As a consequence of this, the average holding size increases. But larger farms can compensate for the higher cost, which leads to an increase in the average profit per farm. This also explains why the average profit per farm is lower in the other four scenarios (Table 3).

EFFECTS ON THE FARM'S ECONOMY

In the model, the other five scenarios offer farmers more flexibility than the *Environmental optimum* scenario. This because the farmers in these scenarios can choose from among several different types of ecological focus areas. In addition, the generous conversion factor for uncultivated buffer strips means that the actual area coved by EFAs is less than five per cent. In the scenarios *Current situation* and *Collaboration,* these uncultivated buffer strips do not either need to be sown with flowering plants, which gives even greater freedom of choice. The greater flexibility the farmer has, the better his/her chances are of reducing the costs of implementing ecological focus areas. This is evident when comparing the change in "Profit per ha" (Table 3) for the least demanding scenario, *Current situation* with the (second) most demanding scenario *Collaboration++*. It follows that all scenarios entail significantly lower costs per hectare than *Environmental optimum*. Another interesting observation is that the profits per hectare observed for the scenarios *Collaboration+* and *Collaboration++* are equivalent, despite the EFA discount that collaboration provides in the scenario *Collaboration+*. This is because the model farms in the scenario *Collaboration++* changed their EFA choices and used the weighting factor for uncultivated buffer strips, so that in practice they do not need to increase the actual area of land allocated as EFAs compared with *Collaboration+*. These substitution effects are studied in more detail in the next section.

Table 3. Changes in various structural indicators compared with the scenario *Environmental optimum* 2020.

Scenario	Holdings (%)	Average holding size (ha)	Profit (SEK per holding)	Profit (SEK per ha)
Current situation	20.1	-31	-33,504	270
Current situation+	19.6	-29	-31,847	254
Collaboration	18.7	-29	-32,524	244
Collaboration+	17.2	-27	-31,520	218
Collaboration++	17.7	-28	-33,213	218

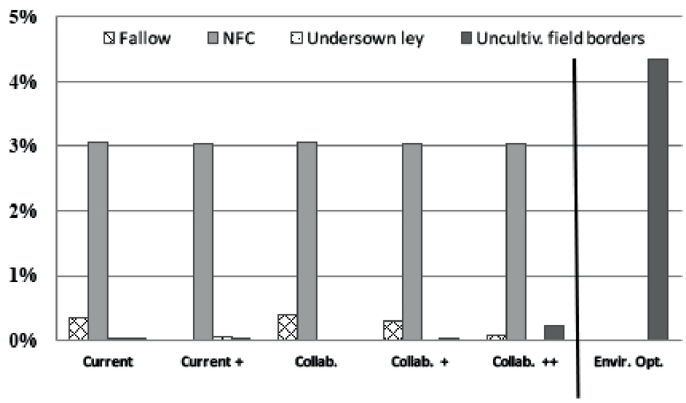
MODEL FARMERS' CHOICES OF ECOLOGICAL FOCUS AREAS IN THE CURRENT SITUATION SCENARIO

Even before the requirement for ecological focus areas was introduced, there were significant areas of land lying fallow (on low-productivity arable land), of nitrogen-fixing crops (on high-productivity land), and of undersown green cover. These are now often declared as ecological focus areas. Consequently, the scenario *Current situation* does not generate any significant changes in land use and therefore differs greatly in terms of land use from the scenario *Environment optimum* (Figure 4, Table 4 and Table 5). Furthermore, because of the weighting factor for uncultivated buffer strips (x9), the model farmers only need to allocate a small area of uncultivated buffer strips to achieve the requirement of five per cent EFA. In the scenarios *Current situation* and

Collaboration, neither fallows nor uncultivated buffer strips are sown with flowering plants because it is costly.

A large proportion of the EFAs in 2020 end up being on low-productivity land rather than on high-productivity land, where they would benefit the ecosystem services pollination and natural biological pest control the most. This is because the model farmers with only high-productivity arable land in 2015 lease out more low-productivity land over time. This behaviour is facilitated by structural change, which leads to less productive farms closing down and releasing land to the lease market. Even though the collective implementation of environmental focus areas is not permitted under the current rules, the simulations show that the farmers in the model collaborate indirectly by leasing less productive land in other regions, which undermines the potential for environmental effects on crop-producing farms.

a) High-productivity arable land



b) Low-productivity arable land

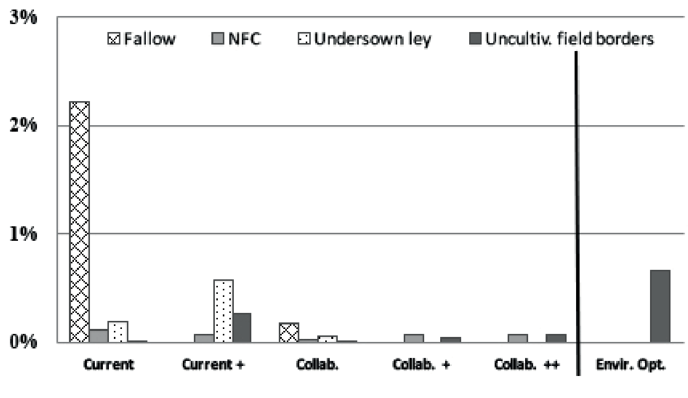


Table 4. Land use in AgriPoliS under the different scenarios. The areas covered by different crops are reported separately for high- and low-productivity land (ha).

	High-productivity land			Low-productivity land				
Scenario	**Grains**	**Sugar beet**	**Oilseed rape**	**Grains**	**Oilseed rape**	**Grass on fields**	**Green cover**	**Natural grasslands**
Current situation	21,850	5,935	3,213	893	201	722	148	1,382
Current situation+	21,857	5,939	3,214	875	197	726	144	1,385
Collaboration	21,844	5,933	3,212	793	184	705	145	1,382
Collaboration+	21,797	5,923	3,205	890	199	714	156	1,386
Collaboration++	21,774	5,918	3,202	891	201	735	154	1,387
Environmental optimum	20,730	5,639	3,049	994	216	719	143	1,385

Table 5. Ecological focus areas in AgriPoliS under the different scenarios. Area covered by each type of EFA is reported in hectares. For uncultivated buffer strips, the width is limited to 1 metre in all scenarios except Environmental Optimum, where the width is 6 metres. Areas stated in brackets are crops grown by the model farmers even though they do not need to be counted as EFAs. If a type of EFA is not permitted under a scenario, this is indicated with by a "/".

	EFA on high-productivity land					EFA on low-productivity land				
Scenario	**Land lying fallow**	**Fallow with flowering plants**	**Nitrogen-fix-ing crops**	**Undersown green cover**	**Uncultivated buffer strips**	**Land lying fallow**	**Fallow with flowering plants**	**Nitrogen-fix-ing crops**	**Undersown green cover**	**Uncultivated buffer strips**
Current situation	134	/	1,135	11	1	2,883	/	44	70	5
Current situation+	(121)	0	1,132	20	5	(2,831)	0	26	214	97
Collaboration	144	/	1,135	0	0	3,059	/	11	19	1
Collaboration+	(99)	114	1,129	0	0	(2,897)	0	28	0	13
Collaboration++	(133)	33	1,127	0	81	(2,865)	0	25	0	25
Environmental optimum	(169)	/	(1,068)	(1,215)	1,613	(2,495)	/	(85)	(336)	245

MODEL FARMERS' CHOICES OF ECOLOGICAL FOCUS AREAS IN THE SCENARIO *CURRENT SITUATION+*

The rules for the scenario *Current situation+* mean that fallows and uncultivated buffer strips must be sown in with flowering plants. However, this does not necessarily lead to the same size areas as in the scenario *Current situation* that are allocated as fallows and uncultivated buffer strips, being sown with flowering plants. The results from the simulations show instead that fallows disappear as EFAs in favour of undersown green cover (established on low-productivity land) and uncultivated buffer strips (whose actual area is relatively small due to the high weighting factor for this type of EFA). This is due to the relatively high costs for the holdings of sowing in fallows with flowering plants. When the farmers have greater freedom of choice, these kinds of substitution effects, where one type of EFA is replaced by another, can undermine the potential environmental effects emanating from the more stringent management demands for some measures. This also creates stronger incentives to lease low-productivity land and allocate it as ecological focus area.

THE MODEL FARMERS' CHOICES OF ECOLOGICAL FOCUS AREAS IN THE SCENARIO *COLLABORATION*

In this scenario, the EFA discount given to farmers collectively implementing their EFA obligations results in the effective area covered by ecological focus areas being greatly reduced compared to the scenario *Current situation*. This occurs primarily on low-productivity arable land where the collective EFAs consist primarily of fallows. Consequently, collaboration in itself does not result in the environmentally best EFAs being selected as in the scenario *Environmental optimum*. On the contrary, it can also lead to a reduction in the environmental effect (which was evaluated in the ecological modelling), owing to the fact that EFAs that do not have the same potential to benefit the environment are selected. In other words, allowing the option to collaborate while retaining the current flexibility concerning the choice and location of ecological focus areas creates no incentives for farmers to optimise their choices of ecological focus areas from an environmental perspective.

THE MODEL FARMERS' CHOICES OF ECOLOGICAL FOCUS AREAS IN THE SCENARIOS *COLLABORATION+* AND *COLLABORATION++*

The requirement to sow in fallows and uncultivated buffer strips with flowering plants and the five per cent ecological focus area requirement on both high-productivity and low-productivity land in *Collaboration+* results in only uncultivated buffer strips being used as collective ecological focus areas, and these being located on high-productivity land. However, because the EFA discount on the collective EFA area and the weighting factor for uncultivated buffer strips are so great in *Collaboration+*, the actual area of uncultivated buffer strips ends up being substantially less than in *Environmental optimum*. The flowering plants requirement also results in the farm-specific area covered by EFAs consisting mainly of nitrogen-fixing crops. Consequently, *Collaboration+* also ends up being far from the *Environmental optimum* when it comes to the chosen types of EFAs and their potential environmental benefit. Removing the EFA discount for collaboration in the scenario *Collaboration++* leads to a much larger area of uncultivated buffer strips being sown with flowering plants, in particular on high-productivity land. On the other hand, the generous weighting factor results in the allocated area still being much smaller than in *Environmental optimum*.

5.1.5 Conclusions from the simulations in AgriPoliS

In summary, the economic modelling in AgriPoliS shows that the analysed scenarios have a very limited chance of achieving the environmental optimum solution. To a large extent, this is due to the fact that the current rules offer farmers great freedom of choice without any clear link to environmental benefit. This means that:

- Nitrogen-fixing crops, which were common even before the greening requirements were introduced, are chosen as the first option for ecological focus areas;
- The generous weighting factor for uncultivated buffer strips reduces the actual area covered by ecological focus areas compared with the policy goal of five per cent;
- The lack of any spatial requirement means that the model farmers choose to locate fallows on low-productivity arable land (applies to those farms where already existing land uses are not sufficient to reach the five per cent level);
- The option of collective implementation does not in itself create any incentive to allocate EFAs in such a way that they generate the greatest environmental benefit; and
- Strengthening the requirements for the management of certain types of EFAs resulted in the model farmers switching to relatively less expensive measures.

5.2 Ecological modelling

We estimated the effects of the scenarios on biological control agents and ecosystem services by using spatially explicit and process-based modelling (Jonsson et al. 2014, Clough et al. 2016). This approach made it possible to examine how changes in the quantity, quality, size, geometrical shape, or location of ecological focus areas in the landscape affected important ecological processes such as the movement patterns and population sizes of biological control agents (Figure 5; Scheid 2010). For each scenario, we applied the changes in land use that we had observed in the agent-based model AgriPoliS (see previous section) to GIS map layers based on the Swedish Board of Agriculture's block database for 2014 (the year before the greening requirements came into force). We used a 7 x 7 kilometre landscape in the Scanian plains (which belong to the production area of Götaland's southern plains). The size of the area allowed us to capture the spatial ecological processes that impact pollination and natural biological pest control, while still keeping the computational effort within reasonable bounds.

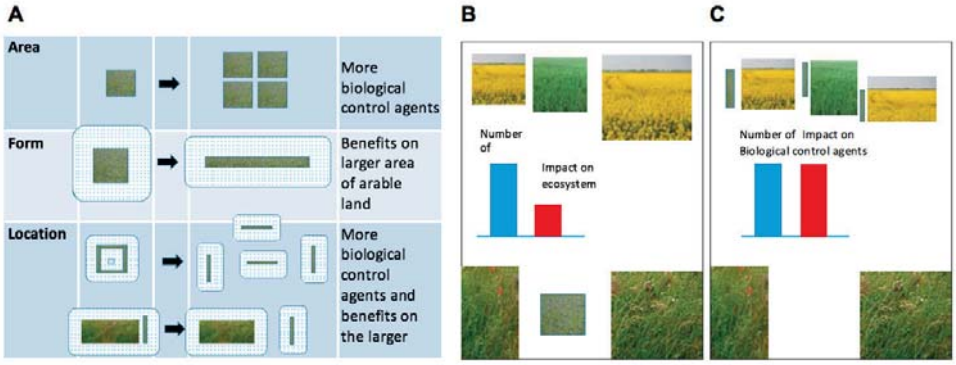


Figure 5. Relationships between establishing flowering plants, number of biological control agents, and economic benefits in the form of pollination of crops and biological pest control. (A) How the yield depends on the size, shape and location of EFAs sown in with flowering plants, as well as the differences in effect depending on whether (B) a fallow sown in with flowering plants is located in a landscape rich in grasslands for example, where the green infrastructure is already good, or (C) flowering buffer strips are located in a landscape of uninterrupted fields with inadequate green infrastructure.

In the benchmark scenario *Environmental optimum,* we simulated that five per cent of arable land in the landscape is covered by uncultivated buffer strips sown in with flowering plants as EFAs (see Chapter 4). The option to choose other types of ecological focus areas, and the high weighting given to uncultivated buffer strips, leads to the size of uncultivated buffer strips being much smaller in the other scenarios, including *Current situation+* and *Collaboration+* (Figure 6). Consequently, the flower resources available to the biological control agents were smaller in the other scenarios compared to *Environmental optimum*.

The proportion of arable land lying fallow varies a little between scenarios. In *Environmental optimum,* the area lying fallow is the smallest due to the large area used for uncultivated buffer strips sown in with flowering plants. When sown in with flowering plants, uncultivated buffer strips and fallows mainly affect the availability of food resources during late spring and summer because the plants do not flower before then, even though sowing occurs early in the spring. We also assumed that buffer strips sown in with flowering plants do not offer suitable nesting sites for wild bees (bumble bees and solitary bees), which build their nests in the ground. This is a reasonable assumption for buffer strips of annuals. This assumption also means that the amount of available food resources during the spring and the number of possible nesting sites are very small (Figure 7).

5.2.1 Effects on biological control agents and ecosystem services

We use two metrics for bumble bees: number of queens as a measure of population size and the number of worker bees in oilseed rape fields as a measure of pollination potential. In the scenario *Environmental optimum,* the large amount of available food resources leads to the population size of bumble bees being high in all the simulated years (Figure 8). In all other scenarios, the variation between the different years is much greater due to smaller amounts of food resources, which also vary more with crop rotation and other changes in land use. The population size in the scenarios *Current situation+, Collaboration+* and *Collaboration++*, in which there are requirements to sow in flowering plants, lay between 20 and 100 per cent of the population size observed in the scenario *Environmental optimum*. These values are greater than the values under the scenarios *Current situation* and *Collaboration* for most of the years modelled. The differences observed in the model between the scenarios concerning the pollination of oilseed rape are affected primarily by variations in the bumble bee populations. The scenarios *Current situation+* and *Collaboration++* performed best, with an effect equivalent to approximately 70 per cent of the pollination value simulated in *Environmental optimum* (Figure 9A). The population size of solitary bees, which are active early in the year when the oilseed rape flowers, is not directly affected by the requirement to sow flowering plants, because these bees have completed their life cycle before these plants begin to flower.

The differences in natural biological pest control (Figure 9B) between the scenarios are primarily driven by the size of the area of flowering buffer strips in the landscape (Figure 6). The potential for natural biological pest control is greatest in the scenarios *Current situation+* and *Collaboration++*. The values in these scenarios lay at more than 80 per cent of the potential biological pest control values simulated under the benchmark scenario *Environmental optimum* (Figure 9B). When we compare Figures 8A and 9A, we can see that narrow buffer strips (1 metre wide) were calculated to be much more effective in benefiting natural biological control than the 6 metre wide buffer strips that were simulated in the scenario *Environmental optimum*. This explains why the potential for biological pest control in the scenarios *Current situation+* and *Collaboration++* reached a high proportion of the potential observed for the scenario *Environmental optimum*. This is despite the fact that the area sown with flowering plants in the scenarios *Current situation+* and *Collaboration+* is only one twentieth of the area sown with flowering plants in *Environmental optimum*.

In conclusion, the ecological modelling showed that:

- Sowing in flowering plants is an effective way to encourage bumble bee populations in the simulations. However, a reduction in the variation in population size of bumble bees between years was only achieved in the scenario *Environmental optimum*.
- Uncultivated buffer strips sown in with flowering plants has particularly great potential for benefiting natural biological pest control. Buffer strips are more effective than flowering fallows.
- Therefore, environmentally it may be more beneficial to require that uncultivated buffer strips and fallows are either sown in with flowering plants or contain a large proportion of flowering plants established naturally.

- The environmental effect of a requirement to sow in fallows and uncultivated buffer strips is relative large, despite the fact that, due to higher costs, to some extent farmers choose not to implement these types of EFAs in the scenarios that set sowing flowering plants as a requirement.
- Collective implementation without a quantity discount for ecological focus areas, but requiring types of EFAs that benefit ecosystem services (*Collaboration*++), is environmentally speaking only slightly better than *Current situation*+. This suggests that collective implementation without simultaneous requirements for measures that increase the quality of the EFAs (such as sowing flowering plants) has only a low environmental potential.

5.2.2 Limitations due to assumptions in the models

The results from the modelling are impacted by the assumptions used in models. There is some uncertainty in the parameter values, which means that while the ranking relationships are correct, the absolute values and the quantitative differences must be interpreted with caution (Häussler et al. 2017). Pollinating insects are mainly affected by the flowering times of the flowering plants sown into buffer strips and fallows. We have assumed that these plants mainly bloom during the summer, after the oilseed rape has finished flowering. Common flowering plant mixes, dominated by species such as purple tansy and Persian clover, flower in the summer. If, instead of annuals, farmers sowed perennial species, the flowering times would change, which could lead to a greater proportion of plants flowering already in the spring, for example. It is probable that a mix of perennials also results in, on average, a lower density of flowering plants, because grass often takes over a larger part of the surface area over time. Regarding wild bees, due to our focus on the pollination of oilseed, in addition to bumble bees we have only modelled solitary bees, which are active early in the year. However, flowering buffer strips will probably mainly benefit species that are active during the summer.

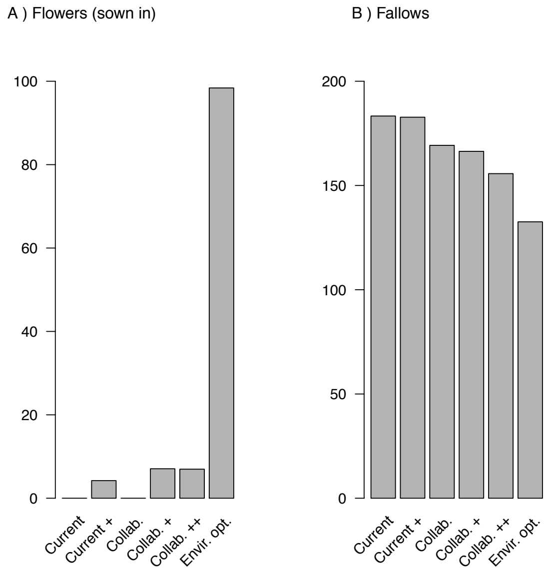


Figure 6. Area (ha) covered by EFAs with flowering plants (on buffer strips or fallows) and fallows without flowering plants (bare or vegetated) in the different scenarios simulated.

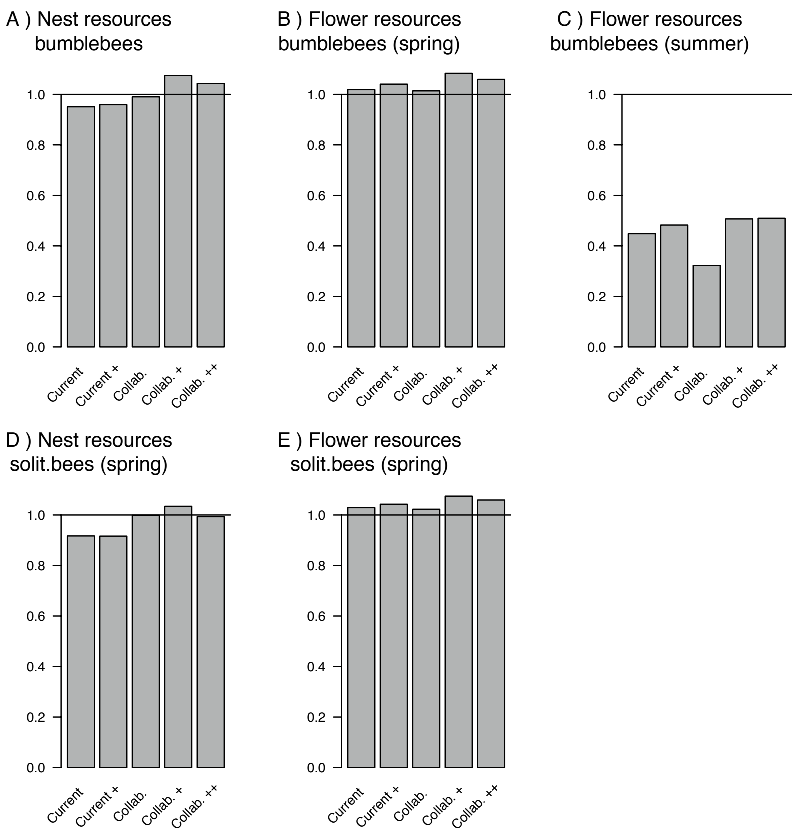


Figure 7. The effectiveness of different land use scenarios on pollinators' nesting sites (A & D) and food resources (B, C & E). Graphs A, B & C refer to bumble bees. D and E refer to solitary bees. The bars are expressed as proportions in comparison with the scenario Environmental optimum.

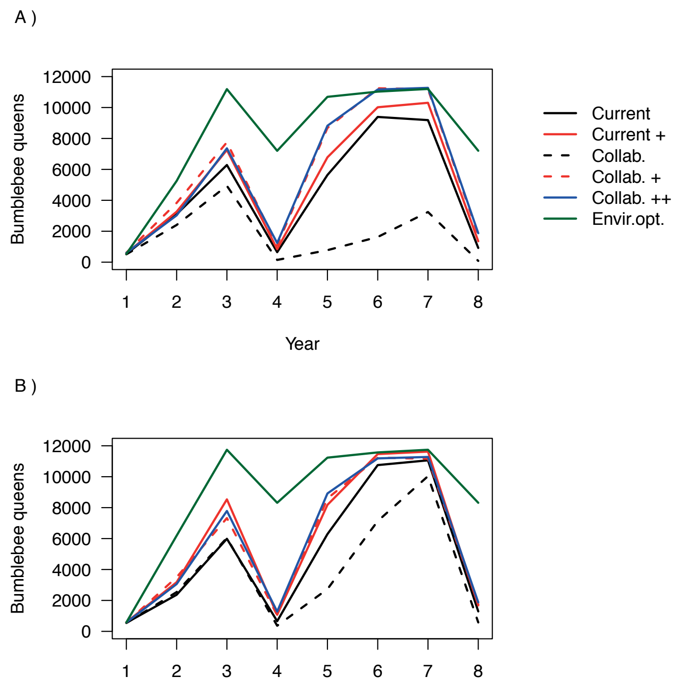


Figure 8. The effects of different land use scenarios on the simulated number of bumble bee queens in the landscape under the assumption that all fallows throughout the entire landscape (A) lack vegetation (bare fallows), or (B) are covered with flowering plants.

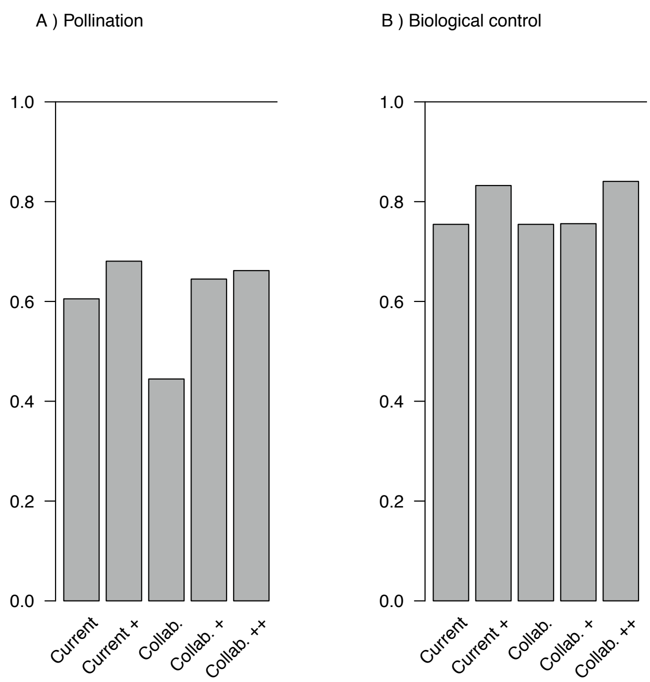


Figure 9. The effects of different land use scenarios on the simulated quantity of bumble bees per 25 × 25 m square of oilseed rape (A), and the impact on biological pest control in the same square (B), in proportion to the simulated values in the scenario Environmental optimum. Here, we assume that fallows lack vegetation (bare fallows).

5.3 Views of farmers and officials on the choice and location of ecological focus areas

In this chapter, we report on the views expressed by farmers and officials concerning alternative regimes for ecological focus areas. In this part of the investigation as well, we used our scenarios (Chapter 4), which include the option to collaborate as well as quality improvement measures. The aim here is to assess the transaction costs and to gain a deeper understanding of the attitudes of each group to implementing the different scenarios. We end this chapter by comparing the perspectives of the farmers and the officials, and then we discuss the different scenarios in relation to identified constraints and opportunities.

It is difficult to make a quantitative assessment of transaction costs for this type of complex instrument, which is why we have chosen to make a primarily qualitative assessment. The advantage of a qualitative perspective is that it creates a deeper understanding of the relationships between the factors affecting the motivation of the various stakeholders to implement the policy. To satisfy the requirements of the task, in terms of the transaction costs for the authorities, we have supplemented the qualitative perspective with an attempt to assess the quantitative differences between the different scenarios.

5.3.1 Workshop with farmers and survey

We held a workshop with nine farmers from south-west Scania. The workshop was based on exercises in which participants used fictitious typical farms and were asked to respond to our various scenarios (Figure 10). We based the size, field size, and rough appearance in the landscape of the typical farms on what an average farm in Götaland's southern plains looks like according to the Swedish Board of Agriculture's block database. We repre-sented the EFAs using sheets of coloured paper whose size took into account the arable land area of the typical farms as well as the weighting factors for each type of EFA (Figure 10).

The workshop consisted of five exercises. During the first exercises, the participants were asked to locate the ecological focus areas and discuss their choices in the different scenarios. In the concluding exercise, the participants were asked to discuss freely with the aim of defining an additional scenario, *Farmers' best*, which would reflect the participants' own preferences.

Figure 10. In the workshop, farmers were asked to locate ecological focus areas on their typical farms. They gave reasons for their choices of type and location of EFAs under the different scenarios (Current situation, Current situation+, Collaboration, Collaboration+) and discussed these in the group. (Photo: Lovisa Nilsson).

At the end of the workshop, the participants were asked to individually fill in a survey which included asking them to rank the four different scenarios based on what they thought was the best one from various perspectives.

5.3.2 Telephone interviews and expert evaluations with officials

Telephone interviews were conducted with six officials in Sweden, the Netherlands, and the UK. These officials all work with issues related to the EU's Common Agricultural Policy or have experience of collective implementation issues in similar contexts. In Sweden, managers and case officers at the Swedish Board of Agriculture and at three different county boards were interviewed. In the Netherlands, which has implemented Article 46(6) on the collective implementation of ecological focus areas, an official at the Ministry of Economic Affairs (equivalent to Sweden's to the Ministry of Enterprise and Innovation) was interviewed. In addition, a coordinator for a *Facilitation Fund* in the UK was interviewed. The facilitation fund is where farmers receive advice in groups with the aim of promoting cooperation between farmers and facilitating the implementa-tion of nature conservation measures at a landscape scale. The *Facilitation Fund* is implemented under the UK's Rural Development Programme.

The interview questions focused primarily on the perceptions and attitudes of officials to collaboration based on their experiences. Officials in Sweden and the Netherlands were also asked questions about perceived or anticipated transaction costs associated with the collective implementation of ecological focus areas.

It proved difficult for individual officials at the Swedish Board of Agriculture to estimate anticipated transaction costs for the whole of the government agency. For this reason, we expanded the individual telephone interviews, using a Delphi-inspired expert evaluation, by five officials from different departments at the Swedish Board of Agriculture (cf. Okoli and Pavlovski 2004). The aim was to estimate transaction costs quantitatively and investigate how these costs would change with the implementation of the different scenarios *Current situation*, *Current situation+*, *Collaboration* and *Collaboration+*. The scenario *Current situation* was used as the comparison reference.

Based on the information gathered from the telephone interviews, we developed a table, where officials were asked to fill in different steps and what type of change in the transaction cost they anticipated in each scenario. The table was filled in individually by two officials at the Swedish Board of Agriculture. The results were compiled by Lund University and then discussed at a group interview involving five participants, at which they agreed on a common table.

5.3.3 Analytical framework

Creating objective evaluation structures for collaborative natural resource management is difficult if not impossible (Conley and Moote 2003).

The starting point must always be to adapt the evaluation to the aim of the study. We chose to base our evaluation criteria on six factors that have been shown to constitute constraints on the implementation of policy instruments. These factors are (1) technical, (2) economic, (3) organisational, (4) legal, (5) knowledge-based and (6) social (see Chapter 4.3.3 above). We have chosen to use the terms "constraints and opportunities" rather than just "constraints", because the respondents sometimes proposed solutions or something positive in relation to some of the constraints.

Based on the notes from the workshop with the farmers and interviews with officials, we compiled all the comments received concerning constraints and opportunities. The comments were then categorised into 13 themes, which were in turn related to the general categories (Table 6). Due to the overlap between legal and organisational constraints, in this study we chose to merge these categories.

5.3.4 The workshop demonstrated that farmers were favourably disposed towards collaboration but critical of measures without any clear environmental benefit

Generally speaking, the farmers were positive to collaboration and it was clearly apparent that collaboration was not something unknown to them, but something that they encounter regularly in collectively owned enterprises for drainage and roads. However, they were critical of the greening payment. A recurring comment was that it should be clear what benefit a measure adds in order to create an incentive to implement it. This indicates that the perceived environmental benefit may be significant in the decision to opt for certain types of ecological focus areas over others. They also commented that the rules and conditions must be clear and simple to enable long-range planning and rational implementation without fear of sanctions.

Long-range planning and a comprehensive approach recurred as themes a number of times in the workshop, for example in the context of discussions about frequent changes in the regulatory framework, or the challenges arising when managing leased land. The participants also returned many times to the importance of having and being able to adopt a comprehensive approach to their operations, and how agricultural policy rules and recommendations affect and in some instances, are at odds with this. The need for a comprehensive approach was clearly expressed in the farmers' need to identify synergies between mandatory measures or management requirements arising from the regulatory framework, and other activities carried out on the farm. Time and again, the participants expressed the view that such synergies facilitate their work, but these arguments also have an economic dimension. For example, the workshop participants argued that for crops, it is the most rational solution to have the lost metre-wide buffer strip located next to fields of oilseed rape, where plants hang over the buffer strips anyway. The need for sufficient flexibility to adapt the measures to the conditions on one's own farm or in the neighbourhood were also raised as important in relation to the management conditions for a specific measure, but also in relation to the possibility of linking ecological focus areas to other greening measures. In general, opportunities were put forward almost as much as constraints by farmers. But even though the discussions about willingness for collaboration and the introduction of quality improvement measures were mostly positive, this positive spirit was often conditional on relatively large changes in the current rules and organisational structures. Many of the arguments used in the discussion – regardless of whether they were put forward as constraints or opportunities – are also based on economic considerations. It was seen as preferable that measures could be implemented in a profitable way and without too much fuss.

However, it was also apparent that money was not everything for the participants. Among other things, a number of social and socio-technical solutions to collective implementation problems were put forward, and the participants would much prefer to avoid compensating each other financially for help with management measures or other type of cooperation.

5.3.5 The survey of the farmers suggests only weak support for the current regime and a positive attitude to sowing in flowering plants

The survey asked the farmers to rank the four scenarios discussed at the workshop from different perspectives. The responses from the survey should be interpreted with great caution because of the very limited number of responses. The question concerning which scenario farmers thought was the best for them generated a variety of responses. But it was clear that the current regime (*Current situation*) was experienced by most as the worst alternative. The scenario *Collaboration* was given a neutral rating by most, while the two scenarios that required sowing in flowering plants (*Collaboration+* and *Current situation+*) were ranked highest.

The responses to the question which scenario is best for society at large showed a similar range of preferences. Most (albeit considerably fewer than above) felt that the scenario *Current situation* was the worst for society as a whole, followed by *Collaboration*. As above, the two scenarios with requirements for sowing in flowering plants achieved the highest rankings.

When asked which scenario the farmers perceived as best for the Swedish Board of Agriculture and the EU, respectively, their responses varied greatly. Even though the range of responses was great, the overall differences between the various scenarios were very small.

5.3.6 Collaboration has positive effects but in Sweden appears to be an administrative challenge

All those interviewed were very interested and engaged in the issue of collaboration on environmental measures in the agricultural landscape, regardless of whether their day-to-day activities dealt with ecological focus areas or cooperation related to voluntary measures under the Rural Development Programme. They had a range of prior experiences of cooperation at different levels, which included both horizontal cooperation between farmers and vertical cooperation involving stakeholders from different levels (farmers, non-profit organisations, government agencies, etc.).

It was apparent that the officials who had had more experience of collaboration were generally more positive to collaboration than those who had less or no experience. Individuals with experience of collaboration pointed out that collaboration can result in cross-fertilisation of ideas and in higher commitment among farmers. These individuals also emphasized the importance of a comprehensive approach, where it was seen as important to see the role of the landscape perspective in strengthening and improving the quality of green infrastructure. Interviewees with very little or a lot of experience of cooperation also had different views on flexibility. The more inexperienced respondents expressed concern that there might be situations where the flexibility permitted under collective implementation was too great, which these respondents thought could lead to inspection problems. On the other hand, the respondents who had more experience of collaboration instead saw collaboration as an opportunity for increased flexibility for participating farmers to spatially allocate ecological focus areas. Interviewees with less experience also expressed greater concerns about the potential for intractable conflicts between collaborating farmers.

A key problem for officials in Sweden was difficulties or concerns about a non-functional IT system, which they felt posed problems for the officials themselves, but ultimately also for the farmers. This concern had its origin in negative experiences from a recent update of current IT systems, which caused many problems and incurred high costs. During the interview with the official from the Netherlands, where there is a more positive attitude to collaboration on environmental measures, the IT system was not brought up as a problem in the context of collaboration. Even though there had been a cost increase for collective implementation and there was an awareness of the limited environmental benefit of current EFAs, the option of collaboration was seen as a step in the right direction.

Potentially more complex rules and more problematic inspections were also experienced as a constraint on collective implementation. Like the concerns about problems with the IT system, this was experienced as both an actual cost increase and as generating an increased risk.

5.3.7 Costs related to the IT system are estimated to be the biggest item of expenditure by Swedish Board of Agriculture officials

The expert evaluation was conducted with a group of officials at the Swedish Board of Agriculture because it proved difficult for individual employees to make overall estimates of anticipated changes in costs. Group discussions also made clear that there were major uncertainties regarding the estimates made and employees repeatedly stressed that the values provided were rough approximations and ought to be interpreted with caution.

The expert evaluation showed that increased transaction costs for all three scenarios compared with the scenario *Current situation* were anticipated. The costs were expected to rise in relation to how complex the scenario was perceived to be. Introducing the option of collaboration was seen as leading to the biggest changes compared with the current system, which led to the anticipated cost increases being highest for the scenario *Collaboration+*, slightly less for the scenario *Collaboration,* and lowest for the scenario *Current situation+*.

The changes in costs were estimated separately for the different steps arising for the government agency in connection with processing a payments case. Initially, the experts estimated the proportional distribution of these steps under the current rules (*Current situation*). The single biggest cost anticipated concerned ongoing maintenance and updating of the IT system. Compared with this item, all other steps were estimated as relatively small costs. Among the more labour-intensive of the smaller steps were different types of internal and external communications, as well as the costs incurred in connection with audits.

Due to the high labour input which, according to the officials, is already required to maintain a functioning IT system, it was this step in particular that was anticipated to result in the single biggest cost should changes be made in the regulatory framework. All officials agreed that it would require a substantial upgrade of the IT systems to be able to satisfy all the needs that would arise from an adjustment to a new regulatory framework. For this reason, the relative cost increase for work with the IT system was estimated as the largest compared with the current situation. The costs of different types of communications and training were also expected to rise quite significantly.

5.3.8 Constraints and opportunities for change

The officials did not have any comments with regard to the identified themes Synergy and Coordination and Voluntariness, and otherwise all general categories (constraints and opportunities) and themes were touched on by both farmers and officials (Table 6). A closer look identified that officials just as frequently expressed themselves in terms of constraints as in terms of opportunities, while proportionately farmers more frequently expressed themselves in terms of opportunities.

TECHNICAL CONSTRAINTS AND OPPORTUNITIES

Themes that were raised under technical constraints and opportunities were the IT system, machinery, and materials. In the case of the IT system, farmers and officials had similar views and similar concerns about the system, even though the Swedish officials especially were more negative. For both groups, negative views concerned prior experiences. For example, one of the major IT systems used by the authorities to process direct payments for farmers was recently replaced, which was experienced as having caused major problems. A further factor discussed was the width of the buffer strips, which were felt to be too narrow in relation to the technical conditions. From the farmers' perspective, it was difficult to understand the thinking behind them, because a tractor is much wider than 1 metre.

ORGANISATIONAL AND LEGAL CONSTRAINTS AND OPPORTUNITIES

Themes that were identified under organisational and legal constraints were the Long View and Comprehensive Approach, Coordination, Flexibility and Clarity. As regards organisational and legal constraints and opportunities, mainly the farmers, but to some extent also the officials, put forward the view that a comprehensive approach was important. Farmers in particular saw the long view as an important constraint, because setting up cooperation costs money. Consequently, they are more interested in establishing a well-functioning collaboration if it can be seen as a long-term investment. The individuals from the authorities more frequently tended to discuss constraints associated with the current administrative tools, while the farmers took up the importance of the long-term view in the regulatory framework implementing the Common Agricultural Policy.

Within this constraint, we have also categorised the theme Coordination, which includes attitudes to an external coordinating stakeholder. The farmers had a range of views on the usefulness of an external facilitator. While some participants felt that this could be a good thing or even essential for coordinating the optimum location of EFAs at a landscape scale, others were afraid of being controlled.

ECONOMIC CONSTRAINTS AND OPPORTUNITIES

In the category of economic constraints and opportunities, three themes were identified: Costs and Incentives, Synergy and Coordination, and Risks. For the farmers, costs and incentives are about whether policy choices concerning crops that are approved for ecological focus areas will affect the market price, which resulted in farmers perceiving measures of this kind as "double punishment". For officials, the issue was mostly about increased costs for inspections and IT systems. An additional aspect that was mentioned more indirectly by the farmers is that measures can be managed at a lower cost if their implementation is collectively based. Some participants stated that *"you can manage the buffer strip one year and I'll do it another year"*, which is an opportunity to reduce the total cost of management. Risk was raised in both the interviews and the workshop. In the interviews, the worry raised was that complex rules make it difficult to understand and check whether a measure can be approved, something that causes concern in both farmers and case officers. The farmers experienced that rules and conditions change, are removed and added at a rate that makes it difficult to plan environmental actions as well as the rest of the business of running a farm. Concerning the theme Synergy, in the workshop the discussions centred mainly around the option of being able to coordinate the work involved in environmental measures with each other to improve the environmental benefit, and to be able to fit these measures into the farm's activities in a seamless way.

KNOWLEDGE CONSTRAINTS AND OPPORTUNITIES

Concerning knowledge, two themes were identified: Experience and Increased Knowledge. A number of the participating farmers had different types of experiences of cooperation. These experiences were overwhelmingly positive. Previous research has also shown that farmers' prior experiences and interest in participating in environmental measures in general have played a crucial role for their attitudes to collaboration (Emery and Franks 2012, McKenzie et al. 2013). It also emerged in the interviews that the officials who had a lot of experience of collaboration had a far more positive view of the opportunities and risks than those with less experience. A number of examples of how collaboration can lead to learning, which promotes the exchange of ideas on ways to cooperate, technical solutions, and solutions to any conflicts that may arise, also emerged from the workshop.

SOCIAL CONSTRAINTS AND OPPORTUNITIES

Two themes were identified in relation to social constraints: Trust and Voluntariness. It was in reference to these constraints that the differences between the perspectives of the farmers and the officials became most apparent. The farmers saw mainly social opportunities and so they presented various types of social solutions. For example, the farmers did not see cooperation as a major problem and tended to refer to the social norms that regulate interaction in the countryside as a kind of social incentive that will help the collaboration to work. They also emphasised the camaraderie in and the aesthetics of establishing flowering buffer strips as a group: "*Anyone travelling through the village can see our flowering buffer strips*". On the other hand, the Swedish officials claimed that collaboration could lead to increased dependence on each other and potentially more conflicts.

The table below (Table 6) compiles the comments in relation to the identified themes and the five categories of general constraints and opportunities for collaboration.

Table 6. Constraints and opportunities for collaboration. Compilation by theme of comments from the workshop with farmers and interviews with officials. The comments are divided after five general categories. Comments by the authorities are highly focused on collective implementation under Articles 46(5) and 46(6) of the EU Direct Payments Regulation, while comments by the farmers also apply to a greater extent to various forms of informal collaboration. C = Constraint O = Opportunity. The numbers 1 to 5 in parentheses refer to the workshop exercise in which the theme was mentioned. EFA = ecological focus areas. UBS = uncultivated buffer strips.

	Authorities	Farmers
1. Technical constraints and opportunities		
IT	C: Technically difficult to create a new IT system that works. C: The IT system must detect that the EFA requirement has been fulfilled. C: Difficult to see beyond the current problems with the IT system.	C: Errors in the IT system – incorrect payments (3). O: All collaborating farmers specify the customer number for all participants (3).
Machinery and materials	O: Adviser coordinates purchasing and is responsible for processing applications for direct payments (NL).	C: Too narrow for any benefit, too narrow for rational use (UBS) (1, 5) O: Buffer strips ought to be at least 3 metres wide, like a tractor, this is rational (5).
2. Organisational and legal constraints and opportunities		
The long view and comprehensive approach	O: A comprehensive approach at a landscape scale is required to create contiguous green infrastructure. Examples of functioning solutions are *Facilitation Fund* (UK) and collective agri-environment payments (NL).	C: Lack of long-term objectives, planning and a comprehensive approach – rules and recommendations do not tally with each other or fit reality, new rules all the time. Cultural landscape aid (1, 4) O: Landscape perspective and coordination are nothing unusual (3).
Coordination	O: Coordinating advisers positive for those with experience of collaboration. O: In the UK, the coordinator for the Facilitation Fund contributes knowledge and encouragement.	C: Need to agree on what you want to benefit (3). O: Rotating system of responsibility for EFA, rotating sowing schedule (2, 3). O: Strategic planning – benefit for all (3). O: Common adviser "helicopter perspective" (3). O: "We put half of my land, half on his" (beetle banks) (3). O: Share machinery (4). C: There are neighbours who don't want flowering plants because they generate too many insects (2).
Flexibility	C: Too much choice is perceived as making processing and inspection more difficult. O: A collectively implemented EFA means greater flexibility in where to locate it in the landscape.	C: With cooperation, you get stuck with certain types of EFAs (4). O: Local adaptation of payments/measures such as rose hip bushes (2). O: Management conditions and solutions ought to be simple and flexible (1, 3, 5). O: Cooperation should be voluntary (3). O: Less land area, higher quality (3). O: Freedom of choice. Flexible solutions. EFA without requirements, voluntary – agri-environment payment (5). O: Better if you have the freedom to choose independently of others (4).

	Authorities	Farmers
Clarity	O: The regulatory framework should be simple and clear. C: Rules are perceived as complex, there is a concern about managing complexity and more difficult to inspect.	C: Complicated, ambiguous rules open to interpretation increase the risk of making mistakes (3, 4). O: The regulatory framework and rules should be simple and clear. (4, 5). O: Collaboration contracts must exist, and they should be well-written (3, 4).
3. Economic constraints and possibilities		
Cost/incentive	C: It is costly to change and adapt the IT system. C: Increased cost for applications and inspections in	C: Choice of EFA affects market prices – ”double punishment” (1, 5). C: Discount results in reduced environmental benefit – discount not big enough (3, 4). O: Collaboration in group at a higher weighting (5). O: Include EFA in an effective and seamless way (1).
Synergies and coordination		O: Synergies, coordination with other measures such as EFA catch crops, EFA land improvement measures EFA where most beneficial (1, 2, 4, 5). O: Coordinated cooperation can give synergies (4). O: “We’ll locate the flowering buffer strip running right through the village, it will make people stop and look” (2).
Risks	C: Complex rules constitute a risk since they are already difficult to understand, something that causes concern among both farmers and case officers. C: Feared big risk that the IT system malfunctions (even more) if additional needs for updating arise.	C: The risk of not being able to decide fully for oneself (4). C: Complicated, ambiguous rules increase the risk of error – incorrect sanctions (3). C: Difficult for the authorities to implement inspections, illogical sanctions, incorrect payments (3). C: Crop failure in flowering buffer strips, sanctions in the event of an inspection (1).
4. Knowledge constraints and opportunities		
Experience	O: Prior experience of collaboration positively affects attitude to collabora-tion.	C: Environmental benefit of ecological focus areas is challenged – ‘black mourning bands’ (1). O: Collectively own enterprise for drainage as collective greening enterprise (3). O: “What we usually do, and it works”.
Increased knowledge	O: Cooperation on environmental measures can resulting “cross-pollination” of ideas and experiences. O: Positive experience of collaboration generates greater interest among farmers.	O: More concrete information on the benefit of EFAs, e.g. are flowers sensitive to weed control (2). O: Older farmers would like to leave something for posterity (2).

	Authorities	Farmers
	5. Social constraints and opportunities	
Trust/ Social control	C: Farmers become dependent on one another in collaborations. O: The application must be made individually (UK). O: In NL, a contract is signed between the farmers as participating in a "Ten-farmer collective", in which obligations, etc., are regulated. C: Officials at the county administrative boards and the Swedish Board of Agriculture expressed concern that conflicts might arise between collaborating farmers.	C: Cannot rely on the IT system (3). C: Common advisor – one might be steamrollered (4). C: Leased farm for EFA – can be difficult to agree, it takes time (3). C: Social consequences/sanctions: neighbours don't greet each other, not invited to 50th birthday party (3). C: Concern about "rigid inspectors" (2). O: Prefer to cooperate with those you know have similar views (3). O: "*We'll fix that at the Christmas party!*" (3). O: Solution other than economic (3). C: Not going to implement some measures if not required (5). O: A lot is done voluntarily (5).

6 Discussion

Can collective implementation of ecological focus areas under Article 46(5) or 46(6) in the Direct Payments Regulation benefit the ecosystem services pollination and natural biological pest control? In that case, what would this implementation cost in the form of transaction costs for farmers and the authorities? Or it would be more effective to work for amendments to the rules and informal forms of collaboration around ecological focus areas? We responded to these questions by analysing six different scenarios from the ecological, business economics, and administrative (including acceptability) perspectives (Figure 11) in terms of:

1. Environmental benefit, measured here as the potential for (a) pollination and (b) biological pest control;
2. The farm's economy, including income per hectare and percentage of surviving farms; and
3. The views of the authorities and farmers on the regulatory framework, specified among other things as (a) the authorities' transaction costs, and (b) popularity with farmers.

The scenario analyses involved first evaluating the current regulatory framework (scenario *Current situation*) and identifying potential weaknesses. Then we evaluated four alternative regimes (*Current situation* +, *Collaboration, Collaboration*+ and *Collaboration*++), with the objective of identifying potential opportunities for improvement. To be able to relate the scenarios to a fixed goal, we developed an environmentally optimised benchmark scenario (*Environmental Optimum*).

6.1 Current design of EFAs has only weak environmental benefit

Compared with the scenario *Environmental optimum*, the ecosystem services are benefited least in the scenario *Current situation*, which reflects the current regime. There are a number of reasons why the current regime does not achieve the optimum environmental effect. Firstly, in practice farmers allocate less than five per cent of their arable land as ecological focus areas. This is partly due to the weighting factor for uncultivated buffer strips being 9 times the actual area. The option of crediting certain types of crops already being grown on the farm also limits the potential for increasing the environmental benefit. This applies in particular to the nitrogen-fixing crops peas, broad beans and field beans, which are popular as EFAs, but are only moderately important for bumble bees, and do nothing to benefit other biological control agents such as solitary bees and many natural enemies of pests (Knight et al. 2009, Hanley et al. 2011).

Furthermore, the management requirements for EFAs are low, and consequently these areas are often of low quality as biotopes. For example, fallows and uncultivated buffer strips may be left bare of vegetation, with the result that many farmers choose to have bare earth on these EFAs, both in practice and in our modelling.

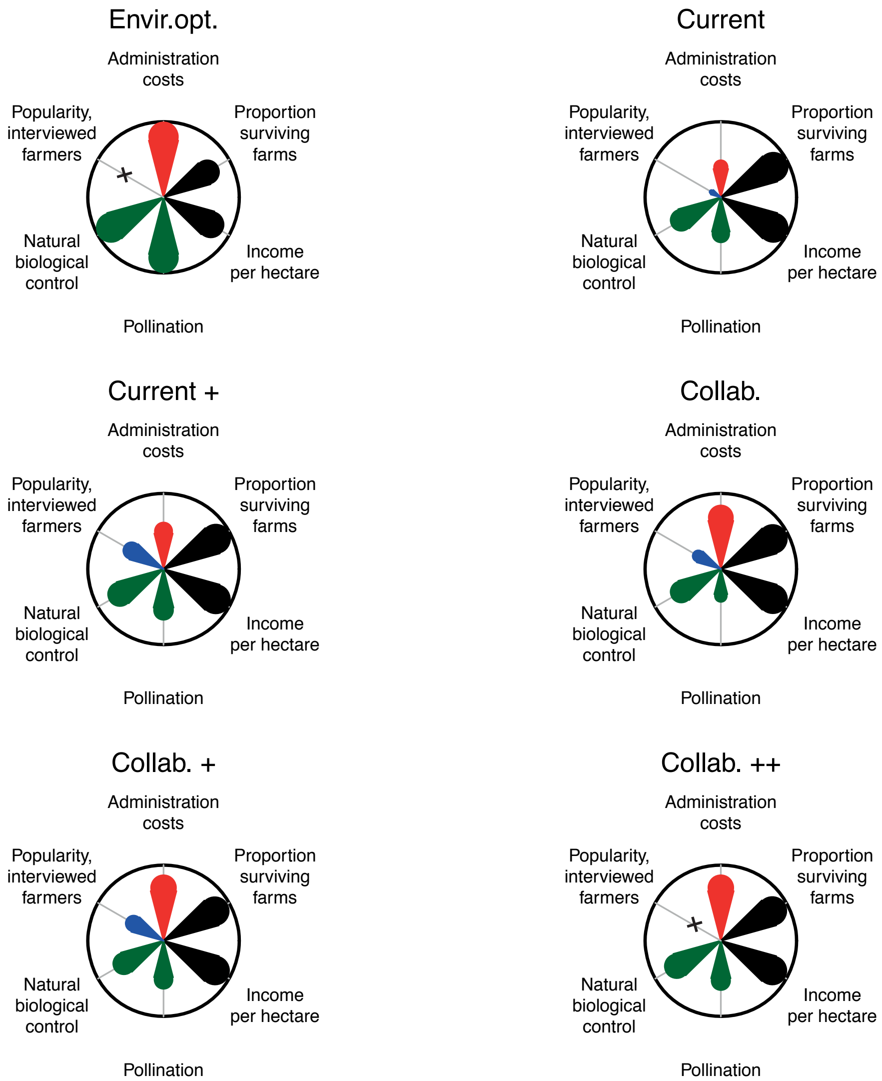


Figure 11. Summary of the differences between the different scenarios with respect to (1) environmental benefit (pollination and biological pest control; green petals), (2) the farm's economy (income per hectare and percentage of surviving farms; black petals) and (3) authorities' work (transaction costs; red petals) and farmers' perceived opportunities and constraints (popularity; blue petals). All variables in the figure are continuous: we have reinterpreted the transaction costs into continuous variable values, where we used the centre point of the cost categories, and reinterpreted the popularity values on a points scale. To be able to compare the variables, we have recalculated all the values as index values between zero (centre of the flower) and one (the outer edge of the circle). X = no data available.

The absence of vegetation, in particular of flowering plants, means that these areas have minimal impact on the investigated ecosystem services. This perception was also put forward during the discussions at the workshop with farmers. The participants argued that at the present time, the link between this measure and environmental benefit is difficult to comprehend, which results in less motivation to implement the measure. This means that the perceived environmental benefit may be significant in the decision to opt for certain types of ecological focus areas over others.

Finally, the requirement is to allocate ecological focus areas at the farm level and not, as in the benchmark scenario *Environmental optimum*, at a landscape scale. Consequently, there is no spatial perspective, which is essential if the design of this policy instrument is to benefit ecosystem services.

All in all, there are a number of overall weaknesses in the current regulatory framework for ecological focus areas which are preventing an optimum effect on biodiversity being achieved:

- The ecological focus areas currently allowed give farmers the option of choosing cheap EFAs that have small environmental benefits.
- The weighting factor for uncultivated buffer strips (these generate a great environmental benefit when sown in with flowering plants) is so high that only very small areas need to be allocated.
- The option of crediting some types of existing crops as EFAs, in particular nitrogen-fixing crops, has only moderate significance for biodiversity.
- Low demands on habitat quality.
- The obligation to allocate five per cent of arable area being applied at the farm level makes it difficult to get to the “right measure in the right place” from the landscape perspective.

6.2 Ecological focus areas are not popular with farmers

Concerning the current structure of ecological focus areas, workshop participants expressed great doubts about what benefit EFAs actually produced. They also felt that the design of the regulatory framework around these measures has not been adapted to the farmer’s perspective and the farmers’ need for rational land management. This undermines the farmers’ confidence in the policy and their commitment to finding environmentally effective solutions. The knowledge that measures really do some good is thus an important motivation and fundamental to having confidence in the system. The general impression from the discussions at the workshop was that there is a great willingness to do more for the environment, if one could just be sure that the measures really are important for the environment. That farmers implement a lot of environmental measures without compensation supports this impression.

6.3 Ecological focus areas are not currently an effective environmental instrument

The identified weaknesses in the current regulatory framework in combination with a lack of confidence in the policy strengthens incentives for farmers to select EFAs that are the cheapest and most pragmatic for them to implement. Besides being able to credit certain types of EFAs that they already have on their farms (such as existing nitrogen-fixing crops), this means that farmers allocate EFAs to their least productive land where the need for environmental measures is the least, and also that they choose management methods that are easy and cost-effective. The economic modelling showed that these negative incentives are reinforced over time by the possibility of leasing low-productivity land, since the EFA requirement applies at the farm level. In other words, there is no clear rewards system for farmers to optimise the environmental effect at the landscape scale. On the other hand, minimising their own costs is a clear incentive, which is also apparent from the farmers' comments at the workshop. Because the farmers perceive the system as both complex and without any clear environmental benefit, their confidence in the policy and their motivation to improve the environmental effect over time through long-term planning and innovative solutions are undermined.

6.4 Enhanced quality requirements may lead to increased environmental benefit if other requirements are added

One way of trying to increase environmental effectiveness is to impose requirements to implement quality improvement measures. Sowing in flowering plants benefits wild bees including bumble bees, and benefits biological control agents which aid natural biological control of pests. The simulations in the scenarios *Current situation+* and in the other two scenarios that included a requirement to sow in flowering plants (*Collaboration+* and *Collaboration++*) showed that it can be environmentally worthwhile to require that types of EFAs such as uncultivated buffer strips and fallows are either sown in with flowering plants, or have a large proportion of flowering plants during the summer (Figure 6). However, with a requirement to sow in flowering plants in fallows and uncultivated buffer strips, management costs rise due to the cost of purchasing seed and of the sowing itself. At the same time, the other types of EFAs are relatively speaking more profitable compared with fallows and uncultivated buffer strips. In the simulation, the farmers dealt with this by choosing to establish smaller areas of fallows and buffer strips, and more nitrogen-fixing crops and undersown green cover. This led to a reduction in the effect of the requirement to sow in fallows and uncultivated buffer strips with flowering plants compared with if the farmers had been required to allocate five per cent of their arable land to flowering buffer strips (corresponding to scenario *Environmental optimum*). Despite the fact that the workshop participants were generally positive to sowing in flowering plants and were well aware of the environmental benefit of this, it was obvious that their perceptions of the regulatory framework as complex, and of the lack of a clear link to environmental benefit in general, can impact their motivation to implement measures with enhanced quality requirements.

Furthermore, the current high weighting factor for uncultivated buffer strips contributes to a significant watering down of their environmental effects because the actual areas allocated to these EFAs end up being very small. It would be better to use the most effective environmental measure (in this case, flowering uncultivated buffer strips) as a benchmark (with a weighting factor of 1). The weighting factors of other types of EFAs ought to be lower in relation to this benchmark. This is particularly important in view of the fact that the policy objective for ecological focus areas is to promote biodiversity. This was also something that the farmers discussed during the workshop. Changing the weighting factors would mean that the actual area of land allocated to EFAs would increase, which would be good from the environmental point of view.

The survey conducted with the farmers who participated in the workshop showed that the scenarios with a requirement to sow in flowering plants were the most popular (Figure 6). The group was, of course, small, and it is reasonable to assume that the proportion of these farmers with a particular interest in the environment is higher than plains farmers in general, but their attitudes nonetheless point to a genuine interest among farmers to do something good for the environment. Although the farmers who participated in the workshop were generally aware of the benefits that uncultivated buffer strips and fallows sown in with flowering plants can have for biodiversity, some of the participants were sceptical about flowering buffer strips because they considered the cost to be high compared with other options. For this reason, in most cases a financial reward is needed to induce the farmers themselves to sow in flowering plants. However, many of the farmers were positive to flowering buffer strips, and put forward various ideas about how they could create them in practical terms. They also referred to flowering buffer strips as aesthetically pleasing.

An important limitation in our ecological-economic modelling was that we assumed that farmers do not take into account the effects of ecosystem services on the harvest and thus the farm's economy. Consequently, it is probable that the costs of allocating certain types of EFAs were overestimated, since the model does not take into account the harvest gain that these EFAs can generate as a result of increased pollination or a reduction in pest infestations. However, there are currently no effective ways of integrating the economic value of these ecosystem services into business economics decision tools such as AgriWise (2016), which are used to do the production costings. Armed with the knowledge of the value of the ecosystem services, it might be possible to motivate the farmers to implement more costly measures on a voluntary basis (Brady et al. 2015).

6.5 Collective implementation is not an effective solution as long as EFAs generate small environmental effects

In theory, the option of collective implementation under Article 46(5) or 46(6) of the Direct Payments Regulation allows the authorities or the farmers to optimise the location of ecological focus areas for the environment at the landscape scale, rather than on individual farms. This in turn could result in a greater environmental benefit. For the collective implementation of ecological focus areas to be an effective way of benefiting ecosystem services, there must be adequate incentives for farmers to optimise these measures for the environment at a landscape scale, among other things by allocating high-productivity arable land as ecological focus areas.

Our analysis shows that the collective implementation of ecological focus areas in the current situation would generate relatively small environmental effects, while it is estimated that the transaction costs for the authorities would be relatively high (Figure 6). This is because the scheme lacks essential prerequisites for collaboration to be environmentally effective, namely a structure that is linked to the achieved environmental benefit. The link to environmental benefit is weakened by the option of choosing EFAs that generate only a small environmental benefit, weighting factors, and the absence of a spatial perspective when locating these measures. Because in the models we assumed that the farmers would be keen to minimise their costs for ecological focus areas (which was also confirmed in the workshop), the scenario *Collaboration* generates even less environmental benefit than the scenario *Current situation*. This effect occurs because the ecological focus areas are allocated to the least productive land in the collective implementation group, but also because new low-productivity parcels of land are leased over time. However, during the workshop, other difficulties with, and potential indirect costs of, locating ecological focus areas on leased land emerged, which led to this option not always being seen as economically the best option.

To achieve a good environmental effect in terms of pollination and biological pest control, it is necessary to limit the types of ecological focus areas to flowering buffer strips (or other high-quality measures) and to steer their location to high-productivity arable land (i.e., areas with the greatest potential to generate environmental benefit) in accordance with the scenario *Environmental optimum*. In our models, collaboration (in particular collaboration to satisfy specific environmental requirements) results in much higher costs for farmers compared with the equivalent scenarios without collaboration. In other words, as long as it is cheaper to allocate EFAs that generate a moderate environmental benefit on an individual basis, there will be no financial incentives for environmentally more effective collaboration.

If the collective implementation of ecological focus areas is to have a positive environmental effect, higher demands on quality must be set for areas to be counted as EFAs, and in addition there must be requirements concerning where EFAs are to be located in the landscape. However, it should be noted that, during the workshop, the farmers discussed possible ways of increasing the environmental benefit in scenarios *Collaboration* and *Collaboration+*. What farmers were particularly interested in was opportunities for linking ecological focus areas to other environmental measures implemented in the landscape. This would allow the measures to be coordinated in a more integrated way from the farmers' perspective.

6.6 Collective implementation is anticipated to result in higher transaction costs

The transaction costs for the authorities (red petals in Figure 11) were estimated to be the lowest under the current regime (*Current situation*) and increase the more complex the regulatory framework was perceived to be. This is mainly explained by the costs of adapting the IT systems to amended rules being assessed as very high. The interviewed officials at the Swedish authorities generally found it difficult to disregard the current problems with the IT systems. They felt that the current problems created uncertainty for themselves and for the farmers. This was also confirmed by the farmers at the workshop, who also commented on the current IT system, albeit in somewhat less negative terms.

It should also be mentioned that the transaction costs in the flower diagram above (Figure 11) are based only on data from the Swedish Board of Agriculture, because equivalent data was not available for the county administrative boards. Consequently, there is no complete picture of the potential transaction costs for authorities arising from a change in the rules on ecological focus areas. Unlike the Netherlands and the UK, where officials had experience of different forms of collaboration within the CAP, the Swedish officials at both the Swedish Board of Agriculture and the County administrative boards, had not had these kinds of experiences. The Swedish officials assessed that collaboration in general would be administratively cumbersome for the authorities. They also saw more potential problems than opportunities associated with collaboration for the farmers. The Swedish farmers also mentioned the uncertainty and complexity of the rules as a potential problem for collective implementation, in particular with regard to inspectors being able to make accurate assessments of compliance or not with the rules.

The opposite applied for the people interviewed from the Netherlands and the UK, who in general were very positive to collaboration. In the Netherlands, administration has been reduced for the authorities as a result of transitioning to collective applications for agri-environment payments under the Rural Development Programme. In the Netherlands, the costs of collectively implementing ecological focus areas under Article 46(6) were assessed as being slightly higher than the usual, individual implementation (which is still the preferred method of implementation for the vast majority of farmers). The cost increase was mainly due to the added costs for the development of forms, communications, and a double assessment of the application (EFA and contract). None of the officials from the Netherlands or the UK mentioned any problems with IT systems, and they were positive to collective implementation under Article 46(5) and 46(6) of the Direct Payments Regulation.

6.7 Flexibility concerning EFAs is misguided

Naturally, flexibility in the choice of environmental measures like ecological focus areas is important. Farmers must be able to adapt their activities to new requirements at the lowest possible cost and incorporate these requirements into their operations in a natural way. In the workshop, farmers mentioned the importance of being able to include ecological focus areas in their crop rotation systems in a way that made it possible to exploit their potential for soil improvement or the prevention of diseases. Flexibility was also put forward as an important prerequisite for being able to adapt environmental measures to local conditions so as to generate the maximum environmental effect. The problem is therefore not flexibility *per se* but the incentives structure that arises in an administration system (Ostrom 1990). Unfortunately, the EFA scheme allows great flexibility without any link to environmental effect, since it is possible to choose less costly EFAs with only a small environmental benefit. Consequently, the current flexibility results in a low degree of environmental effectiveness. This flexibility without any link to the environmental outcome helps to reduce the potential for collective implementation as a way of increasing environmental effectiveness in both the short and long term, which the farmers at the workshop also pointed out.

6.8 Factors other than profit guide the farmers' choices

Because the economic modelling was based on a strict assumption that the farmers would maximise their profits, we used the discussions at the workshop to gain a more nuanced picture of the factors that can influence the farmers' choice and location of ecological focus areas. Even though minimising costs was an important factor for the participants, the farms' objectives and the farmers' attitudes to environmental measures varied to the extent that they do not always strive for pure profit maximisation.

The workshop demonstrated several examples of this. For example, one participant stated "*Yes, you younger people must consider your economy, but we older ones can afford to think about wanting to leave something nice after we go*".

For example, some farmers would consider leasing low-productivity land for EFAs. However, this was not an obvious solution for the majority of the participants. This was partly because it was not perceived as a given that a lease would be a more cost-effective solution, among other things because of long distances, the expense of leasing land, and potential demands from and difficulties communicating with the owner of the land. Instead, some farmers were seeking synergies through the strategic location of their EFAs, with the purpose of simplifying and rationalising then land management, adapted to the conditions for different crops or as a buffer against pests.

Overall, we can still say that the financial incentives created within the EFA system are strong compared with other incentives. The EU's common rules for the single payment scheme and ecological focus areas therefore strongly limit opportunities to design a more effective environmental policy.

6.9 What is required for collaboration to succeed?

For a collaboration structure to work in practice and generate added value such as innovations over the long term, the immediate economic needs must be tempered by other factors. The factors that, in the conversations with farmers and officials at the Swedish government agencies and other organisations, emerged as the most important were *clarity*, *the long view, communications, synergy* and *flexibility.* Many of these factors do not only apply to collaboration, but are also important for policy instruments in general. It is of the utmost importance that there is *clarity* about what is expected of the farmers.

Where *clarity* is lacking, regardless of whether this relates to the rules governing the measures or their environmental benefits, it fuels concerns about doing the wrong thing among both farmers and case officers, which increases the risks for the farmers. This in turn causes them to lose confidence in the policy and avoid choosing collaboration or measures that enhance the benefits for the environment. *The long view* is lacking in many aspects of agricultural policy. Rules are amended so often that it is difficult to achieve continuity in activities, both for farmers and for case officers at the Swedish authorities. For collaboration to work, time is needed for the development of collaboration projects, and there is a need for assurance that the rules will apply for a longer period of time.

Communications about the purpose and the objectives of the measures must be clear for the farmers. When people know that the measures can benefit biodiversity or ecosystem services, they are more inclined to implement them.

No one voluntarily establishes a "*black mourning band*" along their fields with any sense of pride (a reference to the bare black soil of uncultivated buffer strips). That the structures for agricultural payments should support farmers in managing and developing their farms in a coordinated way was emphasised as very important. This applies in particular to communications about where in the landscape various environmental measures ought to be implemented to deliver the greatest environmental benefit. *Synergy* is something that the farmers relate to the payment schemes, which are regarded as "*spasmodic*", and also to how the schemes are capable of relating to the existing landscape. This can include opportunities for increasing environmental benefits in connection with old infrastructure such as trees, shrubs, "*the strip along the riverbank*" (relates to what was similar to a protection zone in the typical farms used in the workshop), or through new structures such as "*the flowering strip through the village that makes people stop and look*". Ultimately, collaboration requires that there is a degree of *flexibility* in the scheme.

For example, it must be possible to make local adaptations or test relevant innovations without fear of sanctions if the experiment fails. A concrete example that was mentioned in the workshop was the need to test different ways of establishing and managing buffer strips of perennial flowering plants. However, the current flexibility without any link to environmental outcomes cancels out any such potential improvements in effectiveness.

6.10 The importance of collaboration and choice of EFAs for other types of ecosystem services

The two ecosystem services that the study focused on were benefited generally by environmental measures that are implemented scattered across the landscape. The collective implementation of ecological focus areas under Article 46(5) or 46(6) aims instead to concentrate measures spatially and contributes to EFAs being located in a way that strengthens the landscape's green infrastructure and thus biodiversity in a strict sense (conservation of species). However, it is not clear to what extent the current types of ecological focus areas contribute to the conservation of biodiversity as such (Dicks et al. 2014), whether or not they are spatially concentrated. Both biodiversity and the ecosystem services investigated here are also expected to benefit most from non-productive ecological focus areas such as fallows and uncultivated buffer strips (Pe'er et al. 2016). However, these are often not chosen, while productive ecological focus areas such as nitrogen-fixing crops and grassland are chosen instead, because they are economically more attractive.

As stated above, collective implementation can be based on either Article 46(5) or Article 46(6) of the Direct Payments Regulation. The authorities in each Member State can either designate priority areas, the types of EFAs, and set the conditions under which collaboration is to take place (Article 46(5)); or the initiative can come from the farmers themselves (Article 46(6)). Collaboration in priority areas (designated by the authorities) might be good in specific cases where coordinated management across larger areas is needed to conserve certain species. An analogous example comes from the Netherlands, where the conservation of the wet meadow wader using agri-environmental payments under the Rural Development Programme is coordinated regionally in certain priority areas that the authorities have chosen (personal communication with the Ministry of Economic Affairs, Agriculture and Innovation, the Netherlands).

In the case of pollination and natural biological pest control, it is doubtful whether an arrangement under Article 46(5), where the government agency designates priority areas in which collective implementation should take place, would improve environmental benefits. On the one hand, these ecosystem services are benefited by adequate environments being established at scattered locations throughout the landscape; and on the other hand, both pollination and biological pest control are ecosystem services that, through a potential gain in the harvest, would benefit the farmers themselves. Therefore, with the right information (such as quantifications of the effects on the harvest) there is an economic incentive for farmers to choose EFAs that benefit these services (Cong et al. 2014).

Even the transaction costs that arise for the authorities in connection with collective implementation under Article 46(5) can be slightly higher than for collective implementation on the farmers' initiative. Knowledge of both suitable areas and relevant EFAs is required, and the implementation needs to be coordinated.

Finally, it should be noted that pollination and biological pest control are ecosystem services produced above the ground, which of course may affect the conclusions we draw about the environmental effect of EFAs. Some EFAs of limited value for pollination and natural biological pest control could benefit other ecosystem services. One such example is undersown green cover, which is the measure that we anticipate would be the most beneficial to organisms under the ground, and thus for the fertility of the soil (Thomsen and Christensen 2004, Haddaway et al. 2015). However, the proportion of grassland in crop rotation differs greatly between the scenarios we evaluated, indicating that our ranking of the scenarios from the environmental point of view is not significantly affected by us not having included this aspect in the study. On the contrary, we assess that our conclusions concerning collective implementation under the current regulatory framework have a bearing on environmental benefits at a general level, because most of the reasons that collective implementation under the current regulatory framework do not benefit pollination and biological pest control also apply to environmental benefits in general.

7 Conclusions and recommendations

In this report, we have looked at how quality requirements for ecological focus areas and collective implementation of them can affect the environmental benefit expressed as the effects on pollination and natural biological pest control. The potential environmental effects have also been weighed against the effects on farmers' economies and their acceptance, as well as the transaction costs for the authorities. In the following, we summarise our conclusions and recommendations for the future.

7.1 Poor basis for successful collective implementation

The ecological-economic modelling, the workshop with farmers, and the interviews with officials all demonstrated that the current requirement to implement ecological focus areas is not an effective environmental policy instrument. The current incentive structure reinforces the farmers' tendency to minimise implementation costs (business economics). The implementation costs in turn are positively correlated with environmental benefit: in other words, measures that cost less also deliver a lower degree of environmental benefit. Collective implementation should be able to lift the handling of ecological focus areas from a limited farm perspective to a landscape ecology perspective, but here, too, the incentive structure is deficient within the current regime for ecological focus areas. For collaboration between farmers to achieve its full potential requires committed and motivated farmers who have confidence in the scheme, and who are prepared to invest with a longer-term perspective in view. The perceptions of a low degree of environmental benefit and high level of bureaucratic requirements have made the concept of ecological focus areas generally unpopular among farmers.

The farmers also see collaboration as an investment that should pay for itself in the long term. It costs money to set up a functioning collaboration. Therefore, investing in collaboration requires that the policy and instrument design take the long view, which can apply to both the regulatory framework and the measures themselves.

In the documentation of the policy processes leading up to the most recent CAP reform, there is talk of cooperation around the value chains of agriculture as a way of creating a more sustainable income for the sector, more jobs through innovation, and greener agriculture. The farmers' generally positive attitudes towards cooperation could be encouraged by an advisory-based cooperation structure similar to the UK's *Facilitation Fund*. Cooperation there focuses on what the collaboration group identifies as interesting and relevant for them, which helps to build cooperation capacity, trust and technical expertise among both the farmers and the officials. Because the goal of the form of corporation is locally defined, the implementation can take advantage of the bottom-up perspective and also satisfy requirements to maintain flexibility.

7.2 Potential to improve environmental effects is conditional on changes in the rules

There are several ways of achieving an environmentally better outcome with the help of ecological focus areas. Sowing in fallows and uncultivated buffer strips with flowering plants is a measure that has great potential for benefiting the ecosystem services pollination and biological pest control. However, for this potential to be realised, an incentive structure that rewards the most environmentally effective types of EFAs is needed, so that farmers can choose these over others. That is not the case today. In the current situation, just requiring sowing in flowering plants on fallows and uncultivated buffer strips would not have the desired effect. This is because more farmers would then switch to cheaper types of EFAs with a poorer environmental effect. A necessary adjustment following from this is restricting the list of EFAs to types that can clearly contribute to the net benefit for the environment. Approving EFAs that form part of normal farming as is the case today is simply inflating the scheme with deadweight. If the aim is to benefit the ecosystem services pollination and natural biological pest control, an environmentally effective solution would be to allow only fallows and uncultivated buffer strips (sown in with flowering plants) to be allocated as EFAs.

7.3 Recommendations

In conclusion, we note that the introduction of the option to collectively implement ecological focus areas within the framework of the current regulatory framework would not lead to the intended positive environmental effects. Besides shortcomings in the incentive structure, there are shortcomings in what types of EFAs are available and the management conditions linked to these. In combination with feared high transaction costs, this mean that we do not currently recommend the collective implementation of ecological focus areas under Article 46(5) or 46(6) in the EU's Direct Payments Regulation.

This does not mean that in our view collective implementation of ecological focus areas is a bad thing *per se*. On the contrary, there are many potential benefits of collective implementation – both for the farmers and for the environment (see Chapter 4). Even if there are few examples of collective implementation under the Direct Payments Regulation, it is possible to learn from collective implementations related to other, often voluntary, environmental measures. These include the advisory-based collaboration within the *Facilitation Fund* in the UK, and collective agri-environment payments in the Netherlands. Both of these examples were perceived as being very positive by the stakeholders we interviewed.

For collaboration to be able to function in a positive way, in the first instance you need a regulatory regime and incentive structure that are perceived as reasonable and positive by both farmers and the authorities. This means that:

- The regulatory framework and its purpose must be clear and well communicated to engender trust in the scheme;
- There must be a clear and concrete link between approved EFAs, management conditions where applicable, and their environmental benefit in order to promote acceptance and motivation to implement the measures;
- Clear information on the rules is required, but also about the concrete ecological and economic benefits of EFAs to both the authorities and farmers in order to reduce concerns about doing the wrong thing among the authorities and farmers; and
- The regulatory framework should permit flexibility in the implementation and management of EFAs to make it possible for farmers to fit these requirements into their activities seamlessly, but without jeopardising the environmental benefit of these EFAs.

For collective implementation of ecological focus areas to fulfil its purpose, namely to promote biodiversity, it is of course essential that the EFAs are implemented in a way that has a positive effect on the environment. Our analyses clearly show that this is not the case under the current regime. If ecological focus areas are to benefit pollination and biological pest control in particular, we therefore recommend that Sweden works towards:

- Limiting approved EFAs to measures that provide significant environmental benefits, primarily uncultivated buffer strips and fallows;
- Introduce a requirement that uncultivated buffer strips and fallows are to be sown with seed mixes that flower in late spring and summer;
- Define concrete objectives for the environmental benefits to be achieved and clear recommendations for the implementation and location of EFAs; and
- Permit flexibility in how environmental benefit is to be achieved in order to increase acceptance and motivation to implement the measures.

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Collective Implementation of Ecological Focus Areas

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Evaluation of the effects on ecosystem services, agriculture and administration

Ecosystem services are fundamental to the welfare of mankind, yet these services are often invisible in many social decisions. This report evaluates the effects on the ecosystem services pollination and biological pest control if Sweden were to introduce collective implementation of EFAs as part of the single payment scheme, including quality improvement measures such as establishing flowering plants.

The potential environmental effects are seen in relation to the impacts on the economies of farmers and their acceptance of collective implementation, as well as the administrative costs for the authorities. This study is a step towards integrating the value of ecosystem services into decisions in society, something that is to be achieved by 2018 under the milestone targets in Sweden's environmental objectives system. The study that formed the basis of this report was carried out by the Centre for Environmental and Climate Research at Lund University. The work was carried out within the government commission Environmental effects of the CAP. The Swedish Environmental Protection Agency is the primary authority responsible for this report. The Swedish Board of Agriculture, the Swedish National Heritage Board, the Swedish Agency for Marine and Water Management and the County administrative boards also participated in this project.

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